# PLATEAU REGION WATER PLAN

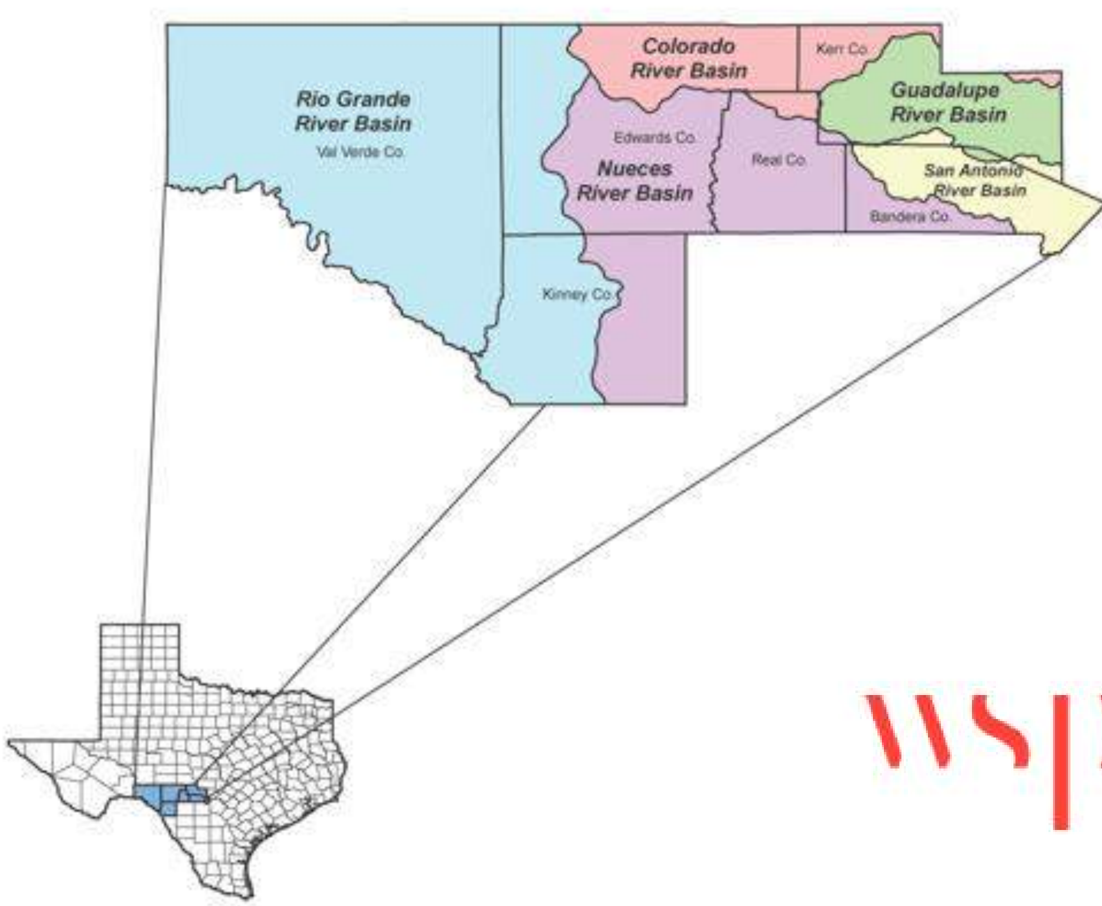
## January 2021

**Prepared by**

***Plateau Water Planning Group***

**Prepared for**

***Texas Water Development Board***

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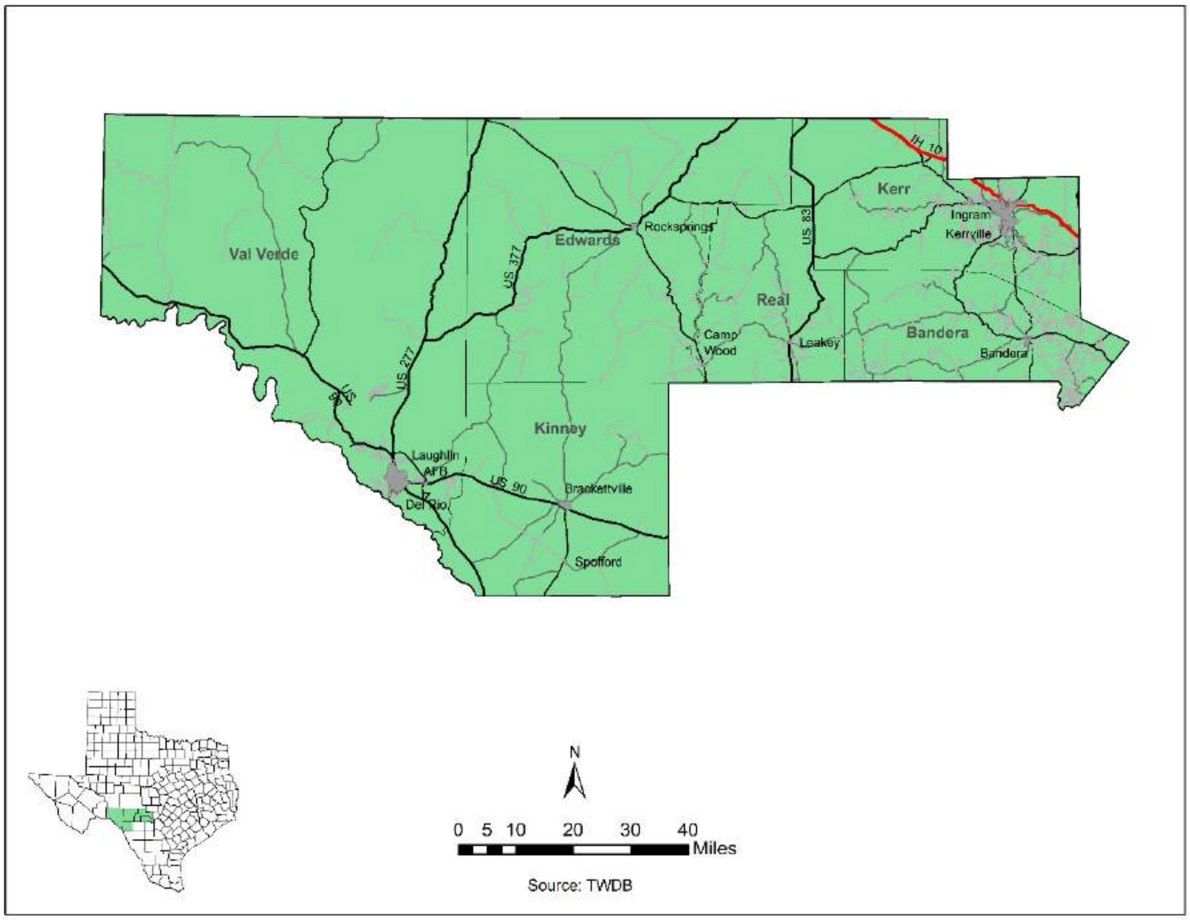
# EXECUTIVE SUMMARY

Located along the southern boundary of the Edwards Plateau, the Plateau Water Planning Region (Region J) stretches from the Central Texas Hill Country westward to the Rio Grande and consists of Bandera, Edwards, Kerr, Kinney, Real and Val Verde Counties (Figure ES-1). Tourism, hunting, ranching, agribusiness, government and military activities support the regional economy. 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 and recreational trade. Natural resources of the Region include both terrestrial and aquatic habitats that boast some of the best scenic drives, beautiful vistas, river rafting, and hunting and fishing in Texas.

**Figure ES-1. Plateau Region Water Planning Area Map**




In January of 2016, the fourth round of regional water planning was concluded with the adoption of the *2016 Plateau Region Water Plan*. It is understood that this is not a static *Plan* but rather is intended to be revised as conditions change. For this reason, the current *2021 Plateau Region Water Plan* put forth in this document is not a new *Plan*, but rather an evolutionary modification of the preceding *Plan.* Only those parts of the original *Plan* that require updating, and there are many, have been revised.

The purpose of the *Plateau Region Water Plan* is to provide a document that water planners and water users can reference for long- and short-term water management recommendations. Equally important, this

*Plan* serves as an educational tool to enlighten all citizens to the importance of properly managing and conserving the pristine water resources of this Region. The *2021 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. The *Plan* provides an evaluation of current and future water demands for all water-use categories, and water supplies available during drought-of-record conditions to meet those demands.  Where future water demands exceed an entity's ability to supply that need, alternative strategies are considered to meet the potential water shortages.  Water management strategies are also presented that reflects an entity's desire to upgrade their water supply system. In all cases, conservation practices are first considered in managing water supplies.

Because our understanding of current and future water demand and supply sources is constantly changing, it is intended for this *Regional Water Plan* to be revised every five years or sooner if deemed necessary. This *Plan* fully recognizes and protects existing water rights, water contracts, and option agreements, and there are no known conflicts between this *Plan* and plans prepared for other regions.

# POPULATION AND WATER DEMAND

The U.S. Census Bureau performed a census count in 2010, which provides the base year for future population projections. Although the Plateau Water Planning Group (PWPG) accepts the 2010 census count, 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 properties. Therefore, an emphasis is made in this *Plan*, especially for the rural counties, to recognize a need for more water than is justified simply from the population-derived water-demand estimates.

The Plateau Region covers 9,252 square miles and contains a projected year-2020 population of 141,476 (Table ES-1). The mostly rural nature of this Region is reflected in its population density of 15.3 (in 2020) people per square mile, which is significantly less than the State average of 72 people per square mile. Approximately 46 percent of the total population of the area is located in the two largest cities, Del Rio and Kerrville. In the year 2020, Del Rio, including the population of Laughlin Air Force Base, is projected to have 39,542 residents and Kerrville with 25,658. The projected year-2020 populations of other major communities in the Region are: Bandera (1,875); Rocksprings (1,259); Brackettville and Fort Clark Springs (3,217); and Camp Wood (747) and are presented in Figure ES-2. 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.

Total population of the six counties is expected to increase by 52 percent from the projected year-2020 census count of 141,476 to 184,595 by 2070. The greatest percentage increase in population is projected to occur in Val Verde County, which is expected to grow from a projected year-2020 population of 54,694 to 82,161 by the year 2070, an increase of 50 percent. Bandera County (30 percent) and Kerr County (15 percent) are also anticipating growth. Population in the rural counties of Edwards, Kinney and Real is expected to remain relatively constant over the 50-year planning period, however the transient population will likely increase.

Total projected water consumptive use in the Plateau Region in the year 2020 is 37,337 acre-feet (Table ES-1). The largest category of projected demand is municipal and county-other (25,975 acre-feet), followed by irrigation (8,805 acre-feet), livestock (2,182 acre-feet), mining (355 acre-feet), and manufacturing (20 acre-feet) as illustrated in Figure ES-3. Municipal and irrigation combined represent 93 percent of all water used in the Region. The forecasted total demand for water needed in the Region will increase from the year 2020 by 44,937 acre-feet (13 percent) by the year 2070. Municipal and County-Other water demand in the Plateau Region is projected to increase from a year-2020 level of 25,975 acre-feet to 31,767 acre-feet by the year 2070.

The largest center of municipal demand in the Region is the City of Del Rio in Val Verde County, where 10,558 acre-feet of water is projected to be used in 2020 to supply the residents and businesses within the City. Fifty-five percent of the Region's total municipal water use occurs in Val Verde County. The City of Del Rio is the only entity in the Plateau Region that is designated as a wholesale water provider. In addition to its own use, the City provides water to Laughlin Air Force Base and subdivisions outside of the City.

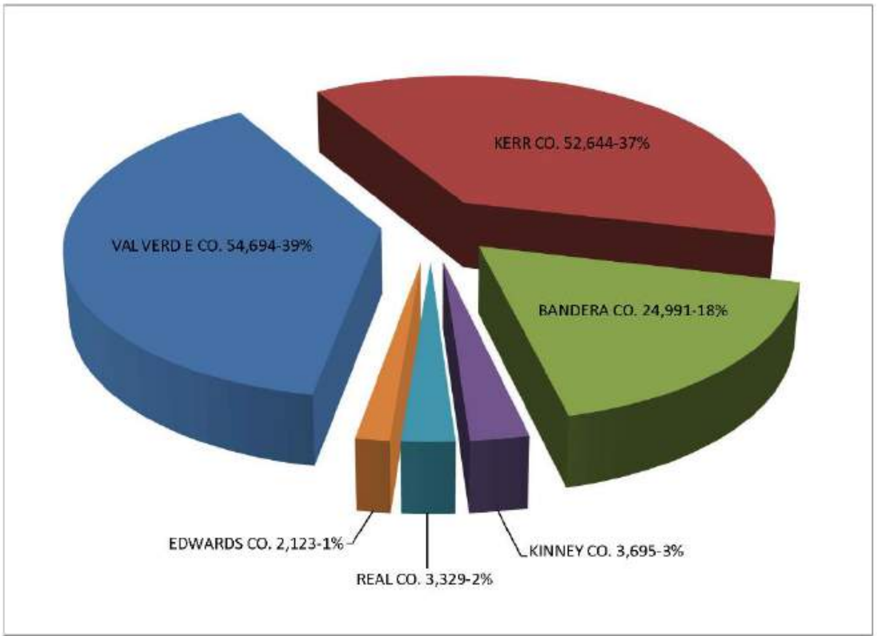



**Figure ES-2. Year 2020 Projected Population**

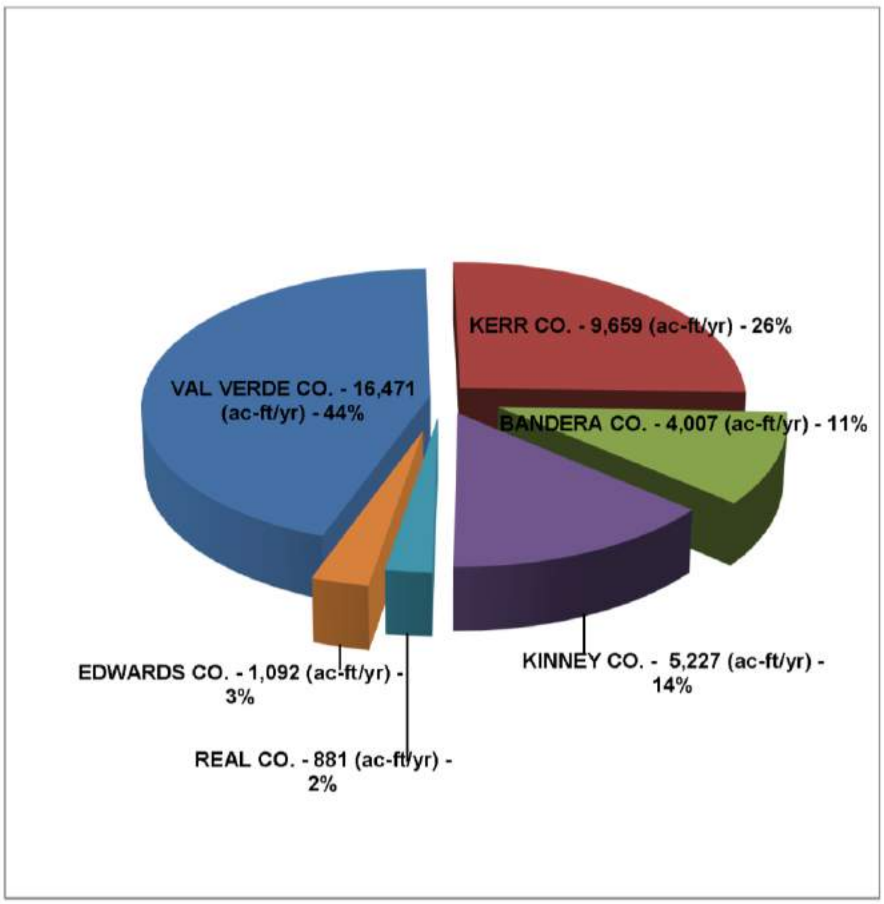



**Figure ES-3. Year 2020 Projected Water Demand by County**

The Upper Guadalupe River Authority (UGRA) anticipates becoming a wholesale water provider in coming years with the intent to provide conjunctive water-supply sources to meet the needs of Kerr County citizens that will not be served by the City of Kerrville. The use of water for manufacturing purposes only occurs in Kerr County.

Most irrigation that occurs in the Plateau Region is for the watering of pastures and hay fields. Because of the typically rocky and uneven terrain throughout much of the Region, irrigation of commercial row crops is minimal other than in Kinney County. Kinney County has the highest irrigation water use (62 percent of the Region's total) and is the only county in which irrigation use is greater than municipal use. On a regional basis, water used for irrigation is projected to remain consistent at 8,805 acre-feet per year over the 50-year planning horizon. However, as any irrigator can attest, climate, water availability, and the market play key roles in how much water is actually applied on a year-by-year basis.

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 centered around the 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.

# WATER SUPPLY RESOURCES

Water supply sources in the Plateau Region include groundwater from six aquifers (176,292 acre-feet in 2020), and surface water within five river basins (20,654 acre-feet in 2020) (Chapter 3, Table 3-2). Reuse of existing supplies is also considered a water supply source.  Water supply availability under drought-of-record conditions is considered in the planning process to insure that water demands can be met under the worst of circumstances. In the consideration of available water supply sources, this *Plan* fully recognizes and protects existing water rights, water contracts, and option agreements.

Within the Plateau Region, the TWDB recognizes three major aquifers [the Trinity, the Edwards-Trinity (Plateau), and the Edwards (Balcones Fault Zone)] as illustrated in Figure ES-4. For this *Plan*, the Austin Chalk Aquifer in Kinney County, and the Frio and Nueces River Alluvium Aquifers in Edwards and Real Counties are also identified as groundwater sources. Groundwater conservation districts in Bandera, Kerr, Kinney, Real and Edwards Counties provide for local management control of the groundwater resources in their respective districts. Over much of the Region, water levels generally fluctuate with seasonal precipitation and are highly susceptible to declines during drought conditions. Discharge from the aquifers occurs naturally through springs and seeps, and artificially by pumping from wells. Some discharge also occurs through leakage from one aquifer to another and through natural down-gradient subsurface flow out of the Region.

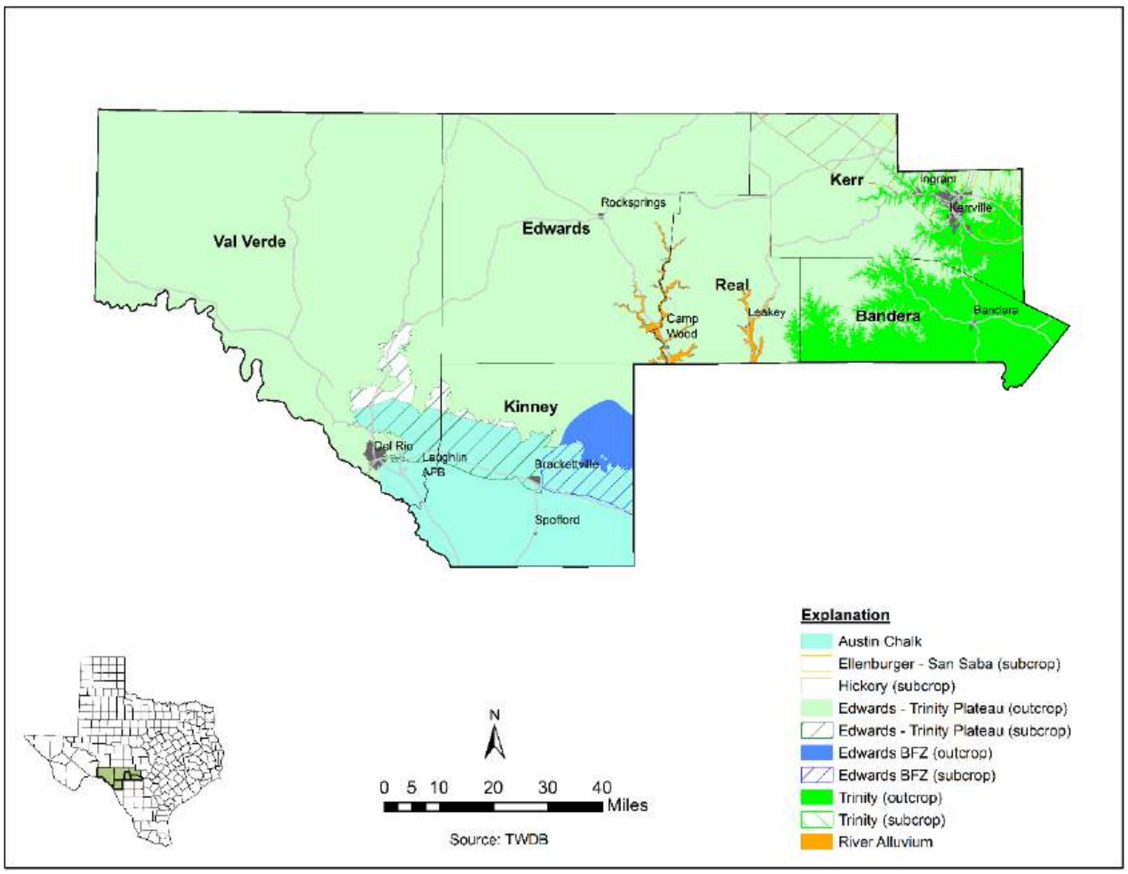



**Figure ES-4.  Groundwater Sources**

Base flow to the many rivers and streams that flow through the Plateau Region is principally generated from the numerous springs that issue from rock formations that form the major aquifers. It is thus recognized that sustaining flow in these important rivers and streams is highly dependent on maintaining an appropriate water level in the aquifer systems that feed the supporting springs. With the sustainability of local water supplies and the economic welfare of the Region in mind, the PWPG thus defines groundwater availability as a maximum level of aquifer withdrawal that results in an acceptable level of long-term aquifer impact such that the base flow in rivers and streams is not significantly affected beyond a level that would be anticipated due to naturally occurring conditions. The PWPG also acknowledges that groundwater conservation districts have regulatory authority over permitted withdrawals.

The volumetric availability of groundwater for this *2021 Plan* is based on TWDB provided Modeled Available Groundwater (MAG) as developed through the Groundwater Management Area process. Aquifers recognized in this *Plan* that are not included in the GAM-MAG process are termed “non-relevant” and “other aquifer”. Groundwater availability for these sources is calculated by modeling or standard geohydrologic methods, with include the following:

The counties that comprise the Plateau Region contain the headwaters of the Guadalupe, San Antonio, Medina, Sabinal, Frio, Nueces, and West Nueces rivers; and tributaries to the Colorado River and Rio Grande such as the Pecos, Devils, and South Llano rivers. Flow in these rivers and streams is critical to the Plateau Region in that it provides municipal drinking water, supplies irrigation and livestock needs, maintains environmental habitats, and supports a thriving ecological and recreational tourist economy. Water users downstream of the Plateau Region (Regions K, L, and M) likewise have a stake in maintaining and protecting river flows.

Although rather limited during severe drought conditions, surface-water supplies in the Region are important (Figure ES-5). The Cities of Kerrville and Del Rio currently use surface water from the Guadalupe River and from San Felipe Springs, respectively. Camp Wood in Real County is supplied from Old Faithful Spring located on a tributary to the Nueces River. 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 Run 3 of the TCEQ Water Availability Models (WAMs).

Water recycling, or reuse, is reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation or industrial processes, and potentially for public consumption. The Cities of Kerrville and Camp Wood have active water reuse programs.

The PWPG 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 that inhabit the Region throughout the year. The spring wetlands host numerous terrestrial and aquatic species, some of which are recognized as threatened and endangered.

The PWPG has identified three “Major Springs” that are important for their municipal water supply contribution. The fourth largest spring system in Texas, San Felipe Springs, discharges to San Felipe Creek east of Del Rio and provides municipal drinking water for the City, 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 Springs community and is hydrologically associated with the same aquifer system that serves Fort Clark Springs 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. 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.

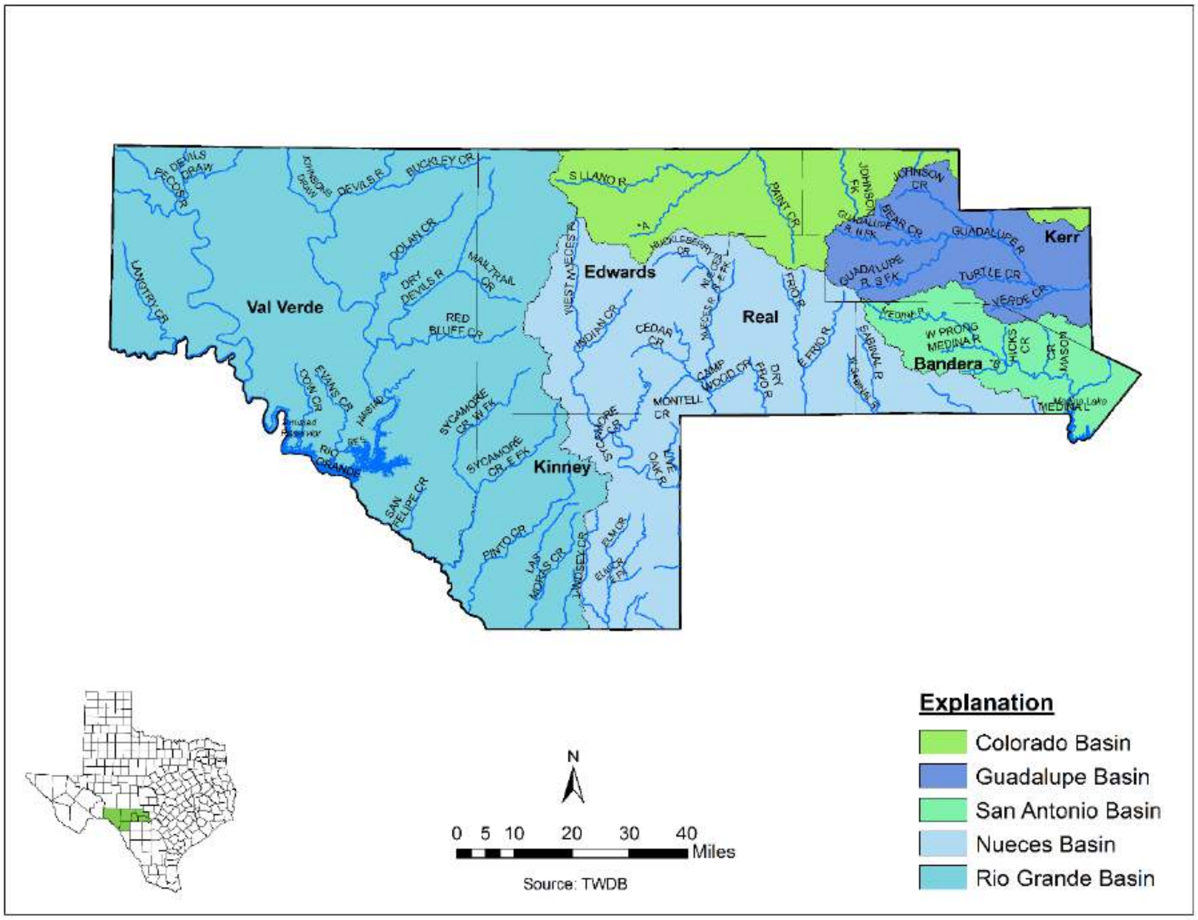



**Figure ES-5. Surface Water Sources**

# WATER MANAGEMENT STRATEGIES

A major component of this *Plan* is to identify municipalities and water-use categories that may, in times of severe drought, be unable to meet expected water-supply needs based on today's ability to access, treat, and distribute the supply. Recommended alternatives, or water management strategies, to meet anticipated drought-induced shortages are presented for consideration. It should be acknowledged that the PWPG has no authority to mandate that any recommended strategy be implemented, and that it is the individual entity's initiative to act on needed changes.

Tables provided in the Executive Summary Appendix (TWDB Water Planning Data Reports) list projected water supply shortages within the Region under drought-of-record conditions based on no new infrastructure development, along with a secondary water needs analysis for all water user groups and wholesale water providers for which conservation or direct reuse water management strategies are recommended. This secondary water needs analysis calculates the water needs that would remain after assuming all recommended conservation and reuse water management strategies are fully implemented. Additional tables provide a listing of all recommended (68) and alternative (6) water management strategies in this *Plan* that if implemented may assist in meeting supply shortages. Additional strategies are recommended for other entities that have no projected supply shortage, but have desired projects to be considered for funding. Conservation and water-loss strategies are also recommended where appropriate. Total capital cost to implement the recommended strategies is $230,456,000.

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. Recreation activities involve human interaction with the outdoor environment and 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.

The implementation of water management strategies recommended in Chapter 5 of this Regional *Plan* is not expected to have any impact on native water quality. Primary and secondary safe drinking water standards, which are the key parameters of water quality identified by the PWPG as important to the use of the water resource, are not compromised by the implementation of the strategies. Also, no recommended strategies involve moving water from a rural location for use in an urban area.

# WATER QUALITY

Water quality plays an important role in determining the suitability of water supplies to meet current and future water needs. Primary and secondary safe drinking water standards are the key parameters of water quality identified by the PWPG as important to the use of water resources and are used for comparisons of water quality data. The reservoirs within the Plateau Region - Amistad Reservoir and Medina Lake - are some of the clearest (most transparent) water bodies in the State of Texas. Amistad Reservoir is the third clearest water body in Texas and Medina Lake is the fifth clearest.

Groundwater resources in the Plateau Region are generally potable, although between five and ten percent of the groundwater is brackish. Groundwater quality problems are generally related to naturally high concentrations of total dissolved solids (TDS) or to the occurrence of elevated concentrations of individual dissolved constituents. High concentrations of TDS are primarily the result of the lack of sufficient recharge and restricted circulation. Together, these retard the flushing action of fresh water moving through the aquifers.

Water quality is generally good throughout the Plateau Region; however, a few specific water quality issues are of concern.

- Increase in urban runoff generally comes with an increase in impervious cover in populated areas. Urbanization also causes increased pollutant loads, including sediment, chemicals from motor vehicles, pesticides/herbicides/fertilizers from gardens and lawns, viruses/bacteria/ nutrients from human and animal wastes including septic systems, heavy metals from a variety of sources, and higher temperatures of the runoff.
- 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 individual properties. Each new well thus becomes another potential conduit for surface contamination to reach the underlying aquifer system.
- Vehicular traffic in streambeds disrupts streamflow, damages plants and animals living in these areas, damages channels and erodes banks, and decreases water quality by increasing the turbidity of the water in these rivers and streams.
- The constituent of most concern is nitrate, which was 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.
- Poorer groundwater quality in the Region is generally from two sources, evaporite beds in the Glen Rose limestone 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.

# WATER CONSERVATION AND DROUGHT CONTINGENCY

Water conservation and drought contingency planning are two of the most important components of water supply management. Recognizing their potential contribution, setting realistic goals, and aggressively enforcing their implementation may significantly extend the time when new supplies and associated infrastructure are needed. Water conservation are those practices, techniques, programs, and technologies that will protect water resources, reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling or reuse of water so that a water supply is made available for future or alternative uses. Water conservation strategies and recommendations are discussed in Chapter 5, Section 5.3.

Although residents of the Plateau Region are generally accustomed to highly variable climatic conditions, the relatively low rainfall and the accompanying high levels of evaporation underscore the necessity of developing plans that respond to potential disruptions in the supply of groundwater and surface water caused by drought conditions.

Drought contingency plans provide a structured response that is intended to minimize the damaging effects caused by water shortage conditions. A common feature of drought contingency plans is a structure that allows increasingly stringent drought response measures to be implemented in successive stages as water supply or water demand conditions intensify. This measured or gradual approach allows for timely and appropriate action as a water shortage develops. The onset and termination of each implementation stage should be defined by specific “triggering” criteria. Triggering criteria are intended to ensure that timely action is taken in response to a developing situation and that the response is appropriate to the level of severity of the situation. Chapter 7 provides a detailed discussion on drought impact and preparedness in the Plateau Region.

# PROTECTION OF WATER, AGRICULTURAL AND NATURAL RESOURCES

The long-term protection of the Plateau Region's water resources, agricultural resources, and natural resources is an important component of this *2021* update of the *Plateau Region Water Plan*. Long-term water resources protection occurs in the conservative methodology of estimating water supply availability, evaluation of water management strategies for potential threats to water resources, the recommendation of water conservation strategies, and regional recommendations pertaining to water conservation and drought management practices. When enacted, the conservation practices will diminish water demand, the drought management practices will extend supplies over stress periods, and land management practices (land stewardship) will potentially increase aquifer recharge and stream base flow conditions.

Agricultural resources are protected in this *Plan*. There is no current movement of water from agricultural areas in the Region for use in urban areas; and there are no recommended strategies in this *Plan* that involve moving water from rural locations. Also, non-agricultural strategies include an analysis of potential impact to agricultural interests.

The protection of natural resources as intended in this *Plan* is closely linked with the protection of water resources as discussed above. The methodology adopted to assess groundwater source availability is based on not significantly impacting spring flows that contribute to base flows in area rivers. Thus, the intention to protect surface flows is directly related to those natural resources that are dependent on surface water sources for their existence.

Environmental impacts were evaluated in the consideration of strategies to meet water-supply deficits. Of prime consideration was whether a strategy potentially could diminish the quantity of water currently existing in the natural environment and if a strategy could impact water quality to a level that would be detrimental to animals and plants that naturally inhabit the area under consideration. Although no specific "ecologically unique river and stream segments" are recommended in this *Plan*, the PWPG is very explicit in acknowledging the importance of all springs and stream segments for their significance as wildlife habitat.

# POLICY RECOMMENDATIONS

Water-supply resources intended to meet the future needs of all water-use categories in the Plateau Region are recognized to be limited in comparison to resources available in many other parts of the State. A conscientious effort to maintain an awareness of existing conditions and anticipate future water needs is recognized by the PWPG as being the foundation of continued regional water planning. In support of this belief, the PWPG is providing specific recommendations in this *Plan* that address:

- Water Conservation
- Water Management
- Water Planning
- Water Research Needs
- Consideration of Ecologically Unique River and Stream Segments
- Consideration of Unique Sites for Reservoir Construction

The PWPG encourages the continued public process of developing region-based water plans. Copies of the *2021 Plateau Region Water Plan* are accessible in county courthouses, public libraries, and through the PWPG website at http://www.ugra.org/waterdevelopment.html. The *Plan* is also accessible through the Texas Water Development Board web site: http://www.twdb.state.tx.us/.

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# ES – APPENDIX
# TWDB WATER PLANNING
# DATA REPORTS

- **Water User Group (WUG) Population**
- **WUG Demand**
- **WUG Category Summary**
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- **WUG Existing Water Supply**
- **WUG Needs / Surplus**
- **WUG Second-Tier Identified Water Needs**
- **WUG Second-Tier Water Needs Summary**
- **Source Water Balance (Availability – WUG Supply)**
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- **Source Data Comparison to 2016 Regional Water Plan**
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- **Recommended WUG Water Management Strategies**
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- **Alternate WUG Water Management Strategies**
- **Alternate Projects Associated with Water Management Strategies**
- **WUG Management Supply Factor**
- **Recommended Water Management Strategy Supply Associated with a New or Amended Inter-Basin Transfer Permit** ***(No relevant data for the Plateau Region)***
- **WUG Recommended WUG Supply Associated with a New or Amended Inter-Basin Transfer Permit and Total Recommended Conservation Water Management Supply** ***(No relevant data for the Plateau Region)***
- **Recommended Water Management Strategy Supplies Unallocated to WUG** ***(No relevant data for the Plateau Region)***
- **WUG Strategy Supplies by Water Management Strategy Type**
- **WUG Recommended Water Management Strategy Supplies by Source Type**
- **Major Water Provider Existing Sales and Transfers**
- **Major Water Provider Water Management Strategy Summary**

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# Region J Water User Group (WUG) Population

| | WUG POPULATION | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| COUNTY-OTHER | 122 | 140 | 150 | 155 | 157 | 158 |
| **GUADALUPE BASIN TOTAL** | **122** | **140** | **150** | **155** | **157** | **158** |
| COUNTY-OTHER | 1,114 | 1,282 | 1,376 | 1,414 | 1,438 | 1,450 |
| **NUECES BASIN TOTAL** | **1,114** | **1,282** | **1,376** | **1,414** | **1,438** | **1,450** |
| BANDERA | 1,875 | 2,160 | 2,316 | 2,380 | 2,420 | 2,442 |
| BANDERA COUNTY FWSD 1 | 679 | 781 | 838 | 862 | 876 | 883 |
| COUNTY-OTHER \| BANDERA RIVER RANCH 1 | 929 | 1,070 | 1,148 | 1,180 | 1,199 | 1,209 |
| COUNTY-OTHER \| LAKE MEDINA SHORES | 2,415 | 2,781 | 2,985 | 3,068 | 3,118 | 3,144 |
| COUNTY-OTHER \| MEDINA WSC | 895 | 1,031 | 1,107 | 1,137 | 1,156 | 1,166 |
| COUNTY-OTHER | 16,962 | 19,535 | 20,961 | 21,546 | 21,901 | 22,085 |
| **SAN ANTONIO BASIN TOTAL** | **23,755** | **27,358** | **29,355** | **30,173** | **30,670** | **30,929** |
| **BANDERA COUNTY TOTAL** | **24,991** | **28,780** | **30,881** | **31,742** | **32,265** | **32,537** |
| ROCKSPRINGS | 844 | 844 | 844 | 844 | 844 | 844 |
| COUNTY-OTHER | 136 | 136 | 136 | 136 | 136 | 136 |
| **COLORADO BASIN TOTAL** | **980** | **980** | **980** | **980** | **980** | **980** |
| ROCKSPRINGS | 415 | 415 | 415 | 415 | 415 | 415 |
| COUNTY-OTHER \| BARKSDALE WSC | 264 | 264 | 264 | 264 | 264 | 264 |
| COUNTY-OTHER | 391 | 391 | 391 | 391 | 391 | 391 |
| **NUECES BASIN TOTAL** | **1,070** | **1,070** | **1,070** | **1,070** | **1,070** | **1,070** |
| COUNTY-OTHER | 73 | 73 | 73 | 73 | 73 | 73 |
| **RIO GRANDE BASIN TOTAL** | **73** | **73** | **73** | **73** | **73** | **73** |
| **EDWARDS COUNTY TOTAL** | **2,123** | **2,123** | **2,123** | **2,123** | **2,123** | **2,123** |
| COUNTY-OTHER | 507 | 541 | 562 | 582 | 596 | 607 |
| **COLORADO BASIN TOTAL** | **507** | **541** | **562** | **582** | **596** | **607** |
| KERRVILLE | 25,658 | 26,638 | 27,217 | 27,792 | 28,203 | 28,522 |
| KERRVILLE SOUTH WATER | 2,821 | 2,969 | 3,057 | 3,143 | 3,206 | 3,254 |
| COUNTY-OTHER \| CENTER POINT | 161 | 172 | 178 | 184 | 189 | 192 |
| COUNTY-OTHER \| CENTER POINT NORTH WATER SYSTEM | 255 | 272 | 282 | 291 | 298 | 304 |
| COUNTY-OTHER \| CENTER POINT TAYLOR SYSTEM | 530 | 564 | 585 | 605 | 619 | 631 |
| COUNTY-OTHER \| HILLS AND DALES ESTATES | 202 | 216 | 223 | 231 | 237 | 241 |
| COUNTY-OTHER \| NICKERSON FARM WATER SYSTEM | 200 | 213 | 221 | 229 | 234 | 238 |
| COUNTY-OTHER \| OAK FOREST SOUTH WATER | 669 | 712 | 738 | 763 | 782 | 796 |
| COUNTY-OTHER \| PARK PLACE SUBDIVISION | 129 | 138 | 143 | 148 | 151 | 154 |
| COUNTY-OTHER \| PECAN VALLEY | 123 | 131 | 135 | 140 | 144 | 146 |
| COUNTY-OTHER \| RUSTIC HILLS WATER | 80 | 85 | 88 | 91 | 93 | 95 |
| COUNTY-OTHER \| VERDE PARK ESTATES | 178 | 189 | 196 | 203 | 208 | 211 |
| COUNTY-OTHER \| WESTWOOD WATER SYSTEM | 269 | 287 | 297 | 307 | 315 | 320 |
| COUNTY-OTHER | 20,583 | 21,982 | 22,813 | 23,636 | 24,226 | 24,679 |
| **GUADALUPE BASIN TOTAL** | **51,858** | **54,568** | **56,173** | **57,763** | **58,905** | **59,783** |
| COUNTY-OTHER | 6 | 7 | 7 | 7 | 8 | 8 |
| **NUECES BASIN TOTAL** | **6** | **7** | **7** | **7** | **8** | **8** |
| COUNTY-OTHER | 273 | 291 | 302 | 313 | 321 | 327 |
| **SAN ANTONIO BASIN TOTAL** | **273** | **291** | **302** | **313** | **321** | **327** |
| **KERR COUNTY TOTAL** | **52,644** | **55,407** | **57,044** | **58,665** | **59,830** | **60,725** |
| COUNTY-OTHER | 81 | 82 | 82 | 82 | 82 | 82 |
| **NUECES BASIN TOTAL** | **81** | **82** | **82** | **82** | **82** | **82** |
| BRACKETTVILLE | 1,958 | 1,971 | 1,971 | 1,971 | 1,971 | 1,971 |
| FORT CLARK SPRINGS MUD | 1,259 | 1,267 | 1,267 | 1,267 | 1,267 | 1,267 |

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

# Region J Water User Group (WUG) Population

| | WUG POPULATION | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| COUNTY-OTHER | 397 | 400 | 400 | 400 | 400 | 400 |
| **RIO GRANDE BASIN TOTAL** | **3,614** | **3,638** | **3,638** | **3,638** | **3,638** | **3,638** |
| **KINNEY COUNTY TOTAL** | **3,695** | **3,720** | **3,720** | **3,720** | **3,720** | **3,720** |
| COUNTY-OTHER | 35 | 35 | 35 | 35 | 35 | 35 |
| **COLORADO BASIN TOTAL** | **35** | **35** | **35** | **35** | **35** | **35** |
| CAMP WOOD | 747 | 747 | 747 | 747 | 747 | 747 |
| LEAKEY | 1,415 | 1,415 | 1,415 | 1,415 | 1,415 | 1,415 |
| COUNTY-OTHER | 1,132 | 1,132 | 1,132 | 1,132 | 1,132 | 1,132 |
| **NUECES BASIN TOTAL** | **3,294** | **3,294** | **3,294** | **3,294** | **3,294** | **3,294** |
| **REAL COUNTY TOTAL** | **3,329** | **3,329** | **3,329** | **3,329** | **3,329** | **3,329** |
| DEL RIO UTILITIES COMMISSION | 37,775 | 40,196 | 42,540 | 44,948 | 47,242 | 49,453 |
| LAUGHLIN AIR FORCE BASE | 1,767 | 1,951 | 2,129 | 2,239 | 2,239 | 2,239 |
| COUNTY-OTHER | 15,152 | 18,242 | 21,233 | 24,379 | 27,479 | 30,469 |
| **RIO GRANDE BASIN TOTAL** | **54,694** | **60,389** | **65,902** | **71,566** | **76,960** | **82,161** |
| **VAL VERDE COUNTY TOTAL** | **54,694** | **60,389** | **65,902** | **71,566** | **76,960** | **82,161** |
| **REGION J POPULATION TOTAL** | **141,476** | **153,748** | **162,999** | **171,145** | **178,227** | **184,595** |

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

# Region J Water User Group (WUG) Demand

| | WUG DEMAND (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| COUNTY-OTHER | 13 | 14 | 15 | 15 | 15 | 15 |
| LIVESTOCK | 11 | 11 | 11 | 11 | 11 | 11 |
| **GUADALUPE BASIN TOTAL** | **24** | **25** | **26** | **26** | **26** | **26** |
| COUNTY-OTHER | 116 | 129 | 136 | 138 | 140 | 141 |
| LIVESTOCK | 47 | 47 | 47 | 47 | 47 | 47 |
| IRRIGATION | 182 | 182 | 182 | 182 | 182 | 182 |
| **NUECES BASIN TOTAL** | **345** | **358** | **365** | **367** | **369** | **370** |
| BANDERA | 342 | 383 | 404 | 413 | 419 | 423 |
| BANDERA COUNTY FWSD 1 | 141 | 158 | 167 | 171 | 174 | 175 |
| COUNTY-OTHER \| BANDERA RIVER RANCH 1 | 97 | 108 | 113 | 115 | 117 | 118 |
| COUNTY-OTHER \| LAKE MEDINA SHORES | 251 | 280 | 294 | 299 | 303 | 306 |
| COUNTY-OTHER \| MEDINA WSC | 93 | 104 | 109 | 111 | 112 | 113 |
| COUNTY-OTHER | 1,765 | 1,965 | 2,066 | 2,102 | 2,132 | 2,149 |
| LIVESTOCK | 185 | 185 | 185 | 185 | 185 | 185 |
| IRRIGATION | 764 | 764 | 764 | 764 | 764 | 764 |
| **SAN ANTONIO BASIN TOTAL** | **3,638** | **3,947** | **4,102** | **4,160** | **4,206** | **4,233** |
| **BANDERA COUNTY TOTAL** | **4,007** | **4,330** | **4,493** | **4,553** | **4,601** | **4,629** |
| ROCKSPRINGS | 198 | 194 | 191 | 190 | 190 | 190 |
| COUNTY-OTHER | 15 | 14 | 14 | 14 | 14 | 14 |
| MINING | 19 | 19 | 19 | 19 | 19 | 19 |
| LIVESTOCK | 106 | 106 | 106 | 106 | 106 | 106 |
| IRRIGATION | 66 | 66 | 66 | 66 | 66 | 66 |
| **COLORADO BASIN TOTAL** | **404** | **399** | **396** | **395** | **395** | **395** |
| ROCKSPRINGS | 98 | 96 | 94 | 94 | 94 | 94 |
| COUNTY-OTHER \| BARKSDALE WSC | 29 | 28 | 27 | 26 | 26 | 26 |
| COUNTY-OTHER | 43 | 41 | 39 | 39 | 39 | 39 |
| MINING | 25 | 25 | 25 | 25 | 25 | 25 |
| LIVESTOCK | 192 | 192 | 192 | 192 | 192 | 192 |
| IRRIGATION | 89 | 89 | 89 | 89 | 89 | 89 |
| **NUECES BASIN TOTAL** | **476** | **471** | **466** | **465** | **465** | **465** |
| COUNTY-OTHER | 8 | 8 | 7 | 7 | 7 | 7 |
| MINING | 45 | 45 | 45 | 45 | 45 | 45 |
| LIVESTOCK | 99 | 99 | 99 | 99 | 99 | 99 |
| IRRIGATION | 60 | 60 | 60 | 60 | 60 | 60 |
| **RIO GRANDE BASIN TOTAL** | **212** | **212** | **211** | **211** | **211** | **211** |
| **EDWARDS COUNTY TOTAL** | **1,092** | **1,082** | **1,073** | **1,071** | **1,071** | **1,071** |
| COUNTY-OTHER | 43 | 44 | 44 | 44 | 45 | 46 |
| MINING | 14 | 15 | 18 | 19 | 20 | 22 |
| LIVESTOCK | 166 | 166 | 166 | 166 | 166 | 166 |
| IRRIGATION | 61 | 61 | 61 | 61 | 61 | 61 |
| **COLORADO BASIN TOTAL** | **284** | **286** | **289** | **290** | **292** | **295** |
| KERRVILLE | 5,082 | 5,158 | 5,178 | 5,237 | 5,305 | 5,364 |
| KERRVILLE SOUTH WATER | 341 | 346 | 347 | 352 | 358 | 363 |
| COUNTY-OTHER \| CENTER POINT | 14 | 14 | 14 | 14 | 14 | 15 |
| COUNTY-OTHER \| CENTER POINT NORTH WATER SYSTEM | 22 | 22 | 22 | 22 | 23 | 23 |
| COUNTY-OTHER \| CENTER POINT TAYLOR SYSTEM | 45 | 45 | 46 | 46 | 47 | 48 |
| COUNTY-OTHER \| HILLS AND DALES ESTATES | 17 | 17 | 17 | 18 | 18 | 18 |
| COUNTY-OTHER \| NICKERSON FARM WATER SYSTEM | 17 | 17 | 17 | 17 | 18 | 18 |

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

# Region J Water User Group (WUG) Demand

| | WUG DEMAND (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| COUNTY-OTHER \| OAK FOREST SOUTH WATER | 56 | 57 | 57 | 58 | 59 | 60 |
| COUNTY-OTHER \| PARK PLACE SUBDIVISION | 11 | 11 | 11 | 11 | 11 | 12 |
| COUNTY-OTHER \| PECAN VALLEY | 10 | 11 | 11 | 11 | 11 | 11 |
| COUNTY-OTHER \| RUSTIC HILLS WATER | 7 | 7 | 7 | 7 | 7 | 7 |
| COUNTY-OTHER \| VERDE PARK ESTATES | 15 | 15 | 15 | 15 | 16 | 16 |
| COUNTY-OTHER \| WESTWOOD WATER SYSTEM | 23 | 23 | 23 | 23 | 24 | 24 |
| COUNTY-OTHER | 1,737 | 1,769 | 1,773 | 1,804 | 1,842 | 1,875 |
| MANUFACTURING | 20 | 21 | 21 | 21 | 21 | 21 |
| MINING | 62 | 65 | 82 | 83 | 91 | 98 |
| LIVESTOCK | 546 | 546 | 546 | 546 | 546 | 546 |
| IRRIGATION | 1,239 | 1,239 | 1,239 | 1,239 | 1,239 | 1,239 |
| **GUADALUPE BASIN TOTAL** | **9,264** | **9,383** | **9,426** | **9,524** | **9,650** | **9,758** |
| COUNTY-OTHER | 1 | 1 | 1 | 1 | 1 | 1 |
| LIVESTOCK | 9 | 9 | 9 | 9 | 9 | 9 |
| **NUECES BASIN TOTAL** | **10** | **10** | **10** | **10** | **10** | **10** |
| COUNTY-OTHER | 23 | 23 | 24 | 24 | 24 | 25 |
| LIVESTOCK | 36 | 36 | 36 | 36 | 36 | 36 |
| IRRIGATION | 42 | 42 | 42 | 42 | 42 | 42 |
| **SAN ANTONIO BASIN TOTAL** | **101** | **101** | **102** | **102** | **102** | **103** |
| **KERR COUNTY TOTAL** | **9,659** | **9,780** | **9,827** | **9,926** | **10,054** | **10,166** |
| COUNTY-OTHER | 11 | 11 | 11 | 11 | 10 | 10 |
| LIVESTOCK | 100 | 100 | 100 | 100 | 100 | 100 |
| IRRIGATION | 1,300 | 1,300 | 1,300 | 1,300 | 1,300 | 1,300 |
| **NUECES BASIN TOTAL** | **1,411** | **1,411** | **1,411** | **1,411** | **1,410** | **1,410** |
| BRACKETTVILLE | 608 | 602 | 594 | 593 | 592 | 592 |
| FORT CLARK SPRINGS MUD | 618 | 616 | 612 | 610 | 609 | 609 |
| COUNTY-OTHER | 53 | 52 | 51 | 51 | 51 | 51 |
| LIVESTOCK | 124 | 124 | 124 | 124 | 124 | 124 |
| IRRIGATION | 2,413 | 2,413 | 2,413 | 2,413 | 2,413 | 2,413 |
| **RIO GRANDE BASIN TOTAL** | **3,816** | **3,807** | **3,794** | **3,791** | **3,789** | **3,789** |
| **KINNEY COUNTY TOTAL** | **5,227** | **5,218** | **5,205** | **5,202** | **5,199** | **5,199** |
| COUNTY-OTHER | 4 | 4 | 3 | 3 | 3 | 3 |
| LIVESTOCK | 13 | 13 | 13 | 13 | 13 | 13 |
| IRRIGATION | 12 | 12 | 12 | 12 | 12 | 12 |
| **COLORADO BASIN TOTAL** | **29** | **29** | **28** | **28** | **28** | **28** |
| CAMP WOOD | 143 | 139 | 136 | 135 | 135 | 135 |
| LEAKEY | 193 | 186 | 180 | 178 | 177 | 177 |
| COUNTY-OTHER | 120 | 116 | 113 | 111 | 111 | 111 |
| LIVESTOCK | 138 | 138 | 138 | 138 | 138 | 138 |
| IRRIGATION | 258 | 258 | 258 | 258 | 258 | 258 |
| **NUECES BASIN TOTAL** | **852** | **837** | **825** | **820** | **819** | **819** |
| **REAL COUNTY TOTAL** | **881** | **866** | **853** | **848** | **847** | **847** |
| DEL RIO UTILITIES COMMISSION | 10,558 | 11,053 | 11,554 | 12,130 | 12,733 | 13,326 |
| LAUGHLIN AIR FORCE BASE | 1,018 | 1,114 | 1,215 | 1,277 | 1,276 | 1,276 |
| COUNTY-OTHER | 1,976 | 2,307 | 2,637 | 3,002 | 3,376 | 3,741 |
| MINING | 190 | 249 | 259 | 223 | 192 | 171 |
| LIVESTOCK | 410 | 410 | 410 | 410 | 410 | 410 |

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

## Region J Water User Group (WUG) Demand

| | WUG DEMAND (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| IRRIGATION | 2,319 | 2,319 | 2,319 | 2,319 | 2,319 | 2,319 |
| **RIO GRANDE BASIN TOTAL** | **16,471** | **17,452** | **18,394** | **19,361** | **20,306** | **21,243** |
| **VAL VERDE COUNTY TOTAL** | **16,471** | **17,452** | **18,394** | **19,361** | **20,306** | **21,243** |
| **REGION J DEMAND TOTAL** | **37,337** | **38,728** | **39,845** | **40,961** | **42,078** | **43,155** |

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

# Region J Water User Group (WUG) Category Summary

| MUNICIPAL | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| POPULATION | 77,213 | 81,354 | 84,756 | 88,023 | 90,845 | 93,452 |
| DEMAND (acre-feet per year) | 19,340 | 20,045 | 20,672 | 21,380 | 22,062 | 22,724 |
| EXISTING SUPPLIES (acre-feet per year) | 17,880 | 17,880 | 17,880 | 17,880 | 17,880 | 17,880 |
| NEEDS (acre-feet per year)* | 4,817 | 5,419 | 6,025 | 6,666 | 7,271 | 7,865 |

| COUNTY-OTHER | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| POPULATION | 64,263 | 72,394 | 78,243 | 83,122 | 87,382 | 91,143 |
| DEMAND (acre-feet per year) | 6,635 | 7,257 | 7,717 | 8,159 | 8,616 | 9,043 |
| EXISTING SUPPLIES (acre-feet per year) | 18,661 | 18,661 | 18,661 | 18,661 | 18,661 | 18,661 |
| NEEDS (acre-feet per year)* | 265 | 316 | 341 | 350 | 370 | 742 |

| MANUFACTURING | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| DEMAND (acre-feet per year) | 20 | 21 | 21 | 21 | 21 | 21 |
| EXISTING SUPPLIES (acre-feet per year) | 48 | 48 | 48 | 48 | 48 | 48 |
| NEEDS (acre-feet per year)* | 0 | 0 | 0 | 0 | 0 | 0 |

| MINING | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| DEMAND (acre-feet per year) | 355 | 418 | 448 | 414 | 392 | 380 |
| EXISTING SUPPLIES (acre-feet per year) | 194 | 194 | 194 | 194 | 194 | 194 |
| NEEDS (acre-feet per year)* | 221 | 281 | 294 | 259 | 229 | 210 |

| LIVESTOCK | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| DEMAND (acre-feet per year) | 2,182 | 2,182 | 2,182 | 2,182 | 2,182 | 2,182 |
| EXISTING SUPPLIES (acre-feet per year) | 2,562 | 2,562 | 2,562 | 2,562 | 2,562 | 2,562 |
| NEEDS (acre-feet per year)* | 357 | 357 | 357 | 357 | 357 | 357 |

| IRRIGATION | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| DEMAND (acre-feet per year) | 8,805 | 8,805 | 8,805 | 8,805 | 8,805 | 8,805 |
| EXISTING SUPPLIES (acre-feet per year) | 22,233 | 22,233 | 22,233 | 22,233 | 22,233 | 22,233 |
| NEEDS (acre-feet per year)* | 75 | 75 | 75 | 75 | 75 | 75 |

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Category Summary report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

# Region J Source Availability

| GROUNDWATER SOURCE TYPE | | | | SOURCE AVAILABILITY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SOURCE NAME | COUNTY | BASIN | SALINITY * | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| AUSTIN CHALK AQUIFER | KINNEY | NUECES | BRACKISH | 875 | 875 | 875 | 875 | 875 | 875 |
| AUSTIN CHALK AQUIFER | KINNEY | RIO GRANDE | BRACKISH | 1,894 | 1,894 | 1,894 | 1,894 | 1,894 | 1,894 |
| EDWARDS-BFZ AQUIFER | KINNEY | NUECES | FRESH | 6,319 | 6,319 | 6,319 | 6,319 | 6,319 | 6,319 |
| EDWARDS-BFZ AQUIFER | KINNEY | RIO GRANDE | FRESH | 2 | 2 | 2 | 2 | 2 | 2 |
| EDWARDS-TRINITY-PLATEAU AQUIFER | BANDERA | GUADALUPE | FRESH | 81 | 81 | 81 | 81 | 81 | 81 |
| EDWARDS-TRINITY-PLATEAU AQUIFER | BANDERA | NUECES | FRESH | 38 | 38 | 38 | 38 | 38 | 38 |
| EDWARDS-TRINITY-PLATEAU AQUIFER | BANDERA | SAN ANTONIO | FRESH | 1,890 | 1,890 | 1,890 | 1,890 | 1,890 | 1,890 |
| EDWARDS-TRINITY-PLATEAU AQUIFER | KERR | COLORADO | FRESH | 245 | 245 | 245 | 245 | 245 | 245 |
| EDWARDS-TRINITY-PLATEAU AQUIFER | KERR | GUADALUPE | FRESH | 1,015 | 1,015 | 1,015 | 1,015 | 1,015 | 1,015 |
| EDWARDS-TRINITY-PLATEAU AQUIFER | KERR | NUECES | FRESH | 5 | 5 | 5 | 5 | 5 | 5 |
| EDWARDS-TRINITY-PLATEAU AQUIFER | KERR | SAN ANTONIO | FRESH | 12 | 12 | 12 | 12 | 12 | 12 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | EDWARDS | COLORADO | FRESH | 2,305 | 2,305 | 2,305 | 2,305 | 2,305 | 2,305 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | EDWARDS | NUECES | FRESH | 1,631 | 1,631 | 1,631 | 1,631 | 1,631 | 1,631 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | EDWARDS | RIO GRANDE | FRESH | 1,740 | 1,740 | 1,740 | 1,740 | 1,740 | 1,740 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | KINNEY | NUECES | FRESH | 12 | 12 | 12 | 12 | 12 | 12 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | KINNEY | RIO GRANDE | FRESH | 70,329 | 70,329 | 70,329 | 70,329 | 70,329 | 70,329 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | REAL | COLORADO | FRESH | 277 | 277 | 277 | 277 | 277 | 277 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | REAL | GUADALUPE | FRESH | 3 | 3 | 3 | 3 | 3 | 3 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | REAL | NUECES | FRESH | 7,243 | 7,243 | 7,243 | 7,243 | 7,243 | 7,243 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | VAL VERDE | RIO GRANDE | FRESH | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 |
| ELLENBURGER-SAN SABA AQUIFER | KERR | COLORADO | FRESH | 200 | 200 | 200 | 200 | 200 | 200 |
| ELLENBURGER-SAN SABA AQUIFER | KERR | GUADALUPE | FRESH | 1,802 | 1,802 | 1,802 | 1,802 | 1,802 | 1,802 |
| FRIO RIVER ALLUVIUM AQUIFER | REAL | NUECES | FRESH | 2,145 | 2,145 | 2,145 | 2,145 | 2,145 | 2,145 |
| NUECES RIVER ALLUVIUM AQUIFER | EDWARDS | NUECES | FRESH | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 |
| NUECES RIVER ALLUVIUM AQUIFER | REAL | NUECES | FRESH | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 |
| TRINITY AQUIFER | BANDERA | GUADALUPE | FRESH | 76 | 76 | 76 | 76 | 76 | 76 |
| TRINITY AQUIFER | BANDERA | NUECES | FRESH/ BRACKISH | 903 | 903 | 903 | 903 | 903 | 903 |
| TRINITY AQUIFER | BANDERA | SAN ANTONIO | FRESH/ BRACKISH | 6,305 | 6,305 | 6,305 | 6,305 | 6,305 | 6,305 |
| TRINITY AQUIFER | KERR | COLORADO | FRESH | 318 | 318 | 318 | 318 | 318 | 318 |
| TRINITY AQUIFER | KERR | GUADALUPE | FRESH/ BRACKISH | 14,129 | 14,056 | 13,767 | 13,450 | 13,434 | 13,434 |
| TRINITY AQUIFER | KERR | NUECES | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| TRINITY AQUIFER | KERR | SAN ANTONIO | FRESH | 471 | 471 | 471 | 471 | 471 | 471 |
| TRINITY AQUIFER ASR | KERR | GUADALUPE | FRESH | 453 | 453 | 453 | 453 | 453 | 453 |
| **GROUNDWATER SOURCE AVAILABILITY TOTAL** | | | | **176,292** | **176,219** | **175,930** | **175,613** | **175,597** | **175,597** |

* Salinity field indicates whether the source availability is considered 'fresh' (less than 1,000 mg/L), 'brackish' (1,000 to 10,000 mg/L), 'saline' (10,001 mg/L to 34,999 mg/L), or 'seawater' (35,000 mg/L or greater). Sources can also be labeled as 'fresh/brackish' or 'brackish/saline', if a combination of the salinity types is appropriate.

** Since reservoir sources can exist across multiple counties, the county field value, 'reservoir' is applied to all reservoir sources.

# Region J Source Availability

| REUSE SOURCE TYPE | | | | SOURCE AVAILABILITY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **SOURCE NAME** | **COUNTY** | **BASIN** | **SALINITY *** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| DIRECT REUSE | KERR | GUADALUPE | FRESH | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| **REUSE SOURCE AVAILABILITY TOTAL** | | | | **5,000** | **5,000** | **5,000** | **5,000** | **5,000** | **5,000** |

| SURFACE WATER SOURCE TYPE | | | | SOURCE AVAILABILITY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **SOURCE NAME** | **COUNTY** | **BASIN** | **SALINITY *** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| COLORADO RUN-OF-RIVER | EDWARDS | COLORADO | FRESH | 32 | 32 | 32 | 32 | 32 | 32 |
| GUADALUPE RUN-OF-RIVER | BANDERA | GUADALUPE | FRESH | 3 | 3 | 3 | 3 | 3 | 3 |
| GUADALUPE RUN-OF-RIVER | KERR | GUADALUPE | FRESH | 1,375 | 1,375 | 1,375 | 1,375 | 1,375 | 1,375 |
| MEDINA LAKE/RESERVOIR | RESERVOIR** | SAN ANTONIO | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| NUECES RUN-OF-RIVER | BANDERA | NUECES | FRESH | 5 | 5 | 5 | 5 | 5 | 5 |
| NUECES RUN-OF-RIVER | EDWARDS | NUECES | FRESH | 94 | 94 | 94 | 94 | 94 | 94 |
| NUECES RUN-OF-RIVER | REAL | NUECES | FRESH | 1,751 | 1,751 | 1,751 | 1,751 | 1,751 | 1,751 |
| RIO GRANDE RUN-OF-RIVER | KINNEY | RIO GRANDE | FRESH | 3,616 | 3,616 | 3,616 | 3,616 | 3,616 | 3,616 |
| RIO GRANDE RUN-OF-RIVER | VAL VERDE | RIO GRANDE | FRESH | 13,776 | 13,776 | 13,776 | 13,776 | 13,776 | 13,776 |
| SAN ANTONIO RUN-OF-RIVER | BANDERA | SAN ANTONIO | FRESH | 2 | 2 | 2 | 2 | 2 | 2 |
| **SURFACE WATER SOURCE AVAILABILITY TOTAL** | | | | **20,654** | **20,654** | **20,654** | **20,654** | **20,654** | **20,654** |

| | | | | | |
|---|---|---|---|---|---|
| **REGION J SOURCE AVAILABILITY TOTAL** | **201,946** | **201,873** | **201,584** | **201,267** | **201,251** | **201,251** |

* Salinity field indicates whether the source availability is considered 'fresh' (less than 1,000 mg/L), 'brackish' (1,000 to 10,000 mg/L), 'saline' (10,001 mg/L to 34,999 mg/L), or 'seawater' (35,000 mg/L or greater). Sources can also be labeled as 'fresh/brackish' or 'brackish/saline', if a combination of the salinity types is appropriate.

** Since reservoir sources can exist across multiple counties, the county field value, 'reservoir' is applied to all reservoir sources.

# Region J Water User Group (WUG) Existing Water Supply

| WUG NAME | SOURCE REGION | SOURCE DESCRIPTION | EXISTING SUPPLY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| COUNTY-OTHER | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| BANDERA COUNTY | 34 | 34 | 34 | 34 | 34 | 34 |
| LIVESTOCK | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| BANDERA COUNTY | 9 | 9 | 9 | 9 | 9 | 9 |
| | | **GUADALUPE BASIN TOTAL** | **43** | **43** | **43** | **43** | **43** | **43** |
| COUNTY-OTHER | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| BANDERA COUNTY | 38 | 38 | 38 | 38 | 38 | 38 |
| COUNTY-OTHER | J | NUECES RUN-OF-RIVER | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER | J | TRINITY AQUIFER \| BANDERA COUNTY | 399 | 399 | 399 | 399 | 399 | 399 |
| LIVESTOCK | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| BANDERA COUNTY | 0 | 0 | 0 | 0 | 0 | 0 |
| LIVESTOCK | J | TRINITY AQUIFER \| BANDERA COUNTY | 44 | 44 | 44 | 44 | 44 | 44 |
| IRRIGATION | J | NUECES RUN-OF-RIVER | 5 | 5 | 5 | 5 | 5 | 5 |
| IRRIGATION | J | TRINITY AQUIFER \| BANDERA COUNTY | 279 | 279 | 279 | 279 | 279 | 279 |
| | | **NUECES BASIN TOTAL** | **765** | **765** | **765** | **765** | **765** | **765** |
| BANDERA | J | TRINITY AQUIFER \| BANDERA COUNTY | 534 | 534 | 534 | 534 | 534 | 534 |
| BANDERA COUNTY FWSD 1 | J | TRINITY AQUIFER \| BANDERA COUNTY | 75 | 75 | 75 | 75 | 75 | 75 |
| COUNTY-OTHER \| BANDERA RIVER RANCH 1 | J | NUECES RUN-OF-RIVER | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| BANDERA RIVER RANCH 1 | J | SAN ANTONIO RUN-OF-RIVER | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| BANDERA RIVER RANCH 1 | J | TRINITY AQUIFER \| BANDERA COUNTY | 69 | 69 | 69 | 69 | 69 | 69 |
| COUNTY-OTHER \| LAKE MEDINA SHORES | J | NUECES RUN-OF-RIVER | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| LAKE MEDINA SHORES | J | SAN ANTONIO RUN-OF-RIVER | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| LAKE MEDINA SHORES | J | TRINITY AQUIFER \| BANDERA COUNTY | 55 | 55 | 55 | 55 | 55 | 55 |
| COUNTY-OTHER \| MEDINA WSC | J | NUECES RUN-OF-RIVER | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| MEDINA WSC | J | SAN ANTONIO RUN-OF-RIVER | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| MEDINA WSC | J | TRINITY AQUIFER \| BANDERA COUNTY | 58 | 58 | 58 | 58 | 58 | 58 |
| COUNTY-OTHER | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| BANDERA COUNTY | 379 | 379 | 379 | 379 | 379 | 379 |
| COUNTY-OTHER | J | SAN ANTONIO RUN-OF-RIVER | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER | J | TRINITY AQUIFER \| BANDERA COUNTY | 4,356 | 4,356 | 4,356 | 4,356 | 4,356 | 4,356 |
| LIVESTOCK | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| BANDERA COUNTY | 111 | 111 | 111 | 111 | 111 | 111 |
| LIVESTOCK | J | TRINITY AQUIFER \| BANDERA COUNTY | 85 | 85 | 85 | 85 | 85 | 85 |
| IRRIGATION | J | GUADALUPE RUN-OF-RIVER | 3 | 3 | 3 | 3 | 3 | 3 |
| IRRIGATION | J | SAN ANTONIO RUN-OF-RIVER | 2 | 2 | 2 | 2 | 2 | 2 |
| IRRIGATION | J | TRINITY AQUIFER \| BANDERA COUNTY | 684 | 684 | 684 | 684 | 684 | 684 |
| | | **SAN ANTONIO BASIN TOTAL** | **6,411** | **6,411** | **6,411** | **6,411** | **6,411** | **6,411** |
| | | **BANDERA COUNTY TOTAL** | **7,219** | **7,219** | **7,219** | **7,219** | **7,219** | **7,219** |
| ROCKSPRINGS | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | 871 | 871 | 871 | 871 | 871 | 871 |
| COUNTY-OTHER | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | 57 | 57 | 57 | 57 | 57 | 57 |
| MINING | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | 7 | 7 | 7 | 7 | 7 | 7 |
| LIVESTOCK | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | 471 | 471 | 471 | 471 | 471 | 471 |

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

# Region J Water User Group (WUG) Existing Water Supply

| WUG NAME | SOURCE REGION | SOURCE DESCRIPTION | EXISTING SUPPLY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| IRRIGATION | J | COLORADO RUN-OF-RIVER | 32 | 32 | 32 | 32 | 32 | 32 |
| IRRIGATION | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | 78 | 78 | 78 | 78 | 78 | 78 |
| | | **COLORADO BASIN TOTAL** | **1,516** | **1,516** | **1,516** | **1,516** | **1,516** | **1,516** |
| ROCKSPRINGS | | NO WATER SUPPLY ASSOCIATED WITH WUG | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| BARKSDALE WSC | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | 110 | 110 | 110 | 110 | 110 | 110 |
| COUNTY-OTHER | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | 155 | 155 | 155 | 155 | 155 | 155 |
| COUNTY-OTHER | J | NUECES RIVER ALLUVIUM AQUIFER \| EDWARDS COUNTY | 8 | 8 | 8 | 8 | 8 | 8 |
| MINING | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | 9 | 9 | 9 | 9 | 9 | 9 |
| LIVESTOCK | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | 206 | 206 | 206 | 206 | 206 | 206 |
| IRRIGATION | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | 109 | 109 | 109 | 109 | 109 | 109 |
| IRRIGATION | J | NUECES RUN-OF-RIVER | 94 | 94 | 94 | 94 | 94 | 94 |
| | | **NUECES BASIN TOTAL** | **691** | **691** | **691** | **691** | **691** | **691** |
| COUNTY-OTHER | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | 30 | 30 | 30 | 30 | 30 | 30 |
| MINING | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | 14 | 14 | 14 | 14 | 14 | 14 |
| LIVESTOCK | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | 110 | 110 | 110 | 110 | 110 | 110 |
| IRRIGATION | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | 70 | 70 | 70 | 70 | 70 | 70 |
| | | **RIO GRANDE BASIN TOTAL** | **224** | **224** | **224** | **224** | **224** | **224** |
| | | **EDWARDS COUNTY TOTAL** | **2,431** | **2,431** | **2,431** | **2,431** | **2,431** | **2,431** |
| COUNTY-OTHER | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | 64 | 64 | 64 | 64 | 64 | 64 |
| MINING | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | 3 | 3 | 3 | 3 | 3 | 3 |
| LIVESTOCK | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | 47 | 47 | 47 | 47 | 47 | 47 |
| IRRIGATION | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | 92 | 92 | 92 | 92 | 92 | 92 |
| | | **COLORADO BASIN TOTAL** | **206** | **206** | **206** | **206** | **206** | **206** |
| KERRVILLE | J | DIRECT REUSE | 2,425 | 2,425 | 2,425 | 2,425 | 2,425 | 2,425 |
| KERRVILLE | J | GUADALUPE RUN-OF-RIVER | 150 | 150 | 150 | 150 | 150 | 150 |
| KERRVILLE | J | TRINITY AQUIFER \| KERR COUNTY | 3,605 | 3,605 | 3,605 | 3,605 | 3,605 | 3,605 |
| KERRVILLE | J | TRINITY AQUIFER ASR \| KERR COUNTY | 453 | 453 | 453 | 453 | 453 | 453 |
| KERRVILLE SOUTH WATER | J | TRINITY AQUIFER \| KERR COUNTY | 387 | 387 | 387 | 387 | 387 | 387 |
| COUNTY-OTHER \| CENTER POINT | J | TRINITY AQUIFER \| KERR COUNTY | 11 | 11 | 11 | 11 | 11 | 11 |
| COUNTY-OTHER \| CENTER POINT NORTH WATER SYSTEM | J | TRINITY AQUIFER \| KERR COUNTY | 23 | 23 | 23 | 23 | 23 | 23 |
| COUNTY-OTHER \| CENTER POINT TAYLOR SYSTEM | J | TRINITY AQUIFER \| KERR COUNTY | 43 | 43 | 43 | 43 | 43 | 43 |
| COUNTY-OTHER \| HILLS AND DALES ESTATES | J | TRINITY AQUIFER \| KERR COUNTY | 18 | 18 | 18 | 18 | 18 | 18 |
| COUNTY-OTHER \| NICKERSON FARM WATER SYSTEM | J | TRINITY AQUIFER \| KERR COUNTY | 22 | 22 | 22 | 22 | 22 | 22 |
| COUNTY-OTHER \| OAK FOREST SOUTH WATER | J | TRINITY AQUIFER \| KERR COUNTY | 80 | 80 | 80 | 80 | 80 | 80 |
| COUNTY-OTHER \| PARK PLACE SUBDIVISION | J | TRINITY AQUIFER \| KERR COUNTY | 14 | 14 | 14 | 14 | 14 | 14 |
| COUNTY-OTHER \| PECAN VALLEY | J | TRINITY AQUIFER \| KERR COUNTY | 12 | 12 | 12 | 12 | 12 | 12 |

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

# Region J Water User Group (WUG) Existing Water Supply

| WUG NAME | SOURCE REGION | SOURCE DESCRIPTION | EXISTING SUPPLY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| COUNTY-OTHER \| RUSTIC HILLS WATER | J | TRINITY AQUIFER \| KERR COUNTY | 9 | 9 | 9 | 9 | 9 | 9 |
| COUNTY-OTHER \| VERDE PARK ESTATES | J | TRINITY AQUIFER \| KERR COUNTY | 16 | 16 | 16 | 16 | 16 | 16 |
| COUNTY-OTHER \| WESTWOOD WATER SYSTEM | J | TRINITY AQUIFER \| KERR COUNTY | 28 | 28 | 28 | 28 | 28 | 28 |
| COUNTY-OTHER | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | 616 | 616 | 616 | 616 | 616 | 616 |
| COUNTY-OTHER | J | GUADALUPE RUN-OF-RIVER | 10 | 10 | 10 | 10 | 10 | 10 |
| COUNTY-OTHER | J | TRINITY AQUIFER \| KERR COUNTY | 7,636 | 7,636 | 7,636 | 7,636 | 7,636 | 7,636 |
| MANUFACTURING | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | 20 | 20 | 20 | 20 | 20 | 20 |
| MANUFACTURING | J | GUADALUPE RUN-OF-RIVER | 11 | 11 | 11 | 11 | 11 | 11 |
| MANUFACTURING | J | TRINITY AQUIFER \| KERR COUNTY | 17 | 17 | 17 | 17 | 17 | 17 |
| MINING | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | 14 | 14 | 14 | 14 | 14 | 14 |
| MINING | J | GUADALUPE RUN-OF-RIVER | 77 | 77 | 77 | 77 | 77 | 77 |
| MINING | J | TRINITY AQUIFER \| KERR COUNTY | 31 | 31 | 31 | 31 | 31 | 31 |
| LIVESTOCK | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | 230 | 230 | 230 | 230 | 230 | 230 |
| LIVESTOCK | J | TRINITY AQUIFER \| KERR COUNTY | 143 | 143 | 143 | 143 | 143 | 143 |
| IRRIGATION | J | GUADALUPE RUN-OF-RIVER | 1,127 | 1,127 | 1,127 | 1,127 | 1,127 | 1,127 |
| IRRIGATION | J | TRINITY AQUIFER \| KERR COUNTY | 533 | 533 | 533 | 533 | 533 | 533 |
| | | **GUADALUPE BASIN TOTAL** | **17,761** | **17,761** | **17,761** | **17,761** | **17,761** | **17,761** |
| COUNTY-OTHER | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | 0 | 0 | 0 | 0 | 0 | 0 |
| LIVESTOCK | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | 3 | 3 | 3 | 3 | 3 | 3 |
| | | **NUECES BASIN TOTAL** | **3** | **3** | **3** | **3** | **3** | **3** |
| COUNTY-OTHER | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | 3 | 3 | 3 | 3 | 3 | 3 |
| COUNTY-OTHER | J | TRINITY AQUIFER \| KERR COUNTY | 258 | 258 | 258 | 258 | 258 | 258 |
| LIVESTOCK | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | 9 | 9 | 9 | 9 | 9 | 9 |
| IRRIGATION | J | EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | 0 | 0 | 0 | 0 | 0 | 0 |
| IRRIGATION | J | TRINITY AQUIFER \| KERR COUNTY | 63 | 63 | 63 | 63 | 63 | 63 |
| | | **SAN ANTONIO BASIN TOTAL** | **333** | **333** | **333** | **333** | **333** | **333** |
| | | **KERR COUNTY TOTAL** | **18,303** | **18,303** | **18,303** | **18,303** | **18,303** | **18,303** |
| COUNTY-OTHER | J | EDWARDS-BFZ AQUIFER \| KINNEY COUNTY | 29 | 29 | 29 | 29 | 29 | 29 |
| COUNTY-OTHER | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| KINNEY COUNTY | 5 | 5 | 5 | 5 | 5 | 5 |
| LIVESTOCK | J | EDWARDS-BFZ AQUIFER \| KINNEY COUNTY | 66 | 66 | 66 | 66 | 66 | 66 |
| LIVESTOCK | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| KINNEY COUNTY | 7 | 7 | 7 | 7 | 7 | 7 |
| IRRIGATION | J | EDWARDS-BFZ AQUIFER \| KINNEY COUNTY | 2,357 | 2,357 | 2,357 | 2,357 | 2,357 | 2,357 |
| | | **NUECES BASIN TOTAL** | **2,464** | **2,464** | **2,464** | **2,464** | **2,464** | **2,464** |
| BRACKETTVILLE | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| KINNEY COUNTY | 645 | 645 | 645 | 645 | 645 | 645 |
| BRACKETTVILLE | J | RIO GRANDE RUN-OF-RIVER | 0 | 0 | 0 | 0 | 0 | 0 |
| FORT CLARK SPRINGS MUD | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| KINNEY COUNTY | 1,371 | 1,371 | 1,371 | 1,371 | 1,371 | 1,371 |
| COUNTY-OTHER | J | AUSTIN CHALK AQUIFER \| KINNEY COUNTY | 80 | 80 | 80 | 80 | 80 | 80 |
| COUNTY-OTHER | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| KINNEY COUNTY | 85 | 85 | 85 | 85 | 85 | 85 |
| LIVESTOCK | J | AUSTIN CHALK AQUIFER \| KINNEY COUNTY | 226 | 226 | 226 | 226 | 226 | 226 |
| LIVESTOCK | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| KINNEY COUNTY | 95 | 95 | 95 | 95 | 95 | 95 |
| IRRIGATION | J | AUSTIN CHALK AQUIFER \| KINNEY COUNTY | 952 | 952 | 952 | 952 | 952 | 952 |

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

# Region J Water User Group (WUG) Existing Water Supply

| WUG NAME | SOURCE REGION | SOURCE DESCRIPTION | EXISTING SUPPLY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| IRRIGATION | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| KINNEY COUNTY | 3,425 | 3,425 | 3,425 | 3,425 | 3,425 | 3,425 |
| IRRIGATION | J | RIO GRANDE RUN-OF-RIVER | 3,616 | 3,616 | 3,616 | 3,616 | 3,616 | 3,616 |
| | | **RIO GRANDE BASIN TOTAL** | **10,495** | **10,495** | **10,495** | **10,495** | **10,495** | **10,495** |
| | | **KINNEY COUNTY TOTAL** | **12,959** | **12,959** | **12,959** | **12,959** | **12,959** | **12,959** |
| COUNTY-OTHER | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| REAL COUNTY | 15 | 15 | 15 | 15 | 15 | 15 |
| LIVESTOCK | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| REAL COUNTY | 18 | 18 | 18 | 18 | 18 | 18 |
| IRRIGATION | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| REAL COUNTY | 188 | 188 | 188 | 188 | 188 | 188 |
| | | **COLORADO BASIN TOTAL** | **221** | **221** | **221** | **221** | **221** | **221** |
| CAMP WOOD | J | NUECES RUN-OF-RIVER | 0 | 0 | 0 | 0 | 0 | 0 |
| LEAKEY | J | FRIO RIVER ALLUVIUM AQUIFER \| REAL COUNTY | 298 | 298 | 298 | 298 | 298 | 298 |
| COUNTY-OTHER | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| REAL COUNTY | 156 | 156 | 156 | 156 | 156 | 156 |
| COUNTY-OTHER | J | FRIO RIVER ALLUVIUM AQUIFER \| REAL COUNTY | 311 | 311 | 311 | 311 | 311 | 311 |
| COUNTY-OTHER | J | NUECES RIVER ALLUVIUM AQUIFER \| REAL COUNTY | 5 | 5 | 5 | 5 | 5 | 5 |
| COUNTY-OTHER | J | NUECES RUN-OF-RIVER | 0 | 0 | 0 | 0 | 0 | 0 |
| LIVESTOCK | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| REAL COUNTY | 176 | 176 | 176 | 176 | 176 | 176 |
| IRRIGATION | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| REAL COUNTY | 187 | 187 | 187 | 187 | 187 | 187 |
| IRRIGATION | J | NUECES RUN-OF-RIVER | 1,751 | 1,751 | 1,751 | 1,751 | 1,751 | 1,751 |
| | | **NUECES BASIN TOTAL** | **2,884** | **2,884** | **2,884** | **2,884** | **2,884** | **2,884** |
| | | **REAL COUNTY TOTAL** | **3,105** | **3,105** | **3,105** | **3,105** | **3,105** | **3,105** |
| DEL RIO UTILITIES COMMISSION | J | RIO GRANDE RUN-OF-RIVER | 6,135 | 6,135 | 6,135 | 6,135 | 6,135 | 6,135 |
| LAUGHLIN AIR FORCE BASE | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| VAL VERDE COUNTY | 60 | 60 | 60 | 60 | 60 | 60 |
| LAUGHLIN AIR FORCE BASE | J | RIO GRANDE RUN-OF-RIVER | 871 | 871 | 871 | 871 | 871 | 871 |
| COUNTY-OTHER | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| VAL VERDE COUNTY | 2,904 | 2,904 | 2,904 | 2,904 | 2,904 | 2,904 |
| COUNTY-OTHER | J | RIO GRANDE RUN-OF-RIVER | 460 | 460 | 460 | 460 | 460 | 460 |
| MINING | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| VAL VERDE COUNTY | 39 | 39 | 39 | 39 | 39 | 39 |
| LIVESTOCK | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| VAL VERDE COUNTY | 506 | 506 | 506 | 506 | 506 | 506 |
| IRRIGATION | J | EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| VAL VERDE COUNTY | 276 | 276 | 276 | 276 | 276 | 276 |
| IRRIGATION | J | RIO GRANDE RUN-OF-RIVER | 6,310 | 6,310 | 6,310 | 6,310 | 6,310 | 6,310 |
| | | **RIO GRANDE BASIN TOTAL** | **17,561** | **17,561** | **17,561** | **17,561** | **17,561** | **17,561** |
| | | **VAL VERDE COUNTY TOTAL** | **17,561** | **17,561** | **17,561** | **17,561** | **17,561** | **17,561** |
| | | **REGION J EXISTING WATER SUPPLY TOTAL** | **61,578** | **61,578** | **61,578** | **61,578** | **61,578** | **61,578** |

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

# Region J Water User Group (WUG) Needs/Surplus

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Needs/Surplus report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Surplus volumes are shown as positive values, and needs are shown as negative values in parentheses.

| | (NEEDS)/SURPLUS (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| **BANDERA COUNTY - GUADALUPE BASIN** | | | | | | |
| COUNTY-OTHER | 21 | 20 | 19 | 19 | 19 | 19 |
| LIVESTOCK | (2) | (2) | (2) | (2) | (2) | (2) |
| **BANDERA COUNTY - NUECES BASIN** | | | | | | |
| COUNTY-OTHER | 321 | 308 | 301 | 299 | 297 | 296 |
| LIVESTOCK | (3) | (3) | (3) | (3) | (3) | (3) |
| IRRIGATION | 102 | 102 | 102 | 102 | 102 | 102 |
| **BANDERA COUNTY - SAN ANTONIO BASIN** | | | | | | |
| BANDERA | 192 | 151 | 130 | 121 | 115 | 111 |
| BANDERA COUNTY FWSD 1 | (66) | (83) | (92) | (96) | (99) | (100) |
| COUNTY-OTHER \| BANDERA RIVER RANCH 1 | (28) | (39) | (44) | (46) | (48) | (49) |
| COUNTY-OTHER \| LAKE MEDINA SHORES | (196) | (225) | (239) | (244) | (248) | (251) |
| COUNTY-OTHER \| MEDINA WSC | (35) | (46) | (51) | (53) | (54) | (55) |
| COUNTY-OTHER | 2,970 | 2,770 | 2,669 | 2,633 | 2,603 | 2,586 |
| LIVESTOCK | 11 | 11 | 11 | 11 | 11 | 11 |
| IRRIGATION | (75) | (75) | (75) | (75) | (75) | (75) |
| **EDWARDS COUNTY - COLORADO BASIN** | | | | | | |
| ROCKSPRINGS | 673 | 677 | 680 | 681 | 681 | 681 |
| COUNTY-OTHER | 42 | 43 | 43 | 43 | 43 | 43 |
| MINING | (12) | (12) | (12) | (12) | (12) | (12) |
| LIVESTOCK | 365 | 365 | 365 | 365 | 365 | 365 |
| IRRIGATION | 44 | 44 | 44 | 44 | 44 | 44 |
| **EDWARDS COUNTY - NUECES BASIN** | | | | | | |
| ROCKSPRINGS | (98) | (96) | (94) | (94) | (94) | (94) |
| COUNTY-OTHER \| BARKSDALE WSC | 81 | 82 | 83 | 84 | 84 | 84 |
| COUNTY-OTHER | 120 | 122 | 124 | 124 | 124 | 124 |
| MINING | (16) | (16) | (16) | (16) | (16) | (16) |
| LIVESTOCK | 14 | 14 | 14 | 14 | 14 | 14 |
| IRRIGATION | 114 | 114 | 114 | 114 | 114 | 114 |
| **EDWARDS COUNTY - RIO GRANDE BASIN** | | | | | | |
| COUNTY-OTHER | 22 | 22 | 23 | 23 | 23 | 23 |
| MINING | (31) | (31) | (31) | (31) | (31) | (31) |
| LIVESTOCK | 11 | 11 | 11 | 11 | 11 | 11 |
| IRRIGATION | 10 | 10 | 10 | 10 | 10 | 10 |
| **KERR COUNTY - COLORADO BASIN** | | | | | | |
| COUNTY-OTHER | 21 | 20 | 20 | 20 | 19 | 18 |
| MINING | (11) | (12) | (15) | (16) | (17) | (19) |
| LIVESTOCK | (119) | (119) | (119) | (119) | (119) | (119) |
| IRRIGATION | 31 | 31 | 31 | 31 | 31 | 31 |
| **KERR COUNTY - GUADALUPE BASIN** | | | | | | |
| KERRVILLE | 1,551 | 1,475 | 1,455 | 1,396 | 1,328 | 1,269 |
| KERRVILLE SOUTH WATER | 46 | 41 | 40 | 35 | 29 | 24 |
| COUNTY-OTHER \| CENTER POINT | (3) | (3) | (3) | (3) | (3) | (4) |
| COUNTY-OTHER \| CENTER POINT NORTH WATER SYSTEM | 1 | 1 | 1 | 1 | 0 | 0 |

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

## Region J Water User Group (WUG) Needs/Surplus

| | | | | | | |
|---|---|---|---|---|---|---|
| COUNTY-OTHER \| CENTER POINT TAYLOR SYSTEM | (2) | (2) | (3) | (3) | (4) | (5) |
| COUNTY-OTHER \| HILLS AND DALES ESTATES | 1 | 1 | 1 | 0 | 0 | 0 |
| COUNTY-OTHER \| NICKERSON FARM WATER SYSTEM | 5 | 5 | 5 | 5 | 4 | 4 |
| COUNTY-OTHER \| OAK FOREST SOUTH WATER | 24 | 23 | 23 | 22 | 21 | 20 |
| COUNTY-OTHER \| PARK PLACE SUBDIVISION | 3 | 3 | 3 | 3 | 3 | 2 |
| COUNTY-OTHER \| PECAN VALLEY | 2 | 1 | 1 | 1 | 1 | 1 |
| COUNTY-OTHER \| RUSTIC HILLS WATER | 2 | 2 | 2 | 2 | 2 | 2 |
| COUNTY-OTHER \| VERDE PARK ESTATES | 1 | 1 | 1 | 1 | 0 | 0 |
| COUNTY-OTHER \| WESTWOOD WATER SYSTEM | 5 | 5 | 5 | 5 | 4 | 4 |
| COUNTY-OTHER | 6,525 | 6,493 | 6,489 | 6,458 | 6,420 | 6,387 |
| MANUFACTURING | 28 | 27 | 27 | 27 | 27 | 27 |
| MINING | 60 | 57 | 40 | 39 | 31 | 24 |
| LIVESTOCK | (173) | (173) | (173) | (173) | (173) | (173) |
| IRRIGATION | 421 | 421 | 421 | 421 | 421 | 421 |
| **KERR COUNTY - NUECES BASIN** | | | | | | |
| COUNTY-OTHER | (1) | (1) | (1) | (1) | (1) | (1) |
| LIVESTOCK | (6) | (6) | (6) | (6) | (6) | (6) |
| **KERR COUNTY - SAN ANTONIO BASIN** | | | | | | |
| COUNTY-OTHER | 238 | 238 | 237 | 237 | 237 | 236 |
| LIVESTOCK | (27) | (27) | (27) | (27) | (27) | (27) |
| IRRIGATION | 21 | 21 | 21 | 21 | 21 | 21 |
| **KINNEY COUNTY - NUECES BASIN** | | | | | | |
| COUNTY-OTHER | 23 | 23 | 23 | 23 | 24 | 24 |
| LIVESTOCK | (27) | (27) | (27) | (27) | (27) | (27) |
| IRRIGATION | 1,057 | 1,057 | 1,057 | 1,057 | 1,057 | 1,057 |
| **KINNEY COUNTY - RIO GRANDE BASIN** | | | | | | |
| BRACKETTVILLE | 37 | 43 | 51 | 52 | 53 | 53 |
| FORT CLARK SPRINGS MUD | 753 | 755 | 759 | 761 | 762 | 762 |
| COUNTY-OTHER | 112 | 113 | 114 | 114 | 114 | 114 |
| LIVESTOCK | 197 | 197 | 197 | 197 | 197 | 197 |
| IRRIGATION | 5,580 | 5,580 | 5,580 | 5,580 | 5,580 | 5,580 |
| **REAL COUNTY - COLORADO BASIN** | | | | | | |
| COUNTY-OTHER | 11 | 11 | 12 | 12 | 12 | 12 |
| LIVESTOCK | 5 | 5 | 5 | 5 | 5 | 5 |
| IRRIGATION | 176 | 176 | 176 | 176 | 176 | 176 |
| **REAL COUNTY - NUECES BASIN** | | | | | | |
| CAMP WOOD | (143) | (139) | (136) | (135) | (135) | (135) |
| LEAKEY | 105 | 112 | 118 | 120 | 121 | 121 |
| COUNTY-OTHER | 352 | 356 | 359 | 361 | 361 | 361 |
| LIVESTOCK | 38 | 38 | 38 | 38 | 38 | 38 |
| IRRIGATION | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 |
| **VAL VERDE COUNTY - RIO GRANDE BASIN** | | | | | | |
| DEL RIO UTILITIES COMMISSION | (4,423) | (4,918) | (5,419) | (5,995) | (6,598) | (7,191) |
| LAUGHLIN AIR FORCE BASE | (87) | (183) | (284) | (346) | (345) | (345) |
| COUNTY-OTHER | 1,388 | 1,057 | 727 | 362 | (12) | (377) |
| MINING | (151) | (210) | (220) | (184) | (153) | (132) |
| LIVESTOCK | 96 | 96 | 96 | 96 | 96 | 96 |
| IRRIGATION | 4,267 | 4,267 | 4,267 | 4,267 | 4,267 | 4,267 |

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

# Region J Water User Group (WUG) Second-Tier Identified Water Needs

Second-tier needs are WUG split needs adjusted to include the implementation of recommended demand reduction and direct reuse water management strategies.

| | WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| **BANDERA COUNTY - GUADALUPE BASIN** | | | | | | |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 0 |
| LIVESTOCK | 1 | 1 | 1 | 1 | 1 | 1 |
| **BANDERA COUNTY - NUECES BASIN** | | | | | | |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 0 |
| LIVESTOCK | 2 | 2 | 2 | 2 | 2 | 2 |
| IRRIGATION | 0 | 0 | 0 | 0 | 0 | 0 |
| **BANDERA COUNTY - SAN ANTONIO BASIN** | | | | | | |
| BANDERA | 0 | 0 | 0 | 0 | 0 | 0 |
| BANDERA COUNTY FWSD 1 | 66 | 83 | 92 | 96 | 99 | 100 |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| BANDERA RIVER RANCH 1 | 24 | 35 | 40 | 42 | 44 | 45 |
| COUNTY-OTHER \| LAKE MEDINA SHORES | 193 | 222 | 236 | 241 | 245 | 248 |
| COUNTY-OTHER \| MEDINA WSC | 34 | 45 | 50 | 52 | 53 | 54 |
| LIVESTOCK | 0 | 0 | 0 | 0 | 0 | 0 |
| IRRIGATION | 39 | 39 | 39 | 39 | 39 | 39 |
| **EDWARDS COUNTY - COLORADO BASIN** | | | | | | |
| ROCKSPRINGS | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 0 |
| MINING | 12 | 12 | 12 | 12 | 12 | 12 |
| LIVESTOCK | 0 | 0 | 0 | 0 | 0 | 0 |
| IRRIGATION | 0 | 0 | 0 | 0 | 0 | 0 |
| **EDWARDS COUNTY - NUECES BASIN** | | | | | | |
| ROCKSPRINGS | 98 | 96 | 94 | 94 | 94 | 94 |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| BARKSDALE WSC | 0 | 0 | 0 | 0 | 0 | 0 |
| MINING | 16 | 16 | 16 | 16 | 16 | 16 |
| LIVESTOCK | 0 | 0 | 0 | 0 | 0 | 0 |
| IRRIGATION | 0 | 0 | 0 | 0 | 0 | 0 |
| **EDWARDS COUNTY - RIO GRANDE BASIN** | | | | | | |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 0 |
| MINING | 31 | 31 | 31 | 31 | 31 | 31 |
| LIVESTOCK | 0 | 0 | 0 | 0 | 0 | 0 |
| IRRIGATION | 0 | 0 | 0 | 0 | 0 | 0 |
| **KERR COUNTY - COLORADO BASIN** | | | | | | |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 0 |
| MINING | 11 | 12 | 15 | 16 | 17 | 19 |
| LIVESTOCK | 95 | 95 | 95 | 95 | 95 | 95 |
| IRRIGATION | 0 | 0 | 0 | 0 | 0 | 0 |
| **KERR COUNTY - GUADALUPE BASIN** | | | | | | |
| KERRVILLE | 0 | 0 | 0 | 0 | 0 | 0 |
| KERRVILLE SOUTH WATER | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| CENTER POINT | 0 | 2 | 2 | 2 | 2 | 3 |
| COUNTY-OTHER \| CENTER POINT NORTH WATER SYSTEM | 0 | 0 | 0 | 0 | 0 | 0 |

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

# Region J Water User Group (WUG) Second-Tier Identified Water Needs

| | WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| **KERR COUNTY - GUADALUPE BASIN** | | | | | | |
| COUNTY-OTHER \| CENTER POINT TAYLOR SYSTEM | 0 | 1 | 2 | 2 | 3 | 4 |
| COUNTY-OTHER \| HILLS AND DALES ESTATES | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| NICKERSON FARM WATER SYSTEM | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| OAK FOREST SOUTH WATER | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| PARK PLACE SUBDIVISION | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| PECAN VALLEY | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| RUSTIC HILLS WATER | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| VERDE PARK ESTATES | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER \| WESTWOOD WATER SYSTEM | 0 | 0 | 0 | 0 | 0 | 0 |
| MANUFACTURING | 0 | 0 | 0 | 0 | 0 | 0 |
| MINING | 0 | 0 | 0 | 0 | 0 | 0 |
| LIVESTOCK | 138 | 138 | 138 | 138 | 138 | 138 |
| IRRIGATION | 0 | 0 | 0 | 0 | 0 | 0 |
| **KERR COUNTY - NUECES BASIN** | | | | | | |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 0 |
| LIVESTOCK | 5 | 5 | 5 | 5 | 5 | 5 |
| **KERR COUNTY - SAN ANTONIO BASIN** | | | | | | |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 0 |
| LIVESTOCK | 22 | 22 | 22 | 22 | 22 | 22 |
| IRRIGATION | 0 | 0 | 0 | 0 | 0 | 0 |
| **KINNEY COUNTY - NUECES BASIN** | | | | | | |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 0 |
| LIVESTOCK | 27 | 27 | 27 | 27 | 27 | 27 |
| IRRIGATION | 0 | 0 | 0 | 0 | 0 | 0 |
| **KINNEY COUNTY - RIO GRANDE BASIN** | | | | | | |
| BRACKETTVILLE | 0 | 0 | 0 | 0 | 0 | 0 |
| FORT CLARK SPRINGS MUD | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 0 |
| LIVESTOCK | 0 | 0 | 0 | 0 | 0 | 0 |
| IRRIGATION | 0 | 0 | 0 | 0 | 0 | 0 |
| **REAL COUNTY - COLORADO BASIN** | | | | | | |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 0 |
| LIVESTOCK | 0 | 0 | 0 | 0 | 0 | 0 |
| IRRIGATION | 0 | 0 | 0 | 0 | 0 | 0 |
| **REAL COUNTY - NUECES BASIN** | | | | | | |
| CAMP WOOD | 142 | 138 | 135 | 134 | 134 | 134 |
| LEAKEY | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 0 |
| LIVESTOCK | 0 | 0 | 0 | 0 | 0 | 0 |
| IRRIGATION | 0 | 0 | 0 | 0 | 0 | 0 |
| **VAL VERDE COUNTY - RIO GRANDE BASIN** | | | | | | |
| DEL RIO UTILITIES COMMISSION | 4,411 | 1,814 | 2,315 | 2,891 | 3,494 | 4,087 |
| LAUGHLIN AIR FORCE BASE | 87 | 183 | 284 | 346 | 345 | 345 |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 365 |
| MINING | 151 | 210 | 220 | 184 | 153 | 132 |
| LIVESTOCK | 0 | 0 | 0 | 0 | 0 | 0 |
| IRRIGATION | 0 | 0 | 0 | 0 | 0 | 0 |

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

## Region J Water User Group (WUG) Second-Tier Identified Water Needs

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

# Region J Water User Group (WUG) Second-Tier Identified Water Needs Summary

Second-tier needs are WUG split needs adjusted to include the implementation of recommended demand reduction and direct reuse water management strategies.

| WUG CATEGORY | NEEDS (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| MUNICIPAL | 4,804 | 2,314 | 2,920 | 3,561 | 4,166 | 4,760 |
| COUNTY-OTHER | 251 | 305 | 330 | 339 | 347 | 719 |
| MANUFACTURING | 0 | 0 | 0 | 0 | 0 | 0 |
| MINING | 221 | 281 | 294 | 259 | 229 | 210 |
| LIVESTOCK | 290 | 290 | 290 | 290 | 290 | 290 |
| IRRIGATION | 39 | 39 | 39 | 39 | 39 | 39 |

# Region J Source Water Balance (Availability - WUG Supply)

| GROUNDWATER SOURCE TYPE | | | | SOURCE WATER BALANCE (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SOURCE NAME | COUNTY | BASIN | SALINITY* | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| AUSTIN CHALK AQUIFER | KINNEY | NUECES | BRACKISH | 875 | 875 | 875 | 875 | 875 | 875 |
| AUSTIN CHALK AQUIFER | KINNEY | RIO GRANDE | BRACKISH | 636 | 636 | 636 | 636 | 636 | 636 |
| EDWARDS-BFZ AQUIFER | KINNEY | NUECES | FRESH | 3,867 | 3,867 | 3,867 | 3,867 | 3,867 | 3,867 |
| EDWARDS-BFZ AQUIFER | KINNEY | RIO GRANDE | FRESH | 2 | 2 | 2 | 2 | 2 | 2 |
| EDWARDS-TRINITY-PLATEAU AQUIFER | BANDERA | GUADALUPE | FRESH | 38 | 38 | 38 | 38 | 38 | 38 |
| EDWARDS-TRINITY-PLATEAU AQUIFER | BANDERA | NUECES | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| EDWARDS-TRINITY-PLATEAU AQUIFER | BANDERA | SAN ANTONIO | FRESH | 1,400 | 1,400 | 1,400 | 1,400 | 1,400 | 1,400 |
| EDWARDS-TRINITY-PLATEAU AQUIFER | KERR | COLORADO | FRESH | 39 | 39 | 39 | 39 | 39 | 39 |
| EDWARDS-TRINITY-PLATEAU AQUIFER | KERR | GUADALUPE | FRESH | 135 | 135 | 135 | 135 | 135 | 135 |
| EDWARDS-TRINITY-PLATEAU AQUIFER | KERR | NUECES | FRESH | 2 | 2 | 2 | 2 | 2 | 2 |
| EDWARDS-TRINITY-PLATEAU AQUIFER | KERR | SAN ANTONIO | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | EDWARDS | COLORADO | FRESH | 821 | 821 | 821 | 821 | 821 | 821 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | EDWARDS | NUECES | FRESH | 1,042 | 1,042 | 1,042 | 1,042 | 1,042 | 1,042 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | EDWARDS | RIO GRANDE | FRESH | 1,516 | 1,516 | 1,516 | 1,516 | 1,516 | 1,516 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | KINNEY | NUECES | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | KINNEY | RIO GRANDE | FRESH | 64,708 | 64,708 | 64,708 | 64,708 | 64,708 | 64,708 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | REAL | COLORADO | FRESH | 56 | 56 | 56 | 56 | 56 | 56 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | REAL | GUADALUPE | FRESH | 3 | 3 | 3 | 3 | 3 | 3 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | REAL | NUECES | FRESH | 6,724 | 6,724 | 6,724 | 6,724 | 6,724 | 6,724 |
| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS | VAL VERDE | RIO GRANDE | FRESH | 45,755 | 45,755 | 45,755 | 45,755 | 45,755 | 45,755 |
| ELLENBURGER-SAN SABA AQUIFER | KERR | COLORADO | FRESH | 200 | 200 | 200 | 200 | 200 | 200 |
| ELLENBURGER-SAN SABA AQUIFER | KERR | GUADALUPE | FRESH | 1,802 | 1,802 | 1,802 | 1,802 | 1,802 | 1,802 |
| FRIO RIVER ALLUVIUM AQUIFER | REAL | NUECES | FRESH | 1,536 | 1,536 | 1,536 | 1,536 | 1,536 | 1,536 |
| NUECES RIVER ALLUVIUM AQUIFER | EDWARDS | NUECES | FRESH | 1,779 | 1,779 | 1,779 | 1,779 | 1,779 | 1,779 |
| NUECES RIVER ALLUVIUM AQUIFER | REAL | NUECES | FRESH | 1,782 | 1,782 | 1,782 | 1,782 | 1,782 | 1,782 |
| TRINITY AQUIFER | BANDERA | GUADALUPE | FRESH | 76 | 76 | 76 | 76 | 76 | 76 |
| TRINITY AQUIFER | BANDERA | NUECES | FRESH/ BRACKISH | 181 | 181 | 181 | 181 | 181 | 181 |
| TRINITY AQUIFER | BANDERA | SAN ANTONIO | FRESH/ BRACKISH | 389 | 389 | 389 | 389 | 389 | 389 |
| TRINITY AQUIFER | KERR | COLORADO | FRESH | 318 | 318 | 318 | 318 | 318 | 318 |
| TRINITY AQUIFER | KERR | GUADALUPE | FRESH/ BRACKISH | 1,501 | 1,428 | 1,139 | 822 | 806 | 806 |
| TRINITY AQUIFER | KERR | NUECES | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| TRINITY AQUIFER | KERR | SAN ANTONIO | FRESH | 150 | 150 | 150 | 150 | 150 | 150 |

* Salinity field indicates whether the source availability is considered ‘fresh’ (less than 1,000 mg/L), ‘brackish’ (1,000 to 10,000 mg/L), ‘saline’ (10,001 mg/L to 34,999 mg/L), or ‘seawater’ (35,000 mg/L or greater). Sources can also be labeled as ‘fresh/brackish’ or ‘brackish/saline’, if a combination of the salinity types is appropriate.

** Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

# Region J Source Water Balance (Availability - WUG Supply)

| GROUNDWATER SOURCE TYPE | | | | SOURCE WATER BALANCE (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **SOURCE NAME** | **COUNTY** | **BASIN** | **SALINITY*** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| TRINITY AQUIFER ASR | KERR | GUADALUPE | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| **GROUNDWATER SOURCE WATER BALANCE TOTAL** | | | | **137,333** | **137,260** | **136,971** | **136,654** | **136,638** | **136,638** |

| REUSE SOURCE TYPE | | | | SOURCE WATER BALANCE (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **SOURCE NAME** | **COUNTY** | **BASIN** | **SALINITY*** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| DIRECT REUSE | KERR | GUADALUPE | FRESH | 2,575 | 2,575 | 2,575 | 2,575 | 2,575 | 2,575 |
| **REUSE SOURCE WATER BALANCE TOTAL** | | | | **2,575** | **2,575** | **2,575** | **2,575** | **2,575** | **2,575** |

| SURFACE WATER SOURCE TYPE | | | | SOURCE WATER BALANCE (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **SOURCE NAME** | **COUNTY** | **BASIN** | **SALINITY*** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| COLORADO RUN-OF-RIVER | EDWARDS | COLORADO | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| GUADALUPE RUN-OF-RIVER | BANDERA | GUADALUPE | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| GUADALUPE RUN-OF-RIVER | KERR | GUADALUPE | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| MEDINA LAKE/RESERVOIR | RESERVOIR** | SAN ANTONIO | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| NUECES RUN-OF-RIVER | BANDERA | NUECES | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| NUECES RUN-OF-RIVER | EDWARDS | NUECES | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| NUECES RUN-OF-RIVER | REAL | NUECES | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| RIO GRANDE RUN-OF-RIVER | KINNEY | RIO GRANDE | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| RIO GRANDE RUN-OF-RIVER | VAL VERDE | RIO GRANDE | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| SAN ANTONIO RUN-OF-RIVER | BANDERA | SAN ANTONIO | FRESH | 0 | 0 | 0 | 0 | 0 | 0 |
| **SURFACE WATER SOURCE WATER BALANCE TOTAL** | | | | **0** | **0** | **0** | **0** | **0** | **0** |

| | | | | | |
|---|---|---|---|---|---|
| **REGION J SOURCE WATER BALANCE TOTAL** | **139,908** | **139,835** | **139,546** | **139,229** | **139,213** | **139,213** |

* Salinity field indicates whether the source availability is considered ‘fresh’ (less than 1,000 mg/L), ‘brackish’ (1,000 to 10,000 mg/L), ‘saline’ (10,001 mg/L to 34,999 mg/L), or ‘seawater’ (35,000 mg/L or greater). Sources can also be labeled as ‘fresh/brackish’ or ‘brackish/saline’, if a combination of the salinity types is appropriate.

** Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

# Region J Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)

| | 2020 PLANNING DECADE | | | 2070 PLANNING DECADE | | |
|---|---|---|---|---|---|---|
| | 2016 RWP | 2021 RWP | DIFFERENCE (%) | 2016 RWP | 2021 RWP | DIFFERENCE (%) |
| **BANDERA COUNTY \| COUNTY-OTHER WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 2,541 | 5,388 | 112.0% | 2,541 | 5,388 | 112.0% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 2,493 | 2,335 | -6.3% | 3,033 | 2,842 | -6.3% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 0 | 259 | 100.0% | 493 | 355 | -28.0% |
| **BANDERA COUNTY \| IRRIGATION WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 703 | 973 | 38.4% | 703 | 973 | 38.4% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 432 | 946 | 119.0% | 432 | 946 | 119.0% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 129 | 75 | -41.9% | 129 | 75 | -41.9% |
| **BANDERA COUNTY \| LIVESTOCK WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 298 | 249 | -16.4% | 298 | 249 | -16.4% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 297 | 243 | -18.2% | 297 | 243 | -18.2% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 13 | 5 | -61.5% | 13 | 5 | -61.5% |
| **BANDERA COUNTY \| MUNICIPAL WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 660 | 609 | -7.7% | 660 | 609 | -7.7% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 191 | 483 | 152.9% | 236 | 598 | 153.4% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 0 | 66 | 100.0% | 0 | 100 | 100.0% |
| **EDWARDS COUNTY \| COUNTY-OTHER WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 362 | 360 | -0.6% | 362 | 360 | -0.6% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 96 | 95 | -1.0% | 87 | 86 | -1.1% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| **EDWARDS COUNTY \| IRRIGATION WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 443 | 383 | -13.5% | 443 | 383 | -13.5% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 227 | 215 | -5.3% | 184 | 215 | 16.8% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| **EDWARDS COUNTY \| LIVESTOCK WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 523 | 787 | 50.5% | 523 | 787 | 50.5% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 523 | 397 | -24.1% | 523 | 397 | -24.1% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 16 | 0 | -100.0% | 16 | 0 | -100.0% |
| **EDWARDS COUNTY \| MINING WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 89 | 30 | -66.3% | 89 | 30 | -66.3% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 89 | 89 | 0.0% | 89 | 89 | 0.0% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 22 | 59 | 168.2% | 22 | 59 | 168.2% |
| **EDWARDS COUNTY \| MUNICIPAL WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 919 | 871 | -5.2% | 919 | 871 | -5.2% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 295 | 296 | 0.3% | 283 | 284 | 0.4% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 98 | 98 | 0.0% | 94 | 94 | 0.0% |
| **KERR COUNTY \| COUNTY-OTHER WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 5,349 | 8,863 | 65.7% | 5,349 | 8,863 | 65.7% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 2,029 | 2,041 | 0.6% | 2,196 | 2,199 | 0.1% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 6 | 6 | 0.0% | 8 | 10 | 25.0% |
| **KERR COUNTY \| IRRIGATION WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 1,405 | 1,815 | 29.2% | 1,405 | 1,815 | 29.2% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 842 | 1,342 | 59.4% | 719 | 1,342 | 86.6% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 14 | 0 | -100.0% | 12 | 0 | -100.0% |

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2016 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

# Region J Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)

| | 2020 PLANNING DECADE | | | 2070 PLANNING DECADE | | |
|---|---|---|---|---|---|---|
| | 2016 RWP | 2021 RWP | DIFFERENCE (%) | 2016 RWP | 2021 RWP | DIFFERENCE (%) |
| **KERR COUNTY \| LIVESTOCK WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 891 | 432 | -51.5% | 891 | 432 | -51.5% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 890 | 757 | -14.9% | 890 | 757 | -14.9% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 130 | 325 | 150.0% | 130 | 325 | 150.0% |
| **KERR COUNTY \| MANUFACTURING WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 34 | 48 | 41.2% | 34 | 48 | 41.2% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 25 | 20 | -20.0% | 34 | 21 | -38.2% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| **KERR COUNTY \| MINING WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 106 | 125 | 17.9% | 106 | 125 | 17.9% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 76 | 76 | 0.0% | 120 | 120 | 0.0% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 12 | 11 | -8.3% | 21 | 19 | -9.5% |
| **KERR COUNTY \| MUNICIPAL WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 2,364 | 7,020 | 197.0% | 2,364 | 7,020 | 197.0% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 5,201 | 5,423 | 4.3% | 5,474 | 5,727 | 4.6% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 3,224 | 0 | -100.0% | 3,507 | 0 | -100.0% |
| **KINNEY COUNTY \| COUNTY-OTHER WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 291 | 199 | -31.6% | 291 | 199 | -31.6% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 95 | 64 | -32.6% | 90 | 61 | -32.2% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| **KINNEY COUNTY \| IRRIGATION WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 7,833 | 10,350 | 32.1% | 7,833 | 10,350 | 32.1% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 6,730 | 3,713 | -44.8% | 6,730 | 3,713 | -44.8% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| **KINNEY COUNTY \| LIVESTOCK WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 422 | 394 | -6.6% | 422 | 394 | -6.6% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 422 | 224 | -46.9% | 422 | 224 | -46.9% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 22 | 27 | 22.7% | 22 | 27 | 22.7% |
| **KINNEY COUNTY \| MUNICIPAL WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 2,016 | 2,016 | 0.0% | 2,016 | 2,016 | 0.0% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 1,159 | 1,226 | 5.8% | 1,136 | 1,201 | 5.7% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| **REAL COUNTY \| COUNTY-OTHER WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 1,108 | 487 | -56.0% | 1,108 | 487 | -56.0% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 280 | 124 | -55.7% | 257 | 114 | -55.6% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| **REAL COUNTY \| IRRIGATION WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 2,365 | 2,126 | -10.1% | 2,365 | 2,126 | -10.1% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 238 | 270 | 13.4% | 191 | 270 | 41.4% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| **REAL COUNTY \| LIVESTOCK WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 261 | 194 | -25.7% | 261 | 194 | -25.7% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 261 | 151 | -42.1% | 261 | 151 | -42.1% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 33 | 0 | -100.0% | 33 | 0 | -100.0% |

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2016 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

## Region J Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)

| | 2020 PLANNING DECADE | | | 2070 PLANNING DECADE | | |
|---|---|---|---|---|---|---|
| | 2016 RWP | 2021 RWP | DIFFERENCE (%) | 2016 RWP | 2021 RWP | DIFFERENCE (%) |
| **REAL COUNTY \| MUNICIPAL WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 0 | 298 | 100.0% | 0 | 298 | 100.0% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 134 | 336 | 150.7% | 126 | 312 | 147.6% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 134 | 143 | 6.7% | 126 | 135 | 7.1% |
| **VAL VERDE COUNTY \| COUNTY-OTHER WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 4,513 | 3,364 | -25.5% | 4,513 | 3,364 | -25.5% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 1,937 | 1,976 | 2.0% | 3,694 | 3,741 | 1.3% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 0 | 0 | 0.0% | 0 | 377 | 100.0% |
| **VAL VERDE COUNTY \| IRRIGATION WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 2,795 | 6,586 | 135.6% | 2,795 | 6,586 | 135.6% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 2,460 | 2,319 | -5.7% | 2,026 | 2,319 | 14.5% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| **VAL VERDE COUNTY \| LIVESTOCK WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 533 | 506 | -5.1% | 533 | 506 | -5.1% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 533 | 410 | -23.1% | 533 | 410 | -23.1% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 0 | 0 | 0.0% | 0 | 0 | 0.0% |
| **VAL VERDE COUNTY \| MINING WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 186 | 39 | -79.0% | 186 | 39 | -79.0% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 190 | 190 | 0.0% | 171 | 171 | 0.0% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 4 | 151 | 3675.0% | 0 | 132 | 100.0% |
| **VAL VERDE COUNTY \| MUNICIPAL WUG TYPE** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 29,199 | 7,066 | -75.8% | 29,199 | 7,066 | -75.8% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 11,657 | 11,576 | -0.7% | 14,703 | 14,602 | -0.7% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 0 | 4,510 | 100.0% | 0 | 7,536 | 100.0% |
| **REGION J** | | | | | | |
| EXISTING WUG SUPPLY TOTAL (acre-feet per year) | 68,209 | 61,578 | -9.7% | 68,209 | 61,578 | -9.7% |
| PROJECTED DEMAND TOTAL (acre-feet per year) | 39,802 | 37,337 | -6.2% | 44,937 | 43,155 | -4.0% |
| WATER SUPPLY NEEDS TOTAL (acre-feet per year)* | 3,857 | 5,735 | 48.7% | 4,626 | 9,249 | 99.9% |

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2016 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

# Region J Source Data Comparison to 2016 Regional Water Plan (RWP)

| | 2020 PLANNING DECADE | | | 2070 PLANNING DECADE | | |
|---|---|---|---|---|---|---|
| | 2016 RWP | 2021 RWP | DIFFERENCE (%) | 2016 RWP | 2021 RWP | DIFFERENCE (%) |
| **BANDERA COUNTY** | | | | | | |
| GROUNDWATER AVAILABILITY TOTAL (acre-feet per year) | 7,967 | 9,293 | 16.6% | 7,967 | 9,293 | 16.6% |
| SURFACE WATER AVAILABILITY TOTAL (acre-feet per year) | 104 | 10 | -90.4% | 104 | 10 | -90.4% |
| **EDWARDS COUNTY** | | | | | | |
| GROUNDWATER AVAILABILITY TOTAL (acre-feet per year) | 7,425 | 7,463 | 0.5% | 7,425 | 7,463 | 0.5% |
| SURFACE WATER AVAILABILITY TOTAL (acre-feet per year) | 304 | 126 | -58.6% | 304 | 126 | -58.6% |
| **KERR COUNTY** | | | | | | |
| GROUNDWATER AVAILABILITY TOTAL (acre-feet per year) | 16,576 | 18,650 | 12.5% | 15,881 | 17,955 | 13.1% |
| SURFACE WATER AVAILABILITY TOTAL (acre-feet per year) | 1,683 | 1,375 | -18.3% | 1,683 | 1,375 | -18.3% |
| **KINNEY COUNTY** | | | | | | |
| GROUNDWATER AVAILABILITY TOTAL (acre-feet per year) | 81,587 | 79,431 | -2.6% | 81,587 | 79,431 | -2.6% |
| SURFACE WATER AVAILABILITY TOTAL (acre-feet per year) | 1,187 | 3,616 | 204.6% | 1,187 | 3,616 | 204.6% |
| **REAL COUNTY** | | | | | | |
| GROUNDWATER AVAILABILITY TOTAL (acre-feet per year) | 11,461 | 11,455 | -0.1% | 11,461 | 11,455 | -0.1% |
| SURFACE WATER AVAILABILITY TOTAL (acre-feet per year) | 2,215 | 1,751 | -20.9% | 2,215 | 1,751 | -20.9% |
| **VAL VERDE COUNTY** | | | | | | |
| GROUNDWATER AVAILABILITY TOTAL (acre-feet per year) | 24,988 | 50,000 | 100.1% | 24,988 | 50,000 | 100.1% |
| SURFACE WATER AVAILABILITY TOTAL (acre-feet per year) | 14,111 | 13,776 | -2.4% | 14,111 | 13,776 | -2.4% |
| **REGION J** | | | | | | |
| GROUNDWATER AVAILABILITY TOTAL (acre-feet per year) | 150,004 | 176,292 | 17.5% | 149,309 | 175,597 | 17.6% |
| SURFACE WATER AVAILABILITY TOTAL (acre-feet per year) | 19,604 | 20,654 | 5.4% | 19,604 | 20,654 | 5.4% |

* Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

## Region J Water User Group (WUG) Unmet Needs

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future supply volume than projected demand in any given decade, this amount is considered a surplus volume. In order to display only unmet needs associated with the WUG split, these surplus volumes are updated to a zero and the unmet needs water volumes are shown as absolute values.

| | WUG UNMET NEEDS (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| **BANDERA COUNTY - SAN ANTONIO BASIN** | | | | | | |
| COUNTY-OTHER \| BANDERA RIVER RANCH 1 | 24 | 35 | 40 | 42 | 44 | 45 |
| COUNTY-OTHER \| LAKE MEDINA SHORES | 193 | 222 | 236 | 241 | 245 | 248 |
| **KERR COUNTY - COLORADO BASIN** | | | | | | |
| LIVESTOCK | 95 | 95 | 95 | 95 | 95 | 95 |
| **KERR COUNTY - GUADALUPE BASIN** | | | | | | |
| LIVESTOCK | 138 | 138 | 138 | 138 | 138 | 138 |
| **KERR COUNTY - NUECES BASIN** | | | | | | |
| LIVESTOCK | 5 | 5 | 5 | 5 | 5 | 5 |
| **KERR COUNTY - SAN ANTONIO BASIN** | | | | | | |
| LIVESTOCK | 22 | 22 | 22 | 22 | 22 | 22 |
| **KINNEY COUNTY - NUECES BASIN** | | | | | | |
| LIVESTOCK | 27 | 27 | 27 | 27 | 27 | 27 |
| **VAL VERDE COUNTY - RIO GRANDE BASIN** | | | | | | |
| COUNTY-OTHER | 0 | 0 | 0 | 0 | 0 | 365 |

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

# Region J Water User Group (WUG) Unmet Needs Summary

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs Summary report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG category level, calculated surpluses are updated to zero so that only the WUGs with unmet needs in the decade are included with the Needs totals. Unmet needs water volumes are shown as absolute values.

| WUG CATEGORY | NEEDS (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| MUNICIPAL | 0 | 0 | 0 | 0 | 0 | 0 |
| COUNTY-OTHER | 217 | 257 | 276 | 283 | 289 | 658 |
| MANUFACTURING | 0 | 0 | 0 | 0 | 0 | 0 |
| MINING | 0 | 0 | 0 | 0 | 0 | 0 |
| LIVESTOCK | 287 | 287 | 287 | 287 | 287 | 287 |
| IRRIGATION | 0 | 0 | 0 | 0 | 0 | 0 |

# Region J Recommended Water User Group (WUG) Water Management Strategies (WMS)

| | | | | | | WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WUG ENTITY NAME | WMS SPONSOR REGION | WMS NAME | SOURCE NAME | UNIT COST 2020 | UNIT COST 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| BANDERA | J | CITY OF BANDERA - ADDITIONAL MIDDLE TRINITY WELLS WITHIN CITY WATER INFRASTRUCTURE AREA | J \| TRINITY AQUIFER FRESH/BRACKISH \| BANDERA COUNTY | $335 | $62 | 161 | 161 | 161 | 161 | 161 | 161 |
| BANDERA | J | CITY OF BANDERA - PROMOTE, DESIGN AND INSTALL RAINWATER HARVESTING SYSTEMS ON PUBLIC BUILDINGS | J \| RAINWATER HARVESTING | N/A | $0 | 0 | 1 | 1 | 1 | 1 | 1 |
| BANDERA | J | CITY OF BANDERA - REUSE TREATED WASTEWATER EFFLUENT FOR IRRIGATION OF PUBLIC SPACES | J \| DIRECT NON-POTABLE REUSE | N/A | $84 | 0 | 310 | 310 | 310 | 310 | 310 |
| BANDERA | J | CITY OF BANDERA - SURFACE WATER ACQUISITION, TREATMENT AND ASR | J \| TRINITY AQUIFER ASR FRESH/BRACKISH \| BANDERA COUNTY | N/A | $8 | 0 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 |
| BANDERA COUNTY FWSD 1 | J | BANDERA COUNTY OTHER (FWSD #1) - ADDITIONAL GROUNDWATER WELL | J \| TRINITY AQUIFER FRESH/BRACKISH \| BANDERA COUNTY | $1030 | $330 | 100 | 100 | 100 | 100 | 100 | 100 |
| BRACKETTVILLE | J | CITY OF BRACKETTVILLE - INCREASE SUPPLY TO SPOFFORD WITH NEW WATER LINE AND STORAGE | J \| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| KINNEY COUNTY | N/A | $13571 | 0 | 6 | 6 | 6 | 6 | 6 |
| CAMP WOOD | J | CITY OF CAMP WOOD - ADDITIONAL GROUNDWATER WELL | J \| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| REAL COUNTY | $972 | $133 | 143 | 143 | 143 | 143 | 143 | 143 |
| CAMP WOOD | J | CITY OF CAMP WOOD - PUBLIC CONSERVATION EDUCATION | DEMAND REDUCTION | $374 | $374 | 1 | 1 | 1 | 1 | 1 | 1 |
| COUNTY-OTHER, BANDERA | J | BANDERA COUNTY OTHER - DROUGHT MANAGEMENT (BCRAGD) (NUECES) | DEMAND REDUCTION | $0 | $0 | 23 | 26 | 27 | 28 | 28 | 28 |
| COUNTY-OTHER, BANDERA | J | BANDERA COUNTY OTHER - DROUGHT MANAGEMENT (BCRAGD) (SAN ANTONIO) | DEMAND REDUCTION | $0 | $0 | 441 | 491 | 516 | 525 | 533 | 537 |
| COUNTY-OTHER, BANDERA | J | BANDERA COUNTY OTHER (BANDERA RIVER RANCH #1) - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DEMAND REDUCTION | $17275 | $1703 | 4 | 4 | 4 | 4 | 4 | 4 |
| COUNTY-OTHER, BANDERA | J | BANDERA COUNTY OTHER (ENCHANTED RIVER ESTATES) - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DEMAND REDUCTION | $12329 | $1370 | 1 | 1 | 1 | 1 | 1 | 1 |
| COUNTY-OTHER, BANDERA | J | BANDERA COUNTY OTHER (FWSD #1) - PUBLIC CONSERVATION EDUCATION | DEMAND REDUCTION | $170 | $221 | 2 | 2 | 2 | 2 | 2 | 2 |
| COUNTY-OTHER, BANDERA | J | BANDERA COUNTY OTHER (LAKE MEDINA SHORES) - PUBLIC CONSERVATION EDUCATION | DEMAND REDUCTION | $403 | $524 | 3 | 3 | 3 | 3 | 3 | 3 |
| COUNTY-OTHER, BANDERA | J | BANDERA COUNTY OTHER (MEDINA WSC) - ADDITIONAL GROUNDWATER WELL | J \| TRINITY AQUIFER FRESH/BRACKISH \| BANDERA COUNTY | $2582 | $764 | 55 | 55 | 55 | 55 | 55 | 55 |
| COUNTY-OTHER, BANDERA | J | BANDERA COUNTY OTHER (MEDINA WSC) - PUBLIC CONSERVATION EDUCATION | DEMAND REDUCTION | $448 | $583 | 1 | 1 | 1 | 1 | 1 | 1 |

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

# Region J Recommended Water User Group (WUG) Water Management Strategies (WMS)

| | | | | | | WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WUG ENTITY NAME | WMS SPONSOR REGION | WMS NAME | SOURCE NAME | UNIT COST 2020 | UNIT COST 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| COUNTY-OTHER, EDWARDS | J | BARKSDALE WSC - ADDITIONAL GROUNDWATER WELL AND RO WELLHEAD TREATMENT | J \| NUECES RIVER ALLUVIUM AQUIFER \| EDWARDS COUNTY | $852 | $611 | 54 | 54 | 54 | 54 | 54 | 54 |
| COUNTY-OTHER, KERR | J | EASTERN KERR COUNTY REGIONAL WATER SUPPLY PROJECT | J \| ELLENBURGER-SAN SABA AQUIFER \| KERR COUNTY | N/A | $241 | 0 | 108 | 108 | 108 | 108 | 108 |
| COUNTY-OTHER, KERR | J | EASTERN KERR COUNTY REGIONAL WATER SUPPLY PROJECT | J \| GUADALUPE RIVER OFF-CHANNEL LAKE/RESERVOIR | N/A | $130 | 0 | 1,121 | 1,121 | 1,121 | 1,121 | 1,121 |
| COUNTY-OTHER, KERR | J | EASTERN KERR COUNTY REGIONAL WATER SUPPLY PROJECT | J \| TRINITY AQUIFER ASR FRESH/BRACKISH \| KERR COUNTY | N/A | $10 | 0 | 1,124 | 1,124 | 1,124 | 1,124 | 1,124 |
| COUNTY-OTHER, KERR | J | EASTERN KERR COUNTY REGIONAL WATER SUPPLY PROJECT | J \| TRINITY AQUIFER FRESH/BRACKISH \| KERR COUNTY | N/A | $294 | 0 | 860 | 860 | 806 | 806 | 806 |
| COUNTY-OTHER, KERR | J | KERR COUNTY OTHER - CENTER POINT - PUBLIC CONSERVATION EDUCATION | DEMAND REDUCTION | $128 | $152 | 3 | 1 | 1 | 1 | 1 | 1 |
| COUNTY-OTHER, KERR | J | KERR COUNTY OTHER - CENTER POINT TAYLOR SYSTEM - PUBLIC CONSERVATION EDUCATION | DEMAND REDUCTION | $265 | $316 | 2 | 1 | 1 | 1 | 1 | 1 |
| COUNTY-OTHER, KERR | J | KERR COUNTY OTHER - PUBLIC CONSERVATION EDUCATION (NUECES) | DEMAND REDUCTION | $3 | $4 | 1 | 1 | 1 | 1 | 1 | 1 |
| COUNTY-OTHER, KERR | J | KERR COUNTY OTHER - VERDE PARK ESTATES WWW - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DEMAND REDUCTION | $12000 | $1000 | 1 | 1 | 1 | 1 | 1 | 1 |
| COUNTY-OTHER, REAL | J | CITY OF LEAKEY - DEVELOP INTERCONNECTIONS BETWEEN WELLS WITHIN THE CITY | J \| FRIO RIVER ALLUVIUM AQUIFER \| REAL COUNTY | N/A | $12 | 0 | 81 | 81 | 81 | 81 | 81 |
| COUNTY-OTHER, REAL | J | CITY OF LEAKEY - ADDITIONAL GROUNDWATER WELL IN THE LOWER TRINITY AQUIFER | J \| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| REAL COUNTY | $374 | $231 | 91 | 91 | 91 | 91 | 91 | 91 |
| COUNTY-OTHER, REAL | J | REAL COUNTY OTHER - OAKMONT SADDLE MOUNTAIN WSC - ADDITIONAL GROUNDWATER WELL | J \| FRIO RIVER ALLUVIUM AQUIFER \| REAL COUNTY | $593 | $56 | 54 | 54 | 54 | 54 | 54 | 54 |
| COUNTY-OTHER, REAL | J | REAL COUNTY OTHER - REAL WSC - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DEMAND REDUCTION | $23457 | $2469 | 2 | 2 | 2 | 2 | 2 | 2 |
| COUNTY-OTHER, VAL VERDE | J | VAL VERDE COUNTY OTHER - SAN PEDRO CANYON SUBDIVISION - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DEMAND REDUCTION | $5500 | $500 | 7 | 7 | 7 | 7 | 7 | 7 |
| COUNTY-OTHER, VAL VERDE | J | VAL VERDE COUNTY OTHER - TIERRA DEL LAGO - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DEMAND REDUCTION | $2072 | $188 | 4 | 4 | 4 | 4 | 4 | 4 |

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## Region J Recommended Water User Group (WUG) Water Management Strategies (WMS)

| | | | | | | WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WUG ENTITY NAME | WMS SPONSOR REGION | WMS NAME | SOURCE NAME | UNIT COST 2020 | UNIT COST 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| COUNTY-OTHER, VAL VERDE | J | VAL VERDE COUNTY OTHER - VAL VERDE COUNTY WCID COMSTOCK- WATER LOSS AUDIT AND MAIN-LINE REPAIR | DEMAND REDUCTION | $41026 | $3846 | 1 | 1 | 1 | 1 | 1 | 1 |
| DEL RIO UTILITIES COMMISSION | J | CITY OF DEL RIO - DEVELOP A WASTEWATER REUSE PROGRAM | J \| DIRECT POTABLE REUSE | N/A | $6 | 0 | 3,092 | 3,092 | 3,092 | 3,092 | 3,092 |
| DEL RIO UTILITIES COMMISSION | J | CITY OF DEL RIO - DRILL AND EQUIP A NEW WELL AND CONNECT TO DISTRIBUTION SYSTEM | J \| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| VAL VERDE COUNTY | $202 | $78 | 7,191 | 7,191 | 7,191 | 7,191 | 7,191 | 7,191 |
| DEL RIO UTILITIES COMMISSION | J | CITY OF DEL RIO - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DEMAND REDUCTION | $13960 | $1330 | 12 | 12 | 12 | 12 | 12 | 12 |
| DEL RIO UTILITIES COMMISSION | J | CITY OF DEL RIO - WATER TREATMENT PLANT EXPANSION | J \| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| VAL VERDE COUNTY | N/A | $661 | 0 | 943 | 943 | 943 | 943 | 943 |
| FORT CLARK SPRINGS MUD | J | FORT CLARK SPRINGS MUD - INCREASE STORAGE FACILITY | J \| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| KINNEY COUNTY | N/A | $18 | 0 | 620 | 620 | 620 | 620 | 620 |
| FORT CLARK SPRINGS MUD | J | FORT CLARK SPRINGS MUD - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DEMAND REDUCTION | $1515 | $140 | 79 | 79 | 79 | 79 | 79 | 79 |
| IRRIGATION, BANDERA | J | BANDERA COUNTY IRRIGATION - ADDITIONAL GROUNDWATER WELLS (SAN ANTONIO) | J \| TRINITY AQUIFER FRESH/BRACKISH \| BANDERA COUNTY | $333 | $67 | 75 | 75 | 75 | 75 | 75 | 75 |
| IRRIGATION, BANDERA | J | BANDERA COUNTY IRRIGATION - IRRIGATION SCHEDULING | DEMAND REDUCTION | $0 | $0 | 36 | 36 | 36 | 36 | 36 | 36 |
| KERRVILLE | J | CITY OF KERRVILLE - EXPLORE AND DEVELOP NEW ELLENBURGER AQUIFER WELL SUPPLY | J \| ELLENBURGER-SAN SABA AQUIFER \| KERR COUNTY | $1075 | $193 | 1,156 | 1,156 | 1,156 | 1,156 | 1,156 | 1,156 |
| KERRVILLE | J | CITY OF KERRVILLE - INCREASE WASTEWATER REUSE | J \| DIRECT NON-POTABLE REUSE | $289 | $53 | 2,500 | 2,500 | 2,500 | 2,500 | 2,500 | 2,500 |
| KERRVILLE | J | CITY OF KERRVILLE - INCREASED WATER TREATMENT AND ASR CAPACITY | J \| TRINITY AQUIFER ASR \| KERR COUNTY | N/A | $256 | 0 | 3,360 | 3,360 | 3,360 | 3,360 | 3,360 |
| KERRVILLE | J | CITY OF KERRVILLE - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DEMAND REDUCTION | $3979 | $384 | 134 | 134 | 134 | 134 | 134 | 134 |
| LAUGHLIN AIR FORCE BASE | J | PURCHASE WATER FROM CITY OF DEL RIO | J \| RIO GRANDE RUN-OF-RIVER | $616 | $616 | 87 | 183 | 284 | 346 | 345 | 345 |
| LIVESTOCK, BANDERA | J | BANDERA COUNTY LIVESTOCK - ADDITIONAL GROUNDWATER WELL (GUADALUPE) | J \| TRINITY AQUIFER \| BANDERA COUNTY | $5000 | $500 | 2 | 2 | 2 | 2 | 2 | 2 |
| LIVESTOCK, BANDERA | J | BANDERA COUNTY LIVESTOCK - ADDITIONAL GROUNDWATER WELL (NUECES) | J \| TRINITY AQUIFER FRESH/BRACKISH \| BANDERA COUNTY | $3333 | $333 | 3 | 3 | 3 | 3 | 3 | 3 |
| LIVESTOCK, BANDERA | J | BANDERA COUNTY LIVESTOCK - CONSERVATION (GUADALUPE) | DEMAND REDUCTION | $0 | $0 | 1 | 1 | 1 | 1 | 1 | 1 |

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

## Region J Recommended Water User Group (WUG) Water Management Strategies (WMS)

| | | | | | | WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WUG ENTITY NAME | WMS SPONSOR REGION | WMS NAME | SOURCE NAME | UNIT COST 2020 | UNIT COST 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| LIVESTOCK, BANDERA | J | BANDERA COUNTY LIVESTOCK - CONSERVATION (NUECES) | DEMAND REDUCTION | $0 | $0 | 1 | 1 | 1 | 1 | 1 | 1 |
| LIVESTOCK, KERR | J | KERR COUNTY LIVESTOCK - CONSERVATION (COLORADO) | DEMAND REDUCTION | $0 | $0 | 24 | 24 | 24 | 24 | 24 | 24 |
| LIVESTOCK, KERR | J | KERR COUNTY LIVESTOCK - CONSERVATION (GUADALUPE) | DEMAND REDUCTION | $0 | $0 | 35 | 35 | 35 | 35 | 35 | 35 |
| LIVESTOCK, KERR | J | KERR COUNTY LIVESTOCK - CONSERVATION (NUECES) | DEMAND REDUCTION | $0 | $0 | 1 | 1 | 1 | 1 | 1 | 1 |
| LIVESTOCK, KERR | J | KERR COUNTY LIVESTOCK - CONSERVATION (SAN ANTONIO) | DEMAND REDUCTION | $0 | $0 | 5 | 5 | 5 | 5 | 5 | 5 |
| MINING, EDWARDS | J | EDWARDS COUNTY MINING - ADDITIONAL GROUNDWATER WELL (COLORADO) | J \| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | $500 | $83 | 12 | 12 | 12 | 12 | 12 | 12 |
| MINING, EDWARDS | J | EDWARDS COUNTY MINING - ADDITIONAL GROUNDWATER WELL (NUECES) | J \| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | $688 | $125 | 16 | 16 | 16 | 16 | 16 | 16 |
| MINING, EDWARDS | J | EDWARDS COUNTY MINING - ADDITIONAL GROUNDWATER WELLS (RIO GRANDE) | J \| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | $387 | $97 | 31 | 31 | 31 | 31 | 31 | 31 |
| MINING, KERR | J | KERR COUNTY MINING - ADDITIONAL GROUNDWATER WELLS (COLORADO) | J \| EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | $842 | $105 | 19 | 19 | 19 | 19 | 19 | 19 |
| MINING, VAL VERDE | J | VAL VERDE COUNTY MINING - ADDITIONAL GROUNDWATER WELLS (RIO GRANDE) | J \| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| VAL VERDE COUNTY | $384 | $66 | 242 | 242 | 242 | 242 | 242 | 242 |
| ROCKSPRINGS | J | CITY OF ROCKSPRINGS - ADDITIONAL GROUNDWATER WELLS | J \| EDWARDS-TRINITY-PLATEAU, PECOS VALLEY, AND TRINITY AQUIFERS \| EDWARDS COUNTY | $587 | $190 | 121 | 121 | 121 | 121 | 121 | 121 |
| ROCKSPRINGS | J | CITY OF ROCKSPRINGS - PUBLIC CONSERVATION EDUCATION | DEMAND REDUCTION | $208 | $208 | 1 | 1 | 1 | 1 | 1 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **REGION J RECOMMENDED WMS SUPPLY TOTAL** | 12,939 | 26,211 | 26,338 | 26,356 | 26,363 | 26,367 |

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

# Region J Recommended Projects Associated with Water Management Strategies

| SPONSOR NAME | SPONSOR IS WWP? | ONLINE DECADE | PROJECT NAME | PROJECT DESCRIPTION | CAPITAL COST |
|---|---|---|---|---|---|
| BANDERA | YES | 2020 | CITY OF BANDERA - ADDITIONAL MIDDLE TRINITY WELLS WITHIN CITY WATER INFRASTRUCTURE | CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD | $625,000 |
| BANDERA | YES | 2030 | CITY OF BANDERA - PROMOTE, DESIGN AND INSTALL RAINWATER HARVESTING SYSTEMS | RAINWATER HARVESTING SYSTEM | $56,000 |
| BANDERA | YES | 2030 | CITY OF BANDERA - REUSE TREATED WASTEWATER EFFLUENT FOR IRRIGATION | CONTRACT AMENDMENT; CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; STORAGE TANK; WATER TREATMENT PLANT EXPANSION | $1,496,000 |
| BANDERA | YES | 2030 | CITY OF BANDERA - SURFACE WATER ACQUISITION, TREATMENT AND ASR | CONVEYANCE/TRANSMISSION PIPELINE; DIVERSION AND CONTROL STRUCTURE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT | $34,188,000 |
| BANDERA COUNTY FWSD 1 | YES | 2020 | BANDERA COUNTY FWSD #1 - ADDITIONAL GROUNDWATER WELL | SINGLE WELL; CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; STORAGE TANK | $990,000 |
| BRACKETTVILLE | YES | 2030 | CITY OF BRACKETTVILLE - INCREASE STORAGE FACILITY | STORAGE TANK | $1,272,000 |
| BRACKETTVILLE | YES | 2030 | CITY OF BRACKETTVILLE - INCREASE SUPPLY TO SPOFFORD WITH NEW WATER LINE | CONVEYANCE/TRANSMISSION PIPELINE; STORAGE TANK | $4,271,000 |
| CAMP WOOD | YES | 2020 | CITY OF CAMP WOOD - ADDITIONAL GROUNDWATER WELLS | CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD | $1,709,000 |
| COUNTY-OTHER, BANDERA | YES | 2020 | ADDITIONAL GROUNDWATER WELL FOR THE TOWN OF MEDINA | CONVEYANCE/TRANSMISSION PIPELINE; NEW CONTRACT; STORAGE TANK; SINGLE WELL | $1,417,000 |
| COUNTY-OTHER, BANDERA | YES | 2020 | BANDERA COUNTY OTHER - ENCHANTED RIVER ESTATES - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DATA GATHERING/MONITORING TECHNOLOGY; WATER LOSS CONTROL | $117,000 |
| COUNTY-OTHER, BANDERA | YES | 2020 | BANDERA RIVER RANCH #1 - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DATA GATHERING/MONITORING TECHNOLOGY; WATER LOSS CONTROL | $902,000 |
| COUNTY-OTHER, EDWARDS | YES | 2020 | BARKSDALE WSC - ADDITIONAL GROUNDWATER WELL | CONVEYANCE/TRANSMISSION PIPELINE; SINGLE WELL | $178,000 |
| COUNTY-OTHER, KERR | YES | 2030 | EKCRWSP - CONSTRUCTION OF AN ELLENBURGER AQUIFER WATER SUPPLY WELL | SINGLE WELL | $652,000 |
| COUNTY-OTHER, KERR | YES | 2030 | EKCRWSP - CONSTRUCTION OF ASR FACILITY | INJECTION WELL; CONVEYANCE/TRANSMISSION PIPELINE | $1,461,000 |
| COUNTY-OTHER, KERR | YES | 2030 | EKCRWSP - CONSTRUCTION OF DESALINATION PLANT | CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT; EVAPORATIVE POND | $21,126,000 |
| COUNTY-OTHER, KERR | YES | 2030 | EKCRWSP - CONSTRUCTION OF OFF-CHANNEL SURFACE WATER STORAGE | DIVERSION AND CONTROL STRUCTURE; CONVEYANCE/TRANSMISSION PIPELINE | $25,231,000 |
| COUNTY-OTHER, KERR | YES | 2030 | EKCRWSP - CONSTRUCTION OF SURFACE WATER TREATMENT FACILITIES AND TRANSMISSION LINES | CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT; SURFACE WATER INTAKE MODIFICATION; PUMP STATION; STORAGE TANK | $22,829,000 |
| COUNTY-OTHER, KERR | YES | 2030 | EKCRWSP - CONSTRUCTION OF WELLFIELD FOR DENSE, RURAL AREAS | CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW WATER TREATMENT PLANT; NEW WATER RIGHT/PERMIT NO IBT | $8,367,000 |
| COUNTY-OTHER, KERR | YES | 2020 | VERDE PARK ESTATES WWW - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DATA GATHERING/MONITORING TECHNOLOGY; WATER LOSS CONTROL | $155,000 |
| COUNTY-OTHER, REAL | YES | 2020 | CITY OF LEAKEY - ADDITIONAL GROUNDWATER WELL | CONVEYANCE/TRANSMISSION PIPELINE; SINGLE WELL | $189,000 |
| COUNTY-OTHER, REAL | YES | 2030 | CITY OF LEAKEY - DEVELOP INTERCONNECTIONS BETWEEN WELLS WITHIN THE CITY | CONVEYANCE/TRANSMISSION PIPELINE | $202,000 |
| COUNTY-OTHER, REAL | YES | 2020 | REAL COUNTY OTHER - ADDITIONAL WELL FOR OAKMONT SADDLE WSC | SINGLE WELL | $417,000 |
| COUNTY-OTHER, REAL | YES | 2020 | REAL WSC - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DATA GATHERING/MONITORING TECHNOLOGY; WATER LOSS CONTROL | $482,000 |
| COUNTY-OTHER, VAL VERDE | YES | 2020 | VAL VERDE COUNTY OTHER - SAN PEDRO CANYON SUBDIVISION - WATER LOSS AUDIT AND MAIN-LINE REPAIR | WATER LOSS CONTROL; DATA GATHERING/MONITORING TECHNOLOGY | $142,000 |
| COUNTY-OTHER, VAL VERDE | YES | 2020 | VAL VERDE COUNTY OTHER - TIERRA DEL LAGO - WATER LOSS AUDIT AND MAIN-LINE REPAIR | WATER LOSS CONTROL; DATA GATHERING/MONITORING TECHNOLOGY | $146,000 |
| COUNTY-OTHER, VAL VERDE | YES | 2020 | VAL VERDE COUNTY OTHER - VAL VERDE COUNTY WCID - WATER LOSS AUDIT AND MAIN-LINE REPAIR | WATER LOSS CONTROL; DATA GATHERING/MONITORING TECHNOLOGY | $406,000 |
| DEL RIO UTILITIES COMMISSION | YES | 2020 | CITY OF DEL RIO - ADDITIONAL GROUNDWATER WELL | SINGLE WELL; CONVEYANCE/TRANSMISSION PIPELINE | $12,695,000 |
| DEL RIO UTILITIES COMMISSION | YES | 2030 | CITY OF DEL RIO - DEVELOP A WASTEWATER REUSE PROGRAM | CONVEYANCE/TRANSMISSION PIPELINE | $2,846,000 |

# Region J Recommended Projects Associated with Water Management Strategies

| SPONSOR NAME | SPONSOR IS WWP? | ONLINE DECADE | PROJECT NAME | PROJECT DESCRIPTION | CAPITAL COST |
|---|---|---|---|---|---|
| DEL RIO UTILITIES COMMISSION | YES | 2020 | CITY OF DEL RIO - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DATA GATHERING/MONITORING TECHNOLOGY; WATER LOSS CONTROL | $5,672,000 |
| DEL RIO UTILITIES COMMISSION | YES | 2030 | CITY OF DEL RIO - WATER TREATMENT PLANT EXPANSION | WATER TREATMENT PLANT EXPANSION | $8,646,000 |
| FORT CLARK SPRINGS MUD | YES | 2030 | FORT CLARK SPRINGS MUD - INCREASE STORAGE FACILITY | STORAGE TANK | $1,501,000 |
| FORT CLARK SPRINGS MUD | YES | 2020 | FORT CLARK SPRINGS MUD - WATER LOSS AUDIT AND MAIN-LINE REPAIR | WATER LOSS CONTROL; DATA GATHERING/MONITORING TECHNOLOGY | $1,531,000 |
| IRRIGATION, BANDERA | YES | 2020 | BANDERA COUNTY IRRIGATION - ADDITIONAL GROUNDWATER WELLS | MULTIPLE WELLS/WELL FIELD | $291,000 |
| KERRVILLE | YES | 2020 | CITY OF KERRVILLE - EXPLORE AND DEVELOP NEW ELLENBURGER AQUIFER WELL SUPPLY | SINGLE WELL | $14,493,000 |
| KERRVILLE | YES | 2020 | CITY OF KERRVILLE - INCREASE WASTEWATER REUSE | DIVERSION AND CONTROL STRUCTURE | $12,570,000 |
| KERRVILLE | YES | 2030 | CITY OF KERRVILLE - INCREASED WATER TREATMENT AND ASR CAPACITY | INJECTION WELL; WATER TREATMENT PLANT EXPANSION | $15,393,000 |
| KERRVILLE | YES | 2020 | CITY OF KERRVILLE - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DATA GATHERING/MONITORING TECHNOLOGY; WATER LOSS CONTROL | $12,636,000 |
| LIVESTOCK, BANDERA | YES | 2020 | BANDERA COUNTY LIVESTOCK - ADDITIONAL GROUNDWATER WELL (GUADALUPE) | SINGLE WELL | $135,000 |
| LIVESTOCK, BANDERA | YES | 2020 | BANDERA COUNTY LIVESTOCK - ADDITIONAL GROUNDWATER WELL (NUECES) | SINGLE WELL | $126,000 |
| MINING, EDWARDS | YES | 2020 | EDWARDS COUNTY MINING - ADDITIONAL GROUNDWATER WELLS | MULTIPLE WELLS/WELL FIELD | $132,000 |
| MINING, EDWARDS | YES | 2020 | EDWARDS COUNTY MINING - ADDITIONAL GROUNDWATER WELLS (COLORADO) | MULTIPLE WELLS/WELL FIELD | $73,000 |
| MINING, EDWARDS | YES | 2020 | EDWARDS COUNTY MINING - ADDITIONAL GROUNDWATER WELLS (NUECES) | MULTIPLE WELLS/WELL FIELD | $125,000 |
| MINING, KERR | YES | 2020 | KERR COUNTY MINING - ADDITIONAL GROUNDWATER WELL | SINGLE WELL | $197,000 |
| MINING, VAL VERDE | YES | 2020 | VAL VERDE MINING - ADDITIONAL GROUNDWATER WELL | MULTIPLE WELLS/WELL FIELD | $1,096,000 |
| ROCKSPRINGS | YES | 2020 | CITY OF ROCKSPRINGS - ADDITIONAL GROUNDWATER WELL | CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD | $681,000 |

| | |
|---|---|
| **REGION J RECOMMENDED CAPITAL COST TOTAL** | **$219,865,000** |

# Region J Alternative Water User Group (WUG) Water Management Strategies (WMS)

| | | | | | | WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WUG ENTITY NAME | WMS SPONSOR REGION | WMS NAME | SOURCE NAME | UNIT COST 2020 | UNIT COST 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| BANDERA | J | CITY OF BANDERA - ADDITIONAL LOWER TRINITY WELL AND LAY NECESSARY PIPELINE | J \| TRINITY AQUIFER FRESH/BRACKISH \| BANDERA COUNTY | N/A | $206 | 0 | 403 | 403 | 403 | 403 | 403 |
| COUNTY-OTHER, BANDERA | J | BANDERA COUNTY OTHER - ADDITIONAL WELLS TO PROVIDE EMERGENCY SUPPLY TO VFD (SAN ANTONIO) | J \| TRINITY AQUIFER FRESH/BRACKISH \| BANDERA COUNTY | $1894 | $302 | 189 | 189 | 189 | 189 | 189 | 189 |
| COUNTY-OTHER, BANDERA | J | BANDERA COUNTY OTHER (LAKE MEDINA SHORES) - ADDITIONAL GROUNDWATER WELL | J \| TRINITY AQUIFER FRESH/BRACKISH \| BANDERA COUNTY | $582 | $167 | 251 | 251 | 251 | 251 | 251 | 251 |
| LIVESTOCK, KERR | J | KERR COUNTY LIVESTOCK - ADDITIONAL GROUNDWATER WELL (COLORADO) | J \| EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | $706 | $126 | 119 | 119 | 119 | 119 | 119 | 119 |
| LIVESTOCK, KERR | J | KERR COUNTY LIVESTOCK - ADDITIONAL GROUNDWATER WELL (NUECES) | J \| EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | $833 | $0 | 6 | 6 | 6 | 6 | 6 | 6 |
| LIVESTOCK, KERR | J | KERR COUNTY LIVESTOCK - ADDITIONAL GROUNDWATER WELL (SAN ANTONIO) | J \| TRINITY AQUIFER \| KERR COUNTY | $333 | $111 | 27 | 27 | 27 | 27 | 27 | 27 |
| LIVESTOCK, KERR | J | KERR COUNTY LIVESTOCK - ADDITIONAL GROUNDWATER WELLS - (GUADALUPE) | J \| EDWARDS-TRINITY-PLATEAU AQUIFER \| KERR COUNTY | $237 | $87 | 173 | 173 | 173 | 173 | 173 | 173 |
| | | | | | | | | | | | |
| REGION J ALTERNATIVE WMS SUPPLY TOTAL | | | | | | 765 | 1,168 | 1,168 | 1,168 | 1,168 | 1,168 |

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

# Region J Alternative Projects Associated with Water Management Strategies

| SPONSOR NAME | SPONSOR IS WWP? | ONLINE DECADE | PROJECT NAME | PROJECT DESCRIPTION | CAPITAL COST |
|---|---|---|---|---|---|
| BANDERA | YES | 2030 | CITY OF BANDERA - ADDITIONAL LOWER TRINITY WELL AND LAY NECESSARY PIPELINE | CONVEYANCE/TRANSMISSION PIPELINE; NEW CONTRACT; NEW WATER RIGHT/PERMIT NO IBT; SINGLE WELL | $3,298,000 |
| COUNTY-OTHER, BANDERA | YES | 2020 | BANDERA COUNTY OTHER - ADDITIONAL GROUNDWATER WELLS TO PROVIDE EMERGENCY SUPPLY TO VFD | CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD | $4,280,000 |
| COUNTY-OTHER, BANDERA | YES | 2020 | BANDERA COUNTY OTHER - LAKE MEDINA SHORES - ADDITIONAL GROUNDWATER WELLS | CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD | $1,477,000 |
| LIVESTOCK, KERR | YES | 2020 | KERR COUNTY LIVESTOCK - ADDITIONAL GROUNDWATER WELL | SINGLE WELL | $79,000 |
| LIVESTOCK, KERR | YES | 2020 | KERR COUNTY LIVESTOCK - ADDITIONAL GROUNDWATER WELL (NUECES) | SINGLE WELL | $66,000 |
| LIVESTOCK, KERR | YES | 2020 | KERR COUNTY LIVESTOCK - ADDITIONAL GROUNDWATER WELLS | MULTIPLE WELLS/WELL FIELD | $985,000 |
| LIVESTOCK, KERR | YES | 2020 | KERR COUNTY LIVESTOCK - ADDITIONAL GROUNDWATER WELLS - GUADALUPE RIVER BASIN | MULTIPLE WELLS/WELL FIELD | $370,000 |

| | |
|---|---|
| **REGION J ALTERNATIVE CAPITAL COST TOTAL** | **$10,555,000** |

# Region J Water User Group (WUG) Management Supply Factor

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. To calculate the Management Supply Factor for each WUG as a whole, not split by region-county-basin, the combined total of existing and future supply is divided by the total projected demand. If a WUG is split by more than one planning region, the whole WUG's management supply factor will show up in each of its planning region's management supply factor reports.

| | WUG MANAGEMENT SUPPLY FACTOR | | | | | |
|---|---|---|---|---|---|---|
| **WUG NAME** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| BANDERA | 2.0 | 6.5 | 6.2 | 6.1 | 6.0 | 5.9 |
| BANDERA COUNTY FWSD 1 | 1.2 | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 |
| BRACKETTVILLE | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| CAMP WOOD | 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 |
| COUNTY-OTHER, BANDERA | 3.0 | 2.7 | 2.6 | 2.6 | 2.5 | 2.5 |
| COUNTY-OTHER, BANDERA \| BANDERA RIVER RANCH 1 | 0.8 | 0.7 | 0.6 | 0.6 | 0.6 | 0.6 |
| COUNTY-OTHER, BANDERA \| LAKE MEDINA SHORES | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| COUNTY-OTHER, BANDERA \| MEDINA WSC | 1.2 | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 |
| COUNTY-OTHER, EDWARDS | 3.8 | 4.0 | 4.2 | 4.2 | 4.2 | 4.2 |
| COUNTY-OTHER, EDWARDS \| BARKSDALE WSC | 5.7 | 5.9 | 6.1 | 6.3 | 6.3 | 6.3 |
| COUNTY-OTHER, KERR | 4.8 | 6.4 | 6.4 | 6.3 | 6.1 | 6.0 |
| COUNTY-OTHER, KERR \| CENTER POINT | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| COUNTY-OTHER, KERR \| CENTER POINT NORTH WATER SYSTEM | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| COUNTY-OTHER, KERR \| CENTER POINT TAYLOR SYSTEM | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| COUNTY-OTHER, KERR \| HILLS AND DALES ESTATES | 1.1 | 1.1 | 1.1 | 1.0 | 1.0 | 1.0 |
| COUNTY-OTHER, KERR \| NICKERSON FARM WATER SYSTEM | 1.3 | 1.3 | 1.3 | 1.3 | 1.2 | 1.2 |
| COUNTY-OTHER, KERR \| OAK FOREST SOUTH WATER | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.3 |
| COUNTY-OTHER, KERR \| PARK PLACE SUBDIVISION | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.2 |
| COUNTY-OTHER, KERR \| PECAN VALLEY | 1.2 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| COUNTY-OTHER, KERR \| RUSTIC HILLS WATER | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| COUNTY-OTHER, KERR \| VERDE PARK ESTATES | 1.1 | 1.1 | 1.1 | 1.1 | 1.0 | 1.0 |
| COUNTY-OTHER, KERR \| WESTWOOD WATER SYSTEM | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| COUNTY-OTHER, KINNEY | 3.1 | 3.2 | 3.2 | 3.2 | 3.3 | 3.3 |
| COUNTY-OTHER, REAL | 5.1 | 6.0 | 6.2 | 6.3 | 6.3 | 6.3 |
| COUNTY-OTHER, VAL VERDE | 1.7 | 1.5 | 1.3 | 1.1 | 1.0 | 0.9 |
| DEL RIO UTILITIES COMMISSION | 1.3 | 1.6 | 1.5 | 1.4 | 1.3 | 1.3 |
| FORT CLARK SPRINGS MUD | 2.3 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 |
| IRRIGATION, BANDERA | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| IRRIGATION, EDWARDS | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| IRRIGATION, KERR | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| IRRIGATION, KINNEY | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 |
| IRRIGATION, REAL | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 |
| IRRIGATION, VAL VERDE | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 |
| KERRVILLE | 2.1 | 2.7 | 2.7 | 2.6 | 2.6 | 2.6 |
| KERRVILLE SOUTH WATER | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| LAUGHLIN AIR FORCE BASE | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| LEAKEY | 1.5 | 1.6 | 1.7 | 1.7 | 1.7 | 1.7 |
| LIVESTOCK, BANDERA | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| LIVESTOCK, EDWARDS | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| LIVESTOCK, KERR | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| LIVESTOCK, KINNEY | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| LIVESTOCK, REAL | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| LIVESTOCK, VAL VERDE | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| MANUFACTURING, KERR | 2.4 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

## Region J Water User Group (WUG) Management Supply Factor

| | WUG MANAGEMENT SUPPLY FACTOR | | | | | |
|---|---|---|---|---|---|---|
| WUG NAME | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| MINING, EDWARDS | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| MINING, KERR | 1.9 | 1.8 | 1.4 | 1.4 | 1.3 | 1.2 |
| MINING, VAL VERDE | 1.5 | 1.1 | 1.1 | 1.3 | 1.5 | 1.6 |
| ROCKSPRINGS | 3.4 | 3.4 | 3.5 | 3.5 | 3.5 | 3.5 |

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

# Region J Recommended Water Management Strategy (WMS) Supply Associated with a New or Amended Inter-Basin Transfer (IBT) Permit

IBT WMS supply is the portion of the total WMS benefitting WUGs that will require a new or amended IBT permit that is not considered exempt under the Texas Water Code § 11.085.

| | | | IBT WMS SUPPLY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|
| WMS NAME | SOURCE BASIN | RECIPIENT WUG BASIN | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |

# Region J Water User Groups (WUGs)
# Recommended Water Management Strategy (WMS) Supply Associated with a
# New or Amended Inter-Basin Transfer (IBT) Permit and Total Recommended Conservation WMS Supply

IBT WMS supply is the portion of the total WMS benefitting the WUG basin split listed that will require a new or amended IBT permit that is not considered exempt under the Texas Water Code § 11.085. Total conservation supply represents all conservation WMS volumes recommended within the WUG's region-basin geographic split.

| BENEFITTING WUG NAME \| BASIN | WMS SOURCE ORIGIN BASIN \| WMS NAME | WMS SUPPLY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |

# Region J Sponsored Recommended Water Management Strategy (WMS) Supplies Unallocated* to Water User Groups (WUG)

| WMS NAME | WMS SPONSOR | SOURCE NAME | UNALLOCATED STRATEGY SUPPLY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| | | TOTAL UNALLOCATED STRATEGY SUPPLIES | | | | | | |

* Strategy supplies created through the WMS that have not been assigned to a WUG will be allocated to the entity responsible for the water through an ‘unassigned water volumes’ entity. Only strategy supplies associated with an 'unassigned water volume' entity are shown in this report, and may not represent all strategy supplies associated with the listed WMS.

# Region J Water User Group (WUG) Strategy Supplies by Water Management Strategy (WMS) Type

| WMS TYPE * | STRATEGY SUPPLY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| AQUIFER STORAGE & RECOVERY | 0 | 5,984 | 5,984 | 5,984 | 5,984 | 5,984 |
| DIRECT POTABLE REUSE | 0 | 3,092 | 3,092 | 3,092 | 3,092 | 3,092 |
| DROUGHT MANAGEMENT | 464 | 517 | 543 | 553 | 561 | 565 |
| GROUNDWATER WELLS & OTHER | 9,526 | 12,144 | 12,144 | 12,090 | 12,090 | 12,090 |
| IRRIGATION CONSERVATION | 36 | 36 | 36 | 36 | 36 | 36 |
| MUNICIPAL CONSERVATION | 259 | 256 | 256 | 256 | 256 | 256 |
| OTHER CONSERVATION | 67 | 67 | 67 | 67 | 67 | 67 |
| OTHER DIRECT REUSE | 2,500 | 2,810 | 2,810 | 2,810 | 2,810 | 2,810 |
| OTHER STRATEGIES | 0 | 1 | 1 | 1 | 1 | 1 |
| OTHER SURFACE WATER | 87 | 1,304 | 1,405 | 1,467 | 1,466 | 1,466 |
| NEW MAJOR RESERVOIR | 0 | 0 | 0 | 0 | 0 | 0 |
| INDIRECT REUSE | 0 | 0 | 0 | 0 | 0 | 0 |
| CONJUNCTIVE USE | 0 | 0 | 0 | 0 | 0 | 0 |
| SEAWATER DESALINATION | 0 | 0 | 0 | 0 | 0 | 0 |
| GROUNDWATER DESALINATION | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL STRATEGY SUPPLIES** | **12,939** | **26,211** | **26,338** | **26,356** | **26,363** | **26,367** |

* WMS type descriptions can be found on the interactive state water plan website at http://texasstatewaterplan.org/ using the 'View data for' drop-down menus to navigate to a specific WMS Type page. The data used to create each WMS type value is available in Appendix 3 of the Guidelines for Regional Water Planning Data Deliverable (Exhibit D) document at http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/ExhibitD.pdf.

# Region J Water User Group (WUG)
# Recommended Water Management Strategy (WMS) Supplies by Source Type

| SOURCE SUBTYPE* | STRATEGY SUPPLY (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| AQUIFER STORAGE & RECOVERY | 0 | 5,984 | 5,984 | 5,984 | 5,984 | 5,984 |
| GROUNDWATER | 9,526 | 12,144 | 12,144 | 12,090 | 12,090 | 12,090 |
| **GROUNDWATER TOTAL STRATEGY SUPPLIES** | **9,526** | **18,128** | **18,128** | **18,074** | **18,074** | **18,074** |
| DIRECT NON-POTABLE REUSE | 2,500 | 2,810 | 2,810 | 2,810 | 2,810 | 2,810 |
| DIRECT POTABLE REUSE | 0 | 3,092 | 3,092 | 3,092 | 3,092 | 3,092 |
| INDIRECT NON-POTABLE REUSE | 0 | 0 | 0 | 0 | 0 | 0 |
| INDIRECT POTABLE REUSE | 0 | 0 | 0 | 0 | 0 | 0 |
| **REUSE TOTAL STRATEGY SUPPLIES** | **2,500** | **5,902** | **5,902** | **5,902** | **5,902** | **5,902** |
| ATMOSPHERE | 0 | 0 | 0 | 0 | 0 | 0 |
| GULF OF MEXICO | 0 | 0 | 0 | 0 | 0 | 0 |
| LIVESTOCK LOCAL SUPPLY | 0 | 0 | 0 | 0 | 0 | 0 |
| OTHER LOCAL SUPPLY | 0 | 0 | 0 | 0 | 0 | 0 |
| RAINWATER HARVESTING | 0 | 1 | 1 | 1 | 1 | 1 |
| RESERVOIR | 0 | 1,121 | 1,121 | 1,121 | 1,121 | 1,121 |
| RESERVOIR SYSTEM | 0 | 0 | 0 | 0 | 0 | 0 |
| RUN-OF-RIVER | 87 | 183 | 284 | 346 | 345 | 345 |
| **SURFACE WATER TOTAL STRATEGY SUPPLIES** | **87** | **1,305** | **1,406** | **1,468** | **1,467** | **1,467** |
| **REGION J TOTAL STRATEGY SUPPLIES** | **12,113** | **25,335** | **25,436** | **25,444** | **25,443** | **25,443** |

* A full list of source subtype definitions can be found in section 3 of the Guidelines for Regional Water Planning Data Deliverable (Exhibit D) document at http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/ExhibitD.pdf.

# Region J Major Water Provider (MWP) Existing Sales and Transfers

Major Water Providers are entities of particular significance to a region's water supply as defined by the Regional Water Planning Group (RWPG), and may be a Water User Group (WUG) entity, Wholesale Water Provider (WWP) entity , or both (WUG/WWP).

Retail denotes WUG projected demands and existing water supplies used by the WUG. Wholesale denotes a WWP or WUG/WWP selling water to another entity.

| **DEL RIO UTILITIES COMMISSION - WUG/WWP** | **WATER VOLUMES (ACRE-FEET PER YEAR)** | | | | | |
|---|---|---|---|---|---|---|
| **DATA DESCRIPTION** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| PROJECTED RETAIL WUG DEMANDS | 10,558 | 11,053 | 11,554 | 12,130 | 12,733 | 13,326 |
| PROJECTED WHOLESALE CONTRACT DEMANDS | 1,331 | 1,331 | 1,331 | 1,331 | 1,331 | 1,331 |
| **TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS** | **11,889** | **12,384** | **12,885** | **13,461** | **14,064** | **14,657** |
| SURFACE WATER SALES TO RETAIL CUSTOMERS | 6,135 | 6,135 | 6,135 | 6,135 | 6,135 | 6,135 |
| GROUNDWATER SALES TO WHOLESALE CUSTOMERS | 0 | 0 | 0 | 0 | 0 | 0 |
| SURFACE WATER SALES TO WHOLESALE CUSTOMERS | 1,331 | 1,331 | 1,331 | 1,331 | 1,331 | 1,331 |
| **TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS** | **7,466** | **7,466** | **7,466** | **7,466** | **7,466** | **7,466** |

# Region J Major Water Provider (MWP) Water Management Strategy (WMS) Summary

MWPs are entities of significance to a region's water supply as defined by the Regional Water Planning Group (RWPG) and may be a Water User Group (WUG) entity, Wholesale Water Provider (WWP) entity, or both (WUG/WWP).'MWP Retail Customers' denotes recommended WMS supply used by the WUG. 'Transfers Related to Wholesale Customers' denotes a WWP or WUG/WWP selling or transferring recommended WMS supply to another entity. Supply associated with the MWP's wholesale transfers will only display if it is listed as the main seller in the State Water Planning database, even if multiple sellers are involved with the sale of water to WUGs. Unallocated water volumes represent MWP recommended WMS supply not currently allocated to a customer of the MWP.'Total MWP Related WMS Supply' will display if the MWP's WMS is related to more than one WMS supply type (retail, wholesale, and/or unallocated). Associated WMS Projects are listed when the MWP is one of the project's sponsors. Report contains draft data and is subject to change.

**DEL RIO UTILITIES COMMISSION | CITY OF DEL RIO - DEVELOP A WASTEWATER REUSE PROGRAM**

| DATA DESCRIPTION | WATER VOLUMES (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| MWP RETAIL CUSTOMERS | 0 | 3,092 | 3,092 | 3,092 | 3,092 | 3,092 |

| WMS RELATED MWP SPONSORED PROJECTS | PROJECT DESCRIPTION |
|---|---|
| CITY OF DEL RIO - DEVELOP A WASTEWATER REUSE PROGRAM | CONVEYANCE/TRANSMISSION PIPELINE |

**DEL RIO UTILITIES COMMISSION | CITY OF DEL RIO - DRILL AND EQUIP A NEW WELL AND CONNECT TO DISTRIBUTION SYSTEM**

| DATA DESCRIPTION | WATER VOLUMES (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| MWP RETAIL CUSTOMERS | 7,191 | 7,191 | 7,191 | 7,191 | 7,191 | 7,191 |

| WMS RELATED MWP SPONSORED PROJECTS | PROJECT DESCRIPTION |
|---|---|
| CITY OF DEL RIO - ADDITIONAL GROUNDWATER WELL | SINGLE WELL; CONVEYANCE/TRANSMISSION PIPELINE |

**DEL RIO UTILITIES COMMISSION | CITY OF DEL RIO - WATER LOSS AUDIT AND MAIN-LINE REPAIR**

| DATA DESCRIPTION | WATER VOLUMES (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| MWP RETAIL CUSTOMERS | 12 | 12 | 12 | 12 | 12 | 12 |

| WMS RELATED MWP SPONSORED PROJECTS | PROJECT DESCRIPTION |
|---|---|
| CITY OF DEL RIO - WATER LOSS AUDIT AND MAIN-LINE REPAIR | DATA GATHERING/MONITORING TECHNOLOGY; WATER LOSS CONTROL |

**DEL RIO UTILITIES COMMISSION | CITY OF DEL RIO - WATER TREATMENT PLANT EXPANSION**

| DATA DESCRIPTION | WATER VOLUMES (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| MWP RETAIL CUSTOMERS | 0 | 943 | 943 | 943 | 943 | 943 |

| WMS RELATED MWP SPONSORED PROJECTS | PROJECT DESCRIPTION |
|---|---|
| CITY OF DEL RIO - WATER TREATMENT PLANT EXPANSION | WATER TREATMENT PLANT EXPANSION |

**DEL RIO UTILITIES COMMISSION | PURCHASE WATER FROM CITY OF DEL RIO**

| DATA DESCRIPTION | WATER VOLUMES (ACRE-FEET PER YEAR) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| TRANSFERS RELATED TO WHOLESALE CUSTOMERS | 87 | 183 | 284 | 346 | 345 | 345 |

# Table of Contents

# 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.

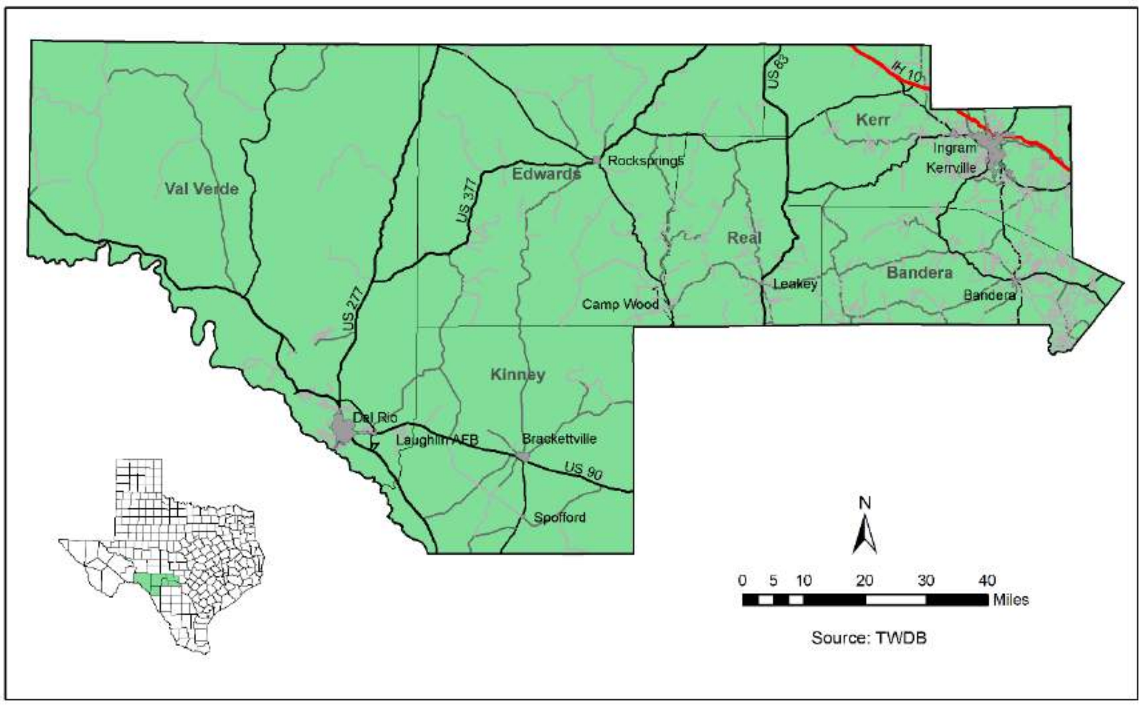


**Figure 1-1. Location of the Plateau Region**

# 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 and 2016)*. Only those parts of the previous *2016 Plan* that required updating, and there were many, have been revised.

The purpose of the *2021 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 Plateau Water Planning Group (PWPG) is a voluntary association comprised of voting and non-voting members whom represent a minimum of 11 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 *2021 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.

For the first time, water planning projections have been reassembled by utility service areas rather than political boundaries to better plan for the actual water-supply service entity. Previous Regional and State water plans have been aligned with political boundaries, such as city limits rather than water utility service areas. Recent TWDB rule changes now define a municipal water user group (WUG) as being utility-based, and thus emphasis of the development of municipal water demands and supplies for the 2021 regional water plans transition from political boundaries to utility-service area boundaries.

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 Run 3 of the Texas Commission on Environmental Quality (TCEQ) - Water Availability Models (WAM). This *Plan* has no impact on navigation on these surface-water courses.

The availability of groundwater during drought-of-record conditions is based primarily on Modeled Available Groundwater (MAG) declarations based on Groundwater Management Area (GMA) "desired future conditions". 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 *2021 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 measure 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 2010, 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 2010 census count, 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 Plateau Water Planning Group (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/waterdevelopment.html.

**Table 1-1. Interim Planning Project Reports**

| Interim Planning Project Reports | Date |
|---|---|
| Ground-Water 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 adopted *Water for Texas 2017* 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 2017 State Water Plan is the fourth 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
- Fort Clark Municipal Utility District
- Headwaters Groundwater Conservation District
- City of Bandera
- Bandera County River Authority and Groundwater District
- Wiedenfeld Water Works
- Kinney County Groundwater Conservation District
- Real-Edwards Conservation and Reclamation District

- City of Leakey
- City of Camp Wood

### 1.1.5 Groundwater Conservation Districts

The Texas Legislature has established a process for local management of groundwater resources through Groundwater Conservation Districts, 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

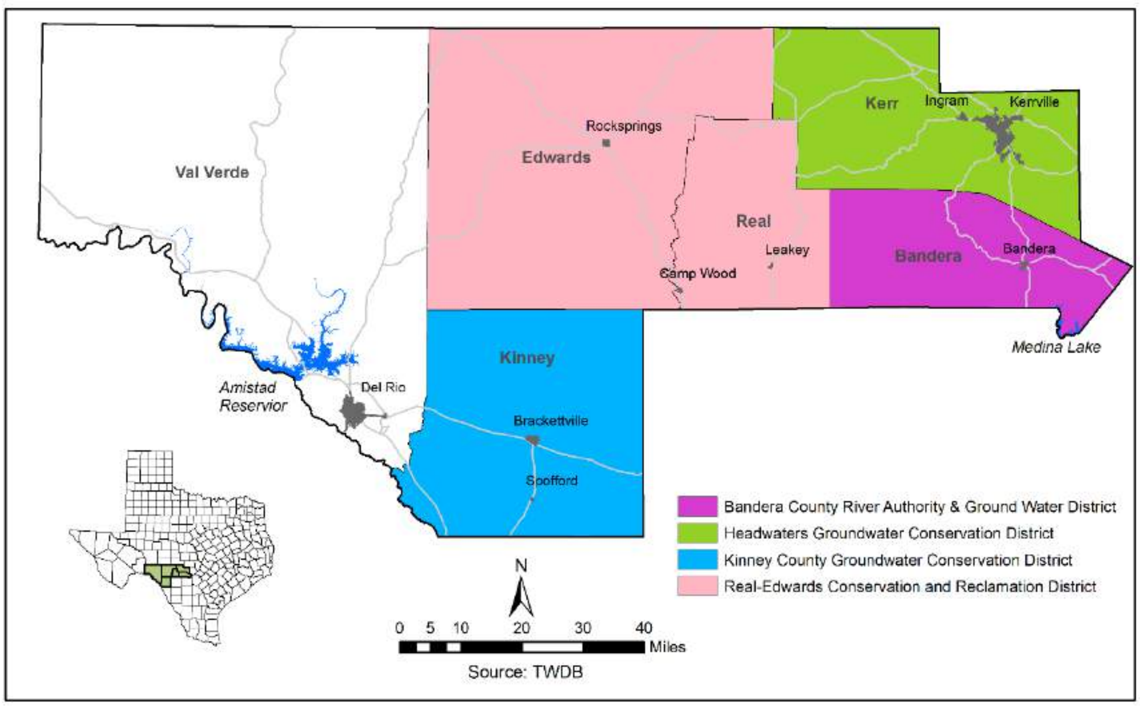


**Figure 1-2. Groundwater Conservation Districts**

### 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 (http://www.twdb.texas.gov/mapping/index.asp).

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)* are a description of aquifers at some time in the future. This description is a precursor to developing a volumetric number called *modeled available groundwater (MAG)*. The TWDB is responsible for providing each Groundwater Conservation District and Regional Water Planning Group, 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 *2021 Plateau Region Water Plan* includes a significant revision to all groundwater source availability estimates based on *MAG* volumes generated from the GMA process.

### 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 Groundwater Conservation District (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 Groundwater Management Area (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: http://www.tceq.state.tx.us/assets/public/permitting/watersupply/groundwater/maps/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 (3,171$mi^2$).

## 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-2020 population in the Plateau Region of 141,476 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 30 percent to 184,595 by 2070. Approximately 46 percent of the total population of the Region is in the two largest cities, Del Rio / Laughlin AFB (39,542) and Kerrville (25,658). The projected year-2020 populations of other major communities in the Region are: Brackettville and Fort Clark Springs (3,217); Bandera (1,875); Leakey (1,415); Rocksprings (1,259); and Camp Wood (747) (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.

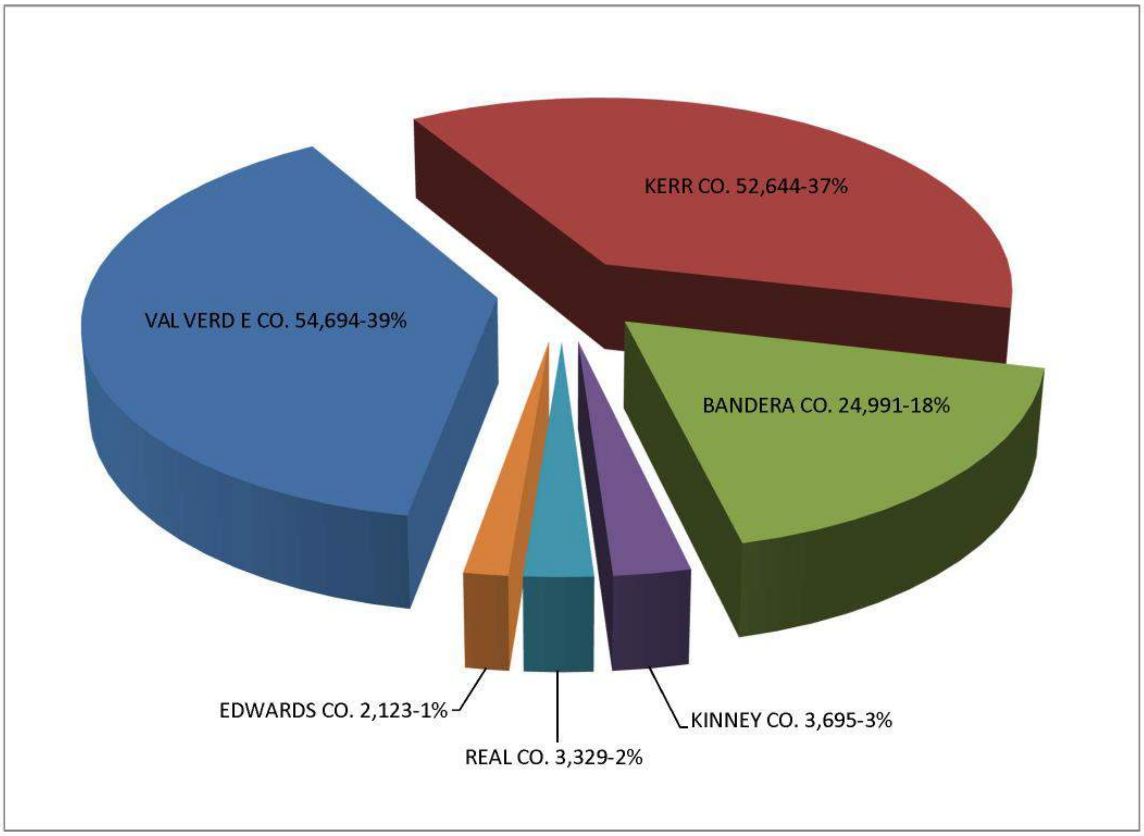


**Figure 1-3. Year 2020 Projected Population**

### 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)
- Range
- Forest
- Water
- Wetlands
- Barren

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. 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.

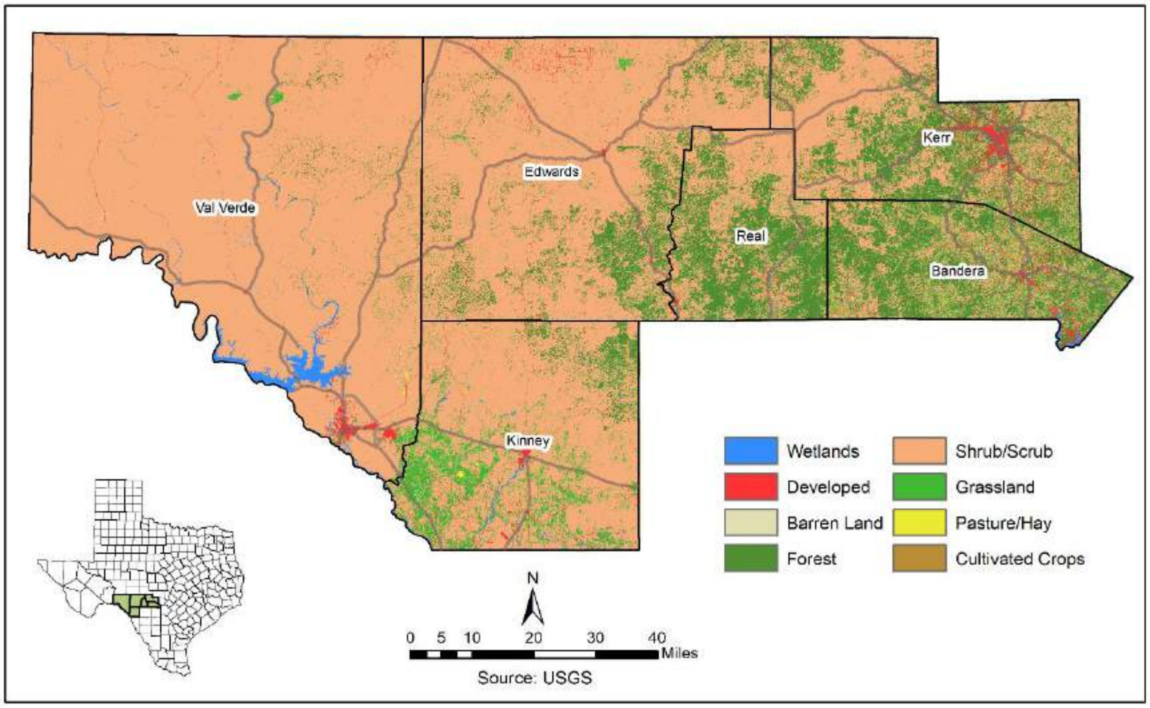


**Figure 1-4. Land Use**

### 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 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 33 inches in the easternmost reaches of Bandera and Kerr Counties to less than 18 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 its 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.

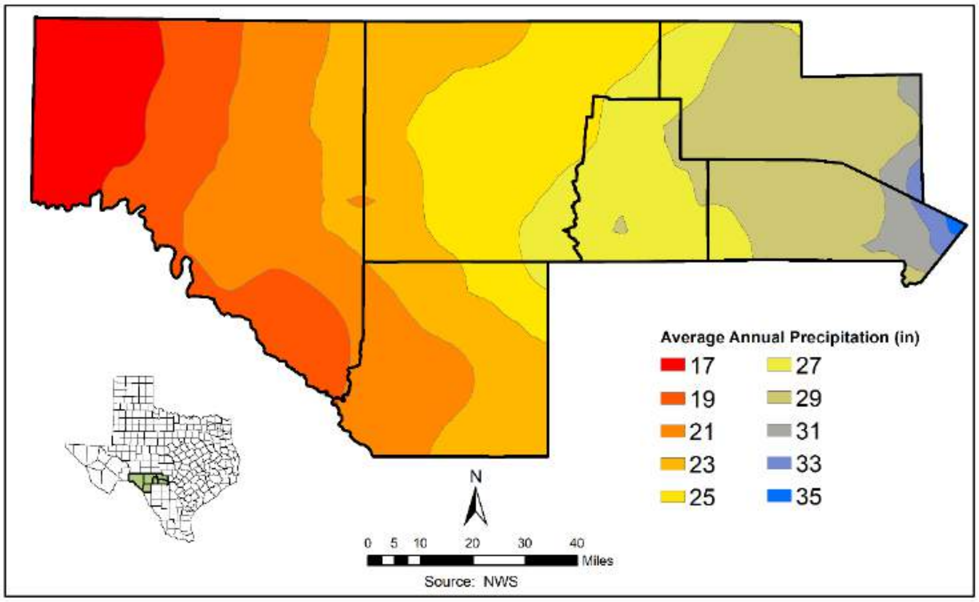


**Figure 1-5. Variation of Precipitation**

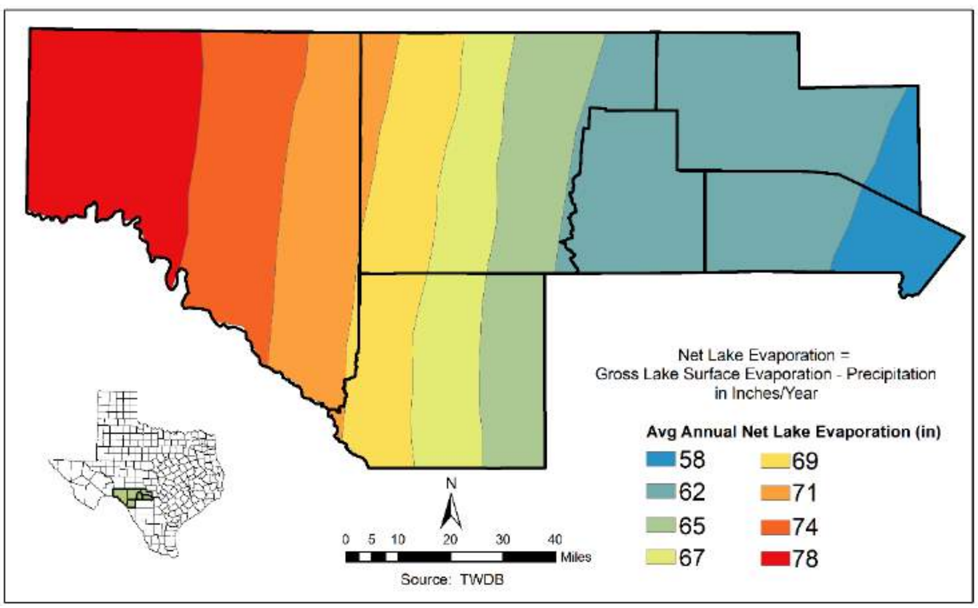


**Figure 1-6. Net Lake Evaporation**

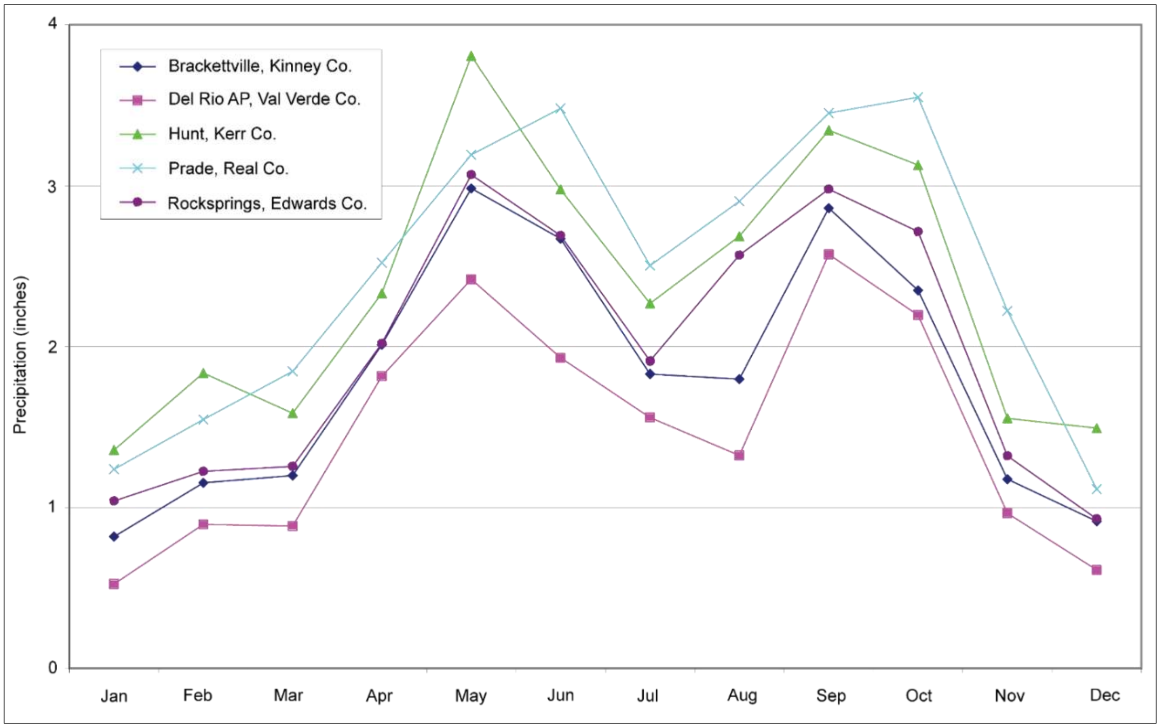


**Figure 1-7. Average Monthly Rainfall for Selected Stations**

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 springflow 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 *2021 Plan*, to illustrate in Chapter 7 that although the 1950s drought is the Historic Drought of Record, current drought conditions are of major significance. Current preparation for drought in the Plateau planning region is presented in detail in Chapter 7. Existing groundwater conservation district 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.

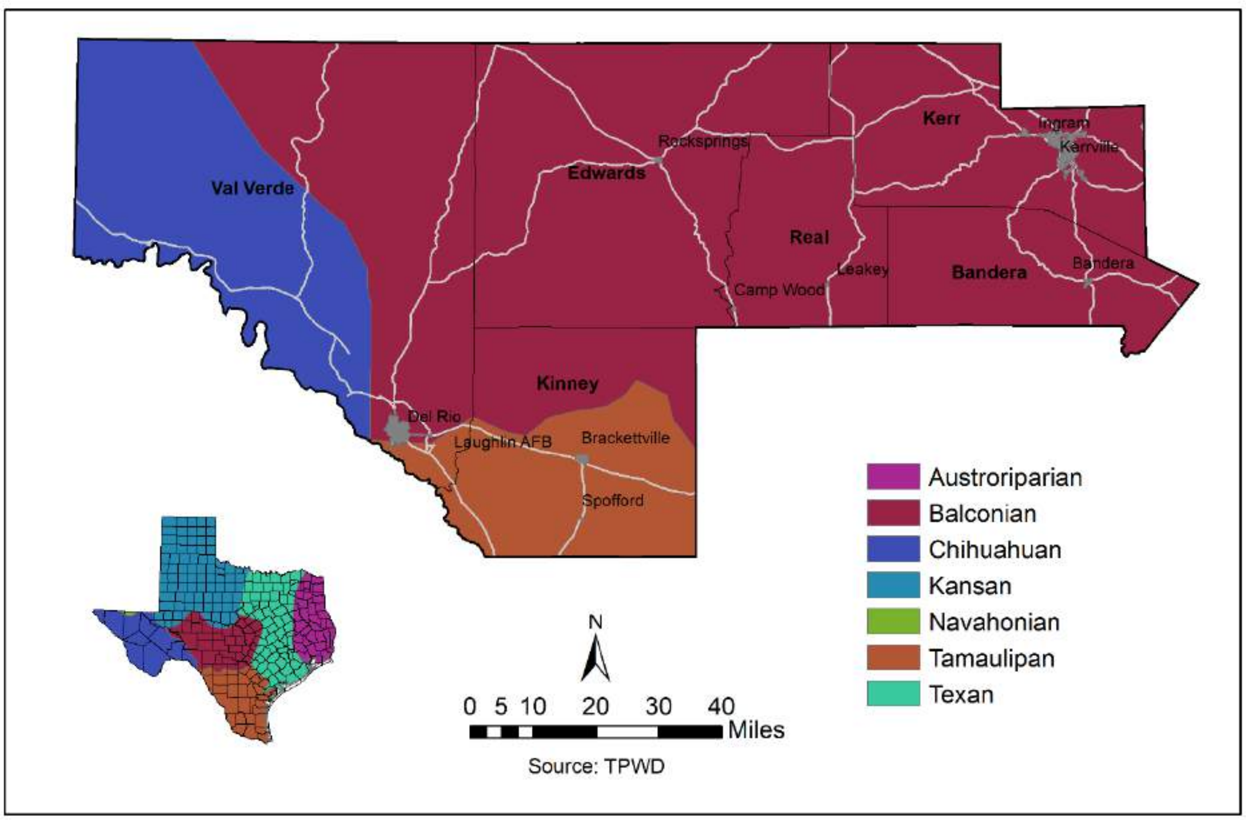


**Figure 1-8. Biotic Provinces**

### 1.2.7 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, account 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 March 30, 2020) (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. Springflow 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 springflow 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 sever 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 principal 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.

### 1.2.8 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 WPP 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%
- 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% of the riparian zone
- Identify and implement best management practices to address urban runoff
- Improve water use efficiency by 10%

### 1.2.9 Water-Supply Source Vulnerability/Security

Following the events of September 11$^{th}$ 2001, Congress passed the Bio-Terrorism Preparedness and Response Act. Drinking water utilities serving more than 3,300 people were required and 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* www.awwa.org

*Interim Voluntary Security Guidance for Wastewater/Stormwater Utilities* www.wef.org

*Interim Voluntary Guidelines for Designing an Online Contaminant Monitoring System* www.asce.org

### 1.2.10 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 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 1-2 lists Plateau Region public water systems currently involved in the TCEQ's Source Water Protection Program.

**Table 1-2. Plateau Region Source Water Protection Participants**

| PWS Name | County | Report Date |
|---|---|---|
| Bandera County FWSD 1 | Bandera | 7/1/1997 |
| City of Bandera | Bandera | 7/1/1997 |
| Medina Children's Home | Bandera | 7/1/1999 |
| Flying L Ranch PUD | Bandera | 7/1/1999 |
| Bandera River Ranch 1 | Bandera | 7/31/2000 |
| TPWD Lost Maples SNA | Bandera | 7/1/1999 |
| Bandina Christian Youth Camp | Bandera | 7/1/1999 |
| Camp Sionito Business | Bandera | 7/1/1999 |
| Bandera ISD Bandera High School | Bandera | 7/1/1999 |
| Mayan Dude Ranch | Bandera | 7/1/1999 |
| Dixie Dude Ranch | Bandera | 7/1/1999 |
| Blue Medina Water | Bandera | 1/31/2001 |
| Lake Medina Shores | Bandera | 6/30/2005 |
| Bandera Homestead Condominiums | Bandera | 7/31/1999 |
| MHC Medina Lake Campgrounds | Bandera | 5/30/2000 |
| Bandera ISD Alkek Elementary | Bandera | 7/1/1999 |
| Pipe Creek Junction Café | Bandera | 7/1/1999 |
| Lakewood Water | Bandera | 7/31/1999 |
| Elmwood Estates | Bandera | 7/31/1999 |
| Twin Elm Guest Ranch and RV Park | Bandera | 7/1/1999 |
| Bandina | Bandera | 7/1/1999 |
| Hill Country Mobile Home Park | Bandera | 7/1/1999 |
| Oak Country Property Owners Assn | Bandera | 7/1/1999 |
| Mansfield Park | Bandera | 7/1/1999 |
| Comanche Cliffs | Bandera | 7/31/1999 |
| Pomarosa RV Park | Bandera | 7/1/1999 |
| Bandera East Utility (Bridlegate) | Bandera | 8/31/2015 |
| Scenic Valley Mobile Home Park | Kerr | 1/31/2001 |

**Table 1-3. (Continued) Plateau Region Source Water Protection Participants**

| PWS Name | County | Report Date |
|---|---|---|
| Cedar Springs MHP | Kerr | 5/31/2000 |
| Verde Park Estates Wiedenfeld Water Work | Kerr | 7/31/2000 |
| Westcreek Estates Water System | Kerr | 9/1/2002 |
| Hills & Dales Wiedenfeld Water Work | Kerr | 5/31/2000 |
| Verde Hills WSC | Kerr | 7/31/1999 |
| Oak Forest South Water Supply | Kerr | 5/31/2000 |
| Nickerson Farm Water System | Kerr | 5/31/2000 |
| Park Place Subdivision | Kerr | 8/31/2015 |
| Four Seasons | Kerr | 5/31/2000 |
| Sleepy Hollow | Kerr | 5/31/2000 |
| Pecan Valley | Kerr | 7/31/2000 |
| Forest Oaks Mobile Home Park | Kerr | 5/31/2000 |
| Center Point North Water System | Kerr | 5/31/2000 |
| Center Point Taylor System | Kerr | 8/31/2014 |
| Four Seasons | Kerr | 5/31/2000 |
| Horseshoe Oaks Subdivision Water System | Kerr | 5/31/2000 |
| Northwest Hills Subdivision | Kerr | 7/31/1999 |
| Bear Paw Water System | Kerr | 7/31/1999 |
| Southern Hills | Kerr | 5/31/2000 |
| Cardinal Acres | Kerr | 7/31/1999 |
| Kamira Water System | Kerr | 5/31/2000 |
| Real Oaks Subdivision | Kerr | 7/31/2000 |
| Cherry Ridge Water | Kerr | 5/31/2000 |
| Silver Hills Park | Kerr | 1/31/2001 |
| Saddlewood Subdivision | Kerr | 5/31/2000 |
| Ingram Water Supply | Kerr | 8/31/2015 |
| Twin Forks Estates WSC | Real | 8/31/2010 |
| Del Rio Utilities Commission | Val Verde | 12/31/1986 |

# 1.3 REGIONAL WATER DEMAND

## 1.3.1 Major Demand Categories

Total estimated year-2020 water consumptive use in the Plateau Region is 37,337 acre-feet. The largest category of demand is municipal and county other (25,975 acre-feet), followed by irrigation (8,805 acre-feet), livestock (2,182 acre-feet), mining (355 acre-feet), and manufacturing (20 acre-feet). Municipal, county-other and irrigation combined represent 93 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.

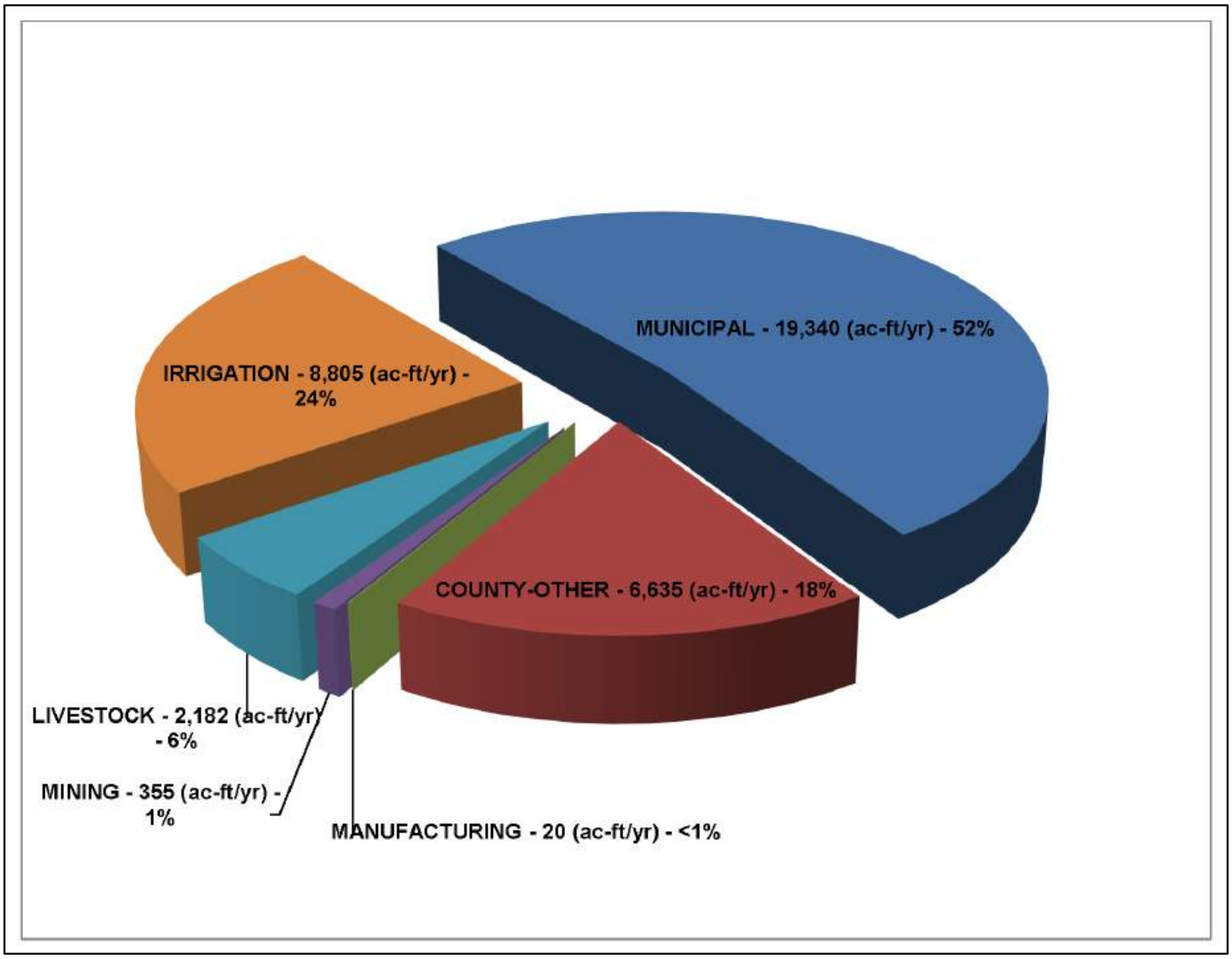


**Figure 1-9. Year 2020 Projected Water Demand by Water-Use Category**

### 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 10,558 acre-feet of water was estimated to be used in 2020 to supply residents and businesses. Fifty-five percent of regional municipal water is used in Val Verde County, and 28 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. 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 consists 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 2020, irrigation represents the second greatest water use in the Region (8,805 acre-feet) with Kinney County accounting for 42 percent of the regional total. Livestock use in the Region amounted to 2,182 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 only accounted for in Kerr County.

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 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.

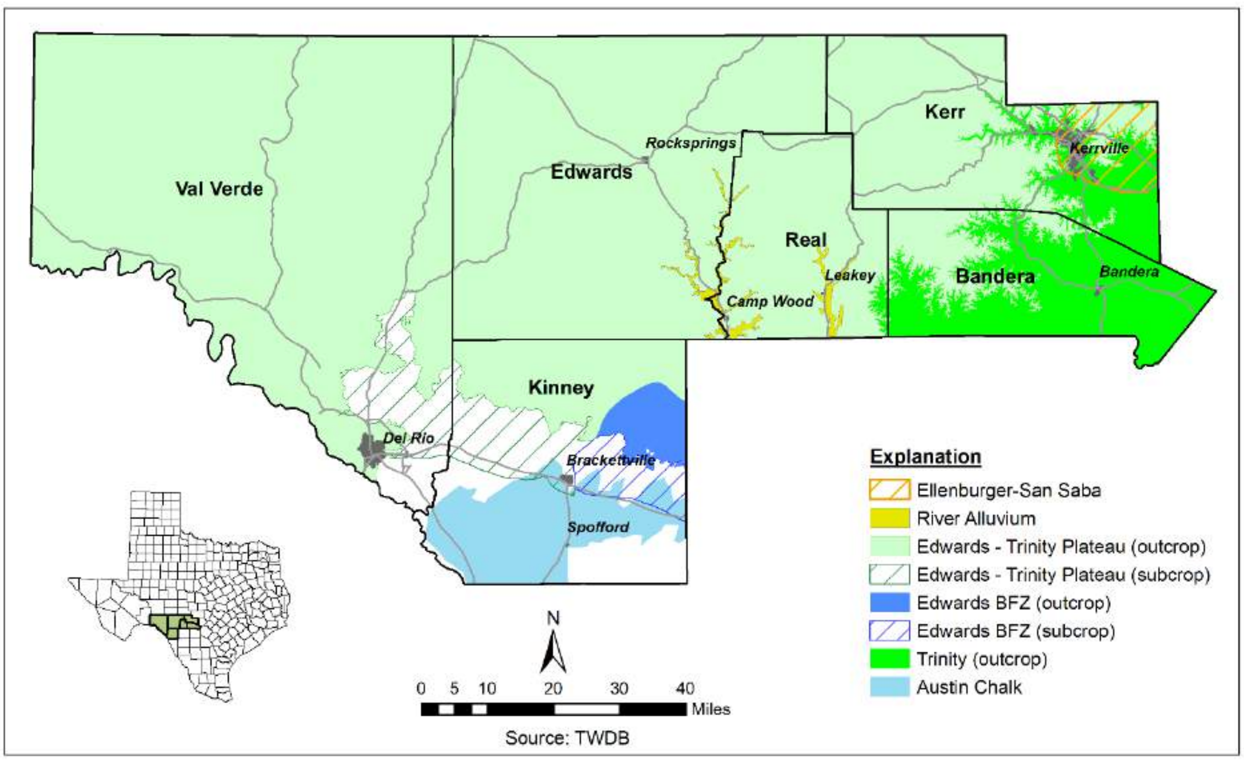


**Figure 1-10. Groundwater Sources**

#### 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-centrals 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 $mi^2$ 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

Recent advances in aquifer research has suggested the desirability of adding the Ellenburger-San Saba Aquifer in Kerr County to the list of available groundwater sources in the Plateau Planning Region. Although no production wells in the Ellenburger are currently in use, 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, these basins include the Rio Grande, Nueces, Colorado, Guadalupe, and San Antonio. 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.

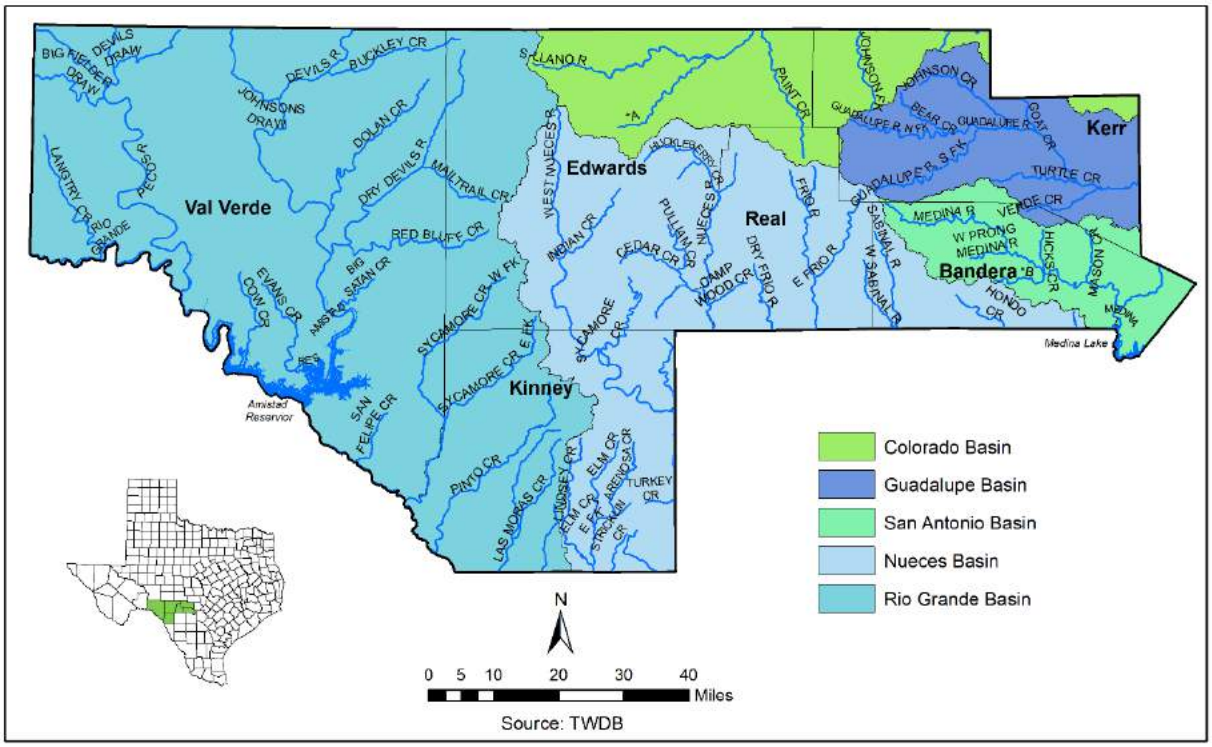


**Figure 1-11. Surface Water Sources**

#### 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-foot 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 main stream 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 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. 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 principal 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 during the previous planning period 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 springflow in western Kerr County to base flow in the three branches of the upper Guadalupe River.

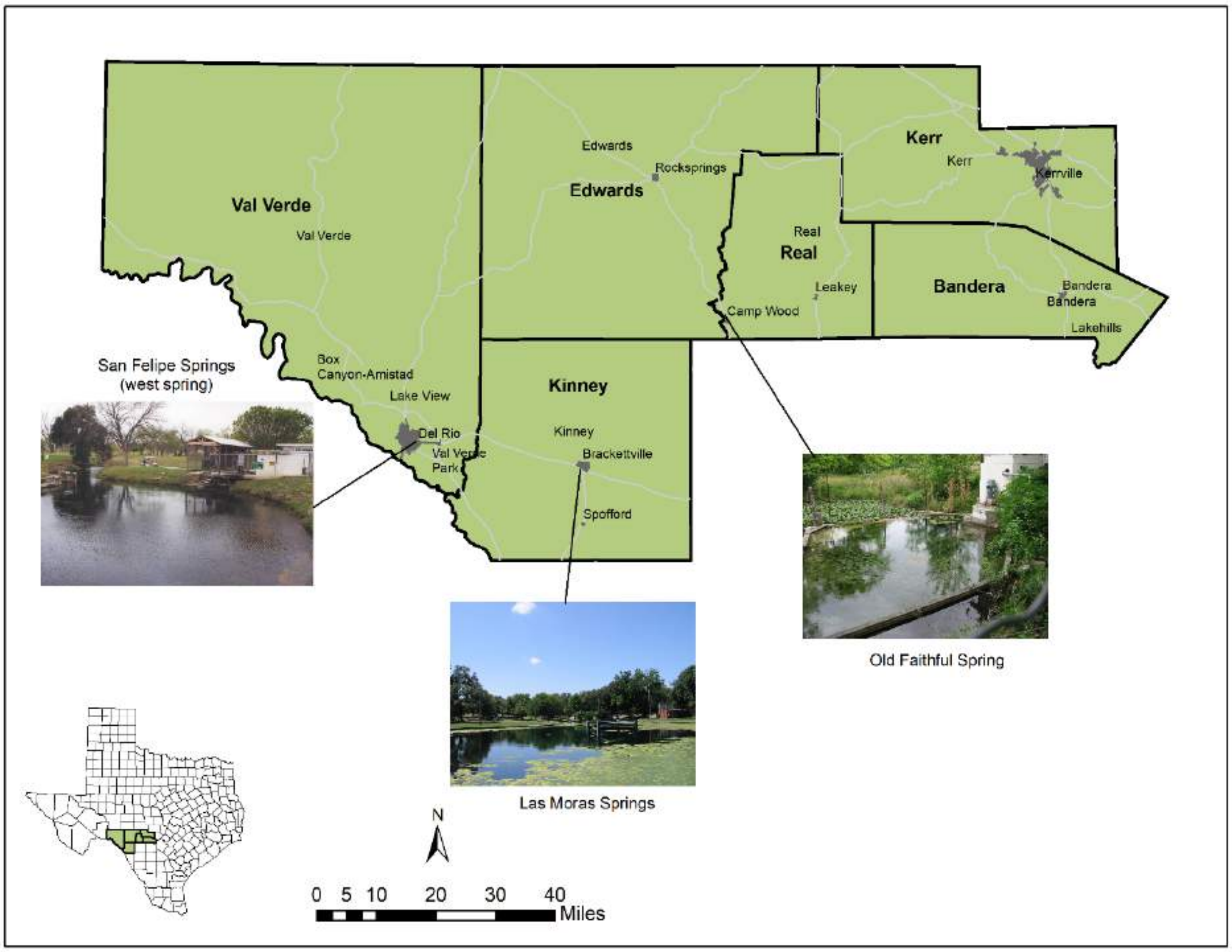


**Figure 1-12. Major Springs**

### 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, Bandera and Camp Wood have active water reuse programs that are 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: http://www.twdb.texas.gov/financial/programs/EDAP/index.asp.

EDAP projects in the Plateau Region are located in Kerr, Kinney, Real and Val Verde Counties (Table 1-3). Data pertaining to all EDAP projects in the State can be accessed through the TWDB web site: http://www.twdb.texas.gov/publications/reports/edap_reports/doc/Status.pdf. The following construction and planning projects are listed as EDAP funded as of February 28, 2019:

**Table 1-3. Economically Distressed Area Program Projects (February 2019)**

| County | Recipient | Project | EDAP Funding | Other TWDB Funding | Status |
|---|---|---|---|---|---|
| Kerr | Upper Guadalupe RA | Center Point Water System | $39,554 | | Completed |
| Kerr | Kerr County | Center Point Wastewater System | $27,668,118 | $33,697,673 | Active |
| Kerr | Kerr County | | $13,375,000 | | New commitment 12 / 2018 |
| Kinney | City of Spoford | Brackettville Transmission Line | $243,113 | | Completed |
| Real | Nueces River Authority | Leakey Wastewater System | $20,251,979 | $9,961,460 | Active |

**Table 1-3. (Continued) Economically Distressed Area Program Projects (February 2019)**

| County | Recipient | Project | EDAP Funding | Other TWDB Funding | Status |
|---|---|---|---|---|---|
| Val Verde | Val Verde County | Colonia Water Service | $942,000 | | Active |
| Val Verde | City of Del Rio | Cienega Terrace | $3,245,986 | | Completed |
| Val Verde | City of Del Rio | Val Verde Park Estates | $10,747,009 | | Completed |
| Val Verde | Val Verde County | Water & Wastewater Planning | $283,284 | | Completed |
| Val Verde | Val Verde County | Lakeview Estates Water & Wastewater | $410,967 | | Completed |

## 1.6 WATER LOSS AUDITS

In 2003, the 78th Texas Legislature, 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 retail public utilities providing water within Texas file a standardized water audit once every five years with the Texas Water Development Board (TWDB). 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. By reducing water loss, utilities can increase their efficiency, improve their financial status, minimize their need for additional water resources, and assist long-term water sustainability.

Any retail water supplier that has an active financial obligation with the TWDB is required to submit a water loss audit annually. Additionally, retail water suppliers with more than 3,300 connections are now required to submit an audit annually; all other retail public water suppliers are required to submit a water loss audit once every five years. 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).

Table 1-4 provides a listing of reported utility audits performed in the Plateau Region that show a loss of more than 10 percent.

**Table 1-4. Public Water System Water Loss Reports (Gallons per year)**

| Public Water System | Report Year | Reported Breaks Leaks | Unreported Loss | Total Real Losses | Cost of Real Losses $ | Total Loss Percent |
|---|---|---|---|---|---|---|
| Bandera River Ranch 1 | 2015 | 364,487 | 4,426,897 | 4,791,384 | 3,656 | 27.9 |
| City of Kerrville | 2017 | 13,534,319 | 224,001,131 | 237,535,450 | 539,443 | 18.4 |
| Community Water Group WSC | 2015 | 1,252,104 | 663,788 | 1,915,892 | 1,341 | 20.3 |
| Del Rio Utilities Commission | 2016 | 1,540,400 | 33,261,796 | 34,802,196 | 144,777 | 11.4 |
| Enchanted River Estates | 2015 | 1,667,400 | 365,663 | 2,033,063 | 1,789 | 11.7 |
| Fort Clark Springs MUD | 2015 | 0 | 62,273,567 | 62,273,567 | 9,341 | 41.1 |
| Real WSC | 2015 | 100,000 | 1,533,416 | 1,633,416 | 1,111 | 32.3 |
| San Pedro Canyon Subdivision - Upper | 2016 | 0 | 5,394,010 | 5,394,010 | 2,551 | 40.0 |
| Tierra Del Lago | 2016 | 0 | 2,471,426 | 2,471,426 | 989 | 54.9 |
| Val Verde County WCID Comstock | 2015 | 20,000 | 1,534,206 | 1,554,206 | 894 | 16.4 |
| Verde Park Estates | 2015 | 32,000 | 630,140 | 662,140 | 2,715 | 15.5 |

*American Water Works Association (AWWA) recommends entities with more than 10% water loss take corrective action.*

# 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 Resources 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 sivicultural nonpoint source pollution. Currently, the agricultural/sivicultural 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 (http:/ibwc.state.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 (http://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 (http://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 (http://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) (http://www.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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# CHAPTER 2
# POPULATION AND WATER DEMAND

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# 2 POPULATION AND WATER DEMAND

Planning for the wise use of the existing water resources in the Plateau Region requires a reasonable estimation of current and future water needs for all water-use categories. Regional population and water demand data was initially provided to the Plateau Water Planning Group (PWPG) at the beginning of the planning period, which incorporated data from the State Data Center and the U.S. Census Bureau's 2010 census count. The Plateau Water Planning Group (PWPG) requested revisions to specific water demand categories for use in the *2021 Plateau Region Water Plan*, which were subsequently approved by the TWDB. Thus, the population and water demand projections shown in this chapter are derived from a combination of TWDB data and approved revisions.

The PWPG made available the draft population and water demand summary tables to municipalities, water providers, county judges, and non-municipal water use representatives, and solicited all entities within the Region to submit desired changes to the projections. After thoughtful consideration, the PWPG chose to accept the draft population and water demand estimates. However, the PWPG did voice reservations with the way that these population numbers are used to calculate county rural water demand projections as further expressed in Section 2.2.1 below. Requested revisions in draft water demand projections fell into two categories, City of Kerrville and Kerr County-Other. Both of the revision requests were subsequently granted by the TWDB.

Population projections and associated water demand projections have been reassembled by utility service areas rather than political boundaries in order to better plan for the actual water-supply service entity. Previous regional and State water plans have been aligned with political boundaries, such as city limits rather than water utility service areas. Recent TWDB rule changes now define a municipal water user group (WUG) as being utility-based, and thus emphasis of the development of population and municipal water demands for the 2021 regional water plans transition from political boundaries to utility-service area boundaries.

# 2.1 POPULATION

## 2.1.1 Population Projection Methodology

County population projections are prepared by the Texas State Data Center / Office of the State Demographer and are based on recent and projected demographic trends, including birth and survival rates and net migration rates of population groups defined by age, gender, and race/ethnicity. Because the fifth cycle of regional water planning falls within an inter-census planning cycle, no new decennial census data is available in time for the use of this *Plan.* Population projections are therefore based on the 2017 State Water Plan population data.

The projected municipal population is allocated to water systems or utilities that provide an average of more than 100 acre-feet per year for municipal use. This newly defined (municipal WUG) includes water systems that vary from privately-owned, systems serving institutions, facilities owned by the State and Federal government, and all other retail public utilities that meet the 100-acre feet criteria.

Rural "county-other" population is calculated as the difference between the total projected population of the utility service areas and the total projected county population. Population is then projected from the 2010 base year by decade to the year 2070. However, a new set of 2010 population estimates were developed to reflect a utility based boundary (not political boundary) as a baseline population to be projected for the use of this *Plan*. A more detailed explanation of the TWDB population projection methodology is available at

http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/project_docs/20170405_pop_muni_proj_method_summ.pdf?d=75388.485.

The PWPG expresses concern that the population projections do not recognize the impact to the municipal and rural population and its related water demand that occurs as the result of seasonal vacationers, hunters, and absentee land-owner homes, especially in the rural counties. The PWPG recommends that for future regional water plans, that a region be allowed to adjust the total regional population rather than having to adjust individual county populations to achieve a non-changeable total population.

## 2.1.2 Current and Projected Population

In the year 2010, the U.S. Census Bureau performed a census count, which provides the base year for future population projections. Although the PWPG accepts the 2010 census count, members again expressed concern that the census does not recognize the significant seasonal population increase that occurs as the Region draws large numbers of hunters and recreational visitors, as well as absentee land owners who maintain vacation, retirement, and hunting properties. Therefore, an emphasis is being made in this planning document, especially for the rural counties, to recognize a need for more water than is justified simply from the population-derived water demand quantities.

The approved projections may also underestimate population and subsequent water demand in Kerr County. The cohort-component model used to project population growth does not adequately account for expected business and market factors that can influence population growth. Several Kerr County organizations are actively pursuing market development and business growth in order to maintain a consistent double-digit growth rate not reflected in the long-term population forecast. Similar underestimations may also occur elsewhere in the Region.

Population projections by decade for water utilities, and county rural areas in the Plateau Region are listed in Table 2-1. The projected year-2020 population for the entire Region is 141,476 of which 76 percent reside in Kerr and Val Verde Counties (Figure 2-1). Del Rio, with a year-2020 projected population of 37,775 is the largest community in the Region. The Regional population is projected to increase by 30 percent to 184,595 by the year 2070, which is an increase of 43,119 citizens (Figure 2-2). The water demand table (Table 2-2) depicts water demand for county-other use as equally distributed throughout the rural portion of each county; whereas in reality, county-other population and water demand are often concentrated in smaller areas of the county, such as unincorporated communities, subdivisions and mobile home parks.

Population estimates do not consider rural population density, which concentrates water demand and strains available local water supplies. Figure 2-3 shows the concentration of rural population in the eastern portions of both Kerr and Bandera Counties. The challenge of meeting the water needs for these concentrated rural areas is addressed in water management strategies provided in Chapter 5.

**Table 2-1. Plateau Region Population Projections**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Bandera County - Guadalupe Basin** | | | | | | |
| County-Other | 122 | 140 | 150 | 155 | 157 | 158 |
| **Guadalupe Basin Total Population** | **122** | **140** | **150** | **155** | **157** | **158** |
| **Bandera County - Nueces Basin** | | | | | | |
| County-Other | 1,114 | 1,282 | 1,376 | 1,414 | 1,438 | 1,450 |
| **Nueces Basin Total Population** | **1,114** | **1,282** | **1,376** | **1,414** | **1,438** | **1,450** |
| **Bandera County - San Antonio Basin** | | | | | | |
| Bandera | 1,875 | 2,160 | 2,316 | 2,380 | 2,420 | 2,442 |
| Bandera County FWSD #1 | 679 | 781 | 838 | 862 | 876 | 883 |
| County-Other | 16,962 | 19,535 | 20,961 | 21,546 | 21,901 | 22,085 |
| County-Other (Bandera River Ranch 1) | 929 | 1,070 | 1,148 | 1,180 | 1,199 | 1,209 |
| County-Other (Lake Medina Shores) | 2,415 | 2,781 | 2,985 | 3,068 | 3,118 | 3,144 |
| County-Other (Medina WSC) | 895 | 1,031 | 1,107 | 1,137 | 1,156 | 1,166 |
| **San Antonio Basin Total Population** | **23,755** | **27,358** | **29,355** | **30,173** | **30,670** | **30,929** |
| **Bandera County Total Population** | **24,991** | **28,780** | **30,881** | **31,742** | **32,265** | **32,537** |
| **Edwards County - Colorado Basin** | | | | | | |
| Rocksprings | 844 | 844 | 844 | 844 | 844 | 844 |
| County-Other | 136 | 136 | 136 | 136 | 136 | 136 |
| **Colorado Basin Total Population** | **980** | **980** | **980** | **980** | **980** | **980** |
| **Edwards County - Nueces Basin** | | | | | | |
| Rocksprings | 415 | 415 | 415 | 415 | 415 | 415 |
| County-Other | 391 | 391 | 391 | 391 | 391 | 391 |
| County-Other (Barksdale WSC) | 264 | 264 | 264 | 264 | 264 | 264 |
| **Nueces Basin Total Population** | **1,070** | **1,070** | **1,070** | **1,070** | **1,070** | **1,070** |
| **Edwards County - Rio Grande Basin** | | | | | | |
| County-Other | 73 | 73 | 73 | 73 | 73 | 73 |
| **Rio Grande Basin Total Population** | **73** | **73** | **73** | **73** | **73** | **73** |
| **Edwards County Total Population** | **2,123** | **2,123** | **2,123** | **2,123** | **2,123** | **2,123** |
| **Kerr County - Colorado Basin** | | | | | | |
| County-Other | 507 | 541 | 562 | 582 | 596 | 607 |
| **Colorado Basin Total Population** | **507** | **541** | **562** | **582** | **596** | **607** |
| **Kerr County - Guadalupe Basin** | | | | | | |
| Kerrville | 25,658 | 26,638 | 27,217 | 27,792 | 28,203 | 28,522 |
| Kerrville South Water | 2,821 | 2,969 | 3,057 | 3,143 | 3,206 | 3,254 |
| County-Other | 20,583 | 21,982 | 22,813 | 23,636 | 24,226 | 24,679 |
| County-Other (Center Point North Water System) | 255 | 272 | 282 | 291 | 298 | 304 |
| County-Other (Center Point Taylor System) | 530 | 564 | 585 | 605 | 619 | 631 |
| County-Other (Center Point) | 161 | 172 | 178 | 184 | 189 | 192 |
| County-Other (Hills and Dales Estates) | 202 | 216 | 223 | 231 | 237 | 241 |
| County-Other (Nickerson Farm Water System) | 200 | 213 | 221 | 229 | 234 | 238 |
| County-Other (Oak Forest South Water) | 669 | 712 | 738 | 763 | 782 | 796 |
| County-Other (Park Place Subdivision) | 129 | 138 | 143 | 148 | 151 | 154 |
| County-Other (Pecan Valley) | 123 | 131 | 135 | 140 | 144 | 146 |
| County-Other (Rustic Hills Water) | 80 | 85 | 88 | 91 | 93 | 95 |
| County-Other (Verde Park Estates) | 178 | 189 | 196 | 203 | 208 | 211 |
| County-Other (Westwood Water System) | 269 | 287 | 297 | 307 | 315 | 320 |
| **Guadalupe Basin Total Population** | **51,858** | **54,568** | **56,173** | **57,763** | **58,905** | **59,783** |
| **Kerr County - Nueces Basin** | | | | | | |
| County-Other | 6 | 7 | 7 | 7 | 8 | 8 |
| **Nueces Basin Total Population** | **6** | **7** | **7** | **7** | **8** | **8** |

**Table 2-1. (continued) Plateau Region Population Projections**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Kerr County - San Antonio Basin** | | | | | | |
| County-Other | 273 | 291 | 302 | 313 | 321 | 327 |
| **San Antonio Basin Total Population** | **273** | **291** | **302** | **313** | **321** | **327** |
| **Kerr County Total Population** | **52,644** | **55,407** | **57,044** | **58,665** | **59,830** | **60,725** |
| **Kinney County - Nueces Basin** | | | | | | |
| County-Other | 81 | 82 | 82 | 82 | 82 | 82 |
| **Nueces Basin Total Population** | **81** | **82** | **82** | **82** | **82** | **82** |
| **Kinney County - Rio Grande Basin** | | | | | | |
| Brackettville | 1,958 | 1,971 | 1,971 | 1,971 | 1,971 | 1,971 |
| Fort Clark Springs MUD | 1,259 | 1,267 | 1,267 | 1,267 | 1,267 | 1,267 |
| County-Other | 397 | 400 | 400 | 400 | 400 | 400 |
| **Rio Grande Basin Total Population** | **3,614** | **3,638** | **3,638** | **3,638** | **3,638** | **3,638** |
| **Kinney County Total Population** | **3,695** | **3,720** | **3,720** | **3,720** | **3,720** | **3,720** |
| **Real County - Colorado Basin** | | | | | | |
| County-Other | 35 | 35 | 35 | 35 | 35 | 35 |
| **Colorado Basin Total Population** | **35** | **35** | **35** | **35** | **35** | **35** |
| **Real County - Nueces Basin** | | | | | | |
| Camp Wood | 747 | 747 | 747 | 747 | 747 | 747 |
| Leakey | 1,415 | 1,415 | 1,415 | 1,415 | 1,415 | 1,415 |
| County-Other | 1,132 | 1,132 | 1,132 | 1,132 | 1,132 | 1,132 |
| **Nueces Basin Total Population** | **3,294** | **3,294** | **3,294** | **3,294** | **3,294** | **3,294** |
| **Real County Total Population** | **3,329** | **3,329** | **3,329** | **3,329** | **3,329** | **3,329** |
| **Val Verde County - Rio Grande Basin** | | | | | | |
| Del Rio Utilities Commission | 37,775 | 40,196 | 42,540 | 44,948 | 47,242 | 49,453 |
| Laughlin AFB | 1,767 | 1,951 | 2,129 | 2,239 | 2,239 | 2,239 |
| County-Other | 15,152 | 18,242 | 21,233 | 24,379 | 27,479 | 30,469 |
| **Rio Grande Basin Total Population** | **54,694** | **60,389** | **65,902** | **71,566** | **76,960** | **82,161** |
| **Val Verde County Total Population** | **54,694** | **60,389** | **65,902** | **71,566** | **76,960** | **82,161** |
| **Region J Total Population** | **141,476** | **153,748** | **162,999** | **171,145** | **178,227** | **184,595** |

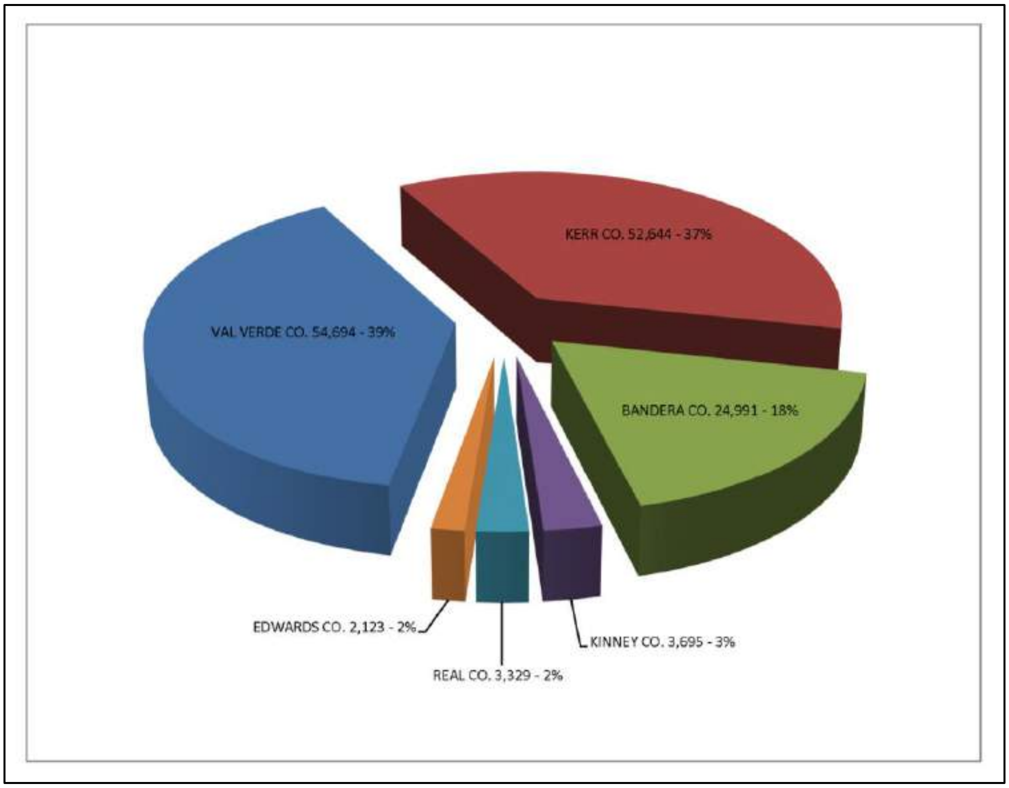



**Figure 2-1. Year 2020 Population Projection**

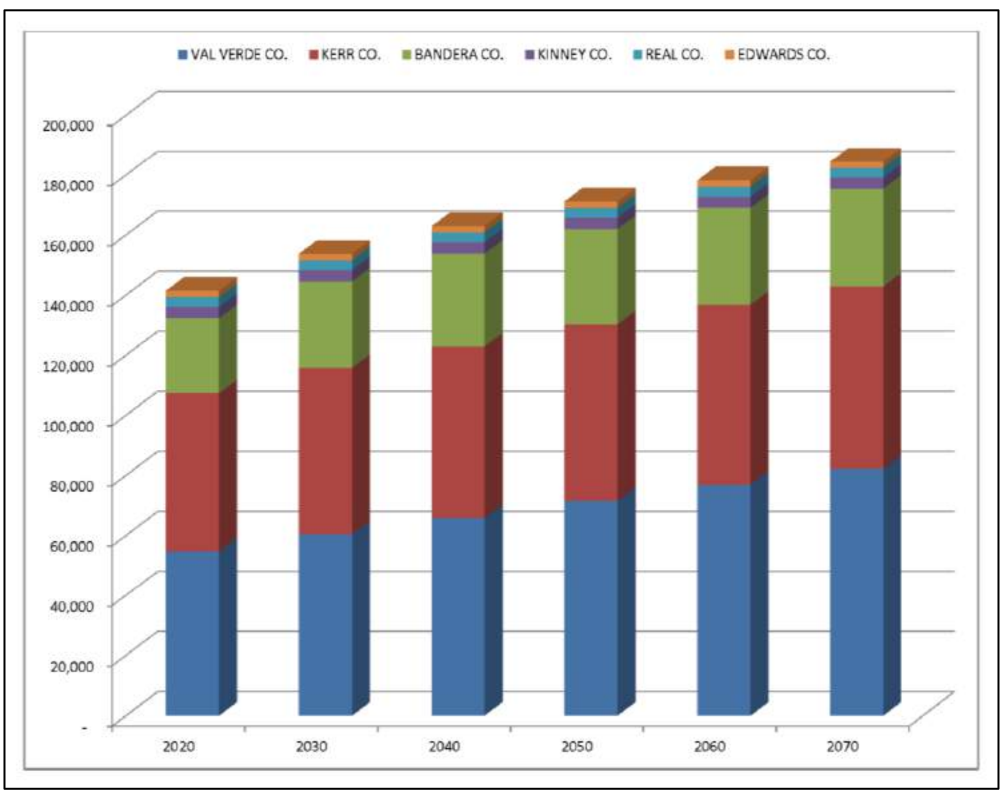
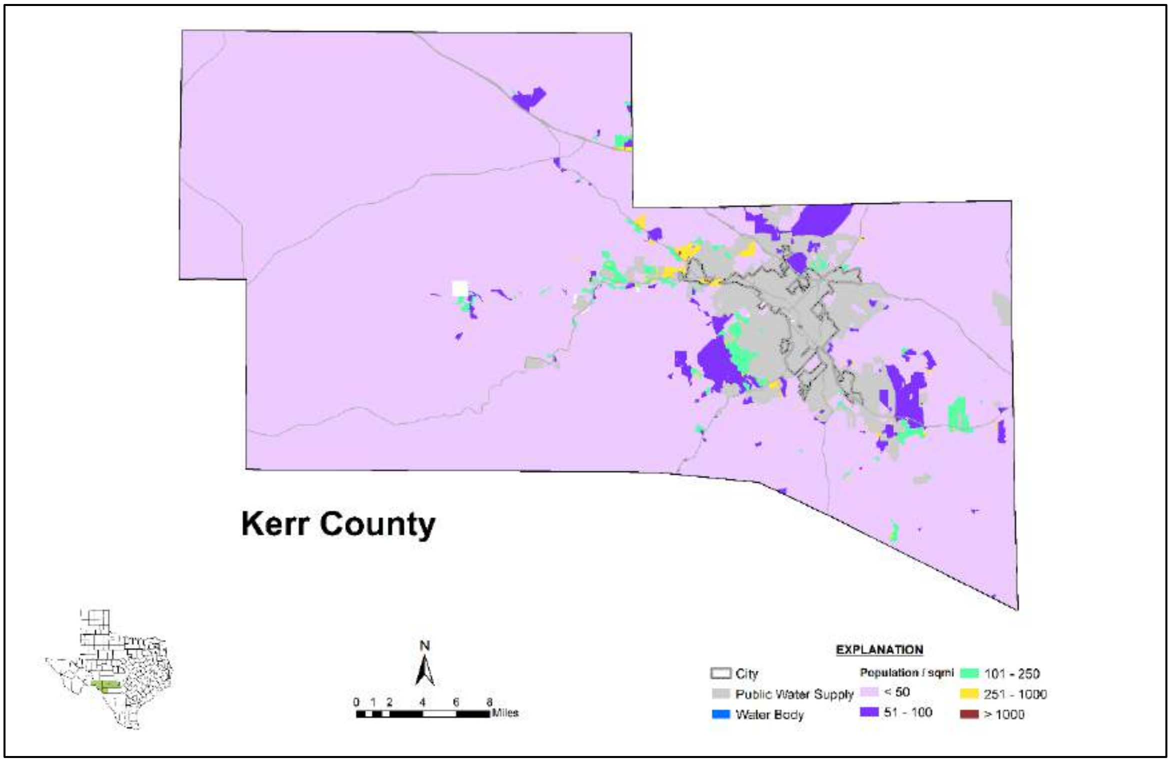



**Figure 2-2. Regional Population Projection**



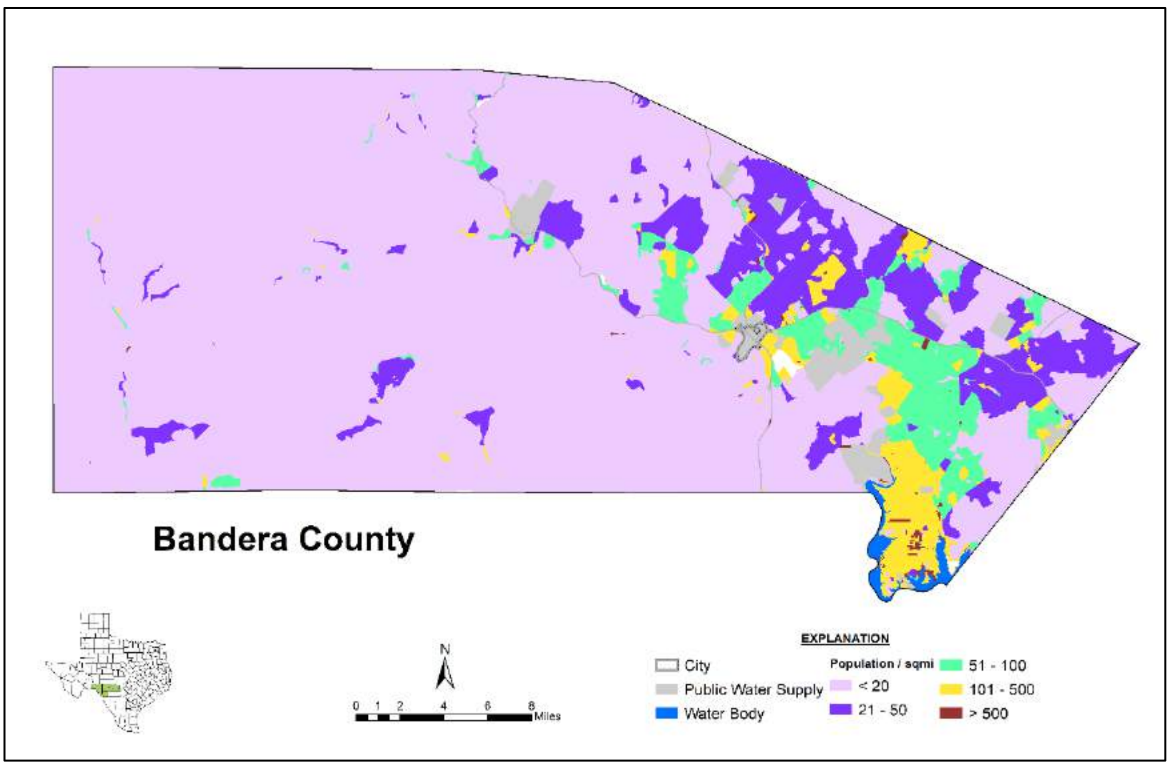




**Figure 2-3. Rural Population Concentration in Kerr and Bandera Counties**

# 2.2 WATER DEMAND

## 2.2.1 Water Demand Projections

A major component of water planning is the establishment of accurate water demand estimates for all water-use categories. Categories of water use include (1) municipal, (2) county-other (rural domestic), (3) manufacturing, (4) irrigation, (5) livestock, and (6) mining. There is no recognized water use in the Plateau Region for "steam-electric power generation". Other water use categories that are not quantified in this *Plan* include environmental and recreational needs, and are addressed in Section 2.3.

In early 2016, the TWDB contracted CDM Smith to review the projection methodologies previously used, provide insight on how projections were developed in other state planning efforts, and recommend alternative methodologies. The TWDB determined that the water demand projections methodologies for three of the categories – manufacturing, irrigation and steam-electric power – should be revised to better reflect reported historical water use. Summaries of the methodologies are provided in the following subsections. A more descriptive report can be found here: http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/current_docs.asp.

Table 2-2 lists the current and future projected Regional water demand by county and water-use category. The percent distribution of water demand in the Region by the six water-use categories is shown in Figure 2-4. Water demand is reported in "acre-feet"; one acre-foot is equivalent to a quantity of water one-foot deep occupying one acre, or 325, 851 gallons.

Figure 2-5 and Figure 2-6 show projected water demand by county in acre-feet per year. From the 2020 decade to the 2070 decade the total water demand in the Region is projected to increase from 37,337 acre-feet to 43,155 acre-feet.

The potential role of conservation is an important factor in projecting future water supply requirements. In this *Plan*, conservation is included in the municipal projections as a measure of expected savings based on requirements of the State plumbing code. All other conservation practices are discussed in terms of water supply management strategies in Chapter 5 and as a component of drought management plans in Chapter 7.

As stated previously, the PWPG is concerned that the population and subsequent water demand projections throughout the Region may be understated due to the large number of temporary residents in the Region including hunters, tourists and absentee landowners. In addition to these factors, water demand may be understated in Kerr County (as well as elsewhere in the Region) because the cohort-component model does not reflect market and business factors that are expected to increase water demand in the county, especially in the municipal and manufacturing use category. Population estimates do not consider population density, which concentrates water demand and strains available local water supplies.

The following sections present an overview of water supply needs for major water providers and for each of the six-designated water-use categories and include methods and assumptions used in the State's consensus water planning process.

**Table 2-2. Plateau Region Water Demand Projections**
**(Acre-Feet per Year)**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Bandera County - Guadalupe Basin** | | | | | | |
| County-Other | 13 | 14 | 15 | 15 | 15 | 15 |
| Livestock | 11 | 11 | 11 | 11 | 11 | 11 |
| **Guadalupe Basin Total Water Demand** | **24** | **25** | **26** | **26** | **26** | **26** |
| **Bandera County - Nueces Basin** | | | | | | |
| County-Other | 116 | 129 | 136 | 138 | 140 | 141 |
| Irrigation | 182 | 182 | 182 | 182 | 182 | 182 |
| Livestock | 47 | 47 | 47 | 47 | 47 | 47 |
| **Nueces Basin Total Water Demand** | **345** | **358** | **365** | **367** | **369** | **370** |
| **Bandera County - San Antonio Basin** | | | | | | |
| Bandera | 342 | 383 | 404 | 413 | 419 | 423 |
| Bandera County FWSD #1 | 141 | 158 | 167 | 171 | 174 | 175 |
| County-Other | 1,765 | 1,965 | 2,066 | 2,102 | 2,132 | 2,149 |
| County-Other (Bandera River Ranch #1) | 97 | 108 | 113 | 115 | 117 | 118 |
| County-Other (Lake Medina Shores) | 251 | 280 | 294 | 299 | 303 | 306 |
| County-Other (Medina WSC) | 93 | 104 | 109 | 111 | 112 | 113 |
| Irrigation | 764 | 764 | 764 | 764 | 764 | 764 |
| Livestock | 185 | 185 | 185 | 185 | 185 | 185 |
| **San Antonio Basin Total Water Demand** | **3,638** | **3,947** | **4,102** | **4,160** | **4,206** | **4,233** |
| **Bandera County Total Water Demand** | **4,007** | **4,330** | **4,493** | **4,553** | **4,601** | **4,629** |
| **Edwards County - Colorado Basin** | | | | | | |
| Rocksprings | 198 | 194 | 191 | 190 | 190 | 190 |
| County-Other | 15 | 14 | 14 | 14 | 14 | 14 |
| Irrigation | 66 | 66 | 66 | 66 | 66 | 66 |
| Livestock | 106 | 106 | 106 | 106 | 106 | 106 |
| Mining | 19 | 19 | 19 | 19 | 19 | 19 |
| **Colorado Basin Total Water Demand** | **404** | **399** | **396** | **395** | **395** | **395** |
| **Edwards County - Nueces Basin** | | | | | | |
| Rocksprings | 98 | 96 | 94 | 94 | 94 | 94 |
| County-Other | 43 | 41 | 39 | 39 | 39 | 39 |
| County-Other (Barksdale WSC) | 29 | 28 | 27 | 26 | 26 | 26 |
| Irrigation | 89 | 89 | 89 | 89 | 89 | 89 |
| Livestock | 192 | 192 | 192 | 192 | 192 | 192 |
| Mining | 25 | 25 | 25 | 25 | 25 | 25 |
| **Nueces Basin Total Water Demand** | **476** | **471** | **466** | **465** | **465** | **465** |
| **Edwards County - Rio Grande Basin** | | | | | | |
| County-Other | 8 | 8 | 7 | 7 | 7 | 7 |
| Irrigation | 60 | 60 | 60 | 60 | 60 | 60 |
| Livestock | 99 | 99 | 99 | 99 | 99 | 99 |
| Mining | 45 | 45 | 45 | 45 | 45 | 45 |
| **Rio Grande Basin Total Water Demand** | **212** | **212** | **211** | **211** | **211** | **211** |
| **Edwards County Total Water Demand** | **1,092** | **1,082** | **1,073** | **1,071** | **1,071** | **1,071** |
| **Kerr County - Colorado Basin** | | | | | | |
| County-Other | 43 | 44 | 44 | 44 | 45 | 46 |
| Irrigation | 61 | 61 | 61 | 61 | 61 | 61 |
| Livestock | 166 | 166 | 166 | 166 | 166 | 166 |
| Mining | 14 | 15 | 18 | 19 | 20 | 22 |
| **Colorado Basin Total Water Demand** | **284** | **286** | **289** | **290** | **292** | **295** |

**Table 2-2. (continued) Plateau Region Water Demand Projections**
**(Acre-Feet per Year)**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Kerr County - Guadalupe Basin** | | | | | | |
| Kerrville | 5,082 | 5,158 | 5,178 | 5,237 | 5,305 | 5,364 |
| Kerrville South Water | 341 | 346 | 347 | 352 | 358 | 363 |
| County-Other | 1,737 | 1,769 | 1,773 | 1,804 | 1,842 | 1,875 |
| County-Other (Center Point North Water System) | 22 | 22 | 22 | 22 | 23 | 23 |
| County-Other (Center Point Taylor System) | 45 | 45 | 46 | 46 | 47 | 48 |
| County-Other (Center Point) | 14 | 14 | 14 | 14 | 14 | 15 |
| County-Other (Hills and Dales Estates) | 17 | 17 | 17 | 18 | 18 | 18 |
| County-Other (Nickerson Farm Water System) | 17 | 17 | 17 | 17 | 18 | 18 |
| County-Other (Oak Forest South Water) | 56 | 57 | 57 | 58 | 59 | 60 |
| County-Other (Park Place Subdivision) | 11 | 11 | 11 | 11 | 11 | 12 |
| County-Other (Pecan Valley) | 10 | 11 | 11 | 11 | 11 | 11 |
| County-Other (Rustic Hills Water) | 7 | 7 | 7 | 7 | 7 | 7 |
| County-Other (Verde Park Estates) | 15 | 15 | 15 | 15 | 16 | 16 |
| County-Other (Westwood Water System) | 23 | 23 | 23 | 23 | 24 | 24 |
| Irrigation | 1,239 | 1,239 | 1,239 | 1,239 | 1,239 | 1,239 |
| Livestock | 546 | 546 | 546 | 546 | 546 | 546 |
| Manufacturing | 20 | 21 | 21 | 21 | 21 | 21 |
| Mining | 62 | 65 | 82 | 83 | 91 | 98 |
| **Guadalupe Basin Total Water Demand** | **9,264** | **9,383** | **9,426** | **9,524** | **9,650** | **9,758** |
| **Kerr County - Nueces Basin** | | | | | | |
| County-Other | 1 | 1 | 1 | 1 | 1 | 1 |
| Livestock | 9 | 9 | 9 | 9 | 9 | 9 |
| **Nueces Basin Total Water Demand** | **10** | **10** | **10** | **10** | **10** | **10** |
| **Kerr County - San Antonio Basin** | | | | | | |
| County-Other | 23 | 23 | 24 | 24 | 24 | 25 |
| Irrigation | 42 | 42 | 42 | 42 | 42 | 42 |
| Livestock | 36 | 36 | 36 | 36 | 36 | 36 |
| **San Antonio Basin Total Water Demand** | **101** | **101** | **102** | **102** | **102** | **103** |
| **Kerr County Total Water Demand** | **9,659** | **9,780** | **9,827** | **9,926** | **10,054** | **10,166** |
| **Kinney County - Nueces Basin** | | | | | | |
| County-Other | 11 | 11 | 11 | 11 | 10 | 10 |
| Irrigation | 1,300 | 1,300 | 1,300 | 1,300 | 1,300 | 1,300 |
| Livestock | 100 | 100 | 100 | 100 | 100 | 100 |
| **Nueces Basin Total Water Demand** | **1,411** | **1,411** | **1,411** | **1,411** | **1,410** | **1,410** |
| **Kinney County - Rio Grande Basin** | | | | | | |
| Brackettville | 608 | 602 | 594 | 593 | 592 | 592 |
| Fort Clark Springs MUD | 618 | 616 | 612 | 610 | 609 | 609 |
| County-Other | 53 | 52 | 51 | 51 | 51 | 51 |
| Irrigation | 2,413 | 2,413 | 2,413 | 2,413 | 2,413 | 2,413 |
| Livestock | 124 | 124 | 124 | 124 | 124 | 124 |
| **Rio Grande Basin Total Water Demand** | **3,816** | **3,807** | **3,794** | **3,791** | **3,789** | **3,789** |
| **Kinney County Total Water Demand** | **5,227** | **5,218** | **5,204** | **5,201** | **5,199** | **5,199** |
| **Real County - Colorado Basin** | | | | | | |
| County-Other | 4 | 4 | 3 | 3 | 3 | 3 |
| Irrigation | 12 | 12 | 12 | 12 | 12 | 12 |
| Livestock | 13 | 13 | 13 | 13 | 13 | 13 |
| **Colorado Basin Total Water Demand** | **29** | **29** | **28** | **28** | **28** | **28** |

**Table 2-2. (continued) Plateau Region Water Demand Projections**
**(Acre-Feet per Year)**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Real County - Nueces Basin** | | | | | | |
| Camp Wood | 143 | 139 | 136 | 135 | 135 | 135 |
| Leakey | 193 | 186 | 180 | 178 | 177 | 177 |
| County-Other | 120 | 116 | 113 | 111 | 111 | 111 |
| Irrigation | 258 | 258 | 258 | 258 | 258 | 258 |
| Livestock | 138 | 138 | 138 | 138 | 138 | 138 |
| **Nueces Basin Total Water Demand** | **852** | **837** | **825** | **820** | **819** | **819** |
| **Real County Total Water Demand** | **881** | **866** | **853** | **848** | **847** | **847** |
| **Val Verde County - Rio Grande Basin** | | | | | | |
| Del Rio Utilities Commission | 10,558 | 11,053 | 11,554 | 12,130 | 12,733 | 13,326 |
| Laughlin AFB | 1,018 | 1,114 | 1,215 | 1,277 | 1,276 | 1,276 |
| County-Other | 1,976 | 2,307 | 2,637 | 3,002 | 3,376 | 3,741 |
| Irrigation | 2,319 | 2,319 | 2,319 | 2,319 | 2,319 | 2,319 |
| Livestock | 410 | 410 | 410 | 410 | 410 | 410 |
| Mining | 190 | 249 | 259 | 223 | 192 | 171 |
| **Rio Grande Basin Total Water Demand** | **16,471** | **17,452** | **18,394** | **19,361** | **20,306** | **21,243** |
| **Val Verde County Total Water Demand** | **16,471** | **17,452** | **18,394** | **19,361** | **20,306** | **21,243** |
| **Region J Total Water Demand** | **37,337** | **38,728** | **39,844** | **40,960** | **42,078** | **43,155** |

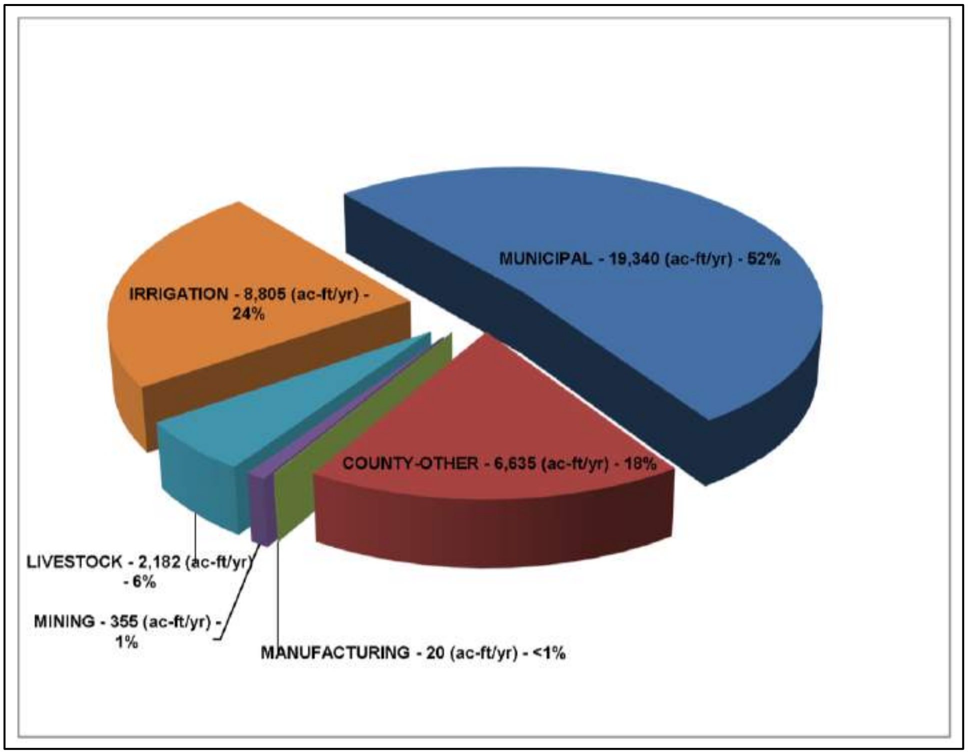



**Figure 2-4. Year 2020 Projected Water Demand by Water-Use Category**

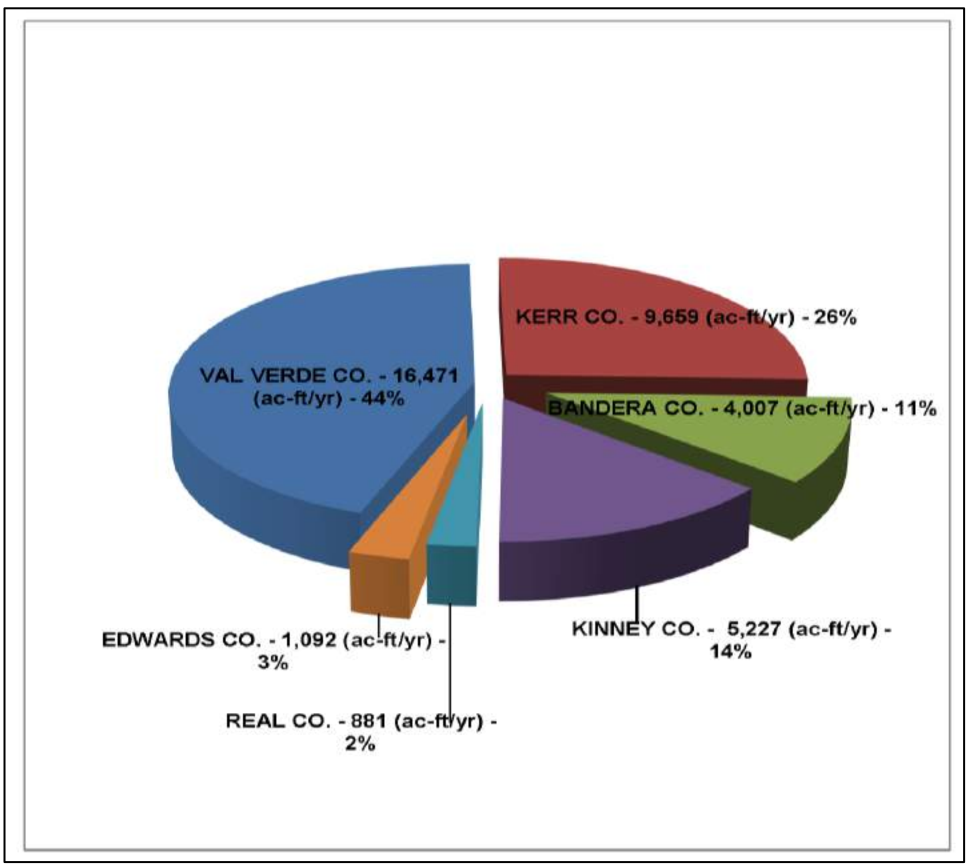



**Figure 2-5. Year 2020 Projected Water Demand by County**

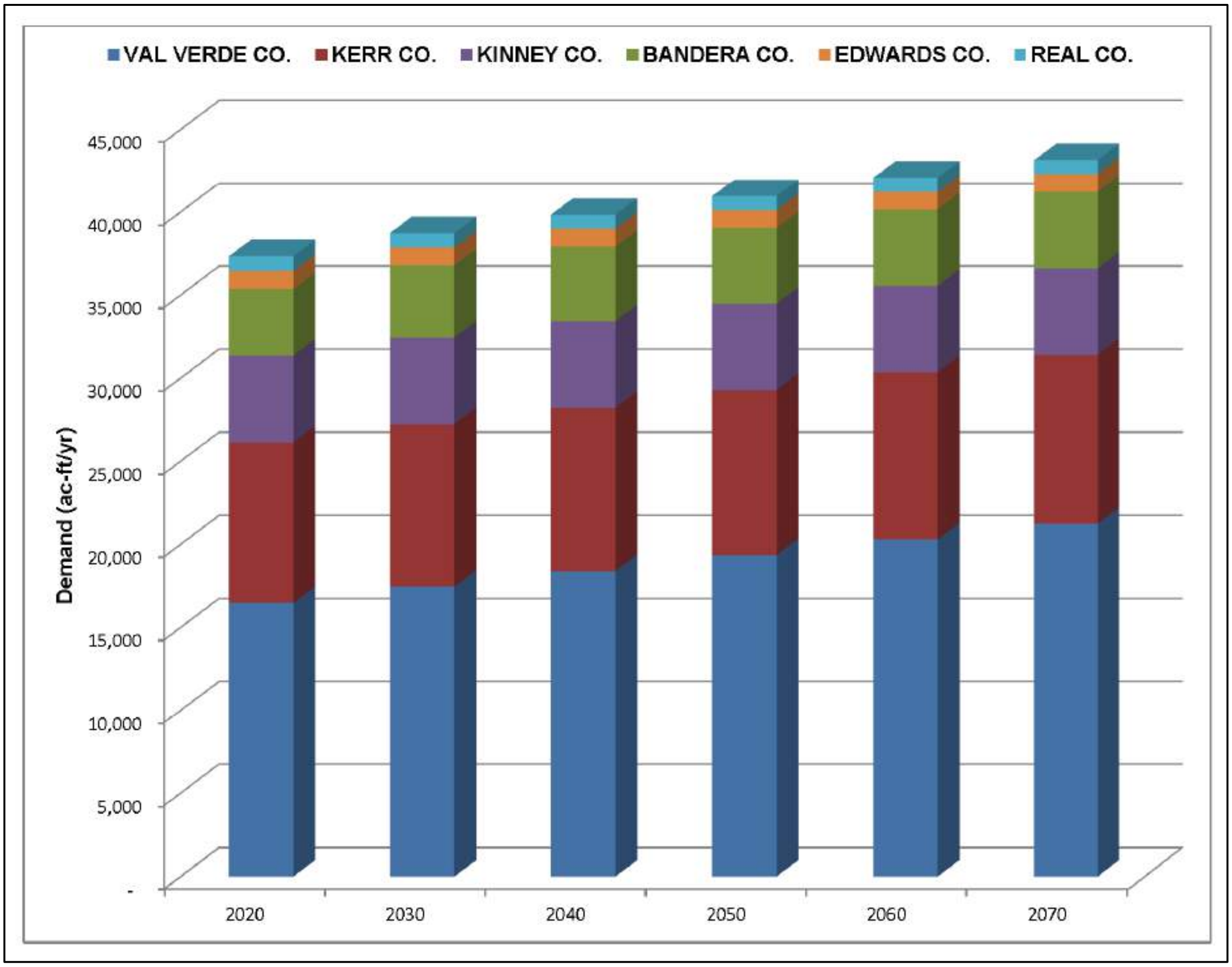



**Figure 2-6. Projected Water Demand by County**

### 2.2.2 Municipal and County-Other

The quantity of water used for municipal and county-other (rural domestic) is heavily dependent on population growth, climatic conditions, and water-conservation measures. For planning purposes, municipal water use comprises both residential and commercial. Commercial water use includes business establishments, public offices, and institutions. 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. Also included in this category is water supplied to golf courses from municipal supply sources. Water use within a utility service area that is not included in the quantification of municipal demand, is that used in manufacturing and industrial processes that are self-supplied.

Municipal and county-other water demand is calculated based on utility service boundaries designated in the population projections process and include rural domestic use. Projected municipal and county-other water demand is based on the year-2010 per-capita water use, which is calculated with year-2010 population counts divided into reported water use for the same year. Per-capita water use in communities with significant non-residential water demands, such as commercial customers will appear abnormally high. The year-2010 per-capita water use is reduced slightly over time to simulate expected conservation savings due to State-mandated plumbing code implementation. Table 2-3 presents municipal savings due to the expected installation of more water efficient fixtures and appliances. The conservation adjusted per-capita water use is then applied to each of the decade population estimates to produce the projected water demand for each entity. Table 2-4 presents the municipal and county-other projected water use for each decade in the current planning cycle.

**Table 2-3. Municipal Savings Due to Plumbing Fixture Requirements**
**(Acre-Feet per Year)**

| County | Entity Name | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|
| Bandera | Bandera | 24 | 38 | 48 | 51 | 52 | 53 |
| Bandera | Bandera County FWSD#1 | 9 | 14 | 17 | 18 | 19 | 19 |
| Bandera | County-Other | 228 | 353 | 435 | 476 | 491 | 496 |
| Edwards | Rocksprings | 14 | 20 | 25 | 26 | 26 | 26 |
| Edwards | County-Other | 10 | 14 | 17 | 18 | 18 | 18 |
| Kerr | Kerrville | 264 | 391 | 493 | 554 | 571 | 579 |
| Kerr | Kerrville South | 29 | 43 | 53 | 60 | 62 | 63 |
| Kerr | County-Other | 234 | 351 | 436 | 492 | 514 | 524 |
| Kinney | Brackettville | 21 | 31 | 40 | 41 | 41 | 41 |
| Kinney | Fort Clark Springs MUD | 13 | 18 | 22 | 25 | 25 | 25 |
| Kinney | County-Other | 4 | 5 | 6 | 7 | 7 | 7 |
| Real | Camp Wood | 8 | 11 | 15 | 16 | 16 | 16 |
| Real | Leakey | 15 | 22 | 28 | 30 | 30 | 30 |
| Real | County-Other | 11 | 15 | 18 | 20 | 21 | 21 |
| Val Verde | Del Rio | 401 | 609 | 788 | 910 | 973 | 1021 |
| Val Verde | Laughlin AFB | 23 | 35 | 39 | 42 | 43 | 43 |
| Val Verde | County-Other | 163 | 268 | 360 | 439 | 502 | 559 |
| **Total** | | **1,468** | **2,239** | **2,840** | **3,224** | **3,413** | **3,542** |

Municipal (and county-other) water demand in the Plateau Region is projected to increase from 25,711 acre-feet in 2020 to 31,478 acre-feet by 2070 (Table 2-4). Because municipal water demand is directly related to population, Val Verde County has the highest demand in the Region.

**Table 2-4. Municipal and County-Other Water Demand Projection**
**(Acre-Feet per Year)**

| County | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| Bandera | 2,818 | 3,141 | 3,304 | 3,364 | 3,412 | 3,440 |
| Edwards | 391 | 381 | 372 | 370 | 370 | 370 |
| Kerr | 7,464 | 7,580 | 7,607 | 7,704 | 7,823 | 7,926 |
| Kinney | 1,290 | 1,281 | 1,267 | 1,264 | 1,262 | 1,262 |
| Real | 460 | 445 | 432 | 427 | 426 | 426 |
| Val Verde | 13,552 | 14,474 | 15,406 | 16,409 | 17,385 | 18,343 |
| **County Total Demand** | **25,975** | **27,302** | **28,388** | **29,538** | **30,678** | **31,767** |

A significant portion of the municipal water demand in Bandera and Kerr Counties is assigned to the county-other (rural) category. This category represents the aggregation of utilities that provide less than an average of 100 acre-feet per year, as well as rural areas not served by a water utility in a given county. Table 2-5 presents a listing of water systems that comprise the county other category along with the corresponding annual water use survey data (2010-2015).

A water user group (WUG) within county-other can be further divided into a "sub-WUG" at the discretion of the planning group for a more detailed analysis. This option allows for a higher resolution in water needs analyses to better account for present water supplies and needs within certain county-other systems of interest, that would otherwise be aggregated at the county level. Table 2-5 indicates in green the water systems that the Plateau Region Water Planning Group designated as official sub-WUGs.

**Table 2-5. County-Other Water Supply Entities**
**(Acre-Feet per Year)**

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| **Bandera County-Other** | | | | | | |
| **Medina WSC | 49 | 58 | 45 | 41 | 48 | 46 |
| **Lake Medina Shores | 112 | 110 | 106 | 116 | 43 | 59 |
| **Bandera River Ranch 1 | 36 | 46 | 64 | 65 | 65 | 48 |
| Enchanted River Estates | 21 | 23 | 26 | 29 | 22 | 55 |
| Flying L Ranch PUD | 66 | 65 | 73 | 50 | 52 | 47 |
| Lakewood Water | 28 | 28 | 28 | 28 | 63 | 59 |
| The Falls WSC | 19 | 25 | 23 | 22 | 22 | 13 |
| Ranch Hills WSC | 15 | 18 | 13 | 13 | 14 | 13 |
| River Bend Estates | 0 | 12 | 11 | 8 | 12 | 13 |

**Table 2-5. (continued) County-Other Water Supply Entities**
**(Acre-Feet per Year)**

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| **Bandera County-Other** | | | | | | |
| Blue Medina Water | 15 | 15 | 12 | 11 | 11 | 13 |
| Elmwood Estates | 10 | 10 | 10 | 10 | 9 | 7 |
| Bandina | 4 | 5 | 5 | 6 | 5 | 5 |
| Bear Springs Trails Subdivision | 5 | 4 | 4 | 4 | 4 | 5 |
| Bandera Homestead Condominiums | 4 | 4 | 3 | 3 | 3 | 3 |
| Comanche Cliffs | 3 | 3 | 3 | 3 | 9 | 11 |
| Medina Highlands | 3 | 2 | 2 | 2 | 2 | 2 |
| San Julian Creek Estates | 0 | 0 | 0 | 0 | 4 | 5 |
| TPWD Lost Maples SNA | 3 | 2 | 3 | 3 | 0 | 3 |
| *Medina Children's Home | 0 | 0 | 0 | 0 | 0 | 0 |
| Bandera ISD - Bandera High School | 3 | 3 | 3 | 0 | 0 | 0 |
| Bandera ISD - Alkek Elementary | 0 | 4 | 0 | 0 | 0 | 0 |
| Cielo Rio Ranch Water System | 0 | 35 | 0 | 0 | 10 | 9 |
| Bridlegate | 0 | 9 | 0 | 24 | 11 | 32 |
| **Edwards County-Other** | | | | | | |
| **Barksdale WSC | 17 | 16 | 16 | 17 | 18 | 15 |
| **Kerr County-Other** | | | | | | |
| Ingram Water Supply | 373 | 373 | 373 | 373 | 373 | 373 |
| Woodcreek Utility CO2 | 331 | 331 | 331 | 331 | 273 | 273 |
| Guadalupe Heights Utility | 69 | 69 | 69 | 69 | 69 | 69 |
| Canyon Springs Water Works | 65 | 81 | 65 | 67 | 67 | 67 |
| VA Hospital Kerrville | 93 | 98 | 95 | 89 | 66 | 66 |
| **Oak Forest South Water Supply | 62 | 62 | 62 | 62 | 62 | 62 |
| Erlund Subdivision | 54 | 54 | 54 | 54 | 54 | 54 |
| Southern Hills Wiedenfeld Water Works | 50 | 55 | 51 | 50 | 50 | 50 |
| Woods WSC | 45 | 55 | 44 | 39 | 43 | 38 |
| Community Water Group WSC | 25 | 43 | 28 | 34 | 32 | 36 |
| Bumblebee Hills | 0 | 0 | 0 | 3 | 37 | 31 |
| Mary Mead Water System | 31 | 32 | 24 | 28 | 28 | 28 |
| Sleepy Hallow | 27 | 27 | 27 | 27 | 27 | 27 |
| Fremont Water | 33 | 40 | 41 | 30 | 29 | 25 |
| **Westwood Water System | 23 | 27 | 25 | 25 | 24 | 24 |
| Aqua Vista Utilities | 35 | 35 | 24 | 24 | 24 | 24 |
| White Oak Ranch Section One | 24 | 24 | 24 | 24 | 24 | 24 |
| Northwest Hills Subdivision | 22 | 22 | 22 | 22 | 22 | 22 |
| Kamira Water System | 24 | 25 | 24 | 21 | 27 | 20 |
| The Wilderness | 13 | 16 | 12 | 14 | 17 | 17 |

**Table 2-5. (continued) County-Other Water Supply Entities**
**(Acre-Feet per Year)**

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| **Kerr County-Other** | | | | | | |
| Bear Paw Water System | 17 | 17 | 17 | 17 | 17 | 17 |
| Royal Oaks Water | 15 | 15 | 15 | 15 | 15 | 15 |
| **Nickerson Farm Water System | 14 | 14 | 14 | 14 | 14 | 14 |
| **Verde Park Estates Wiedenfeld Water Works | 12 | 12 | 12 | 13 | 14 | 13 |
| Hill River Country Estates | 11 | 12 | 13 | 0 | 0 | 13 |
| **Hills & Dales Wiedenfeld Water Works | 18 | 17 | 14 | 13 | 13 | 12 |
| Shalako Water Supply | 11 | 14 | 13 | 12 | 12 | 12 |
| Horseshoe Oaks Subdivision Water System | 10 | 10 | 10 | 10 | 10 | 10 |
| Castlecomb Water System | 0 | 11 | 12 | 12 | 10 | 10 |
| **Center Point Wiedenfeld Water Works | 11 | 11 | 11 | 9 | 9 | 9 |
| Four Seasons | 9 | 9 | 9 | 9 | 9 | 9 |
| Village West Water System | 7 | 8 | 10 | 8 | 8 | 8 |
| Camp Honey Creek | 4 | 5 | 8 | 8 | 8 | 8 |
| Oak Ridge Estates Water System | 8 | 8 | 8 | 8 | 8 | 8 |
| **Pecan Valley | 8 | 8 | 8 | 8 | 8 | 8 |
| Ranchero Estates | 5 | 5 | 7 | 7 | 8 | 8 |
| Verde Hills WSC | 11 | 11 | 7 | 7 | 7 | 7 |
| Split Rock Water System | 10 | 10 | 8 | 7 | 7 | 6 |
| **Rustic Hills Water | 6 | 9 | 7 | 6 | 6 | 6 |
| Real Oaks Subdivision | 6 | 6 | 6 | 6 | 6 | 6 |
| Heritage Park Water System | 5 | 6 | 5 | 4 | 5 | 5 |
| Cherry Ridge Water | 4 | 4 | 4 | 4 | 4 | 4 |
| Windwood Oaks Water System | 4 | 5 | 4 | 4 | 4 | 4 |
| Sherman’s Mill | 0 | 6 | 4 | 3 | 6 | 3 |
| **Park Place Subdivision | 3 | 3 | 3 | 3 | 3 | 3 |
| Vista Hills | 0 | 0 | 0 | 2 | 3 | 2 |
| Wood Trail Water Supply | 0 | 0 | 0 | 0 | 0 | 0 |
| Woodhaven Mobile Home Park | 6 | 6 | 5 | 0 | 0 | 0 |
| Cedar Springs Mobile Home Park | 7 | 7 | 7 | 0 | 0 | 0 |
| Oak Grove Mobile Home Park | 22 | 0 | 0 | 0 | 0 | 0 |
| Ingram Oaks Retirement Community | 40 | 49 | 0 | 0 | 0 | 0 |
| Hill Country Ranch Estates | 0 | 6 | 5 | 5 | 6 | 0 |
| Generis Water Works | 0 | 17 | 17 | 17 | 17 | 0 |
| *Cypress Springs | 0 | 0 | 0 | 0 | 0 | 0 |
| *TX Dot Kerr County SRA | 0 | 0 | 0 | 0 | 0 | 0 |
| Scenic Valley Mobile Home Park | 23 | 0 | 0 | 0 | 0 | 0 |
| River Front Village | 20 | 24 | 24 | 0 | 0 | 0 |

**Table 2-5. (continued) County-Other Water Supply Entities**
**(Acre-Feet per Year)**

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| **Kerr County-Other** | | | | | | |
| Kerr Villa Mobile Home Park | 12 | 9 | 10 | 0 | 0 | 0 |
| Ingram Tom Moore High School | 16 | 24 | 14 | 0 | 0 | 0 |
| Hideaway Mobile Home Park | 7 | 6 | 5 | 0 | 0 | 0 |
| *Country Hills Water | 0 | 0 | 0 | 0 | 0 | 0 |
| City of Kerrville Schreiner Park | 5 | 4 | 5 | 0 | 0 | 0 |
| Cherokee Mobile Home Park | 5 | 29 | 7 | 0 | 0 | 0 |
| Camp Flaming Arrow | 4 | 7 | 6 | 0 | 0 | 0 |
| *Blue Ridge Mobile Home Park | 0 | 0 | 0 | 0 | 0 | 0 |
| *Armadillo Junction RV Park | 0 | 0 | 0 | 0 | 0 | 0 |
| **Center Point North Water System | 6 | 8 | 7 | 6 | 6 | 7 |
| **Center Point Taylor System | 11 | 13 | 14 | 12 | 11 | 11 |
| Falling Water Subdivision | 1 | 12 | 12 | 9 | 18 | 7 |
| Saddlewood Subdivision | 12 | 22 | 18 | 14 | 16 | 14 |
| Westcreek Estates Water System | 19 | 22 | 24 | 18 | 17 | 13 |
| **Kinney County-Other** | | | | | | |
| City of Spofford | 17 | 17 | 17 | 14 | 14 | 11 |
| **Real County-Other** | | | | | | |
| Oakmont Saddle Mountain Water System | 16 | 16 | 15 | 16 | 16 | 17 |
| Real WSC | 38 | 32 | 20 | 18 | 19 | 17 |
| Twin Forks Estates WSC | 18 | 23 | 17 | 16 | 18 | 15 |
| Frio Canon Water Co, LLC | | | 5 | 10 | 10 | 16 |
| *H.E.B. Family Foundation | | | | | | |
| *Crown Mountain Water Supply | | | | | | |
| **Val Verde County-Other** | | | | | | |
| Val Verde County WCID Comstock | 89 | 89 | 101 | 68 | 82 | 65 |
| Upper San Pedro Canyon Subdivision | 38 | 38 | 38 | 38 | 38 | 34 |
| Del Grande Mobile Home Park | 26 | 26 | 26 | 26 | 26 | 26 |
| Langtry WSC | 8 | 10 | 10 | 23 | 23 | 23 |
| La Caleta Estates | 52 | 52 | 52 | 18 | 18 | 18 |
| Devils Shores WSC | 0 | 15 | 18 | 16 | 13 | 13 |
| Amistad Village Water System | 14 | 25 | 33 | 41 | 19 | 13 |
| Lago Vista Water System | 0 | 0 | 0 | 0 | 7 | 7 |
| *Lake Ridge Water System | 0 | 0 | 0 | 0 | 0 | 0 |
| *TPWD Seminole Canyon SHP | 0 | 0 | 0 | 0 | 0 | 0 |
| *Seguro Water Company | 0 | 0 | 0 | 0 | 0 | 0 |
| Laughlin AFB Recreation Area | 0 | 9 | 4 | 2 | 2 | 0 |

Note: *No survey data provided. **Indicate designated sub-WUGs.

### 2.2.3 Major Water Providers

Recent TWDB rule changes (31TAC §357.30(4)) now require regional water planning groups to identify “major water providers” as opposed to “wholesale water providers” as performed in previous plans. A major water provider (MWP) is defined as a significant public or private WUG or wholesale water provider (WWP) whose significance is determined by the RWPG, and provides water for any water use category in a regional water planning area. This rule revision gives regional water planning groups more flexibility in identifying which large water providers ought to be reported in their regional water plan.

The Plateau Region Water Planning Group has developed and adopted the following definition of a MWP, and feels that this definition captures all significant municipal WUGs or WWPs that provide water for other water use categories within the Region.

> *“An entity that currently provides significant water supplies (>10,000 acre-feet per year) to other users and which will continue to develop new supplies to meet future needs of those whom they supply during the period covered by this Plan.”*

Del Rio Utilities is the only entity in the Plateau Region to meet this criterion. In addition to its own use, the utility provides water to Laughlin Air Force Base and subdivisions outside of the City. Del Rio also provides water and wastewater services to two colonias, Cienegas Terrace and Val Verde Park Estates. Table 2-6 shows the distribution of water demand supplied by the City of Del Rio in the Rio Grande River Basin.

**Table 2-6. Del Rio Wholesale / Major Water Provider Water Demand (Acre-Feet per Year)**

| County | Basin | Water User Group | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|---|
| Val Verde | Rio Grande | City of Del Rio | 10,558 | 11,053 | 11,554 | 12,130 | 12,733 | 13,326 |
| | | Laughlin AFB 94% | 957 | 1,047 | 1,142 | 1,200 | 1,199 | 1,199 |
| | | County Other 6% | 454 | 607 | 607 | 690 | 776 | 860 |
| **Total Wholesale Demand** | | | **11,969** | **12,707** | **13,303** | **14,020** | **14,708** | **15,385** |

### 2.2.4 Manufacturing

Manufacturing and industrial water use that is self-supplied is quantified separately from municipal use even though the demand centers may be located within a utility service area. Draft manufacturing water demand projections are based on the highest county aggregated manufacturing water use in the most recent five years (2010-2015) of reported annual water use survey data. The most recent 10-year projections for employment growth from the Texas Workforce Commission was used as proxy for growth by manufacturing sectors between 2020 and 2030. After 2030, the manufacturing water use was held constant through 2070. In the Plateau Region, the use of water for manufacturing purposes is only recognized in Kerr County (Table 2-7).

**Table 2-7. Manufacturing Water Demand Projection**
**(Acre-Feet per Year)**

| County | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| Bandera | 0 | 0 | 0 | 0 | 0 | 0 |
| Edwards | 0 | 0 | 0 | 0 | 0 | 0 |
| Kerr | 20 | 21 | 21 | 21 | 21 | 21 |
| Kinney | 0 | 0 | 0 | 0 | 0 | 0 |
| Real | 0 | 0 | 0 | 0 | 0 | 0 |
| Val Verde | 0 | 0 | 0 | 0 | 0 | 0 |
| **County Total Demand** | **20** | **21** | **21** | **21** | **21** | **21** |

### 2.2.5 Irrigation

Draft irrigation water demand projections utilize an average of TWDB's 2010-2015 irrigation water use estimates as a base. Those values are held constant between 2020 and 2070. Annual water use estimates are developed at the county level by applying a calculated evapotranspiration-based "crop water need" estimate to reported irrigated acreage from Farm Service Agency (FSA). These estimates are then adjusted based on surface water release data from TCEQ and Texas Water Masters and comments from Groundwater Conservation Districts. In counties where the total groundwater availability over the planning period is projected to be less than the groundwater portion of the baseline water demand projections, the irrigation water demand projections will begin to decline in 2030 or later, to be compatible with the groundwater availability. However, this approach to a 'groundwater constrained' area presently does not occur in the Plateau Region.

Statewide, irrigation water demands are expected to decline over time. More efficient canal delivery systems have improved water-use efficiencies of surface water irrigation. More efficient on-farm irrigation systems have also improved the efficiency of groundwater irrigation. Other factors that have contributed to decreased irrigation demands are declining groundwater supplies and the voluntary transfer of water rights historically used for irrigation to municipal uses.

Kinney County has the highest irrigation water use in the Region (42 percent) and is the only county in which irrigation use is greater than municipal use (Table 2-8). Elsewhere in the Region, most irrigation that occurs is for the watering of pastures and hay fields. Because of the typically rocky and uneven terrain throughout much of the Region, irrigation of commercial row crops is minimal. On a regional basis, water used for irrigation is projected to be held constant at approximately 8,805 acre-feet per year over the 50-year planning horizon. However, as any irrigator can attest, climate, water availability, and the market play key roles in how much water is actually applied on a year- by-year basis.

The PWPG is concerned about the accuracy of the irrigation surveys and believes that there is significantly more irrigation water use than is documented. For example, numerous small irrigated exotic and wildlife feed plots are likely not identified. Also, groundwater used to irrigate golf courses, if not provided by municipalities, may not be accounted for in the irrigation survey estimates. These withdrawals may have a significant impact on local supplies.

**Table 2-8. Irrigation Water Demand Projection**
**(Acre-Feet per Year)**

| County | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| Bandera | 946 | 946 | 946 | 946 | 946 | 946 |
| Edwards | 215 | 215 | 215 | 215 | 215 | 215 |
| Kerr | 1,342 | 1,342 | 1,342 | 1,342 | 1,342 | 1,342 |
| Kinney | 3,713 | 3,713 | 3,713 | 3,713 | 3,713 | 3,713 |
| Real | 270 | 270 | 270 | 270 | 270 | 270 |
| Val Verde | 2,319 | 2,319 | 2,319 | 2,319 | 2,319 | 2,319 |
| **County Total Demand** | **8,805** | **8,805** | **8,805** | **8,805** | **8,805** | **8,805** |

### 2.2.6 Livestock

Texas is the nation's leading livestock producer, accounting for approximately 11 percent of the total United States production. Although livestock production is an important component of the Texas economy, the industry consumes a relatively small amount of water.

Draft livestock water demand projections are a combination of an average of the 2010-2014 water use survey information provided by the TWDB, which is based on livestock inventory data from the National Agricultural Statistical Service (NASS) and the Texas Department of Agriculture, and per head water use consumptions by animal class (Table 2-9). County level water use estimates are calculated by applying a water use coefficient for each livestock category to county level inventory estimates. The rate of change for projections from the *2016 Regional Water Plan* was then applied to the new base. Many counties chose to hold the base constant throughout the planning horizon.

**Table 2-9. Estimated per Head Daily Water Use (in gallons)**

| TWDB | NASS Data Type | Per Head Daily Water Use |
|---|---|---|
| Cattle | Milk | 75 |
| | Fed & Other | 15 |
| Poultry | Hens | 86* (per 1,000 head) |
| | Broilers | 77* (per 1,000 head) |
| Horses | Horses, Ponies, & Burros | 12 |
| Hogs | Hogs | 11 |
| Sheep | Sheep | 2 |
| Goats | Milk, Meat, Angora | 0.5 |

Source: University of Georgia – College of Agricultural and Environment

For water-supply planning purposes, in the Plateau Region Plan, livestock water use is held constant throughout the 50-year planning period. However, reality dictates that during prolonged drought periods, when poor range conditions exist and/or during unfriendly market conditions, livestock herds are generally reduced thus resulting in significantly less water demand. Kerr County has the greatest livestock water use in the Region (Table 2-10).

In recent years, an expanding use of groundwater in the Region has been to fill and maintain artificial lakes that primarily are intended to add aesthetic value to the property. Although not quantified, the amount of water pumped from local aquifers for this purpose is likely significant and is not reflected in the water demand estimates provided in this chapter. To manage the volume of groundwater used for this purpose, the Headwaters Groundwater Conservation District in Kerr County permits a maximum production of one acre-foot (325,851 gallons) per year.

Exotic game ranching has become commonplace throughout the State, and is quite evident in the Plateau Region counties. Bandera and Kerr Counties have the largest population of exotic game in the State (Texas A&M Exotics on the Range). The total number of exotic game likely may equal or even exceed domestic livestock. Yet the livestock water demand projections reported in this *Plan* does not fully reflect this water use.

High game fences that come with the exotic game industry often block the ability of both native and exotic game to access surface water, thus requiring more wells and groundwater use. Groundwater is also often used to irrigate small acreage feed plots for these animals. Future water plans will need to attempt to quantity this specific use and include it in the overall total projected water needs in the State.

In an analysis report prepared for the PWPG during the previous planning period, Water Use by Livestock and Game Animals in the Plateau Regional Water Planning Area, the amount of water used by various exotic game species is estimated. However, the report states that there is insufficient data on the number of animals in the Region to make an estimate of total use. Estimates made by the Real-Edwards Conservation and Reclamation District find that approximately 602 and 233 acre-feet per year in Edwards and Real Counties is consumed by exotic game animals.

**Table 2-10. Livestock Water Demand Projection**
**(Acre-Feet per Year)**

| County | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| Bandera | 243 | 243 | 243 | 243 | 243 | 243 |
| Edwards | 397 | 397 | 397 | 397 | 397 | 397 |
| Kerr | 757 | 757 | 757 | 757 | 757 | 757 |
| Kinney | 224 | 224 | 224 | 224 | 224 | 224 |
| Real | 151 | 151 | 151 | 151 | 151 | 151 |
| Val Verde | 410 | 410 | 410 | 410 | 410 | 410 |
| **County Total Demand** | **2,182** | **2,182** | **2,182** | **2,182** | **2,182** | **2,182** |

### 2.2.7 Mining

Although the Texas mineral industry is foremost in the production of crude petroleum and natural gas in the United States, it also produces a wide variety of important nonfuel minerals. In all instances, water is required in the mining of these minerals either for processing, leaching to extract certain ores, controlling dust at the plant site, or for reclamation.

Draft mining water demand projections were developed by combining annual reported water use data (2010-2014), including reuse ad additional oil and gas estimates provided by the TWDB using the FracFocus database. Oil and gas water use estimates are then broken down by water source based on a TWDB-contracted study with the University of Texas Bureau of Economic Geology (BEG) as summarized in Table 2-11 below. The BEG study estimated current mining water use and projected that use across the planning horizon using data collected from trade, organizations, government agencies, and other industry representatives. County-level projections are compiled as the sum of individual projections for four sub-sector mining categories: oil and gas, aggregates, coal and lignite, and other.

**Table 2-11. Estimated Percentages of Reuse and Brackish Water Use in Hydraulic Fracturing**

| Play | Fresh Water | Reuse / Recycle | Brackish |
|---|---|---|---|
| Permian Farwest | 20% | 0% | 80% |
| Permian Midland | 68% | 2% | 30% |
| Anadarko Basin | 50% | 20% | 30% |
| Barnett Shale | 92% | 5% | 3% |
| Eagle Ford Shale | 80% | 0% | 20% |
| East Texas Basin | 95% | 5% | 0% |

Source: University of Texas Bureau of Economics Geology, 2012

Although the oil and gas industry is relatively minor in the Plateau Region compared to other parts of the State, in recent years increased oil and gas exploration activity has occurred. Railroad Commission of Texas files list 90 wells drilled in Edwards County from 2010 through 2017. As a result, increased water demand is projected for the mining category in Edwards County (Table 2-12).

In Texas, there is an ongoing need for additional fresh water sources, and an unregulated/largely unknown amount of fresh water use occurs in the exploration for oil and gas within the State. The Oil and Gas industry is strongly encouraged to use brackish and /or recycled water in exploration so that fresh water can be preserved for human needs.

**Table 2-12. Mining Water Demand Projection**
**(Acre Feet per Year)**

| County | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| Bandera | 0 | 0 | 0 | 0 | 0 | 0 |
| Edwards | 89 | 89 | 89 | 89 | 89 | 89 |
| Kerr | 76 | 80 | 100 | 102 | 111 | 120 |
| Kinney | 0 | 0 | 0 | 0 | 0 | 0 |
| Real | 0 | 0 | 0 | 0 | 0 | 0 |
| Val Verde | 190 | 249 | 259 | 223 | 192 | 171 |
| **County Total Demand** | **355** | **394** | **424** | **390** | **368** | **356** |

## 2.3 ENVIRONMENTAL AND RECREATIONAL WATER NEEDS

Environmental and recreational water use in the Plateau Region is not quantified but 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 Chapter 1, environmental and recreational resources are identified and described. In this section, the water resources needed to maintain these functions are discussed. Water-supply sources that serve environmental needs are characterized in Chapter 3 and potential water-supply strategy consequences on the environment are analyzed in Chapter 5.

All living organisms require water. The amount and quality of water required to maintain a viable population, whether it is plant or animal, is highly variable. While some individuals are capable of migrating long distances in search of water (birds, larger mammals, etc.), others are stationary (plants, fishes, etc.) and must rely on existing supplies.

Natural and environmental resources are often overlooked when considering the consequences of prolonged drought conditions. As water supplies diminish during drought periods, the balance between both human and environmental water requirements becomes increasingly competitive. 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 includes a distinct consideration of the impact that each implemented strategy might have on the environment.

As discussed in Section 2.2.6 (Livestock), an expanding use of groundwater in the Region has been to fill and maintain artificial lakes. Although this use may exert stress on the local aquifer system, the resulting impoundments do provide aesthetic value to the property and a water source for wildlife.

Recreational activities that involve human interaction with the outdoors environment are often directly dependent on water resources such as fishing, swimming and boating; while a healthy environment enhances many others, such as hunting, hiking, and bird watching. Thus, 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 multitude of annual visitors to this Region.

In Chapter 5, each water management strategy contains an environmental impact assessment. A review of these strategies reveals that while some strategies may contain variable levels of negative impact, other strategies may likely have a positive effect. Negative environmental impacts are generally associated with the lowering of aquifer water levels due to increased groundwater withdrawals and its potential to cause a reduction or cessation of spring flow. Also of concern is that lowered water levels could deplete supplies in shallow livestock wells, which are often the only available source of water for some wildlife. The positive environmental aspect of the strategies is that during severe drought conditions when normal wildlife water supplies may naturally diminish, new supply sources might be developed such that wildlife could benefit. Water supply availability estimated for surface water management strategies in Chapter 5 follow environmental flow standards in TCEQ 30 TAC Chapter 298 rules or the 1997 Consensus Criteria for Environmental Needs.

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# CHAPTER 3

# REGIONAL WATER SUPPLY SOURCES

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# 3 REGIONAL WATER SUPPLY SOURCES

From the semi-arid Hill Country to the arid Rio Grande Basin, both groundwater and surface water are critical resources for the livelihood of the citizens of the Plateau Region and the environment in which they reside. Chapter 3 explores the current and future availability of all water supply resources in the Region including groundwater, surface water, springs, and reuse. The water demand and supply availability analysis developed in Chapters 2 and 3, respectively, form the basis for identifying in Chapter 4 the areas within the Plateau Region that potentially could experience supply shortages in future years. The following tables list water supplies available to meet future needs (demands) reported in Chapter 2:

- Table 3-1 lists groundwater and surface water availability as estimated in each identified source (aquifer, river, spring) by county and river basin. Water source availability analyses, including water-quality concerns, are discussed in more detail in Section 3.1 (groundwater) and Section 3.2 (surface water).

- Table 3-2 lists water supplies available to municipal utilities and general water use categories based on the current infrastructure ability of each to obtain water supplies. These abilities primarily include existing infrastructure, water-rights limitations, and Groundwater Conservation District (GCD) permit limitations.

- Table 3-3 lists water supplies available to Del Rio Utilities as a major water provider.

Only three municipal utilities within the Plateau Region derive municipal supplies from surface water or spring sources. The City of Kerrville currently uses surface water from the Guadalupe River in conjunction with their groundwater supply. Kerrville also injects excess treated surface water into the Trinity Aquifer through an aquifer storage and recovery (ASR) facility. The City of Del Rio obtains most of its water supply from San Felipe Springs, which issues from the Edwards limestone. The spring water is treated to drinking water standards in a new microfiltration plant prior to distribution. For planning purposes, San Felipe Springs is recognized as a surface water source that falls within the Rio Grande Run-of-River. Camp Wood in Real County is supplied from Old Faithful Springs on a tributary of the Nueces River. All other communities in the Region are totally dependent on groundwater sources for their supplies. All water supplies based upon contracts are assumed to be renewed.

**Table 3-1. Water Source Availability (Acre-Feet per Year)**

| Groundwater | County | Basin | Salinity* | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|---|---|
| Austin Chalk Aquifer | Kinney | Nueces | Brackish | 875 | 875 | 875 | 875 | 875 | 875 |
| Austin Chalk Aquifer | Kinney | Rio Grande | Brackish | 1,894 | 1,894 | 1,894 | 1,894 | 1,894 | 1,894 |
| Edwards-BFZ Aquifer | Kinney | Nueces | Fresh | 6,319 | 6,319 | 6,319 | 6,319 | 6,319 | 6,319 |
| Edwards-BFZ Aquifer | Kinney | Rio Grande | Fresh | 2 | 2 | 2 | 2 | 2 | 2 |
| Edwards-Trinity (Plateau) Aquifer | Bandera | Guadalupe | Fresh | 81 | 81 | 81 | 81 | 81 | 81 |
| Edwards-Trinity (Plateau) Aquifer | Bandera | Nueces | Fresh | 38 | 38 | 38 | 38 | 38 | 38 |
| Edwards-Trinity (Plateau) Aquifer | Bandera | San Antonio | Fresh | 1,890 | 1,890 | 1,890 | 1,890 | 1,890 | 1,890 |
| Edwards-Trinity (Plateau) Aquifer | Kerr | Colorado | Fresh | 245 | 245 | 245 | 245 | 245 | 245 |
| Edwards-Trinity (Plateau) Aquifer | Kerr | Guadalupe | Fresh | 1,015 | 1,015 | 1,015 | 1,015 | 1,015 | 1,015 |
| Edwards-Trinity (Plateau) Aquifer | Kerr | Nueces | Fresh | 5 | 5 | 5 | 5 | 5 | 5 |
| Edwards-Trinity (Plateau) Aquifer | Kerr | San Antonio | Fresh | 12 | 12 | 12 | 12 | 12 | 12 |
| Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | Edwards | Colorado | Fresh | 2,305 | 2,305 | 2,305 | 2,305 | 2,305 | 2,305 |
| Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | Edwards | Nueces | Fresh | 1,631 | 1,631 | 1,631 | 1,631 | 1,631 | 1,631 |
| Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | Edwards | Rio Grande | Fresh | 1,740 | 1,740 | 1,740 | 1,740 | 1,740 | 1,740 |
| Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | Kinney | Nueces | Fresh | 12 | 12 | 12 | 12 | 12 | 12 |
| Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | Kinney | Rio Grande | Fresh | 70,329 | 70,329 | 70,329 | 70,329 | 70,329 | 70,329 |
| Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | Real | Colorado | Fresh | 277 | 277 | 277 | 277 | 277 | 277 |
| Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | Real | Guadalupe | Fresh | 3 | 3 | 3 | 3 | 3 | 3 |
| Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | Real | Nueces | Fresh | 7,243 | 7,243 | 7,243 | 7,243 | 7,243 | 7,243 |
| Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | Val Verde | Rio Grande | Fresh | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 |
| Ellenburger-San Saba Aquifer | Kerr | Colorado | Fresh | 200 | 200 | 200 | 200 | 200 | 200 |
| Ellenburger-San Saba Aquifer | Kerr | Guadalupe | Fresh | 1,802 | 1,802 | 1,802 | 1,802 | 1,802 | 1,802 |
| Frio River Alluvium Aquifer | Real | Nueces | Fresh | 2,145 | 2,145 | 2,145 | 2,145 | 2,145 | 2,145 |
| Hickory Aquifer | Kerr | Colorado | Fresh | 0 | 0 | 0 | 0 | 0 | 0 |
| Hickory Aquifer | Kerr | Guadalupe | Fresh | 0 | 0 | 0 | 0 | 0 | 0 |
| Nueces River Alluvium Aquifer | Edwards | Nueces | Fresh | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 |
| Nueces River Alluvium Aquifer | Real | Nueces | Fresh | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 |
| Trinity Aquifer | Bandera | Guadalupe | Fresh | 76 | 76 | 76 | 76 | 76 | 76 |
| Trinity Aquifer | Bandera | Nueces | Fresh/Brackish | 903 | 903 | 903 | 903 | 903 | 903 |
| Trinity Aquifer | Bandera | San Antonio | Fresh/Brackish | 6,305 | 6,305 | 6,305 | 6,305 | 6,305 | 6,305 |
| Trinity Aquifer | Kerr | Colorado | Fresh | 318 | 318 | 318 | 318 | 318 | 318 |

## Table 3-1. (Continued). Water Source Availability (Acre-Feet per Year)

| Groundwater | County | Basin | Salinity* | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|---|---|
| Trinity Aquifer | Kerr | Guadalupe | Fresh/Brackish | 14,129 | 14,056 | 13,767 | 13,450 | 13,434 | 13,434 |
| Trinity Aquifer | Kerr | Nueces | Fresh | 0 | 0 | 0 | 0 | 0 | 0 |
| Trinity Aquifer | Kerr | San Antonio | Fresh | 471 | 471 | 471 | 471 | 471 | 471 |
| Trinity Aquifer ASR | Kerr | Guadalupe | Fresh | 453 | 453 | 453 | 453 | 453 | 453 |
| **Groundwater Total Source Availability** | | | | **176,292** | **176,219** | **175,930** | **175,613** | **175,597** | **175,597** |

| Reuse Source Name \| Type | County | Basin | Salinity* | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|---|---|
| Direct Reuse | Kerr | Guadalupe | Fresh | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| Direct Reuse | Bandera | San Antonio | Fresh | 310 | 310 | 310 | 310 | 310 | 310 |
| Direct Reuse | Val Verde | Rio Grande | Fresh | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 | 3,100 |
| **Reuse Total Source Availability** | | | | **8,410** | **8,410** | **8,410** | **8,410** | **8,410** | **8,410** |

| Surface Water | County | Basin | Salinity | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|---|---|
| Colorado Run-Of-River | Edwards | Colorado | Fresh | 32 | 32 | 32 | 32 | 32 | 32 |
| Guadalupe Run-Of-River | Bandera | Guadalupe | Fresh | 3 | 3 | 3 | 3 | 3 | 3 |
| Guadalupe Run-Of-River | Kerr | Guadalupe | Fresh | 1,375 | 1,375 | 1,375 | 1,375 | 1,375 | 1,375 |
| Medina Lake/Reservoir | Bandera | San Antonio | Fresh | 0 | 0 | 0 | 0 | 0 | 0 |
| Nueces Run-Of-River | Bandera | Nueces | Fresh | 5 | 5 | 5 | 5 | 5 | 5 |
| Nueces Run-Of-River | Edwards | Nueces | Fresh | 94 | 94 | 94 | 94 | 94 | 94 |
| Nueces Run-Of-River | Real | Nueces | Fresh | 1,751 | 1,751 | 1,751 | 1,751 | 1,751 | 1,751 |
| Rio Grande Run-Of-River | Kinney | Rio Grande | Fresh | 3,616 | 3,616 | 3,616 | 3,616 | 3,616 | 3,616 |
| Rio Grande Run-Of-River | Val Verde | Rio Grande | Fresh | 13,776 | 13,776 | 13,776 | 13,776 | 13,776 | 13,776 |
| San Antonio Run-Of-River | Bandera | San Antonio | Fresh | 2 | 2 | 2 | 2 | 2 | 2 |
| **Surface Water Total Source Availability** | | | | **20,654** | **20,654** | **20,654** | **20,654** | **20,654** | **20,654** |
| **Region J Total Source Availability** | | | | **205,356** | **205,283** | **204,994** | **204,677** | **204,661** | **204,661** |

* Salinity field indicates whether the source availability is considered ‘fresh’ (less than 1,000 mg/L), ‘brackish’ (1,000 to 10,000 mg/L), ‘saline’ (10,001 mg/L to 34,999 mg/L), or ‘seawater’ (35,000 mg/L or greater). Sources can also be labeled as ‘fresh/brackish’ or ‘brackish/saline’, if a combination of the salinity types is appropriate.

## Table 3-2. Existing Supply (Acre-Feet per Year)

| | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|
| **Bandera County** | | | | | | | |
| **Guadalupe Basin** | | | | | | | |
| County-Other | Edwards-Trinity (Plateau) Aquifer | 34 | 34 | 34 | 34 | 34 | 34 |
| Livestock | Edwards-Trinity (Plateau) Aquifer | 9 | 9 | 9 | 9 | 9 | 9 |
| **Guadalupe Basin Total Existing Supply** | | **43** | **43** | **43** | **43** | **43** | **43** |
| **Nueces Basin** | | | | | | | |
| County-Other | Edwards-Trinity (Plateau) Aquifer | 38 | 38 | 38 | 38 | 38 | 38 |
| County-Other | Nueces Run-of-River | 0 | 0 | 0 | 0 | 0 | 0 |
| County-Other | Trinity Aquifer | 399 | 399 | 399 | 399 | 399 | 399 |
| Livestock | Edwards-Trinity (Plateau) Aquifer | 0 | 0 | 0 | 0 | 0 | 0 |
| Livestock | Trinity Aquifer | 44 | 44 | 44 | 44 | 44 | 44 |
| Irrigation | Nueces Run-of-River | 5 | 5 | 5 | 5 | 5 | 5 |
| Irrigation | Trinity Aquifer | 279 | 279 | 279 | 279 | 279 | 279 |
| **Nueces Basin Total Existing Supply** | | **765** | **765** | **765** | **765** | **765** | **765** |
| **San Antonio Basin** | | | | | | | |
| Bandera | Trinity Aquifer | 534 | 534 | 534 | 534 | 534 | 534 |
| Bandera County FWSD 1 | Trinity Aquifer | 75 | 75 | 75 | 75 | 75 | 75 |
| County-Other \| Bandera River Ranch 1 | Trinity Aquifer | 69 | 69 | 69 | 69 | 69 | 69 |
| County-Other \| Lake Medina Shores | Trinity Aquifer | 55 | 55 | 55 | 55 | 55 | 55 |
| County-Other \| Medina WSC | Trinity Aquifer | 58 | 58 | 58 | 58 | 58 | 58 |
| County-Other | Edwards-Trinity (Plateau) Aquifer | 379 | 379 | 379 | 379 | 379 | 379 |
| County-Other | San Antonio Run-Of-River | 0 | 0 | 0 | 0 | 0 | 0 |
| County-Other | Trinity Aquifer | 4,356 | 4,356 | 4,356 | 4,356 | 4,356 | 4,356 |
| Livestock | Edwards-Trinity (Plateau) Aquifer | 111 | 111 | 111 | 111 | 111 | 111 |
| Livestock | Trinity Aquifer | 85 | 85 | 85 | 85 | 85 | 85 |
| Irrigation | Guadalupe Run-Of-River | 3 | 3 | 3 | 3 | 3 | 3 |
| Irrigation | San Antonio Run-Of-River | 2 | 2 | 2 | 2 | 2 | 2 |
| Irrigation | Trinity Aquifer | 684 | 684 | 684 | 684 | 684 | 684 |
| **San Antonio Basin Total Existing Supply** | | **6,411** | **6,411** | **6,411** | **6,411** | **6,411** | **6,411** |
| **Bandera County Total Existing Supply** | | **7,219** | **7,219** | **7,219** | **7,219** | **7,219** | **7,219** |
| **Edwards County** | | | | | | | |
| **Colorado Basin** | | | | | | | |
| Rocksprings | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 871 | 871 | 871 | 871 | 871 | 871 |
| County-Other | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 57 | 57 | 57 | 57 | 57 | 57 |
| Mining | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 7 | 7 | 7 | 7 | 7 | 7 |
| Livestock | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 471 | 471 | 471 | 471 | 471 | 471 |
| Irrigation | Colorado Run-Of-River | 32 | 32 | 32 | 32 | 32 | 32 |
| Irrigation | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 78 | 78 | 78 | 78 | 78 | 78 |
| **Colorado Basin Total Existing Supply** | | **1,516** | **1,516** | **1,516** | **1,516** | **1,516** | **1,516** |
| **Nueces Basin** | | | | | | | |
| County-Other \| Barksdale WSC | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 110 | 110 | 110 | 110 | 110 | 110 |
| County-Other | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 155 | 155 | 155 | 155 | 155 | 155 |
| County-Other | Nueces River Alluvium Aquifer | 8 | 8 | 8 | 8 | 8 | 8 |

**Table 3-2. (Continued). Existing Supply (Acre-Feet per Year)**

| | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|
| **Edwards County** | | | | | | | |
| **Nueces Basin** | | | | | | | |
| Mining | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 9 | 9 | 9 | 9 | 9 | 9 |
| Livestock | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 206 | 206 | 206 | 206 | 206 | 206 |
| Irrigation | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 109 | 109 | 109 | 109 | 109 | 109 |
| Irrigation | Nueces Run-of-River | 94 | 94 | 94 | 94 | 94 | 94 |
| **Nueces Basin Total Existing Supply** | | **691** | **691** | **691** | **691** | **691** | **691** |
| **Rio Grande Basin** | | | | | | | |
| County-Other | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 30 | 30 | 30 | 30 | 30 | 30 |
| Mining | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 14 | 14 | 14 | 14 | 14 | 14 |
| Livestock | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 110 | 110 | 110 | 110 | 110 | 110 |
| Irrigation | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 70 | 70 | 70 | 70 | 70 | 70 |
| **Rio Grande Basin Total Existing Supply** | | **224** | **224** | **224** | **224** | **224** | **224** |
| **Edwards County Total Existing Supply** | | **2,431** | **2,431** | **2,431** | **2,431** | **2,431** | **2,431** |
| **Kerr County** | | | | | | | |
| **Colorado Basin** | | | | | | | |
| County-Other | Edwards-Trinity (Plateau) Aquifer | 64 | 64 | 64 | 64 | 64 | 64 |
| Mining | Edwards-Trinity (Plateau) Aquifer | 3 | 3 | 3 | 3 | 3 | 3 |
| Livestock | Edwards-Trinity (Plateau) Aquifer | 47 | 47 | 47 | 47 | 47 | 47 |
| Irrigation | Edwards-Trinity (Plateau) Aquifer | 92 | 92 | 92 | 92 | 92 | 92 |
| **Colorado Basin Total Existing Supply** | | **206** | **206** | **206** | **206** | **206** | **206** |
| **Guadalupe Basin** | | | | | | | |
| Kerrville | Guadalupe Run-Of-River | 150 | 150 | 150 | 150 | 150 | 150 |
| Kerrville | Trinity Aquifer | 3,605 | 3,605 | 3,605 | 3,605 | 3,605 | 3,605 |
| Kerrville | Trinity ASR | 453 | 453 | 453 | 453 | 453 | 453 |
| Kerrville | Direct Reuse | 2,425 | 2,425 | 2,425 | 2,425 | 2,425 | 2,425 |
| Kerrville South Water | Trinity Aquifer | 387 | 387 | 387 | 387 | 387 | 387 |
| County-Other \| Center Point | Trinity Aquifer | 11 | 11 | 11 | 11 | 11 | 11 |
| County-Other \| Center Point North WS | Trinity Aquifer | 23 | 23 | 23 | 23 | 23 | 23 |
| County-Other \| Center Point Taylor System | Trinity Aquifer | 43 | 43 | 43 | 43 | 43 | 43 |
| County-Other \| Hills & Dales Estates | Trinity Aquifer | 18 | 18 | 18 | 18 | 18 | 18 |
| County-Other \| Nickerson Farm WS | Trinity Aquifer | 22 | 22 | 22 | 22 | 22 | 22 |
| County-Other \| Oak Forest South Water | Trinity Aquifer | 80 | 80 | 80 | 80 | 80 | 80 |
| County-Other \| Park Place Subdivision | Trinity Aquifer | 14 | 14 | 14 | 14 | 14 | 14 |
| County-Other \| Pecan Valley | Trinity Aquifer | 12 | 12 | 12 | 12 | 12 | 12 |

**Table 3-2. (Continued). Existing Supply (Acre-Feet per Year)**

| | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|
| **Kerr County** | | | | | | | |
| **Guadalupe Basin** | | | | | | | |
| County-Other \| Rustic Hills Water | Trinity Aquifer | 9 | 9 | 9 | 9 | 9 | 9 |
| County-Other \| Verde Park Estates | Trinity Aquifer | 16 | 16 | 16 | 16 | 16 | 16 |
| County-Other \| Westwood WS | Trinity Aquifer | 28 | 28 | 28 | 28 | 28 | 28 |
| County-Other | Edwards-Trinity (Plateau) Aquifer | 616 | 616 | 616 | 616 | 616 | 616 |
| County-Other | Guadalupe Run-Of-River | 10 | 10 | 10 | 10 | 10 | 10 |
| County-Other | Trinity Aquifer | 7,636 | 7,636 | 7,636 | 7,636 | 7,636 | 7,636 |
| Manufacturing | Edwards-Trinity (Plateau) Aquifer | 20 | 20 | 20 | 20 | 20 | 20 |
| Manufacturing | Guadalupe Run-Of-River | 11 | 11 | 11 | 11 | 11 | 11 |
| Manufacturing | Trinity Aquifer | 17 | 17 | 17 | 17 | 17 | 17 |
| Mining | Edwards-Trinity (Plateau) Aquifer | 14 | 14 | 14 | 14 | 14 | 14 |
| Mining | Guadalupe Run-Of-River | 77 | 77 | 77 | 77 | 77 | 77 |
| Mining | Trinity Aquifer | 31 | 31 | 31 | 31 | 31 | 31 |
| Livestock | Edwards-Trinity (Plateau) Aquifer | 230 | 230 | 230 | 230 | 230 | 230 |
| Livestock | Trinity Aquifer | 143 | 143 | 143 | 143 | 143 | 143 |
| Irrigation | Guadalupe Run-Of-River | 1,127 | 1,127 | 1,127 | 1,127 | 1,127 | 1,127 |
| Irrigation | Trinity Aquifer | 533 | 533 | 533 | 533 | 533 | 533 |
| **Guadalupe Basin Total Existing Supply** | | **17,761** | **17,761** | **17,761** | **17,761** | **17,761** | **17,761** |
| **Nueces Basin** | | | | | | | |
| County-Other | Edwards-Trinity (Plateau) Aquifer | 0 | 0 | 0 | 0 | 0 | 0 |
| Livestock | Edwards-Trinity (Plateau) Aquifer | 3 | 3 | 3 | 3 | 3 | 3 |
| **Nueces Basin Total Existing Supply** | | **3** | **3** | **3** | **3** | **3** | **3** |
| **San Antonio Basin** | | | | | | | |
| County-Other | Edwards-Trinity (Plateau) Aquifer | 3 | 3 | 3 | 3 | 3 | 3 |
| County-Other | Trinity Aquifer | 258 | 258 | 258 | 258 | 258 | 258 |
| Livestock | Edwards-Trinity (Plateau) Aquifer | 9 | 9 | 9 | 9 | 9 | 9 |
| Irrigation | Edwards-Trinity Plateau Aquifer | 0 | 0 | 0 | 0 | 0 | 0 |
| Irrigation | Trinity Aquifer | 63 | 63 | 63 | 63 | 63 | 63 |
| **San Antonio Basin Total Existing Supply** | | **333** | **333** | **333** | **333** | **333** | **333** |
| **Kerr County Total Existing Supply** | | **18,303** | **18,303** | **18,303** | **18,303** | **18,303** | **18,303** |
| **Kinney County** | | | | | | | |
| **Nueces Basin** | | | | | | | |
| County-Other | Edwards-BFZ Aquifer | 29 | 29 | 29 | 29 | 29 | 29 |
| County-Other | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 5 | 5 | 5 | 5 | 5 | 5 |
| Livestock | Edwards-BFZ Aquifer | 66 | 66 | 66 | 66 | 66 | 66 |
| Livestock | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 7 | 7 | 7 | 7 | 7 | 7 |
| Irrigation | Edwards-BFZ Aquifer | 2,357 | 2,357 | 2,357 | 2,357 | 2,357 | 2,357 |
| **Nueces Basin Total Existing Supply** | | **2,464** | **2,464** | **2,464** | **2,464** | **2,464** | **2,464** |
| **Rio Grande Basin** | | | | | | | |
| Brackettville | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 645 | 645 | 645 | 645 | 645 | 645 |
| Brackettville | Rio Grande Run-Of-River | 0 | 0 | 0 | 0 | 0 | 0 |
| Fort Clark Springs MUD | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 1,371 | 1,371 | 1,371 | 1,371 | 1,371 | 1,371 |
| County-Other | Austin Chalk Aquifer | 80 | 80 | 80 | 80 | 80 | 80 |
| County-Other | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 85 | 85 | 85 | 85 | 85 | 85 |

**Table 3-2. (Continued). Existing Supply (Acre-Feet per Year)**

| | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|
| **Kinney County** | | | | | | | |
| **Rio Grande Basin** | | | | | | | |
| Livestock | Austin Chalk Aquifer | 226 | 226 | 226 | 226 | 226 | 226 |
| Livestock | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 95 | 95 | 95 | 95 | 95 | 95 |
| Irrigation | Austin Chalk Aquifer | 952 | 952 | 952 | 952 | 952 | 952 |
| Irrigation | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 3,425 | 3,425 | 3,425 | 3,425 | 3,425 | 3,425 |
| Irrigation | Rio Grande Run-Of-River | 3,616 | 3,616 | 3,616 | 3,616 | 3,616 | 3,616 |
| **Rio Grande Basin Total Existing Supply** | | **10,495** | **10,495** | **10,495** | **10,495** | **10,495** | **10,495** |
| **Kinney County Total Existing Supply** | | **12,959** | **12,959** | **12,959** | **12,959** | **12,959** | **12,959** |
| **Real County** | | | | | | | |
| **Colorado Basin** | | | | | | | |
| County-Other | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 15 | 15 | 15 | 15 | 15 | 15 |
| Livestock | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 18 | 18 | 18 | 18 | 18 | 18 |
| Irrigation | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 188 | 188 | 188 | 188 | 188 | 188 |
| **Colorado Basin Total Existing Supply** | | **221** | **221** | **221** | **221** | **221** | **221** |
| **Nueces Basin** | | | | | | | |
| Camp Wood | Nueces Other Local Supply | 0 | 0 | 0 | 0 | 0 | 0 |
| Leakey | Frio River Alluvium Aquifer | 298 | 298 | 298 | 298 | 298 | 298 |
| County-Other | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 156 | 156 | 156 | 156 | 156 | 156 |
| County-Other | Frio River Alluvium Aquifer | 311 | 311 | 311 | 311 | 311 | 311 |
| County-Other | Nueces River Alluvium Aquifer | 5 | 5 | 5 | 5 | 5 | 5 |
| County-Other | Nueces Run-of-River | 0 | 0 | 0 | 0 | 0 | 0 |
| Livestock | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 176 | 176 | 176 | 176 | 176 | 176 |
| Irrigation | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 187 | 187 | 187 | 187 | 187 | 187 |
| Irrigation | Nueces Run-of-River | 1,751 | 1,751 | 1,751 | 1,751 | 1,751 | 1,751 |
| **Nueces Basin Total Existing Supply** | | **2,884** | **2,884** | **2,884** | **2,884** | **2,884** | **2,884** |
| **Real County Total Existing Supply** | | **3,105** | **3,105** | **3,105** | **3,105** | **3,105** | **3,105** |
| **Val Verde County** | | | | | | | |
| **Rio Grande Basin** | | | | | | | |
| Del Rio Utilities | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 0 | 0 | 0 | 0 | 0 | 0 |
| Del Rio Utilities | Rio Grande Run-Of-River | 6,135 | 6,135 | 6,135 | 6,135 | 6,135 | 6,135 |
| Laughlin AFB | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 60 | 60 | 60 | 60 | 60 | 60 |
| Laughlin AFB | Rio Grande Run-Of-River | 871 | 871 | 871 | 871 | 871 | 871 |
| County-Other | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 2,904 | 2,904 | 2,904 | 2,904 | 2,904 | 2,904 |
| County-Other | Rio Grande Run-Of-River | 460 | 460 | 460 | 460 | 460 | 460 |
| Mining | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 39 | 39 | 39 | 39 | 39 | 39 |
| Livestock | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 506 | 506 | 506 | 506 | 506 | 506 |
| Irrigation | Edwards-Trinity (Plateau), Pecos Valley & Trinity Aquifer | 276 | 276 | 276 | 276 | 276 | 276 |
| Irrigation | Rio Grande Run-Of-River | 6,310 | 6,310 | 6,310 | 6,310 | 6,310 | 6,310 |
| **Rio Grande Basin Total Existing Supply** | | **17,561** | **17,561** | **17,561** | **17,561** | **17,561** | **17,561** |
| **Val Verde County Total Existing Supply** | | **17,561** | **17,561** | **17,561** | **17,561** | **17,561** | **17,561** |
| **Region J Total Existing Supply** | | **61,578** | **61,578** | **61,578** | **61,578** | **61,578** | **61,578** |

**Table 3-3. Del Rio Utilities Major Water Provider Supply (Acre-Feet per Year)**

| County | Basin | Major Water Provider | Receiving Entity | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|---|---|
| Val Verde | Rio Grande | Del Rio Utilities | City of Del Rio | 6,135 | 6,135 | 6,135 | 6,135 | 6,135 | 6,135 |
| | | | Laughlin AFB | 871 | 871 | 871 | 871 | 871 | 871 |
| | | | County Other (6%) | 685 | 685 | 685 | 685 | 685 | 685 |
| **Total Wholesale Supply** | | | | **7,691** | **7,691** | **7,691** | **7,691** | **7,691** | **7,691** |

## 3.1 GROUNDWATER RESOURCES

The principal aquifers in the Plateau Region are the Trinity, Edwards-Trinity (Plateau), Edwards (Balcones Fault Zone), Austin Chalk, Frio and Nueces River Alluviums, and new to this *Plan*, the Ellenburger-San Saba Aquifer (Figure 3-1). Aquifer descriptions provided in this chapter are relatively limited; more detailed hydrogeological characterization of the aquifers may be obtained from reports published by the TWDB, USGS, UTBEG, and other agencies and universities. The water quality of aquifers is relatively good and a detailed discussion on water-quality characteristics and issues is provided in Chapter 1, Section 1.4.5.

Two water-source characterization studies were conducted during a previous planning period. The first study (*Occurrence of Significant River Alluvium Aquifers in the Plateau Region, 2010*) identifies and quantifies viable groundwater sources in shallow alluvial aquifers that parallel many of the major streams in the Region. As a result of the study, substantial volumes were estimated for the Frio and Nueces River Alluvium Aquifers in Real and Edwards Counties.

The second study (*Groundwater Data Acquisition in Edwards, Kinney and Val Verde Counties, Texas, 2009*) was performed to assist in the further characterization of the Edwards and associated aquifers in the western part of the Plateau Region. The project included four general tasks: (1) review of existing aquifer evaluations, field studies and new well data; (2) performance of dye tracer tests to analyze groundwater flow direction and speed; (3) measurement of water levels in wells during two seasonal periods; and (4) review of recent water quality sampling projects. These two reports can be viewed at (www.ugra.org/plateau-water-planning-group).

The Ellenburger-San Saba Aquifer is added to this *Plan* as a new source. Recent test hole exploration, pumping test results, and water chemistry analysis have verified this aquifer as a potential source of water to meet the supply needs of northeastern Kerr County.

Over much of the Region, water levels generally fluctuate with seasonal precipitation and are highly susceptible to declines during drought conditions. Water levels generally recover during wet periods; however, a long-term decline is being observed in some Trinity Aquifer wells in the eastern portion of the Region where pumping is exceeding the capacity of the local aquifer to fully recharge.

Discharge from the aquifers occurs naturally through springs and artificially by pumping from wells. Some discharge also occurs through leakage from one water-bearing unit to another and through natural down-gradient flow out of the Region.

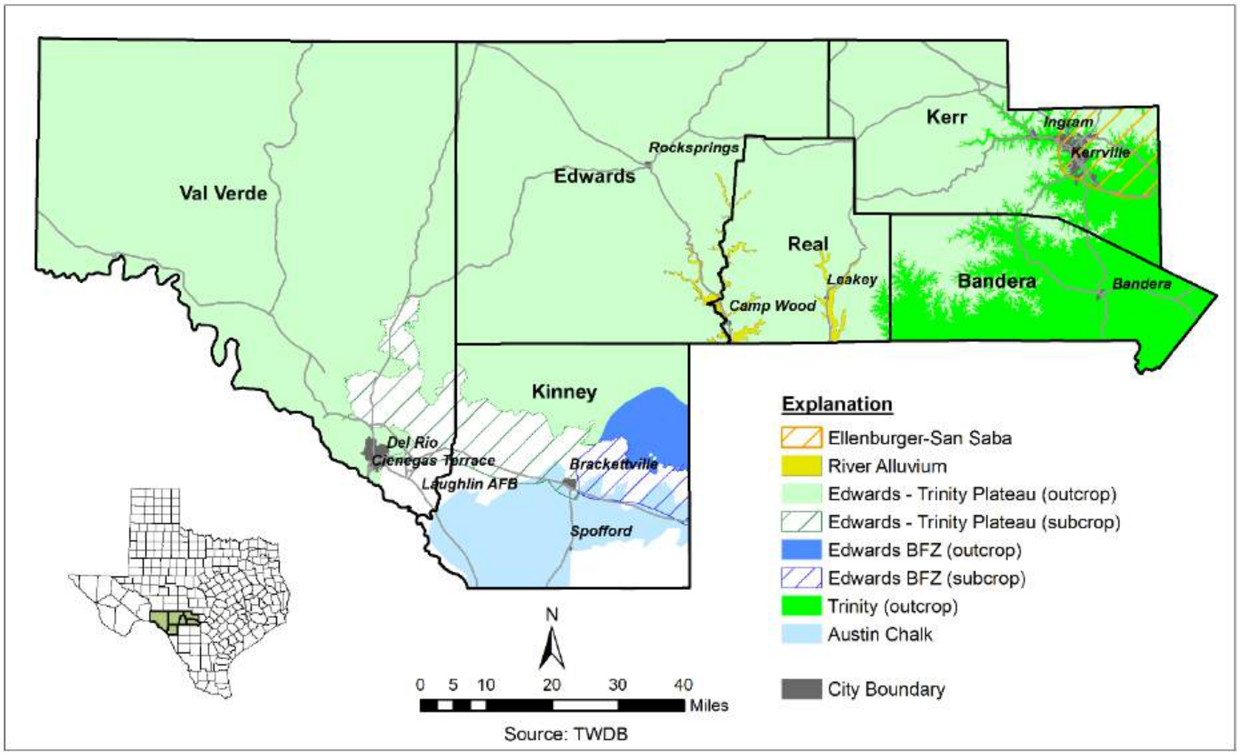


**Figure 3-1. Groundwater Sources**

### 3.1.1 Groundwater Availability

Base flow to the many rivers and streams that flow through the Plateau Region is principally generated from the numerous springs that issue from rock formations that form the major aquifers in the Region. The Plateau Region contains the headwaters of the Guadalupe, San Antonio, Medina, Sabinal, Frio, Nueces, and West Nueces Rivers; and tributaries to the Rio Grande and Colorado River such as the Pecos, Devils, and South Llano Rivers. Flow in these rivers and streams is critical to the Plateau Region in that it provides municipal drinking water, supplies irrigation and livestock needs, maintains environmental habitat, and supports a thriving ecological and recreational tourist economy. Water users downstream of the Plateau Region (Regions K, L, and M) likewise have a stake in maintaining and protecting spring-fed base flows of rivers that originate in the Plateau Region.

It is thus recognized that sustaining flow in these important rivers and streams is highly dependent on maintaining an appropriate water level in the aquifer systems that feed the supporting springs. With the sustainability of local water supplies and the economic welfare of the Region in mind, the PWPG defines groundwater availability *as a maximum level of aquifer withdrawal that results in an acceptable level of long-term aquifer impact such that the base flow in rivers and streams is not significantly affected beyond a level that would be anticipated due to naturally occurring conditions.* In so defining groundwater availability, the planning group establishes a policy decision to protect the long-term water supply and related economic needs of the Plateau Region. The PWPG acknowledges and supports GCD's regulatory authority over permitted withdrawals from aquifers within their respective boundaries.

Groundwater availability as listed in Table 3-1in this *2021 Plateau Region Water Plan* is based on the Modeled Available Groundwater (MAG) volumes 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). The GMA process is explained in more detail in Chapter 1, Section 1.1.5. Groundwater availability for these sources is calculated by modeling or standard geohydrologic methods. Table 3-4 lists the methodology used to calculate groundwater source availability.

**Table 3-4. Groundwater Availability Methodology**

| Source Supply | County | Basin | Methodology |
|---|---|---|---|
| Austin Chalk Aquifer | Kinney | Rio Grande | 0.6% (0.006) of average annual rainfall (22 in) over the aquifer outcrop (189,377 acres) as recharge. Calculated by Planning Group consultant (WSP). |
| | | Nueces | 0.6% (0.006) of average annual rainfall (22 in) over the aquifer outcrop (87,549 acres) as recharge. Calculated by Planning Group consultant (WSP). |
| Nueces River Alluvium Aquifer | Edwards | Nueces | Recharge plus 0.1 volume of water in storage. See Plateau Region Report: Occurrence of Significant River Alluvium Aquifers in the Plateau Region (2010). www.ugra/plateau-water-planning-group |
| | Real | Nueces | |
| Frio River Alluvium Aquifer | Real | Nueces | |
| Ellenburger/San Saba Aquifer | Kerr | Colorado | Annual availability of 0.007 acre-feet/acre/year over 286,000 acres of prime production zone in eastern Kerr County. See Sec 3.1.8 of this 2021 Plan. |
| | | Guadalupe | |
| Edwards-BFZ Aquifer | Kinney | Nueces | GMA10 MAG |
| | | Rio Grande | |
| Edwards Group of the Edwards-Trinity (Plateau) Aquifer | Kerr | Colorado | GMA9 Non-Relavant, TWDB modeled run compatible with DFC, which was provided to PWPG. |
| | | Guadalupe | |
| | | Nueces | |
| | | San Antonio | |
| | Bandera | Guadalupe | GMA9 MAG |
| | | Nueces | |
| | | San Antonio | |
| Edwards-Trinity (Plateau), Pecos Valley, Trinity Aquifer | Edwards | Colorado | GMA7 MAG |
| | | Nueces | |
| | | Rio Grande | |
| | Kinney | Nueces | |
| | | Rio Grande | |
| | Real | Colorado | |
| | | Nueces | |
| | | Guadalupe | |

**Table 3-4. (continued) Groundwater Availability Methodology**

| Source Supply | County | Basin | Methodology |
|---|---|---|---|
| Edwards-Trinity (Plateau), Pecos Valley, Trinity Aquifer | Val Verde | Rio Grande | |
| Trinity Aquifer | Bandera | Guadalupe | GMA9 MAG |
| | | Nueces | |
| | | San Antonio | |
| | Kerr | Colorado | |
| | | Guadalupe | |
| | | Nueces | |
| | | San Antonio | |

### 3.1.2 Trinity Aquifer

Located mostly in the Hill Country counties of Bandera and Kerr, the Trinity Aquifer system is composed of deposits of sand, clay and limestone of the Glen Rose and Travis Peak formations of the Lower Cretaceous Trinity Group where they are not overlain by Edwards Limestone. Limited exposures of Trinity also occur in southern Edwards and Real Counties. The water-bearing units include, in descending order, the Glen Rose Limestone, Hensell Sand, Cow Creek Limestone, Sligo Limestone and Hosston Sand. The Glen Rose formation is divided informally into upper and lower members. Based on their hydrologic relationships, the water-bearing rocks of the Trinity Group, collectively referred to as the Trinity Aquifer system, are organized into the following aquifer units.

- Upper Trinity Aquifer – Upper member of the Glen Rose Limestone
- Middle Trinity Aquifer – Lower Member of the Glen Rose Limestone, Hensell Sand and Cow Creek Limestone
- Pine Island / Hammet Shale - confining bed
- Lower Trinity Aquifer – Sligo Limestone and Hosston Sand

Because of fractures, faults and other hydrogeological factors, the Upper, Middle and Lower Trinity Aquifer units often are in hydraulic communication with one another and collectively should be considered a leaky-aquifer system.

#### 3.1.2.1 Upper and Middle Trinity Aquifer

The upper member of the Glen Rose, when weathered on the land surface, creates the distinctive "stair-step" topography found throughout the hilly train of the Hill Country. The upper Glen Rose, which forms the Upper Trinity Aquifer, often contains water with total dissolved solids (TDS) often exceeding 1,000 milligrams per liter (mg/l), especially in wells that penetrate “gyp” (evaporite) beds. Water percolating through evaporite beds has a tendency to be high in sulfate and generally should be sealed off in a well. Upper Trinity wells are generally shallow and are mostly used for domestic and livestock purposes.

The Middle Trinity Aquifer, consisting of lower Glen Rose, Hensell, and Cow Creek formations, generally contains TDS of less than 1,000 mg/l. In the Hill Country region, the primary contribution to poor water-quality occurs in wells that do not adequately case off water from evaporite beds in the upper part of the Glen Rose (Upper Trinity Aquifer). Water levels in Upper and Middle Trinity wells fluctuate with seasonal precipitation and are highly susceptible to declines during drought conditions. Radium has been detected in some Trinity wells in Kerr County.

#### 3.1.2.2 Lower Trinity Aquifer in Bandera and Kerr Counties

Separating the Middle and Lower Trinity is the Hammett Shale (sometimes referred to as the Pine Island Shale). The approximately 60-foot thick formation acts as a confining bed, or barrier to cross-formational flow in most areas, and thus divides the producing sections of the Middle and Lower Trinity Aquifer units.

The Lower Trinity Aquifer is composed of sandy limestone, sand, clay and shale of the Sligo and Hosston formation. The Lower Trinity thins toward the northeast and is completely missing or coalesces with upper Trinity units near the Llano Uplift. The Lower Trinity is principally a water supply source for the Cities of Bandera and Kerrville and for a few private water-supply companies and resorts.

Yields from wells completed into the Lower Trinity are generally unpredictable and vary greatly. The greater depth and difficulty of sealing off the Hammett Shale make completing wells into the Lower Trinity more difficult and more expensive. However, in some areas, the Lower Trinity has higher yields and better water quality than shallower aquifers. Recharge to the Lower Trinity in Bandera and Kerr Counties likely occurs primarily by lateral underflow from the north and west. The overlying Hammett Shale mostly prevents vertical movement of water downward except possibly in highly fractured or faulted areas.

### 3.1.3 Edwards-Trinity (Plateau) Aquifer

The Edwards-Trinity (Plateau) Aquifer consists of lower Cretaceous age saturated limestone and dolomite formations of the Edwards Group and underlying sediments of the Trinity Group where they occur underlying the Edwards Plateau. The upper Edwards portion of the aquifer system is generally more porous and permeable than the underlying Trinity. Numerous springs that form the headwaters of several eastward and southerly flowing rivers, occur where the contact between the base of the Edwards and the top of the Trinity is exposed at the land surface. See Section 3.3 for a more detailed discussion pertaining to groundwater / surface water relationship.

In Kinney and Val Verde Counties, the Edwards Aquifer consists of groundwater contained in the Salmon Peak and McKnight units of the Devils River Limestone. Aquifer thickness is as much as 1,000 feet. San Felipe and Los Moras Springs in Val Verde and Kinney Counties issue from the Edwards and is the primary municipal supply source for the City of Del Rio.

Recharge to the aquifer occurs primarily by the downward percolation of surface water from streams draining off the Edwards Plateau to the north and west and by direct infiltration of precipitation on the outcrop. Some water enters the Region in the aquifer as underflow from counties up gradient (generally north).

The Glen Rose Limestone is the primary unit in the underlying Trinity in the southern part of the Plateau. The Aquifer generally exists under water-table conditions; however, where the Glen Rose is fully saturated and a zone of low permeability occurs near the base of the overlying Edwards, artesian conditions exist.

Reported well yields commonly range from less than 50 gallons per minute (gpm) where saturated thickness is thin to more than 1,000 gpm where large-capacity wells are completed in jointed and cavernous limestone. There are little pumping withdrawals from the Aquifer over most of its extent, and water levels have generally fluctuated only with seasonal precipitation. In some local instances, water levels have declined as a result of increased pumping.

### 3.1.4 Edwards (BFZ) Aquifer

In the Plateau Region, the Edwards-Balcones Fault Zone (BFZ) Aquifer is designated only in eastern Kinney County at its westernmost extent. The Edwards portion of the Edwards-Trinity (Plateau) Aquifer and the Edwards of the Edwards (BFZ) Aquifer are the same geologic formation and their boundary is arbitrarily established by the TWDB. There is no significant hydrologic boundary between the outcrops of these two aquifer systems, thus groundwater in the Edwards-Trinity freely moves down gradient into the Edwards (BFZ).

The Edwards (BFZ) Aquifer exists under water-table conditions in the outcrop and under artesian conditions where it is confined below the overlying Del Rio Clay in its downdip extent. Water in the Aquifer generally moves from the recharge zone toward natural discharge points such as Las Moras Springs at Brackettville. Additional water is lost from the Kinney County area as underflow that leaves the County to the east into Uvalde County (Region L). Very little pumping has occurred from this Aquifer in Kinney County, and therefore water levels have remained relatively constant with only minor changes over time.

### 3.1.5 Austin Chalk Aquifer

The Austin Chalk Aquifer occurs in the southern half of Kinney County primarily south of Highway 90. A veneer of sand and gravel deposits cover much of the southwest portion of Kinney County, which provides a soil base for agricultural production. Crops grown in this area are irrigated with mostly brackish quality groundwater pumped from the underlying Austin Chalk Aquifer. Much less production is apparent in the Nueces River Basin in the eastern part of the County. Recharge to the Austin Chalk is from precipitation and stream loss over the outcrop area and likely from Edwards Aquifer underflow through faults located up-gradient.

A wide range of production rates exists for wells completed in the Austin Chalk. The best production from the Aquifer occurs in areas that have been fractured or contain numerous solution openings. Most wells only discharge enough water for domestic or livestock use, but a few wells are large enough for irrigation purposes. The largest reported yield for an Austin Chalk well in Kinney County is 2,000 gpm (Bennett and Sayre, 1962). Most of the more productive wells completed in the Austin Chalk are located along Las Moras Creek.

### 3.1.6 Frio River Alluvium Aquifer

The Frio River Alluvium in central Real County extends over an area of approximately 9,530 acres. Recharge to the Aquifer is from cross-formational flow from the adjacent Edwards-Trinity Aquifer and direct infiltration of precipitation. Water supplies for the City of Leakey and other rural domestic homes are derived from this small Aquifer. Because of the limited extent of this Aquifer and its shallow water table, the aquifer system is readily susceptible to diminished supplies during drought conditions and potentially from over pumping. Also, due to its shallow nature, the Aquifer is susceptible to contamination from surface sources.

### 3.1.7 Nueces River Alluvium Aquifer

The Nueces River Alluvium between Edwards and Real Counties extends over an area of approximately 24,450 acres. Recharge to the Aquifer is from cross-formational flow from the adjacent Edwards-Trinity Aquifer and direct infiltration of precipitation. Water supplies for the Community of Barksdale and rural domestic homes are derived from this small Aquifer. As with the Frio Alluvium, the Nueces River Alluvium Aquifer is readily susceptible to diminished supplies during drought conditions and potentially from over pumping, and to contamination from surface sources.

### 3.1.8 Ellenburger – San Saba Aquifer

Recent advances in aquifer research has suggested the desirability of adding the Ellenburger-San Saba Aquifer in Kerr County to the list of available groundwater sources in the Plateau Planning Region. Although no production wells in the Ellenburger are currently in use, the Headwaters GCD has authorized rules for future permitting of this resource.

An exploratory test well (Headwaters GCD Monitor Well #17) in the northeast corner of Kerr County was completed in the Ellenburger Limestone to a total depth of 1,153 feet below land surface in December 2016. A subsequent 24-hour pumping test was performed on the test well, which produced 600 gallons per minute with 69 feet of drawdown. The results suggest a transmissivity range of 7,920 to 12,670 gpd/ft. Water samples were collected and analyzed for chemical quality. Total dissolved solids are 498 mg/l and all constituents are within both primary and secondary drinking-water standards.

Groundwater Management Area 9 (GMA9) is currently classifying the Ellenburger-San Saba Aquifer in Kerr County as non-relevant, and therefore the Texas Water Development Board (TWDB) has not issued a MAG volume for this aquifer in Kerr County. The TWDB Llano Uplift Groundwater Availability Model (LUGAM) (Shi and others, 2017) does include the Ellenburger-San Saba as layer 5.

The Headwaters GCD has been assisted by a voluntary group of local geologists that has refined the structural component of the conceptual model. Their findings are that the most potentially viable part of the Aquifer lies within the eastern half of the County and that within this portion the hydraulic conductivity can be defined between two values, 0.3 feet/day in the less permeable portion and 3.5 feet/day in the more productive areas.

Based on this refined structure and resulting hydraulic conductivities, LBG-Guyton (now WSP USA) was tasked with running the TWDB LUGAM with the above modifications for the identified 286,000-acre eastern portion of Kerr County. To assess the impact of Ellenburger pumping on water level decline, 20 hypothetical wells were added to the selected area and five pumping scenarios (2,000; 5,000; 10,000; 15,000 and 20,000 acre-feet per year) were applied to these wells. The potential groundwater availability calculated for these five pumping scenarios are as follows:

**Table 3-5. Ellenburger Aquifer Availability**

| Pumping Scenario | Annual Availability (acre-feet/acre) | Annual Availability (gallons/acre) |
|---|---|---|
| 2,000 acre-feet/year | 0.007 | 2,300 |
| 5,000 acre-feet/year | 0.017 | 5,700 |
| 10,000 acre-feet/year | 0.035 | 11,400 |
| 15,000 acre-feet/year | 0.052 | 17,100 |
| 20,000 acre-feet/year | 0.07 | 22,800 |

Calculated water-level declines resulting from the above pumping scenarios ranged from a minimum of less than five feet with the 2,000 acre-feet/year, to an average of 35 to 40 feet with the 20,000 acre-feet/year pumping rate.

For Regional Water Planning purposes, it is proposed that until actual production is monitored, the 2021 Plateau Region Plan will adopt a conservative Ellenburger-San Saba Aquifer availability rate of 0.007 acre-feet/acre/year over the 286,000-acre productive area or a total of 2,002 acre-feet/year. This volume is subdivided between the Colorado and Guadalupe river basins in eastern Kerr County into 200 acre-feet/year and 1,802 acre-feet/year respectfully.

### 3.1.9 Public Supply Use of Groundwater

All communities in the Plateau Region rely partially or completely on groundwater supply sources. Even the spring sources (classified as surface water) used by Del Rio and Camp Wood originate from aquifers. The higher concentration of wells in Kerr and Bandera Counties related to population growth may present water supply availability problems in the future. Public supply wells serving communities in Edwards, Kinney, Real and Val Verde Counties are not anticipated to have long-term declines due to the relatively smaller quantities of water that are needed to serve these communities. Also, no long-term water-quality deterioration has been detected in groundwater supplies for these communities. Long-term viability of the aquifers serving these other communities appears to be acceptable. However, new wells should be located outside the local areas of pumping influence of the existing wells. Although no evidence of contamination from surface sources have been detected in public-supply groundwater sources in the Plateau Region, a wellhead protection program should be considered by all communities.

#### 3.1.9.1 City of Bandera

The City of Bandera is primarily dependent on wells completed into the Lower Trinity Aquifer and must compete for this water with numerous private wells in the County. However, a new Middle Trinity well was recently completed, which will provide some backup to the Lower Trinity well supply. Long-term viability of the Trinity Aquifer as a supply source for Bandera and outlying areas will require implementation of management policies aimed at establishing withdrawals based on the sustainable yield of the Aquifer.

City of Bandera Well No. 69-24-202 shows a consistent decline from the 1950s through the 1990s, with a total of approximately 400 feet of water level decline. Most of the water withdrawn by Bandera public supply wells is produced from the Lower Trinity (Hosston) which receives very little vertical recharge and an undetermined amount of lateral underflow from the north and west of the well fields. Because of the continuous water-level decline in these well fields, the City, with the assistance of the BCRAGD, should monitor levels to anticipate production reductions.

### 3.1.9.2 Bandera County FWSD #1

Bandera County FWSD #1 provides water to the Pebble Beach subdivision and obtains its water from wells completed in the Trinity Aquifer. This District currently has four active wells and competes for this water with numerous private wells within the County. Growing subdivisions will increase water demands, causing the District to consider the need for additional supply.

### 3.1.9.3 City of Kerrville

The City of Kerrville is dependent on conjunctive use of surface water from the Guadalupe River and groundwater from Lower Trinity Aquifer wells. Kerrville Wells No. 4 and No. 11 experienced declines of as much as 200 feet through the early to mid-1980s. Between the early to mid-1980s and the early 1990s, water levels in these two wells increased by as much as 200 feet in response to the decreased pumpage by the City when surface water sources were brought on-line. Since 1998, water levels have remained relatively constant.

The only long-term water-quality degradation trend observed in Kerrville public-supply wells is noted in the increase in sodium, chloride and total dissolved solids in the City's Travis Well No. 14 during the late 1960s to mid-1970s. The well showed steady increases in sodium (18 to 72 mg/l), chloride (55 to 200 mg/l), and total dissolved solids (417 to 624 mg/l) between 1968 and 1976. This corresponded with the time period that large drawdowns in water levels were occurring in the Kerrville area. This well is designated as an "Emergency Only" well and is not used for production.

The City of Kerrville operates an aquifer storage and recovery (ASR) operation where treated surface water is injected into the Lower Trinity Aquifer to maintain aquifer pressure and provide a source for peak demand periods.

Specific strategies to meet Kerrville's future water needs are addressed in Chapter 5. If additional wells are needed for increasing supply needs, the City could consider locating new wells outside the local area of pumping influence. The City will continue to cooperate with efforts of the local Groundwater Conservation Districts to establish aquifer management policies.

### 3.1.9.4 City of Rocksprings

The City of Rocksprings obtains its water supply from wells completed in the Edwards Limestone of the Edwards-Trinity (Plateau) Aquifer. This rural community has little competition for groundwater and, thus, its supply is considered dependable. A new well has been drilled and is currently being connected to the City's distribution system.

### 3.1.9.5 City of Brackettville and Fort Clark Springs MUD

Water wells completed in the Edwards portion of the Edwards-Trinity (Plateau) Aquifer produce water used for municipal supply in these two adjacent communities. Las Moras Springs, an identified major spring, also exists at the same location of the Fort Clark Springs wells. Under existing conditions, there appears to be sufficient supply to meet futures needs. The Kinney County GCD is currently evaluating potential impacts that might result from increased future pumping within the District.

### 3.1.9.6 City of Camp Wood

Camp Wood located in southwestern Real County derives its water supply mostly from Old Faithful Springs. The spring has reportedly always flowed. However, with increasing population and the drilling of additional wells in the area, the spring may experience decreasing flow during drought periods in the future. To supplement its supply, the City has completed a new well in the underlying Edwards-Trinity Aquifer.

### 3.1.9.7 City of Leakey

The City of Leakey obtains its water supply from shallow water wells ranging in depth from 34 to 42 feet in the Frio River Alluvium Aquifer. The City competes for groundwater from this small Aquifer with numerous private domestic wells. Trinity Aquifer wells in the local area have proven to be unreliable and often contain poor-quality groundwater.

### 3.1.9.8 City of Del Rio

The City of Del Rio is supplied with water from San Felipe Springs, which issue from the Edwards portion of the Edwards-Trinity (Plateau) Aquifer. The water is collected through pumps set in the springs, treated with microfiltration and chlorine and then distributed to the City, Laughlin Air Force Base, and outlying neighborhoods.

The average discharge of San Felipe Springs since Lake Amistad was filled is about 110 cubic feet per second or about 80,000 acre-feet/yr. During recent droughts, the spring discharge has fallen below 50 cfs or, extrapolated over one year, about 36,000 acre-feet. Recent droughts as compared to the 1950s drought would be appropriate to use as a drought-condition gage because the filling of Amistad Lake has generally increased the springflow after the late 1960s.

## 3.1.10 Agricultural Use of Groundwater

Because of the arid conditions and lack of well-developed soils over much of the Region, irrigated agricultural activities are generally limited in most of the counties. Low well yields common throughout much of the Region also limit the development of large-scale irrigation. Water quality however, is not generally a limiting factor for irrigation in the Region. Kinney County has the greatest amount of agricultural use of water. The acreage of land irrigated by groundwater in the year 2000 in each county as reported in TWDB Report 347 is, from most to least, Kinney, 4,865 acres; Bandera, 173 acres; Val Verde, 145 acres; Kerr, 57 acres; Edwards, 40 acres; and Real, 15 acres. In addition, numerous surveyed small feed plots for game are irrigated with groundwater. The PWPG is concerned about the accuracy of the irrigation surveys and believes that there is significantly more irrigation water use than is documented. For example, the Headwaters Groundwater Conservation District in Kerr County documents approximately 700 acres being irrigated just with groundwater.

A review of historical and current data suggests that there has been no long-term change in regional water levels or water quality as a result of agricultural pumping. Local water-level declines occur during the irrigation season but generally recover during the off-season. Although irrigation conservation efficiencies could be improved, currently used equipment and practices are not resulting in depletion of the aquifers. At the current rate of agricultural use, groundwater of sufficient quantity in the Edwards-Trinity (Plateau), Edwards (BFZ), and Austin Chalk Aquifers should remain available for future agricultural use. However, the competition for Trinity Aquifer water between municipal and agricultural needs in Bandera and Kerr Counties is increasing. The Bandera County River Authority and Groundwater District and the Headwaters Groundwater Conservation District are both actively involved in managing the use of groundwater in these counties.

### 3.1.11 Brackish Groundwater Desalination Sources

Most groundwater in the Plateau Region contains total dissolved-solids (TDS) concentrations of less than 1,000 mg/l and thus meets drinking water standards. Groundwater of slightly poorer quality (1,000 to 3,000 mg/l) occurs in the Trinity Aquifer in some areas. Elevated levels of calcium-sulfate resulting from the dissolution of evaporate beds in the upper Glen Rose is the primary source of higher TDS groundwater. Productivity from this aquifer source makes desalination a marginal option at this time.

## 3.2 SURFACE WATER SUPPLIES

The Plateau Region straddles several different river basins, rather than generally following a single river basin or a large part of a single river basin (Figure 3-2). From west to east, these basins include the Rio Grande, Nueces, Colorado, San Antonio, and Guadalupe. The headwaters of three of these river basins (Nueces, San Antonio, and Guadalupe), as well as major tributaries of the Rio Grande and Colorado River, originate in this Region.

Available surface water supplies under drought-of-record conditions depend on two components: water that is physically present (usually substantially reduced during a drought-of-record since by definition it is the most severe) and the authorized amount per existing water right adjudications. Use of the Texas Commission on Environmental Quality (TCEQ) Water Availability Models (WAMs) allows for the performance of a simulation of availability and diversion for all water rights in a river basin based on naturalized flows over a specified hydrologic period. These models generally follow an appropriation of water in priority date order, but appropriation order from upstream to downstream may also be simulated. The TCEQ WAMs of the five Plateau Region river basins have been used to determine surface water availability during a drought-of-record.

- Rio Grande River Basin WAM Run 3 – Version Feb. 1, 2018 - Hydrologic period 1940-2000.
- Nueces River Basin WAM Run 3 – Version Jan. 7, 2013 – Hydrologic period 1934-1996.
- Colorado River Basin WAM Run 3 – Version Feb. 1, 2018 – Hydrologic period 1940-2013.
- San Antonio River Basin WAM Run 3 – Version Oct. 17, 2014 – Hydrologic period 1934-1989.
- Guadalupe River Basin WAM Run 3 – Version Oct. 17, 2014 – Hydrologic period 1934-1989.

The simulations used to determine water availability assume that all water rights in each basin are allowed to divert the full authorized amount when water is available, following appropriation in priority date order. They also reflect the conservative assumption that no return flows are present, as is consistent with both TWDB regional planning guidelines and TCEQ modeling of water availability and permitting. Municipal run-of-river calculations use the unmodified TCEQ WAM Run 3 to ensure that all monthly demands are fully met. Area-capacity of major reservoirs was adjusted to reflect sedimentation conditions for 2020 through 2070. Drought-of-record source amounts by county and river basin are provided in Table 3-1. Water Source Availability (Acre-Feet per Year). A list of all authorized surface water rights in the Region is available in Appendix 3A.

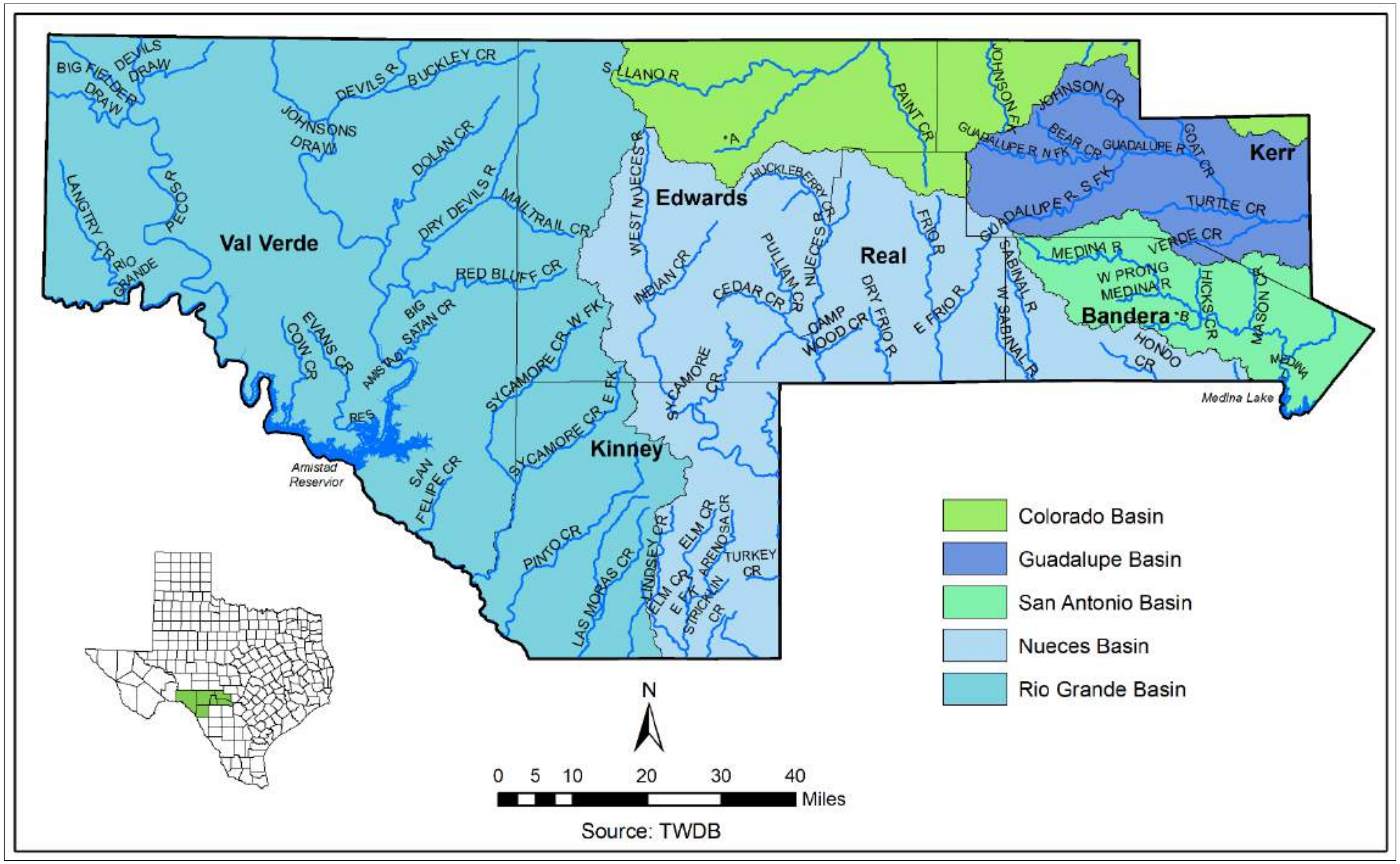


**Figure 3-2. Surface Water Sources**

The term "run-of-the-river" is used to distinguish water rights with diversion points directly on a watercourse from water rights with diversion points on a reservoir. Generally, run-of-the-river water rights, also referred to as "direct diversions", are less dependable than water rights on reservoirs because of the lack of storage. However, run-of-the-river diversions are often very convenient, especially for irrigators and small entities, because a diversion point on a watercourse can be located extremely close to the location where the water will be consumed, thereby negating the need to pipe the water over long distances.

Diversions under a drought-of-record are extracted from results of a WAM simulation for each basin. For purposes of this *Plan*, a drought-of-record supply for run-of-the-river diversions is categorized by use (municipal, irrigation, industrial and other) and by county. Supply amounts on river segments have always been difficult to assess due to the lack of storage to catch excess flows. In this *Plan*, the reliable supply for run-of-the-river diversions for non-municipal use is expressed as the minimum annual diversion for each category during the hydrologic period considered in the water availability models. The reliable supply for run-of-the-river diversions for municipal use is expressed as the minimum monthly diversion amount that is available in all months of the hydrologic period considered in the water availability models.

Drought-of-record supply amounts for reservoirs are on a firm-yield basis. To understand firm yield, one must understand the concept of "mass balance" - the simple but true principle of physics that mass can neither be created nor be destroyed (i.e., what goes in must come out). In practical terms as applied to a reservoir, the water going in (inflows from drainage areas of tributaries feeding the reservoir site and direct precipitation upon the reservoir itself) equals the water going out (evaporation off the lake surface plus water spilled over the dam plus any water allowed to pass through the dam to satisfy senior water rights downstream plus the demand placed on the reservoir plus other factors which may exist). The operation of a reservoir is simulated under various demands, iterating the simulation to find a demand that the reservoir can supply consistently throughout a repeat of the historical hydrologic record. Demand is termed the "firm yield" of the reservoir if for every year of the historical hydrologic record (even during a drought-of-record) the reservoir can supply the demand placed on it.

Canyon Reservoir and the Medina/Diversion system are potential water supply reservoirs for the Plateau Region's future water needs. Although neither reservoir currently serves a water need within the Region, both reservoirs could likely do so in the future. Although recreational use of streams and lakes serves an important function in the Plateau Region, its use has no impact on reservoir yields, as these uses are non-consumptive.

### 3.2.1 Rio Grande Basin (Including the Pecos and Devils River)

The Rio Grande, or Rio Bravo as it is known in Mexico, forms the border between the United States and Mexico. International treaties govern the ownership and distribution of the water in this river. Under the 1906 Treaty, the United States is obligated to deliver 60,000 acre-feet annually from the Rio Grande to Mexico, except in the cases of severe drought or serious accident to the irrigation system in the United States. Diversion of this allotment occurs upriver in El Paso. The 1944 Treaty addresses the waters in the international segment of the Rio Grande from Fort Quitman, Texas to the Gulf of Mexico. The United States receives 1/3 of the flow from six tributaries (Rio Conchos, San Diego, San Rodrigo, Escondido, Salado Rivers, and Las Vacas Arroyo), provided that the running average over a five-year period cannot be less than 350,000 acre-feet/yr.

While the International Boundary and Water Commission is responsible for implementing the allocation of water on the U.S. side, the Watermaster office of TCEQ administers the allocation of Texas' share of the international waters. The two reservoirs located in the middle of the lower Rio Grande, the Amistad and Falcon, store the water regulated by the Watermaster. The Watermaster oversees Texas' share of water in the Rio Grande and its Texas tributaries from Fort Quitman to Amistad Dam, excluding drainage basins of the Pecos River and Devils River.

The Pecos River forms a portion of the boundary between Terrell County in the Far West Texas Region and Crockett County in Region F before reaching Langtry in Val Verde County in the Plateau Region. The Devils River originates in Sutton County and proceeds generally southward through Val Verde County before reaching Amistad International Reservoir. There are no surface-water rights on the Pecos and Devils Rivers within the Plateau Region.

Flow of the Pecos River within the Plateau Region is inconsistent, with livestock and wildlife watering apparently being the only use made of whatever water that may remain in the River. Independence Creek, a large spring-fed creek in northern Terrell County west of Val Verde County, is the most important of the few remaining freshwater tributaries to the lower Pecos River. Independence Creek's contribution increases the Pecos River water volume by 42 percent at the confluence and reduces the total suspended solids by 50 percent, thus improving both water quantity and quality (Nature Conservancy of Texas descriptive flier).

Flows of the Devils River are gaged at the Spafford Crossing near Comstock in Val Verde County. This gage (USGS 08449400) began recording in 1978 and was discontinued in 1985. Therefore, it does not record flows for the 1950s. However, from 1978 through 1985 the flows are consistently between approximately 100 and 300 cfs, with rare spikes ranging from 4,000 cfs up to 50,000 cfs. These spikes result from unusually intense but short rainfall events. In absence of data for the 1950s-drought period, and considering the generally low and undependable flows within the Devils River, a realistic estimate of the drought-of-record amount of supply from the Devils River within the Plateau Region is zero.

### 3.2.2 Amistad International Reservoir on the Rio Grande

The Amistad International Reservoir is located on the border between the United States and Mexico near the City of Del Rio, and was constructed jointly by the two nations. It was completed in 1968 with a maximum capacity of 5,250,000 acre-feet, 3,505,000 acre-feet of which are used for water conservation. The water is distributed among downstream users of Mexico and the United States. Amistad is not a source of supply for the Plateau Region, as the City of Del Rio and downstream irrigators in Val Verde County obtain their supply primarily from San Felipe Springs and Creek. Thus, the constraints on Amistad Reservoir as a source of water supply for the Plateau Region are the existing water rights held by water rights holders and enforced by the Rio Grande Watermaster.

Goodenough Spring is inundated by Lake Amistad and was at one time considered the third largest spring in Texas. The spring, which discharges from the Edwards-Trinity (Plateau) Aquifer, still provides a significant flow contribution to the Rio Grande.

### 3.2.3 Nueces River Basin

The upper Nueces River Basin lies in Edwards, Real, Bandera, and Kinney Counties, with the main stem Nueces forming a portion of the border between Real County and Edwards County. Headwater 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, and Dry Frio Rivers in Real County. Although undocumented, in some places there appears to be an amount of underflow occurring through gravel beds that line long stretches of the river bottom.

Total authorized diversions by water rights on the Nueces River within the Plateau Region are 11,419 acre-feet/year. Most of this amount (10,116 acre-feet/year or 88 percent) is for irrigation use. Diversions for municipal use total 1,259 acre-feet/year. The City of Camp Wood holds the largest municipal right for 1,000 acre-feet/year. Small water rights for other uses have a total authorized diversion of 44 acre-feet/year.

The TCEQ Water Availability Model for the Nueces River Basin was used to evaluate surface water supplies. The model includes data through the year 1996, and addresses the drought-of-record of the 1950's.

### 3.2.4 Colorado River Basin

The headwaters of the South Llano River, a tributary of the Colorado River, lie in Edwards County. There are three water rights on the South Llano River and Paint Creek within the Plateau Region for irrigation use. The combined authorized amount of these rights is 180 acre-feet/year.

The TCEQ Colorado River Basin WAM was used to evaluate the supply for these rights. This model covers the period 2013. Hydrologic data for these streams suggests that the drought-of-record occurred in 2011. The minimum annual diversion for the three rights is 32 acre-ft/yr.

### 3.2.5 San Antonio River Basin

The headwaters of the San Antonio River lie in Bandera County. Most water right authorizations from the San Antonio Basin are run-of-the-river diversions for irrigation use. Run-of-the-river diversions exclude authorizations on Medina Lake. Eight authorized water rights on the Medina River main stem total 236 acre-feet/year. Of these eight water-right holders on the River, six use the water for irrigation. The sum of these six irrigation rights totals 227 acre-feet/year. Of the remaining two water-right holders, one is for 9 acre-feet of water per year used by an individual for municipal purposes, and the other is for a non-consumptive recreation reservoir owned by the City of Bandera. This recreation-only reservoir is for non-consumptive use only.

Since the Guadalupe-San Antonio WAM covers the period 1934-1989, it is appropriate to consider if the drought of 1996 exceeded the severity of the drought of the mid-1950s. USGS gage 08178880 on the Medina River at Bandera just downstream of State Highway 173 gives a lowest annual streamflow amount at 33.7 cubic feet per second (cfs) (approximately 24,600 acre-feet/year) in 1996. However, this gage did not begin recording until 1982, and therefore records from the 1950s drought are missing and cannot be compared directly to the low flows of 1996. Data for the 1950s at the Bandera gage as extracted from the Guadalupe-San Antonio River Basin WAM indicates an annual naturalized flow of 2,662 acre-feet in 1956. Regulated flows would be even lower once upstream diversions and impoundments are accounted for. Therefore, based on estimates of the Guadalupe-San Antonio Basins WAM, the drought of the 1950s represents the drought-of-record conditions for the San Antonio Basin in the Plateau Region.

### 3.2.6 Medina Lake on the Medina River

Medina Lake was constructed in 1911 to provide irrigation water for farmers to the southwest of San Antonio. Although commonly referred to as Medina Lake, the lake is actually a system consisting of Medina Lake and Diversion Lake. Impounded in 1913, Diversion Lake is approximately 4 miles downstream of Medina Lake.

Diversions from the dual-lake system are authorized only from Diversion Lake, as per the water right held by Bexar-Medina-Atascosa Water Control and Improvement District #1 (BMAWCID#1). BMAWCID#1's Adjudication Certificate No. 19-2130C authorizes the District to divert up to 65,830 acre-feet/year of water for irrigation, municipal and industrial use, up to 750 acre-feet/year specifically for domestic and livestock purposes, and up to 170 acre-feet/year specifically for municipal use.

BMAWCID#1 has signed contracts to supply several irrigators and a development corporation with water. In January 2000, BMAWCID#1 signed a contract with Bexar Metropolitan Water Authority indicating that BMAWCID#1 will sell 20,000 acre-feet/year to the Authority for municipal use.

Bandera County currently has a Water Supply Agreement with BMAWCID#1 for purchase of up to 5,000 acre-feet/year; however, this agreement is not currently associated with the infrastructure necessary to carry out the purchase and subsequent distribution of the water.

Loss of impounded water from Medina Lake to the Trinity Aquifer and Diversion Lake to the Edwards Aquifer reduces the firm yield of the system. This loss has long been known to be substantial. Quantification of water recharging the aquifers has been elusive, as different estimates of recharge have resulted in different firm-yield estimates for the system. In 1957, a Bureau of Reclamation study estimated the firm annual yield of the Medina Lake/Diversion Lake system to be 27,500 acre-feet/year if the lake system were operated under an agricultural (irrigation) demand only scenario, but it estimated 29,700 acre-feet/year as the firm yield for municipal and industrial demand. Due to effects of seepage around the dam and of recharge to the underlying aquifers, Espey Huston estimated a firm yield of zero for Medina Lake in 1994, based on the relationship they found between the Lake stage and recharge. HDR Engineering modified the Espey Huston stage-recharge curves for its Trans-Texas report and cited 8,770 acre-feet/year as the firm yield. According to previous communications, HDR assumed diversions would be from Medina Lake rather than from Diversion Lake and that all irrigation use would be curtailed. This assumption does not comply with existing conditions as regards to water right authorizations.

The latest USGS report, "Assessment of Hydrogeology, Hydrologic Budget, and Water Chemistry of the Medina Lake Area, Medina and Bandera Counties, Texas," maintains that earlier methods of estimating recharge (Lowry, Espey Huston curves as modified by HDR for the Trans-Texas report) overestimate recharge. Overestimation of recharge would result in an underestimation of firm yield; however, the USGS report did not include a firm-yield estimate for the reservoir system.

The TCEQ Guadalupe-San Antonio River Basins WAM incorporates the HDR Trans-Texas method of estimating recharge and probably provides the best overall data (water rights, inflows determined by water rights) available at this time. The model was thus used to determine a firm yield of the Medina/Diversion system of zero acre-feet/year.

### 3.2.7 Guadalupe River Basin

Within the Plateau Region, the Guadalupe River Basin occurs almost exclusively within Kerr County. The Basin drains approximately 510 square miles at Kerrville, and approximately 839 square miles at Comfort near the eastern county line. The River originates almost entirely within western Kerr County as three branches (Johnson Creek, North Fork, and South Fork) merge west of Kerrville to form the main river course. A study report titled Spring Flow Contribution to the Headwaters of the Guadalupe River in Western Kerr County (2005) was prepared for the PWPG ([http://www.ugra.org/plateau-water-planning-group](http://www.ugra.org/plateau-water-planning-group)).

The total amount of authorized water rights for the Guadalupe River within the Plateau Region is 21,020 acre-feet/year. Municipal use accounts for 8,076 acre-feet/year. Holders of these water rights include the City of Kerrville, the Upper Guadalupe River Authority (UGRA), and independent persons.

The City of Kerrville and the UGRA own the largest municipal water rights. Certificate of Adjudication 1996, 5394-B, 2026 and Permit 3505 are held by Kerrville. UGRA holds Permit 5394-A. Authorized diversions from the Guadalupe River associated with these water rights are taken from an 840-acre on-channel reservoir located in the City of Kerrville and are pumped from the reservoir to Kerrville's water treatment plant. A summary of the pertinent information for their water rights is shown in Table 3-6.

Texas Parks and Wildlife Department owns a continuous flow-through water right for 5,780 acre-feet/year used for the Heart of the Hills Fisheries Science Center, consumptive use is approximately 400 acre-feet/year. Industrial use permits are authorized for 17 acre-feet/year and irrigation rights for 6,904 acre-feet/year. The remaining water-rights holders use their water for mining, hydroelectric power, and recreation. One individual holds a water right (35,125 acre-feet/year) for hydroelectric use; however, this right has not been exercised. Kerr County holds the rights for three non-consumptive recreation-use reservoirs in and near Kerrville.

**Table 3-6. Municipal Water Rights for Kerrville and UGRA**

| Water Rights Permit | Authorized Diversion (acre-ft/yr) | Permit Holder | Priority Data | Storage (acre-feet) | Restrictions |
|---|---|---|---|---|---|
| 1996 (amended 4/10/98) | 225 (Mun.) | Kerrville | 4/4/1914 | | |
| 3505 | 3,603 | Kerrville | 5/23/1977 | 840 | Max diversion rate = 9.7 cfs Divert only when reservoir is above 1,608 ft msl |
| 5394A and 5394-B (amended 4/10/98) | 2,169 | Kerrville (Kerrville Municipal use) | 1/6/1992 | Utilizes the storage authorized for Permit 3505 | Max combined diversion rate for water rights #3505 and #5394 = 15.5 cfs. Minimum instream flow requirements vary from 30 to 50 cfs during year. |
| | 2,000 | UGRA (County Municipal use) | | | |

Note: Permit 2026 (priority 1961) 54 ac/ft municipal use.

During winter months when there is surplus surface water supply, a portion of the treated water is injected into the Lower Trinity Aquifer for subsequent use during the typically dry summer months. This aquifer storage and recovery (ASR) program has been in full operation since 1998.

Both the City of Kerrville and the UGRA have within their authorizations (Permits Nos. 5394B and 5394A respectively) a Special Condition addressing the seasonal distribution of allowed diversions. The Special Condition stipulates that during the months of October through May, the permittees may divert only when the flow of the Guadalupe River exceeds 50 cfs, and during the months of June through September, the permittees are authorized to divert only when the flow of the Guadalupe River exceeds 30 cfs. Another Special Condition common to both permittees is that, when inflows to Canyon Reservoir are less than 50 cfs, each permittee is to restrict diversions to allow a flow of at least 50 cfs to pass through. Yet another Special Condition imposed on both permittees is that diversions may be made only when the level of UGRA Lake is above 1,608 feet above mean sea level.

Pursuant to a Memorandum of Understanding (MOU) between the Guadalupe-Blanco River Authority (GBRA) and the Commissioner's Court of Kerr County, the South Central Texas Water Planning Group (Region L) recognizes a potential commitment of approximately 2,000 acre-feet/year from the firm yield of Canyon Reservoir for the calendar years 2021 through 2050. GBRA's hydrology studies indicate that a commitment of about 2,000 acre-feet/year would be necessary to allow permits for 6,000 acre-feet/year to be issued by TCEQ for diversions in Kerr County.

Data from the Corps of Engineers show a computed inflow into Lake Canyon of 132,900 acre-feet/year in 1996. The Guadalupe-San Antonio WAM estimates naturalized flows to be 27,800 acre-feet in 1956. The USGS gage 08167000 on the Guadalupe River at Comfort gives a lowest annual streamflow amount of 14.5 cfs (approximately 10,585 acre-feet/year) occurring in 1956. This gage has been recording since 1939. Interestingly, statistics for the gage include the fact that, for water years 1939 through 1997, the mean annual runoff was 157,800 acre-feet or approximately 216 cfs, and that 90 percent of these flows exceeded 25 cfs. This puts the 1956 occurrence of 14.5 cfs within the 0 to 10 percent non-exceedance category. In calendar year 1996, the annual mean was 151 cfs and the median was 85 cfs. The mean and median for 1997 exceeded the 1996 values. These facts seem to substantiate that the drought-of-record for Kerr County occurred in 1956, not in 1996, as consistent with most other areas of the State.

### 3.2.8 San Felipe Springs

The City of Del Rio has a water right authorizing it to divert 11,416 acre-feet/year from San Felipe Springs for municipal use. San Felipe Manufacturing and Irrigation Company has a water right authorizing it to divert 4,962 acre-feet/year for irrigation use and 50 acre-feet/year for industrial use. No data exists for flows during the drought of the 1950s. The only available records are from USGS gage 08452800 maintained by the IBWC at San Felipe Springs that covers the period of February 1961 to present. The minimum annual amount during this time period was 36,580 acre-feet/year (occurring in 1963).

### 3.2.9 Old Faithful Springs

Issuing from the upper Glen Rose Limestone portion of the Edwards-Trinity (Plateau) Aquifer , Old Faithful Springs is the primary water supply for the City of Camp Wood. The Spring has been a dependable source and was reported to have continuously flowed during the 1950s drought. There is current concern that the increase in the number of wells being drilled in the area may lower the local water table and thus negatively impact spring flow. The Spring is privately owned and may not be available for City use after the current contract expires.

### 3.2.10 Surface Water Rights

The right to use surface water from streams and lakes is permitted through the State of Texas. A list of all authorized surface water rights in the Region is available in Appendix 3A.

Major downstream water rights include those in Region L supplied by the Guadalupe-Blanco River Authority out of Canyon Lake and by the Bexar-Medina-Atascosa WCID#1 out of the Medina/Diversion system. The firm yields of Canyon and Medina limit the amount of water available for appropriation in both the Plateau Region and Region L. Major downstream water rights in Region M (i.e., cities and irrigators on the Rio Grande downstream from Amistad Reservoir) do not limit the amount of water available for appropriation in the Plateau Region because currently the Plateau Region does not depend on the Falcon-Amistad system. TCEQ's Lower Rio Grande Watermaster allocates water rights on the Rio Grande according to the supply in the Amistad Reservoir and in accordance with the 1944 International Treaty with Mexico.

## 3.3 GROUNDWATER/SURFACE WATER RELATIONSHIP

In the natural environment, water is constantly in transition between the land surface and underground aquifers. Under certain conditions, stream losses percolate downward to underlying aquifers as recharge; while in other cases, aquifers give up water to the land surface in the form of springs and seeps.

Most of the Plateau Region occurs at higher elevations that constitute the headwaters of the numerous streams and tributaries that frequent this Region. At these elevations, significant quantities of water exit the aquifer systems through springs and form the base flow of the surface streams. Downstream, only a portion of that water may render the underground system. For this reason, these streams are generally gaining throughout much of their extent within the Plateau Region. Spring flows are also environmentally important in that they are the primary source of water for wildlife in the area. These discharges from springs are thus the primary source of continuous flow to the rivers downstream and, therefore, their protection is warranted. Springs are so common to this headwater region that a popular beverage slogan touted “From the Land of 1,100 Springs”.

Some of the largest springs in the Region, such as San Felipe Springs (Val Verde County) and Las Moras Springs (Kinney County), issue from the Edwards limestone. However, numerous other springs issue from either the Edwards or Glen Rose Limestones. Many of the springs, such as Fessenden Spring (Kerr County), issue near the contact between the Edwards and the upper Glen Rose Limestones. Smaller springs are more prevalent where they issue from the Glen Rose, particularly in Bandera and Kerr Counties.

Most springs located in the headwaters of rivers that traverse the eastern part of the Region issue from the contact between the Edwards limestone and underlying upper Glen Rose limestone. Most well production in this area is from deeper aquifers and, therefore, little impact to spring flow from the pumping is anticipated. However, as new development expands to the west, care should be given to potential water level declines that could diminish spring flow and base flow to the rivers.

Springs located in the western part of the Region issue primarily from the Edwards Limestone. Because of limited pumping of groundwater from wells in the Del Rio area, San Felipe Springs has not had to compete for source water. A significant increase in groundwater pumpage immediate updip and to the east of the springs may lower the water table sufficiently to affect flow from the springs. Because much of the recharge areas for the contributing zones of these western springs occur in remote areas, very little information is available concerning the relationship between the springs and the underlying aquifers.

Gain/loss studies are needed to identify stream segments that are critical to aquifer recharge and spring discharge. The studies can be used to identify where recharge structures would be most efficient and where most river base-flow gain occurs. Specific candidate areas occur over the plateau area that is underlain by Edwards Limestone, especially in the upper tributaries of all the rivers. Gain/loss studies of tributaries in the vicinity of Del Rio would be beneficial in understanding the recharge areas that contribute to San Felipe Springs.

Two supplemental study reports were prepared for the *Plateau Region Water Plan* that address springs. The first report (Springs of Kinney and Val Verde Counties, 2005) considers the location and geohydrology of springs in Kinney and Val Verde Counties, and the second report (Spring Flow Contribution to the Headwaters of the Guadalupe River in Western Kerr County, Texas, 2005) relates springflow in western Kerr County to base flow in the three branches of the upper Guadalupe River.

## 3.4 WATER REUSE

While recycling is a term generally applied to aluminum cans, glass bottles, and newspapers, water can be recycled as well. Water recycling is reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, and replenishing a groundwater aquifer (referred to as groundwater recharge or ASR for aquifer storage and recovery). Water is sometimes recycled and reused onsite; for example, when an industrial facility recycles water used for cooling processes. A common type of recycled water is water that has been reclaimed from municipal wastewater, or sewage. The term "water recycling" is generally used synonymously with water reclamation and water reuse.

Kerrville treats its wastewater to TCEQ type 1 level. The treated wastewater is pumped through a dedicated pipeline for reuse as irrigation water for the Scott Schreiner Municipal Golf Course, the Hill Country Youth Soccer Fields, Kerrville Sports Complex, Schreiner University, River Hills Golf Course, Tivy High School Sports Fields, Kerr County Animal Shelter, and the golf course at Comanche Trace Ranch & Golf Club. Additional treated water is sold by the truckload for construction projects. The remaining wastewater is released into Third Creek, which flows into Flatrock Lake on the Guadalupe River. That water is then available for use downstream of Kerrville. Future expansion of Kerrville's reuse project is anticipated to yield approximately 1 million gallons per day. The Cities of Del Rio and Bandera also have wastewater treatment capacities with the potential for future reuse applications.

Future direct reuse supply availability as shown in Table 3-1 is listed as:

- Kerr County – Guadalupe Basin – 5,000 acre-feet/year
  (City of Kerrville permitted volume)
- Bandera County – San Antonio Basin – 310 acre-feet/year
  (City of Bandera average discharge)
- Val Verde County – Rio Grande basin – 3,100 acre-feet/year
  (Del Rio Utilities Commission permitted volume)

## 3.5 LOCAL SUPPLY

"Local Supplies" are limited, unnamed individual surface water supplies that, separately, are available only to particular non-municipal WUGs. These supplies are generally contained within "stock tanks" that catch precipitation runoff and are used primarily for livestock watering, but at times may be available for other local needs such as mining. For planning purposes, the volume of runoff water in these catchment basins is considered to be significantly reduced during drought-of-record conditions and does not include any groundwater that might be pumped into them. No documentation has been identified that quantifies the available supply during a drought of record for these local supplies. Thus, per TWDB guidelines established for the regional water planning process, it has been assumed for the purposes of the 2021 Plateau Region Water Plan that all local supplies not represented by a specific, identified water right are zero ac-ft per year.

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# APPENDIX 3A
# AUTHORIZED SURFACE WATER RIGHTS

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## APPENDIX 3A. AUTHORIZED SURFACE WATER RIGHTS

## AS EXTRACTED FROM TCEQ'S ACTIVE WATER RIGHTS MASTER FILE

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 2027-000 | 6 | Bandera | 7720000000 | ROBERT L PARKER SR ET AL | VERDE CRK | IRRG | 8 | 3 | | |
| 2028-000 | 6 | Bandera | 7750000000 | HOWARD E BUTT | PALMER CRK | OTHER | | | 30 | |
| 2103-000 | 6 | Bandera | 5903000000 | O S PETTY | HONEY CRK | IRRG | 96 | 38 | | |
| 2104-000 | 6 | Bandera | 5902000000 | CLARENCE E LAUTZENHEISER | N PRONG MEDINA RIVER | IRRG | 20.24 | 23.85 | | AMEND 9/29/88, 8/22/89 |
| 2105-000 | 6 | Bandera | 5901500000 | STEVEN L PRICHARD TRUSTEE | MICKLE | IRRG | 5.44 | 8.16 | 5 | |
| 2105-000 | 6 | Bandera | 5901500000 | NEAL INCORPORATED | MICKLE | IRRG | 7.32 | 10.99 | 5 | |
| 2106-000 | 6 | Bandera | 5901450000 | BREWINGTON LAKE RANCH ASSN | BREWINGTON CRK | REC | 190 | | 190 | |
| 2107-000 | 6 | Bandera | 5901100000 | JOEL HELD, TRUSTEE/JJJ RANCH | N PRONG MEDINA RIVER | IRRG | 19 | 25 | | OUT OF A 1666.5 ACRE TRACT |
| 2108-000 | 6 | Bandera | 5900100000 | BEN & KAY MAYBERRY FAM PART | ROCKY CRK | IRRG | 19.82 | 14.41 | | ALSO KERR CO |
| 2108-000 | 6 | Bandera | 5900100000 | WALTER A WILLOUGHBY | ROCKY CRK | IRRG | 24.18 | 17.59 | | ALSO KERR CO |
| 2109-000 | 6 | Bandera | 5897200000 | NEVIN MARR | N PRONG MEDINA RIVER | IRRG | 2 | 10 | | AMEND 1-21-83 INCREASE ACRES |
| 2110-000 | 6 | Bandera | 5897000000 | DONALD F & MARTHA M MEAD | N PRONG MEDINA RIVER | IRRG | 21 | 12 | | |
| 2111-000 | 6 | Bandera | 5896000000 | TEXAS PETROLEUM CO. TR EST | COLLINS CRK | IRRG | 4 | 2 | 16 | |
| 2112-000 | 6 | Bandera | 5894500000 | MRS MARY WINKENHOWER | ELAM CRK | IRRG | 27 | 27 | | JOINTLY OWNS 27 AF TO IRR 27 ACRES |
| 2113-000 | 6 | Bandera | 5894000000 | SUSAN CRAWFORD TRACY | W PRONG MEDINA RIVER | IRRG | 35 | 45 | | OUT OF A 156 ACRE TRACT |
| 2114-000 | 6 | Bandera | 5892000000 | PHIL A GROTHUES ET UX | UNNAMED TRIB | IRRG | 5.705 | 20.715 | | |
| 2114-000 | 6 | Bandera | 5892000000 | INMANN T DABNEY JR ET UX | UNNAMED TRIB | IRRG | 6.542 | 23.756 | | |
| 2114-000 | 6 | Bandera | 5892000000 | RICHARD E WILSON | UNNAMED TRIB | IRRG | 3.753 | 13.629 | | |
| 2115-000 | 6 | Bandera | 5891500000 | DAVID R SCHMIDT MD ET AL | BAUERLEIN CRK | IRRG | 15 | 16 | | |
| 2116-000 | 6 | Bandera | 5891000000 | PAUL LAVON GARRISON | W PRONG MEDINA RIVER | IRRG | 36 | 36 | | |
| 2116-000 | 6 | Bandera | 5891000000 | GEORGE C. YAX | W PRONG MEDINA RIVER | IRRG | 15 | 15 | 162 | |
| 2117-000 | 6 | Bandera | 5889000000 | G. MILTON JOHNSON, ET UX | MEDINA RIVER | IRRG | 7 | 7 | | OUT OF A 175.5 ACRE TRACT |
| 2118-000 | 6 | Bandera | 5888870000 | DAVID J BRASK | UNNAMED TRIB | IRRG | 16 | 16 | | |
| 2119-000 | 6 | Bandera | 5888090000 | RAYMOND HICKS | MEDINA RIVER | IRRG | 3 | 8 | | |
| 2120-000 | 6 | Bandera | 5888051000 | BANDERA ELECTRIC COOP INC | MEDINA RIVER | IRRG | 2 | 4 | | 7/8/82 ADD DIV PT |
| 2121-000 | 6 | Bandera | 5888087000 | ANN DARTHULA MAULDIN | INDIAN CRK | IRRG | 31.03 | 8.27 | | |
| 2121-000 | 6 | Bandera | 5888087000 | TOLBERT S WILKINSON ET UX | INDIAN CRK | IRRG | 69.47 | 18.53 | | AMEND 7/30/90 |

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 2121-000 | 6 | Bandera | 5888087000 | JOHN W DINSE ET UX | INDIAN CRK | IRRG | 49.5 | 13.2 | | |
| 2122-000 | 6 | Bandera | 5887330000 | DON HICKS | MEDINA RIVER | MUNI | 9 | | | |
| 2123-000 | 6 | Bandera | 5887150000 | DON F TOBIN | MEDINA RIVER | IRRG | 152 | 61 | | OUT OF A 452 ACRE TRACT |
| 2124-000 | 6 | Bandera | 5887130000 | EVANGELINE RATCLIFFE WILSON | SAN JULIAN CRK | IRRG | 3 | 5 | | |
| 2125-000 | 6 | Bandera | 5887129000 | PETER K SHAVER ET UX | SAN JULIAN CRK | IRRG | 18 | 30 | | |
| 2126-000 | 6 | Bandera | 5887105000 | STANLEY D ROSENBERG ET UX | MEDINA RIVER | IRRG | 47 | 36 | | |
| 2127-000 | 6 | Bandera | 5887100000 | JERRY B PARKER ET AL | MEDINA RIVER | IRRG | 16 | 8 | | |
| 2128-000 | 6 | Bandera | 5887050000 | JOE H BERRY | SADDLE CRK | IRRG | 14 | 12 | 3 | |
| 2129-000 | 6 | Bandera | 5887000000 | JOE H BERRY | PRIVILEGE CRK | IRRG | 40 | 33 | 110 | |
| 2135-000 | 6 | Bandera | 5660000000 | KITTIE NELSON FERGUSON | SAN GERONIMO CRK | IRRG | 5 | 5 | 28 | |
| 3176-000 | 6 | Bandera | 2851020000 | TEXAS PARKS & WILDLIFE DEPT | CAN CRK | MUNI | 7 | | | |
| 3176-000 | 6 | Bandera | 2851020000 | TEXAS PARKS & WILDLIFE DEPT | CAN CRK | IRRG | | 3 | | |
| 3177-000 | 6 | Bandera | 2850500000 | BETTY F LEIGHTON | SABINAL RIVER | MUNI | 4 | | | |
| 3178-000 | 6 | Bandera | 2850000000 | KING & JEWEL FISHER | SABINAL RIVER | IRRG | 40 | 56 | 2 | AMENDED 6/21/96 |
| 3179-000 | 6 | Bandera | 2825000000 | JOHN K HARRELL | SABINAL RIVER | IRRG | 28.196 | 95.257 | | |
| 3179-000 | 6 | Bandera | 2825000000 | BARBARA JEAN GROTH ET VIR | SABINAL RIVER | IRRG | 8.804 | 29.743 | | |
| 3184-000 | 6 | Bandera | 2675000000 | ENRIQUE S PALOMO ET UX | SPRING CRK | IRRG | 10 | 5 | 42 | |
| 3185-000 | 6 | Bandera | 2651700000 | W H THOMPSON JR | WILLIAMS CRK | IRRG | 15 | 5 | 2 | CURRENT OWNER UNKNOWN, 5/98 |
| 3186-000 | 6 | Bandera | 2651500000 | DOROTHY BAIRD MATTIZA | WILLIAMS CRK | IRRG | 128 | 88 | 73 | |
| 3187-000 | 6 | Bandera | 2651000000 | CHESTER N POSEY ET UX | WILLIAMS CRK | IRRG | 23 | 21 | 15 | |
| 3188-000 | 6 | Bandera | 2650000000 | W J SCHMIDT | HONDO CRK | IRRG | 24 | 47 | 16 | |
| 3693-000 | 1 | Bandera | 5887260000 | GERALD H PERSYN | UNNAMED TRIB BANDERA CRK | REC | | | 11 | |
| 3824-000 | 1 | Bandera | 5887295000 | CITY OF BANDERA | MEDINA RIVER | REC | | | 22 | |
| 3825-000 | 1 | Bandera | 7718000000 | ROBERT L PARKER SR ET AL | VERDE CRK | REC | | | 277 | |
| 3853-000 | 1 | Bandera | 5888230000 | ROCK CLIFF RESERVOIR LAND ASSN | SPIRES CRK | REC | | | 925.4 | AMENDED 2/17/98: IMPOUNDMENT AND EXP |
| 3909-000 | 1 | Bandera | 5888150000 | MAUDEEN M MARKS | MONTAGUE HOLLOW | REC | | | 500 | DOMESTIC, LIVESTOCK & REC |
| 3944-000 | 1 | Bandera | 5887120000 | CONOCO INCORPORATED | UNNAMED TRIB MEDINA RIVER | REC | | | 180 | 2 DAMS |
| 3949-000 | 1 | Bandera | 5886550000 | CASTLE LAND & LIVESTOCK CO INC | BEAR CRK | REC | 33 | | 33 | DOM & LIVESTOCK - SC |
| 4026-000 | 1 | Bandera | 5887125000 | HILL COUNTRY MANAGEMENT CORP | SAN JULIAN | REC | | | 3 | ALSO DOM & LIVESTOCK |

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 5097-000 | 1 | Bandera | 5890300000 | DON CODY ET UX | W PRONG MEDINA RIVER | IRRG | 120 | 72 | | EXP 2/2/2016 BY CONTRACT 1610;AMEND 9/94 |
| 5186-000 | 1 | Bandera | 2824000000 | HILL COUNTRY SPRING WATER TX | SPRING | MUNI | 161 | | | BOTTLED WATER, .049 RES |
| 5204-000 | 1 | Bandera | 2840000000 | ROGER E. CANTER ET UX | SABINAL RIVER | IRRG | 60 | 20 | | |
| 5305-000 | 1 | Bandera | 2621000000 | UTOPIA SPRING WATER INC | W SECO CRK | MUNI | 72 | | | |
| 5339-000 | 1 | Bandera | 5888089000 | YMCA/GREATER HOUSTON AREA | INDIAN CRK | REC | | | 30 | |
| 5342-000 | 1 | Bandera | 5890200000 | RENE H GRACIDA | W PRONG MEDIA | REC | | | 7 | |
| 5475-000 | 1 | Bandera | 2850600000 | GALLERIA HOLDING, LTD | JERNIGAN CRK | IRRG | 26 | 18 | 63 | 2 RESERVOIRS |
| 5575-000 | 1 | Bandera | 2850900000 | ALBERT R GAGE ET UX | MARLER CRK | IRRG | 12 | 6 | | SC: FLOW RESTRICTIONS |
| 1527-000 | 6 | Edwards | 1750010000 | ADDISON LEE PFLUGER | HUFFMAN SPRING | IRRG | 32 | 20 | 1 | |
| 1528-000 | 6 | Edwards | 1735000000 | RUTH MCLEAN BOWERS | PAINT CREEK | IRRG | 60 | 54 | 58 | CO 134, 2 RES |
| 2451-000 | 6 | Edwards | 1750000000 | ADDISON LEE PFLUGER ET AL | S LLANO RIVER | IRRG | 88 | 74 | 7 | AMEND 5/9/83 |
| 3017-000 | 6 | Edwards | 9520000000 | RAY H EUBANK | RUTH DRAW | IRRG | 50 | 50 | | AMEND 7/3/84 |
| 3023-000 | 6 | Edwards | 9195000000 | DONALD P TARPEY | NUECES RIVER | IRRG | 108 | 27 | | |
| 3024-000 | 6 | Edwards | 9170000000 | DOUGLAS B & MARGARET MARSHALL | NUECES RIVER | IRRG | 65 | 43 | | |
| 3038-000 | 6 | Edwards | 8900000000 | ROYCE I REID ESTATE | PULLIAM CRK | IRRG | 48 | 20 | | |
| 3039-000 | 6 | Edwards | 8800000000 | OLGA H. CLOUDT, ET AL | PULLIAM CRK | IRRG | 75 | 50 | 8 | |
| 3039-000 | 6 | Edwards | 8800000000 | OLGA H. CLOUDT, ET AL | PULLIAM CRK | IRRG | 30 | 20 | | |
| 3040-000 | 6 | Edwards | 8790000000 | J R WILLIAMS ET AL | PULLIAM CRK | IRRG | 34 | 17 | | |
| 3041-000 | 6 | Edwards | 8780000000 | JOSEPH C WILLIAMS | PULLIAM CRK | IRRG | 60 | 44 | | 1/2 INTEREST IN 60 AF FOR IRR OF 44 AC |
| 3042-000 | 6 | Edwards | 8779000000 | J R WILLIAMS ET AL | PULLIAM CRK | IRRG | 22 | 13 | | |
| 3043-000 | 6 | Edwards | 8760000000 | JOY JERNIGAN OWENS | PULLIAM CRK | IRRG | 32 | 16 | | |
| 3044-000 | 6 | Edwards | 8700010000 | SUSAN PETTY ARNIM ET AL | CEDAR CRK | IRRG | 6 | 12 | | |
| 3044-000 | 6 | Edwards | 8700010000 | SUSAN PETTY ARNIM ET AL | CEDAR CRK | IRRG | 20 | | | |
| 3044-000 | 6 | Edwards | 8700010000 | SUSAN PETTY ARNIM ET AL | CEDAR CRK | IRRG | 4 | 20 | | |
| 3046-000 | 6 | Edwards | 8460500000 | NORMA JEAN EASLEY | PULLIAM CRK | IRRG | 30 | 59 | | |
| 3047-000 | 6 | Edwards | 8400000000 | BRUCE I HENDRICKSON ET UX | CLEAR CRK | IRRG | 6 | 6 | 11 | |
| 3048-000 | 6 | Edwards | 8340000000 | L A MALACHEK ET AL | PULLIAM CRK | IRRG | 27 | 14 | | |
| 3049-000 | 6 | Edwards | 7630010000 | EDWARDS CO INVEST. PARTNER | PULLIAM CRK | IRRG | 250 | 400 | | |
| 3049-000 | 6 | Edwards | 7630010000 | BRUCE I HENDRICKSON ET UX | PULLIAM CRK | IRRG | 350 | 150 | | |

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 3070-000 | 6 | Edwards | 7041600000 | E B CARRUTH, JR, TRUST | W NUECES RIVER | IRRG | 200 | 184 | | |
| 3070-000 | 6 | Edwards | 7041600000 | E B CARRUTH, JR, TRUST | W NUECES RIVER | REC | | | 19 | |
| 3957-000 | 1 | Edwards | 8550000000 | S A WILLIAMS | CEDAR CRK | IRRG | 40 | 40 | | AMEND 1/13/87 |
| 4006-000 | 1 | Edwards | 8790100000 | BAY-HOUSTON TOWING CO | PULLIAM | IRRG | 150 | 75 | | |
| 4278-000 | 1 | Edwards | 8920000000 | BERRYMAN INVESTMENTS INC | PULLIAM CRK | IRRG | 4.34 | 7.38 | | OWNS DAM & RESERVOIR |
| 4278-000 | 1 | Edwards | 8920000000 | SAM P WORDEN ET UX | PULLIAM CRK | IRRG | 5.66 | 9.62 | | |
| 1930-000 | 6 | Kerr | 9570000000 | HERSHEL REID ET UX | FLAT ROCK CRK | IRRG | 69 | 66 | 35 | |
| 1932-000 | 6 | Kerr | 9560000000 | PRESBYTERIAN MO-RANCH ASSEMBLY | N FRK GUADALUPE RIVER | MUNI | 60 | | | AMEND 6/7/94 |
| 1932-000 | 6 | Kerr | 9560000000 | PRESBYTERIAN MO-RANCH ASSEMBLY | N FRK GUADALUPE RIVER | IRRG | 14 | 7 | | AMEND 6/7/94 |
| 1932-000 | 6 | Kerr | 9560000000 | PRESBYTERIAN MO-RANCH ASSEMBLY | N FRK GUADALUPE RIVER | REC | 25 | | 20 | AMEND 6/7/94 |
| 1934-000 | 6 | Kerr | 9527000000 | CHARLES K HICKEY JR ET AL | DRY CRK | IRRG | 0.45 | 0.68 | | |
| 1934-000 | 6 | Kerr | 9527000000 | KATHY JAN FREEMAN | DRY CRK | IRRG | 1.55 | 2.32 | | |
| 1935-000 | 6 | Kerr | 9525100000 | CHARLES K HICKEY JR ET AL | N FRK GUADALUPE RIVER | IRRG | 8 | 8 | | |
| 1936-000 | 6 | Kerr | 9523000000 | WILLIAM H ARLITT JR ET UX | N FRK GUADALUPE RIVER | IRRG | 17 | 6 | 5 | |
| 1936-000 | 6 | Kerr | 9523000000 | WILLIAM H ARLITT JR ET UX | INDIAN CRK | IRRG | 134 | 48 | | |
| 1937-000 | 6 | Kerr | 9515200000 | BOY SCOUTS- ALAMO AREA | BEAR CRK | REC | | | 10 | |
| 1938-000 | 6 | Kerr | 9515000000 | LOUIS H STUMBERG | N FRK GUADALUPE RIVER | IRRG | 2 | 4 | | |
| 1938-000 | 6 | Kerr | 9515000000 | LOUIS H STUMBERG | N FRK GUADALUPE RIVER | IRRG | 15 | 22 | | |
| 1939-000 | 6 | Kerr | 9512000000 | LOUIS H STRUMBERG | GRAPE CRK | IRRG | 3 | 6 | 6 | |
| 1940-000 | 6 | Kerr | 9511000000 | B E QUINN III ET AL | N FRK GUADALUPE RIVER | IRRG | 32 | 16 | 10 | |
| 1941-000 | 6 | Kerr | 8154502000 | DELMAR SPIER AGENT | TURTLE CRK | IRRG | 6 | 9 | 5 | |
| 1943-000 | 6 | Kerr | 9505000000 | J CONRAD PYLE, ET AL | N FRK GUADALUPE RIVER | MUNI | 14 | | | |
| 1945-000 | 6 | Kerr | 9485010000 | JOHN P HILL | N FRK GUADALUPE RIVER | IRRG | 25 | 20 | | |
| 1946-000 | 6 | Kerr | 9485000000 | JOHN P HILL ADMINISTRATOR | N FRK GUADALUPE RIVER | IRRG | 11 | 9 | | |
| 1947-000 | 6 | Kerr | 9480000000 | GUAD VALLEY LOT OWNERS ASSN | N FRK GUADALUPE RIVER | IRRG | 6 | 10 | | AMEND 3/6/91 |
| 1947-000 | 6 | Kerr | 9480000000 | GUAD VALLEY LOT OWNERS ASSN | N FRK GUADALUPE RIVER | MUNI | 3 | | | |
| 1948-000 | 6 | Kerr | 9489000000 | JOHN H DUNCAN | BRUSHY CRK | IRRG | 7 | 7 | | |
| 1949-000 | 6 | Kerr | 9488000000 | WILLIAM O CARTER, TRUSTEE | HONEY CRK | IRRG | 6 | 2 | | OUT OF A 80 ACRE TRACT |
| 1949-000 | 6 | Kerr | 9488000000 | WILLIAM O CARTER, TRUSTEE | HONEY CRK | IRRG | 27 | 9 | | |

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1950-000 | 6 | Kerr | 9487000000 | JOHN H DUNCAN | HONEY CRK | IRRG | 6 | 20 | 13 | ALSO USE 7 |
| 1953-000 | 6 | Kerr | 9476000000 | LAURA B LEWIS ET VIR | N FRK GUADALUPE RIVER | IRRG | 40 | 24 | | |
| 1956-000 | 6 | Kerr | 9897000000 | RIVER INN ASSOC OF UNIT OWNERS | S FRK GUADALUPE RIVER | REC | | | 50 | |
| 1956-000 | 6 | Kerr | 9897000000 | RIVER INN ASSOC OF UNIT OWNERS | S FRK GUADALUPE RIVER | MUNI | 10 | | | AMEND 4/19/84, 1/4/85 |
| 1957-000 | 6 | Kerr | 9880000000 | BILLIE R VALICEK | S FRK GUADALUPE RIVER | REC | | | 10 | |
| 1958-000 | 6 | Kerr | 9780000000 | T J MOORE ESTATE | CYPRESS CRK | IRRG | 20 | 10 | 100 | |
| 1961-000 | 6 | Kerr | 9670000000 | LAVERNE CRIDER MOORE ET VIR | S FRK GUADALUPE RIVER | MUNI | 3 | | | |
| 1961-000 | 6 | Kerr | 9670000000 | LAVERNE CRIDER MOORE ET VIR | S FRK GUADALUPE RIVER | IRRG | 1 | 3 | | |
| 1963-000 | 6 | Kerr | 9620000000 | LAWRENCE L GRAHAM ET AL | S FRK GUADALUPE RIVER | IRRG | 2 | 12 | 21 | AMEND 9/10/85 |
| 1963-000 | 6 | Kerr | 9620000000 | LAWRENCE L GRAHAM ET AL | S FRK GUADALUPE RIVER | REC | | | 16 | AMENDS 5/26/83 CHG PUR USE & ADD RES |
| 1964-000 | 6 | Kerr | 9400000000 | VIRGINIA MOORE JOHNSTON | TEGENER | IRRG | 10 | 10 | 12 | |
| 1967-000 | 6 | Kerr | 9305000000 | SARAH HICKS BUSS | UNNAMED TRIB GUADALUPE RIVER | REC | 20 | | | ALSO USE 1, AMEND 3/19/91 |
| 1968-000 | 6 | Kerr | 9261000000 | LOUIS DOMINGUES | GUADALUPE RIVER | IRRG | 10 | 20 | | |
| 1969-000 | 6 | Kerr | 9260000000 | TOMMIE SMITH BLACKBURN | GUADALUPE RIVER | INDU | 15 | | 15 | USE 2: MILLING |
| 1969-000 | 6 | Kerr | 9260000000 | TOMMIE SMITH BLACKBURN | KELLY CRK | IRRG | 49 | 80 | | USE 3 - DIVERTING FROM KELLY CREEK |
| 1969-000 | 6 | Kerr | 9260000000 | TOMMIE SMITH BLACKBURN | GUADALUPE RIVER | IRRG | 59 | | | USE 3 - DIVERTING FROM GUADALUPE RIVER |
| 1969-000 | 6 | Kerr | 9260000000 | TOMMIE SMITH BLACKBURN | GUADALUPE RIVER | HYDRO | | | | USE 5; NONCONSUMPTIVE |
| 1970-000 | 6 | Kerr | 9220000000 | CARL HAWKINS | GUADALUPE RIVER | MUNI | 10 | | | |
| 1970-000 | 6 | Kerr | 9220000000 | CARL HAWKINS | GUADALUPE RIVER | IRRG | 32 | 25 | | |
| 1971-000 | 6 | Kerr | 9140000000 | COUNTY OF KERR | GUADALUPE RIVER | REC | | | 450 | |
| 1972-000 | 6 | Kerr | 9110000000 | WESLEY ELLEBRACHT | WELSH BR | IRRG | 0.8 | 0.8 | | |
| 1972-000 | 6 | Kerr | 9110000000 | WELCH CREEK PARTNERS LTD | WELSH BR | IRRG | 5.15 | 5.15 | | |
| 1972-000 | 6 | Kerr | 9110000000 | ARANSAS BAY COMPANY | WELSH BR | IRRG | 0.05 | 0.05 | | |
| 1973-000 | 6 | Kerr | 9100000000 | SHELTON RANCHES INC | SMITHS BR | IRRG | 10 | 10 | 6 | |
| 1974-000 | 6 | Kerr | 9050000000 | SHELTON RANCHES INC | SMITHS BR | IRRG | 70 | 35 | 15 | ALSO JOHNSON CREEK |
| 1975-000 | 6 | Kerr | 9025000000 | TEXAS PARKS & WILDLIFE DEPT | FESSENDEN BR | INDU | 400 | | | FISH HATCHERY & GAME PRESERVE |
| 1975-000 | 6 | Kerr | 9025000000 | TEXAS PARKS & WILDLIFE DEPT | FESSENDEN BR | INDU | 5780 | | 72 | 2 IMP & A POND; USES 3, 1 & 7; EXP 2012 |
| 1976-000 | 6 | Kerr | 8950000000 | F P ZOCH III TRUST & ZEE RANCH | FESSENDEN BR | IRRG | 29 | 14 | | |
| 1976-000 | 6 | Kerr | 8950000000 | F P ZOCH III TRUST & ZEE RANCH | FESSENDEN BR | REC | | | 184 | |

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1977-000 | 6 | Kerr | 8839000000 | TEXAS CATHOLIC BOYS' HOME | JOHNSON CRK | IRRG | 23 | 23 | 23 | |
| 1978-000 | 6 | Kerr | 8815000000 | A J RUST | JOHNSON CRK | IRRG | 33 | 65 | | |
| 1979-000 | 6 | Kerr | 8808000000 | KEITH S MEADOW | BYAS CRK | IRRG | 18 | 6 | | |
| 1980-000 | 6 | Kerr | 8805000000 | A L MOORE | JOHNSON CRK | IRRG | 12 | 6 | | |
| 1981-000 | 6 | Kerr | 8800000000 | JACK D CLARK JR ET AL | JOHNSON CRK | IRRG | 32 | 16 | | |
| 1981-000 | 6 | Kerr | 8800000000 | JACK D CLARK JR ET AL | JOHNSON CRK | IRRG | 143 | 76 | | OUT OF A 111.9 ACRE TRACT |
| 1982-000 | 6 | Kerr | 8775000000 | LOLA DEAN SMITH | JOHNSON CRK | IRRG | 133 | 50 | 12 | |
| 1983-000 | 6 | Kerr | 8770000000 | N V MAMIMAR | JOHNSON CRK | IRRG | 32 | 17 | | JOINTLY OWN 32 & 67 AF TO IRR 17 & 35 AC |
| 1983-000 | 6 | Kerr | 8770000000 | N V MAMIMAR | JOHNSON CRK | IRRG | 67 | 35 | | JOINTLY OWN 32 & 67 AF TO IRR 17 & 35 AC |
| 1983-000 | 6 | Kerr | 8770000000 | DAVID J COPELAND ET UX | JOHNSON CRK | IRRG | | | | JOINTLY OWN 32 & 67 AF TO IRR 17 & 35 AC |
| 1983-000 | 6 | Kerr | 8770000000 | DAVID J COPELAND ET UX | JOHNSON CRK | IRRG | | | | JOINTLY OWN 32 & 67 AF TO IRR 17 & 35 AC |
| 1984-000 | 6 | Kerr | 8750000000 | MICHAEL E & GAIL SEARS | JOHNSON CRK | IRRG | 1 | 2 | | |
| 1985-000 | 6 | Kerr | 8746000000 | ROBERT B O'CONNOR JR ET UX | JOHNSON CRK | IRRG | 80 | 31 | | |
| 1987-000 | 6 | Kerr | 8744000000 | REGINALD E WARREN JR | JOHNSON CRK | IRRG | 90 | 30 | | |
| 1988-000 | 6 | Kerr | 8720000000 | JIMMIE L QUERNER SR ESTATE | FALL BR | IRRG | 128 | 64 | | ALSO GILLESPIE CO |
| 1990-000 | 6 | Kerr | 8650000000 | DOROTHY L JENKINS ET AL | JOHNSON CRK | IRRG | 3 | 1 | | |
| 1991-000 | 6 | Kerr | 8615001000 | LAZY HILLS GUEST RANCH INC | HENDERSON BR | IRRG | 21 | 28 | | |
| 1992-000 | 6 | Kerr | 8600000000 | MARK A RYLANDER ET AL | JOHNSON CRK | IRRG | 23 | 15 | | |
| 1993-000 | 6 | Kerr | 8550000000 | ROY LITTLEFIELD | JOHNSON CRK | IRRG | 50 | 50 | 4 | |
| 1994-000 | 6 | Kerr | 8500000000 | M H & MARY FRANCES MONTGOMERY | GUADALUPE RIVER | IRRG | 5 | 4 | | |
| 1995-000 | 6 | Kerr | 8451000000 | HENRY GRIFFIN CONSTRUCTION CO | GOAT CRK | IRRG | 11 | 11 | 6 | |
| 1996-000 | 6 | Kerr | 8287000000 | KERRVILLE, CITY OF | GUADALUPE RIVER | MUNI | 150 | | | AMEND 3/19/91, 4/10/98: DIV PT #4.SC. |
| 1996-000 | 6 | Kerr | 8287000000 | KERRVILLE, CITY OF | GUADALUPE RIVER | IRRG | 75 | 44 | 75 | AMEND 3/19/91, 4/10/98: DIV PT #4.SC. |
| 1997-000 | 6 | Kerr | 8310000000 | DARRELL G LOCHTE ET AL | GUADALUPE RIVER | MINE | 143 | | | |
| 1997-000 | 6 | Kerr | 8310000000 | DARRELL G LOCHTE ET AL | GUADALUPE RIVER | INDU | 2 | | | |
| 1998-000 | 6 | Kerr | 8295000000 | C W SUNDAY | TOWN CRK | IRRG | 22.3 | 22.3 | 10 | |
| 1998-000 | 6 | Kerr | 8295000000 | JOSE A LOPEZ ET UX | TOWN CRK | IRRG | 4.18 | 4.18 | | |
| 1999-000 | 6 | Kerr | 8297000000 | KERRVILLE STATE HOSPITAL | UNNAMED TRIB GUADALUPE RIVER | REC | 44 | | 44 | |

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 2000-000 | 6 | Kerr | 8260010000 | RIVERHILL COUNTRY CLUB INC | GUADALUPE RIVER | IRRG | 350 | 160 | 70 | 8/31/87 |
| 2001-000 | 6 | Kerr | 8255000000 | CARL D. MEEK | GUADALUPE RIVER | IRRG | 295 | 194 | | AMEND 4/9/92,5/12/95.DIFF PRIORITY DATES |
| 2002-000 | 6 | Kerr | 8230000000 | COMANCHE TRACE RANCH & GOLF CL | GUADALUPE RIVER | IRRG | 136 | 99 | | |
| 2003-000 | 6 | Kerr | 8250000000 | WHEATCRAFT, INC. | GUADALUPE RIVER | IRRG | 42 | 21 | | |
| 2003-000 | 6 | Kerr | 8250000000 | SHELTON RANCH CORPORATION | GUADALUPE RIVER | MINE | 10 | | | |
| 2004-000 | 6 | Kerr | 8200000000 | COUNTY OF KERR | GUADALUPE RIVER | REC | | | 720 | ALSO USE 8 |
| 2005-000 | 6 | Kerr | 8185500000 | HARRIET BOCKHOFF ESTATE | GUADALUPE RIVER | IRRG | 59 | 98 | | |
| 2006-000 | 6 | Kerr | 8174000000 | FARM CREDIT BANK OF TEXAS | GUADALUPE RIVER | IRRG | 179.06 | 512.55 | | AMEND 2/3/88,6/18/90. MAX COMB. CFS:4.0 |
| 2006-000 | 6 | Kerr | 8174000000 | FARM CREDIT BANK OF TEXAS | GUADALUPE RIVER | IRRG | 83.94 | | | AMEND 2/3/88, 6/18/90 |
| 2006-000 | 6 | Kerr | 8174000000 | 1967 SHELTON TRUSTS PART ET AL | GUADALUPE RIVER | IRRG | 106.9 | 78.55 | | AMEND 2/3/88, 6/18/90 |
| 2006-000 | 6 | Kerr | 8174000000 | 1967 SHELTON TRUSTS PART ET AL | GUADALUPE RIVER | IRRG | 50.1 | | | AMEND 2/3/88, 6/18/90 |
| 2006-000 | 6 | Kerr | 8174000000 | KENNETH W WHITEWOOD ET UX | GUADALUPE RIVER | IRRG | 34.04 | | | AMEND 2/3/88, 6/18/90, 11/22/96 |
| 2006-000 | 6 | Kerr | 8174000000 | KENNETH W WHITEWOOD ET UX | GUADALUPE RIVER | IRRG | 15.96 | | | AMEND 2/3/88, 6/18/90, 11/22/96 |
| 2006-000 | 6 | Kerr | 8174000000 | KENNETH W WHITEWOOD ET UX | GUADALUPE RIVER | IRRG | 100 | 76 | | AMEND 2/3/88, 6/18/90, 11/22/96 |
| 2007-000 | 6 | Kerr | 8160000000 | RAY ELLISON JR | SPRING CRK | IRRG | 31 | 31 | 50 | |
| 2008-000 | 6 | Kerr | 8156160000 | LUTHERAN CAMP CHRYSALIS | TURTLE CRK | MUNI | 11 | | 12 | |
| 2009-000 | 6 | Kerr | 8155750000 | FRANCIS C & WILLADEAN BOLEN | BUSHWACK CRK | IRRG | 5 | 5 | 5 | |
| 2010-000 | 6 | Kerr | 8155700000 | G ROBERT SWANTNER JR ET UX | BUSHWACK CRK | IRRG | 7 | 5 | 5 | OUT OF 68.8 ACRE TRACT |
| 2011-000 | 6 | Kerr | 8155000000 | H J GRUY | TURTLE CRK | IRRG | 80 | 50 | 10 | |
| 2012-000 | 6 | Kerr | 8154501000 | SANDRA BLAIR | TURTLE CRK | IRRG | 1 | 1 | 5 | |
| 2013-000 | 6 | Kerr | 8154500000 | FELIX R & LILLIAN STEILER REAL | WEST CRK | IRRG | 11 | 12 | | |
| 2014-000 | 6 | Kerr | 8152000000 | LEAH MARTHA STEPHENS | TURTLE CRK | IRRG | 6.36 | 5.63 | | |
| 2014-000 | 6 | Kerr | 8152000000 | BENNO OOSTERMAN ET UX | TURTLE CRK | IRRG | 6.36 | 5.63 | | |
| 2014-000 | 6 | Kerr | 8152000000 | JOHN M LEBOLT TRUSTEE | TURTLE CRK | IRRG | 9.02 | 7.98 | | |
| 2015-000 | 6 | Kerr | 8151000000 | JAMES E NUGENT | GUADALUPE RIVER | IRRG | 27 | 21 | | |
| 2016-000 | 6 | Kerr | 8150500000 | DORIS J HODGES | GUADALUPE RIVER | IRRG | 8 | 8 | | |
| 2017-000 | 6 | Kerr | 8050000000 | COUNTY OF KERR | GUADALUPE RIVER | REC | | | 87 | ALSO USE 8 |
| 2018-000 | 6 | Kerr | 8049000000 | LEE ANTHONY MOSTY | GUADALUPE RIVER | IRRG | 154 | 94 | | |
| 2020-000 | 6 | Kerr | 7970000000 | ROBERT LEE MOSTY | GUADALUPE RIVER | IRRG | 60 | 30 | | |

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 2021-000 | 6 | Kerr | 7940000000 | RAYMOND F MOSTY ET AL | GUADALUPE RIVER | IRRG | 103 | 45 | 5 | |
| 2022-000 | 6 | Kerr | 7950000000 | ROBERT LEE MOSTY | GUADALUPE RIVER | IRRG | 17 | 119 | 20 | |
| 2023-000 | 6 | Kerr | 7935000000 | ROY A GREEN | GUADALUPE RIVER | IRRG | 7 | 3 | | |
| 2024-000 | 6 | Kerr | 7924990000 | CARL E RHODES | GUADALUPE RIVER | IRRG | 114 | 125 | | |
| 2025-000 | 6 | Kerr | 7925000000 | HARRY J WRAY | GUADALUPE RIVER | IRRG | 155 | 80 | | JOINTLY OWNS 155 AF TO IRR 80 ACRES |
| 2025-000 | 6 | Kerr | 7925000000 | DAVID B WRAY | GUADALUPE RIVER | IRRG | | | | JOINTLY OWNS 155 AF TO IRR 80 ACRES |
| 2025-000 | 6 | Kerr | 7925000000 | BYNO SALSMAN ET UX | GUADALUPE RIVER | IRRG | | | | JOINTLY OWNS 155 AF TO IRR 80 ACRES |
| 2026-000 | 6 | Kerr | 7920000000 | ELGIN JUNG | GUADALUPE RIVER | IRRG | 3.309 | 2.118 | | |
| 2026-000 | 6 | Kerr | 7920000000 | ZANE H ROBINSON ET UX | GUADALUPE RIVER | IRRG | 53.945 | 34.52 | | |
| 2026-000 | 6 | Kerr | 7920000000 | RONNIE W SCHLOTTMAN ET UX | GUADALUPE RIVER | IRRG | 17.83 | 11.41 | | |
| 2026-000 | 6 | Kerr | 7920000000 | KENNETH W WHITEWOOD ET UX | GUADALUPE RIVER | IRRG | 149.916 | 44.72 | | AMENDED 11/22/96 |
| 2029-000 | 6 | Kerr | 7710000000 | ROLAND WALTERS | PRISON CANYON | IRRG | 25 | 200 | 420 | & CO 010, 10/5/82 ADD DIV PT |
| 2030-000 | 6 | Kerr | 7704000000 | JAMES S ERNST | UNNAMED TRIB VERDE CRK | IRRG | 247 | | 120 | |
| 2030-000 | 6 | Kerr | 7704000000 | PETE R SMITH | UNNAMED TRIB VERDE CRK | IRRG | 19 | | | |
| 2031-000 | 6 | Kerr | 7701000000 | JOSEPH PAUL MILLER ET UX | GUADALUPE RIVER | IRRG | 115 | 80 | | AMEND 11/4/85 |
| 2032-000 | 6 | Kerr | 7700700000 | DAVID M LEIBOWITZ ET UX | GUADALUPE RIVER | IRRG | 10 | 6 | | |
| 2033-000 | 6 | Kerr | 7699900000 | JAVIER G REYES ET UX | GUADALUPE RIVER | IRRG | 90 | 90 | | |
| 2034-000 | 6 | Kerr | 7699500000 | CHESTER P HEINEN ET AL | GUADALUPE RIVER | IRRG | 2 | 6 | | |
| 2037-000 | 6 | Kerr | 7652500000 | GENE ARTHUR ALLERKAMP | CYPRESS CRK | IRRG | 5 | 6.33 | | |
| 2037-000 | 6 | Kerr | 7652500000 | JANICE CHARLOTTE BULLARD | CYPRESS CRK | IRRG | 5 | 6.34 | | |
| 2037-000 | 6 | Kerr | 7652500000 | ROMAN LUNA ET UX | CYPRESS CRK | IRRG | 10 | 12.67 | | |
| 2037-000 | 6 | Kerr | 7652500000 | CURTIS BERNARD ALLERKAMP | CYPRESS CRK | IRRG | 5 | 6.33 | | |
| 2037-000 | 6 | Kerr | 7652500000 | WERNER WAYNE ALLERKAMP | CYPRESS CRK | IRRG | 5 | 6.33 | | |
| 2038-000 | 6 | Kerr | 7652000000 | HARRY E REEH | CYPRESS CRK | IRRG | 15 | 15 | | |
| 2039-000 | 6 | Kerr | 7650500000 | FRED SAUR | CYPRESS CRK | IRRG | 7 | 7 | | |
| 2040-000 | 6 | Kerr | 7650000000 | A C & DOROTHY PFEIFFER | CYPRESS CRK | IRRG | 10 | 5 | | |
| 2041-000 | 6 | Kerr | 7645000000 | THOMAS L BRUNDAGE ET AL | CYPRESS CRK | IRRG | 134 | 57 | | AMEND 2/1/85 |
| 2042-000 | 6 | Kerr | 7644800000 | E J & VIRGINIA DOWER | CYPRESS CRK | IRRG | 209 | 125 | | |
| 2043-000 | 6 | Kerr | 7644600000 | MARY LEE EDWARDS | CYPRESS CRK | IRRG | 19.57 | 14.68 | | |
| 2043-000 | 6 | Kerr | 7644600000 | EDGAR SEIDENSTICKER ET UX | CYPRESS CRK | IRRG | 16.85 | 12.63 | | |

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 2043-000 | 6 | Kerr | 7644600000 | L J MANNERING ET UX | CYPRESS CRK | IRRG | 3.58 | 2.69 | | |
| 2437-000 | 6 | Kerr | 9550000000 | CHLOE CULLUM KEARNEY ET AL | N FRK GUADALUPE RIVER | REC | | | 100 | D&L. RESERVOIR JOINTLY OWNED BY SEVERAL. |
| 2437-000 | 6 | Kerr | 9550000000 | DAN W BACON ET UX | N FRK GUADALUPE RIVER | REC | | | | D&L. RESERVOIR JOINTLY OWNED BY SEVERAL. |
| 2438-000 | 6 | Kerr | 9528000000 | LUTZ ISSLIEB ET AL | N FRK GUADALUPE RIVER | IRRG | 30 | 18 | 30 | |
| 2439-000 | 6 | Kerr | 9510000000 | DALE B AND MARSHA G ELMORE | N FRK GUADALUPE RIVER | IRRG | 8 | 8 | 20 | AMEND 10/29/90 |
| 2440-000 | 6 | Kerr | 9507000000 | L F SCHERER | N FRK GUADALUPE RIVER | IRRG | 1 | 1 | | |
| 2441-000 | 6 | Kerr | 9490000000 | SILAS B RAGSDALE | N FRK GUADALUPE RIVER | IRRG | 21 | 105 | | |
| 2442-000 | 6 | Kerr | 9486000000 | LUTHER GRAHAM | HONEY CRK | IRRG | 28 | 14 | 17 | |
| 2443-000 | 6 | Kerr | 9476500000 | JOHN H DUNCAN | HONEY CRK | IRRG | 40 | 20 | 25 | |
| 2444-000 | 6 | Kerr | 9980000000 | BRUCE F. HARRISON | S FRK GUADALUPE RIVER | IRRG | 6 | 3 | 10 | |
| 2444-000 | 6 | Kerr | 9980000000 | BRUCE F. HARRISON | S FRK GUADALUPE RIVER | REC | | | 17 | |
| 2445-000 | 6 | Kerr | 9680000000 | CAMP MYSTIC INC | CYPRESS CRK | IRRG | 12 | 15 | | |
| 2445-000 | 6 | Kerr | 9680000000 | CAMP MYSTIC INC | CYPRESS CRK | MUNI | 14 | | 20 | |
| 2446-000 | 6 | Kerr | 9675000000 | BOB/KAT INC | S FRK GUADALUPE RIVER | IRRG | 10 | 10 | | |
| 2446-000 | 6 | Kerr | 9675000000 | BOB/KAT INC | S FRK GUADALUPE RIVER | MUNI | 10 | | | |
| 2447-000 | 6 | Kerr | 9625000000 | CAMP LA JUNTA INC | S FRK GUADALUPE RIVER | IRRG | 26 | 15 | 30 | |
| 2447-000 | 6 | Kerr | 9625000000 | CAMP LA JUNTA INC | S FRK GUADALUPE RIVER | MUNI | 14 | | | & RECREATION |
| 2448-000 | 6 | Kerr | 9350000000 | ALICE CYNTHIA SIMKINS | TEGENER CRK | IRRG | 6 | 5 | | |
| 2449-000 | 6 | Kerr | 9310000000 | BILLIE ZUBER ET AL | GUADALUPE RIVER | IRRG | 17 | 25.5 | | AMEND 9/24/93:ADD ACREAGE.JUNIOR PRIORTY |
| 2450-000 | 6 | Kerr | 7999000000 | ROBERT L MOSTY ET AL | GUADALUPE RIVER | IRRG | 158 | 117 | | |
| 3769-000 | 1 | Kerr | 8300010000 | CITY OF KERRVILLE | GUADALUPE RIVER | MUNI | 3603 | | 840 | |
| 3769-000 | 1 | Kerr | 8300010000 | CITY OF KERRVILLE | GUADALUPE RIVER | IRRG | | 192 | | USING 2450 AF WASTEWATER FROM SEWAGE.SC |
| 3846-000 | 1 | Kerr | 7715000000 | T & R PROPERTIES | PALMER CRK | REC | 322 | | 322 | |
| 3896-000 | 1 | Kerr | 8276000000 | KENNETH W & MARCIA C MULFORD | RATTLESNAKE | MUNI | | | 13 | 3 TRACTS 34.55 AC, ALSO REC |
| 3904-000 | 1 | Kerr | 8275500000 | CITY OF KERRVILLE | QUINLAN CRK | IRRG | 80 | 56 | 10 | & REC-2 RES-146-AC TR-EXPIRES 20 YEARS |
| 4007-000 | 1 | Kerr | 7703100000 | PECAN VALLEY RANCH OWNERS ASSO | ELM CRK | REC | | | 157 | ALSO DOMESTIC & LIVESTOCK |
| 4034-000 | 1 | Kerr | 9040000000 | SHELTON RANCHES INC | JOHNSON CRK | REC | | | 122 | 2 RES, SEE FILE, & ADJ 1974 |
| 4223-000 | 1 | Kerr | 9105000000 | SHELTON RANCHES INC | JOHNSON CRK | IRRG | 20 | 14 | 39 | |

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 4298-000 | 1 | Kerr | 8294800000 | ALISON B MENCAROW LIVING TRUST | TOWN CRK | IRRG | 12 | 18 | | AMEND 12/10/91 |
| 4486-000 | 1 | Kerr | 7644900000 | JAY & HILDA POTH | CYPRESS CRK | IRRG | 70 | 35 | | RATE SEE 18-2041 |
| 5060-000 | 1 | Kerr | 8710000000 | HORACE COFER ASSOCIATES, INC | FALL BR CRK | IRRG | 10 | 12 | | |
| 5122-000 | 1 | Kerr | 8150800000 | JAMES C STORM | GUADALUPE RIVER | IRRG | 75 | 50 | 8 | |
| 5315-000 | 1 | Kerr | 8294000000 | DANA G KIRK TRUSTEE | E TOWN CRK | OTHER | | | | PRIVATE WATER |
| 5322-000 | 1 | Kerr | 8705000000 | E RAND SOUTHARD ET UX | FALL BR | REC | | | | |
| 5331-000 | 1 | Kerr | 9660000000 | KATHLEEN B FLOURNOY, ET AL | S FRK GUADALUPE RIVER | MUNI | 15 | | 30 | & RECREATION |
| 5331-000 | 1 | Kerr | 9660000000 | KATHLEEN B FLOURNOY, ET AL | S FRK GUADALUPE RIVER | IRRG | 96 | 30 | | |
| 5348-000 | 1 | Kerr | 9526000000 | BRYON DONZIS | N FRK GUADALUPE RIVER | IRRG | 5 | 4 | | |
| 5352-000 | 1 | Kerr | 9650000000 | BONITA OWNERS ASSOC INC | S FRK GUADALUPE RIVER | IRRG | 2 | 2 | | |
| 5394-000 | 1 | Kerr | 8300010000 | UPPER GUADALUPE RIVER AUTH | GUADALUPE RIVER | MUNI | 1661 | | | FIRM YIELD BASIS. AMENDED 4/10/98. SCS. |
| 5394-000 | 1 | Kerr | 8300010000 | UPPER GUADALUPE RIVER AUTH | GUADALUPE RIVER | MUNI | 339 | | | FIRM YIELD BASIS. AMENDED 4/10/98. SCS. |
| 5394-000 | 1 | Kerr | 8300010000 | CITY OF KERRVILLE | GUADALUPE RIVER | MUNI | 761 | | | FIRM YIELD BASIS. AMENDED 4/10/98. SCS. |
| 5394-000 | 1 | Kerr | 8300010000 | CITY OF KERRVILLE | GUADALUPE RIVER | MUNI | 339 | | | RUN OF RIVER BASIS. AMENDED 4/10/98.SCS |
| 5394-000 | 1 | Kerr | 8300010000 | CITY OF KERRVILLE | GUADALUPE RIVER | MUNI | 1069 | | | RUN OF RIVER BASIS. AMENDED 4/10/98.SCS |
| 5402-000 | 1 | Kerr | 8155300000 | TURTLE CREEK INDUSTRIES INC | TURTLE CRK | REC | | | | |
| 5444-000 | 1 | Kerr | 8490000000 | EUGENE D ELLIS ET UX | GUADALUPE RIVER | IRRG | 10 | 25.5 | | |
| 5479-000 | 1 | Kerr | 7701250000 | CITY SOUTH MANAGEMENT CORP | GUADALUPE RIVER | IRRG | 566 | 283 | | AMENDED 3/13/98 |
| 5495-000 | 1 | Kerr | 9800000000 | LOIS & JOSEPH WESSENDORF ET AL | S FRK GUADALUPE RIVER | REC | | | 9 | |
| 5521-000 | 1 | Kerr | 8300050000 | DON D WILSON | GUADALUPE LAKE | IRRG | 30 | 30 | | GUADALUPE RIVER |
| 5531-000 | 1 | Kerr | 8185700000 | LEE ROY COSPER ET UX | GUADALUPE RIVER | IRRG | 80 | 40 | | |
| 5536-000 | 1 | Kerr | 7701350000 | ROBERT H & CHARLOTTE JENNINGS | GUADALUPE RIVER | IRRG | 400 | 200 | | |
| 5541-000 | 1 | Kerr | 9476150000 | BASHARDT LTD | N FRK GUADALUPE RIVER | IRRG | 14 | 15 | | |
| 5641-000 | 1 | Kerr | | MARLIN R MARCUM | | IRRG | 1 | 2 | | SUBJECT TO MAINT OF CONTRACT & AGREEMENT |
| 5737-000 | 1 | Kerr | | SYLVIA SIEKER | | IRRG | 1 | | | |
| 12246-000 | 1 | Kerr | | ELIZABETH CARTER | | REC | | | 6.84 | |
| 2671-000 | 6 | Kinney | 4950000000 | MAVERICK CO WCID 1 | RIO GRANDE | IRRG | 134900 | 45000 | | & CO 162, AMEND 8/22/86,9/22/88,10/30/98 |
| 2671-000 | 6 | Kinney | 4950000000 | MAVERICK CO WCID 1 | RIO GRANDE | MUNI | 2049 | | | AMEND 8/22/86,9/22/88,10/30/98 |

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 2671-000 | 6 | Kinney | 4950000000 | MAVERICK CO WCID 1 | RIO GRANDE | REC | 196 | | | AMEND 8/22/86,9/22/88,10/30/98 |
| 2671-000 | 6 | Kinney | 4950000000 | MAVERICK CO WCID 1 | RIO GRANDE | HYDRO | 1085966 | | | AMEND 8/22/86,9/22/88,10/30/98 |
| 2673-000 | 6 | Kinney | 4950000000 | LENDELL MARTIN ET UX | MUD CRK | IRRG | 52 | 35 | 16 | |
| 2674-000 | 6 | Kinney | 4950000000 | CLYDE M BRADLEY | MUD CRK | IRRG | 20 | 15 | | RATE SEE 23-2673 |
| 2675-000 | 6 | Kinney | 4950000000 | SHERWOOD GAINES TRUSTEE | MUD CRK | IRRG | 60 | 30 | | RATE SEE 23-2673 |
| 2676-000 | 6 | Kinney | 4950000000 | JEWEL FOREMAN ROBINSON | PINTO CRK | IRRG | 252 | 126 | | |
| 2678-000 | 6 | Kinney | 4950000000 | JOHNNY E RUTHERFORD | PINTO CRK | IRRG | 135 | 90 | | |
| 2679-000 | 6 | Kinney | 4950000000 | CITY OF BRACKETTVILLE | LAS MORAS SPRING | MUNI | 3 | | | |
| 2680-000 | 6 | Kinney | 4950000000 | ELISE AULGUR HUNTSMAN ET AL | LAS MORAS CRK | IRRG | 15 | 15 | | JOINT OWNER OF 15 AF TO IRR 15 ACRES |
| 2680-000 | 6 | Kinney | 4950000000 | ANN A LEGG & ERNESTINE A LOPEZ | LAS MORAS CRK | IRRG | | | | JOINT OWNER OF 15 AF TO IRR 15 ACRES |
| 2681-000 | 6 | Kinney | 4950000000 | EARL H NOBLES | LAS MORAS CRK | IRRG | 10 | 10 | | |
| 2682-000 | 6 | Kinney | 4950000000 | BERNARD C MEISCHEN ET AL | LAS MORAS CRK | IRRG | 25 | 25 | | |
| 2682-000 | 6 | Kinney | 4950000000 | CHARLES W GAEBLER ET AL | LAS MORAS CRK | IRRG | 75 | 75 | | +50 AF FROM 7 RES FOR STOCK RAISING |
| 2683-000 | 6 | Kinney | 4950000000 | ANDREW P MALINOVSKY JR | LAS MORAS CRK | IRRG | 60 | 30 | | |
| 2684-000 | 6 | Kinney | 4950000000 | BEN S JONES | ELM CRK | IRRG | 47 | 26 | 6 | |
| 2686-000 | 6 | Kinney | 4950000000 | ROBERT H MEISCHEN, ET AL | LAS MORAS CRK | IRRG | 300 | 300 | | |
| 2686-000 | 6 | Kinney | 4950000000 | ROBERT H MEISCHEN, ET AL | LAS MORAS CRK | MUNI | 50 | | | 4 RESERVOIRS |
| 2687-000 | 6 | Kinney | 4950000000 | CELIA R DE PLAZA, ET AL | LAS MORAS CRK | IRRG | 110 | 55 | | |
| 2913-000 | 6 | Kinney | 4950000000 | MOODY RANCHES INC | RIO GRANDE | IRRG | 5500 | 3000 | 17 | |
| 2913-000 | 6 | Kinney | 4950000000 | MOODY RANCHES INC | RIO GRANDE | IRRG | 500 | 250 | | |
| 3071-000 | 6 | Kinney | 7023010000 | LLOYD L DAVIS | W NUECES RIVER | OTHER | | | 25 | IMPOUNDMENT |
| 4365-000 | 1 | Kinney | 7028000000 | ROBERT L MOODY JR | SPRING BR | REC | 10 | | 42 | 4 RES |
| 4389-000 | 1 | Kinney | 4950000000 | FORT CLARK SPRINGS ASSOC INC | LAS MORAS CRK | REC | | | | |
| 4517-000 | 1 | Kinney | 4950000000 | FORT CLARK SPRINGS ASSOC INC | LAS MORAS CRK | REC | | | 3 | |
| 1610-000 | 9 | Medina | 5700000000 | L KEN EVANS | MEDINA RIVER | IRRG | 20 | | | LAKE MEDINA, EXP 2016 |
| 3016-000 | 6 | Real | 9615000000 | JOHN H WATTS III ET UX | E PRONG NUECES RIVER | IRRG | 4 | 2 | | SC. TWO PRIORITY DATES. AMEND 7/10/98 |
| 3016-000 | 6 | Real | 9615000000 | JOHN H WATTS III ET UX | E PRONG NUECES RIVER | IRRG | 54 | 27 | | SC. TWO PRIORITY DATES. AMEND 7/10/98 |
| 3018-000 | 6 | Real | 9450000000 | LEWIS CLECKLER ET UX | SPRING CRK | IRRG | 22.7 | 12.1 | | BULLHEAD HOLLOW |
| 3018-000 | 6 | Real | 9450000000 | EL CAMINO GIRL SCOUT COUNCIL | SPRING CRK | IRRG | 7.3 | 3.9 | | BULLHEAD HOLLOW |
| 3019-000 | 6 | Real | 9410000000 | SARAH M DAVIS | BULLHEAD CRK | IRRG | 80 | 40 | | |

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 3019-000 | 6 | Real | 9410000000 | SARAH M DAVIS | BULLHEAD CRK | IRRG | | 13 | | |
| 3020-000 | 6 | Real | 9320000000 | H C MCCARTY JR ET UX | BULLHEAD CRK | IRRG | 34.736 | 17.368 | | |
| 3020-000 | 6 | Real | 9320000000 | F WALTER CONRAD JR ET UX | BULLHEAD CRK | IRRG | 85.264 | 42.632 | | |
| 3021-000 | 6 | Real | 9198500000 | DSD, INC | BULLHEAD CRK | IRRG | 418 | 210 | | |
| 3022-000 | 6 | Real | 9190000000 | MARVIN L BERRY | UNNAMED TRIB NUECES RIVER | IRRG | 259 | 300 | 14 | TRIB OF NUECES RIVER |
| 3022-000 | 6 | Real | 9190000000 | MARVIN L BERRY | UNNAMED TRIB NUECES RIVER | IRRG | 485 | | | |
| 3025-000 | 6 | Real | 9150000000 | WILLIAM C & WANDA LEA LANE | DRY CRK | IRRG | 40 | 20 | 1 | |
| 3026-000 | 6 | Real | 9075000000 | JOHN A DANIEL ET UX | DRY CRK | IRRG | 16 | 8 | 90 | |
| 3027-000 | 6 | Real | 9050000000 | J F ALSOP | DRY CRK | IRRG | 20 | 10 | | |
| 3028-000 | 6 | Real | 9040000000 | CLARENCE W HARRISON ET UX | DRY CRK | IRRG | 15.43 | 7.72 | 43 | |
| 3028-000 | 6 | Real | 9040000000 | CLARENCE W HARRISON ET UX | DRY CRK | REC | | | 4 | |
| 3028-000 | 6 | Real | 9040000000 | W THOMAS TAYLOR ET UX | DRY CRK | IRRG | 4.36 | 2.18 | | |
| 3029-000 | 6 | Real | 9008000000 | HENRY D ENGELKING | NUECES RIVER | IRRG | 43 | 52 | | |
| 3034-000 | 6 | Real | 9004000000 | HERBERT C JEFFRIES ET UX | NUECES RIVER | IRRG | | 2 | | SEE ADJ 3030 |
| 3036-000 | 6 | Real | 9000000000 | SALVADOR ORTIZ ET AL | NUECES RIVER | IRRG | 125 | 50 | | |
| 3037-000 | 6 | Real | 8950000000 | DAVID WELDON TINDLE | NUECES RIVER | IRRG | 25 | 25 | | |
| 3050-000 | 6 | Real | 8000000000 | W A MALEY | E CAMP WOOD CRK | IRRG | 28 | 14 | | |
| 3051-000 | 6 | Real | 7980000000 | ROBERT J LLOYD ET UX | E CAMP WOOD CRK | IRRG | 1.42 | 1.42 | | |
| 3051-000 | 6 | Real | 7980000000 | WANNA LOU LLOYD | E CAMP WOOD CRK | IRRG | 4.08 | 4.08 | | |
| 3052-000 | 6 | Real | 7970000000 | BARRY BLANKS MCHALEK ET UX | E CAMP WOOD CRK | IRRG | 5 | 5 | | SEE ADJ 3051 |
| 3053-000 | 6 | Real | 7960000000 | BARRY BLANKS MCHALEK ET UX | E CAMP WOOD CRK | IRRG | 1 | 1 | | SEE ADJ 3051 |
| 3054-000 | 6 | Real | 7950000000 | JOHN CHAMBERS ET AL | E CAMP WOOD CRK | IRRG | 10 | 10 | | SEE ADJ 3051 |
| 3055-000 | 6 | Real | 7900000000 | WILLIAM C & PATRICIA K SUTTON | E CAMP WOOD CRK | IRRG | 105 | 130 | 2 | |
| 3056-000 | 6 | Real | 7810000000 | ROY GIBBENS | E CAMP WOOD CRK | IRRG | 18 | 9 | 4 | |
| 3056-000 | 6 | Real | 7810000000 | ROY GIBBENS | E CAMP WOOD CRK | IRRG | 2 | | | |
| 3057-000 | 6 | Real | 7800000000 | MAGELEE V SWIFT | E CAMP WOOD CRK | IRRG | 21 | 16 | 8 | SEE ADJ 3056 |
| 3057-000 | 6 | Real | 7800000000 | MAGELEE V SWIFT | E CAMP WOOD CRK | IRRG | 10 | 4 | 4 | |
| 3058-000 | 6 | Real | 7740000000 | DOROTHY MERRITT ANDERSON | NUECES RIVER | IRRG | 8 | 8 | | |
| 3059-000 | 6 | Real | 7730000000 | F L JR & CHARLOTTE HATLEY | NUECES RIVER | IRRG | 11 | 7 | | |

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 3060-000 | 6 | Real | 7631000000 | E E GILDART | NUECES RIVER | IRRG | 42 | 21 | | |
| 3060-000 | 6 | Real | 7631000000 | E E GILDART | NUECES RIVER | IRRG | 54 | 26 | | |
| 3060-000 | 6 | Real | 7631000000 | E E GILDART | NUECES RIVER | IRRG | 35 | 46 | | |
| 3061-000 | 6 | Real | 7630000000 | E E GILDART | NUECES RIVER | IRRG | 31 | 31 | | |
| 3062-000 | 6 | Real | 7550000000 | JOANNE FRIEND | NUECES RIVER | IRRG | 46 | 46 | | |
| 3145-000 | 6 | Real | 3900000000 | GEORGE S HAWN INTERESTS ET AL | S P/L P W FRIO RIVER | REC | | | 27 | |
| 3145-000 | 6 | Real | 3900000000 | GEORGE S HAWN INTERESTS ET AL | S P/L P W FRIO RIVER | REC | | | 68 | |
| 3145-000 | 6 | Real | 3900000000 | GEORGE S HAWN INTERESTS ET AL | S P/L P W FRIO RIVER | IRRG | 156 | 78 | | |
| 3146-000 | 6 | Real | 3850000000 | JAMES W HALE ET AL | W FRIO RIVER | REC | | | 16 | |
| 3147-000 | 6 | Real | 3810000000 | DIAMOND J RANCH INC | W FRIO RIVER | IRRG | 165 | 55 | | |
| 3148-000 | 6 | Real | 3750000000 | H. E. BUTT FOUNDATION | E FRIO RIVER | REC | 3.5 | | 10 | |
| 3148-000 | 6 | Real | 3750000000 | H. E. BUTT FOUNDATION | E FRIO RIVER | IRRG | 6.5 | 2 | | UPPER SINGING HILLS RESERVOIR |
| 3148-000 | 6 | Real | 3750000000 | H. E. BUTT FOUNDATION | E FRIO RIVER | REC | 11 | | 11 | UNNAMED DOWNSTREAM RESERVOIR (D-0340) |
| 3148-000 | 6 | Real | 3750000000 | H. E. BUTT FOUNDATION | E FRIO RIVER | IRRG | 34.8 | 12.9 | | UNNAMED RESERVOIR (D-0340) |
| 3148-000 | 6 | Real | 3750000000 | H. E. BUTT FOUNDATION | E FRIO RIVER | IRRG | 6.7 | 2.5 | | UNNAMED RESERVOIR (D-0340) |
| 3148-000 | 6 | Real | 3750000000 | H. E. BUTT FOUNDATION | E FRIO RIVER | REC | 25.08 | | 25.08 | LINNET'S WINGS DAM (D-0220);AMEND 3/91 |
| 3148-000 | 6 | Real | 3750000000 | H. E. BUTT FOUNDATION | E FRIO RIVER | IRRG | 3.2 | 1.2 | | LINNET'S WINGS DAM (D-0220) |
| 3148-000 | 6 | Real | 3750000000 | H. E. BUTT FOUNDATION | E FRIO RIVER | REC | 34 | | 68.7 | LAITY LODGE DAM (D-0240):AF/WATERFALL |
| 3148-000 | 6 | Real | 3750000000 | H. E. BUTT FOUNDATION | E FRIO RIVER | IRRG | 4 | 2 | | LAITY LODGE DAM (D-0240) |
| 3148-000 | 6 | Real | 3750000000 | H. E. BUTT FOUNDATION | E FRIO RIVER | REC | 5.51 | | 5.51 | LOWER SINGING HILLS DAM (D-0280) |
| 3148-000 | 6 | Real | 3750000000 | H. E. BUTT FOUNDATION | E FRIO RIVER | IRRG | 4.1 | 1.5 | | LOWER SINGING HILLS DAM (D-0280) |
| 3148-000 | 6 | Real | 3750000000 | H. E. BUTT FOUNDATION | E FRIO RIVER | REC | 2.64 | | 2.64 | SILVER CREEK DAM (D-0300) |
| 3148-000 | 6 | Real | 3750000000 | H. E. BUTT FOUNDATION | E FRIO RIVER | REC | 0.24 | | 0.24 | LOWER SILVER CREEK DAM (D-0320) |
| 3148-000 | 6 | Real | 3750000000 | H. E. BUTT FOUNDATION | E FRIO RIVER | REC | 17.86 | | 17.86 | ECHO VALLEY DAM (D-0360) |
| 3149-000 | 6 | Real | 3660000000 | ORA L ROGERS ESTATE | E FRIO RIVER | IRRG | 30 | 28 | | |
| 3150-000 | 6 | Real | 3655000000 | R F BINDOCK | E FRIO RIVER | IRRG | 3 | 11 | | |
| 3151-000 | 6 | Real | 3620000000 | KATHERINE MAXINE MORELAND | E FRIO RIVER | IRRG | 67 | 30 | | |
| 3152-000 | 6 | Real | 3600000000 | DAN AULD, JR | E FRIO RIVER | IRRG | 324 | 162 | | |

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 3153-000 | 6 | Real | 3490000000 | JOHN J BURDITT, ET AL | UNNAMED TRIB E FRIO RIVER | IRRG | 15 | 50 | | |
| 3153-000 | 6 | Real | 3490000000 | JOHN J BURDITT, ET AL | UNNAMED TRIB E FRIO RIVER | IRRG | 23 | | | |
| 3154-000 | 6 | Real | 3430000000 | JAMES TREES | YOUNGBLOOD SPRING | IRRG | 2 | 6 | | |
| 3155-000 | 6 | Real | 3420000000 | LOTTIE N WRIGHT | FRIO RIVER | IRRG | 164 | 43 | | |
| 3156-000 | 6 | Real | 3400000000 | H P COOPER ET AL | FRIO RIVER | IRRG | 20 | 22 | | |
| 3156-000 | 6 | Real | 3400000000 | H P COOPER ET AL | FRIO RIVER | IRRG | 2 | | | |
| 3157-000 | 6 | Real | 3350000000 | E F BAYOUTH, MD PENSION PLAN | FRIO RIVER | IRRG | 250 | 125 | | AMEND 1/9/85. CURRENT OWNER UNKNOWN 5/98 |
| 3158-000 | 6 | Real | 3375000000 | LOMBARDY IRRIGATION CO | FRIO RIVER | IRRG | 1600 | 800 | 6 | ALSO COUNTY 232 |
| 3159-000 | 6 | Real | 3294000000 | SAM G HARRISON | FRIO RIVER | IRRG | 140 | 70 | | |
| 3160-000 | 6 | Real | 3290000000 | GRACIA BASSETT HABY | FRIO RIVER | IRRG | 60 | 100 | | JOINTLY OWNS 60 AF TO IRR 100 ACRES |
| 3160-000 | 6 | Real | 3290000000 | THEODORE R REED TRUSTEE | FRIO RIVER | IRRG | | | | JOINTLY OWNS 60 AF TO IRR 100 ACRES |
| 3161-000 | 6 | Real | 3289500000 | R L HUBBARD | DRY FRIO CRK | IRRG | 17 | 21 | | |
| 3162-000 | 6 | Real | 3287500000 | CARL A. DETERING, JR., ET AL | UNNAMED TRIB BUFFALO CRK | IRRG | 5 | 25 | 15 | |
| 3180-000 | 6 | Real | 2799000000 | LANA J STORMONT | UNNAMED TRIB W SABINAL RIVER | IRRG | 5 | 10 | | |
| 3878-000 | 1 | Real | 3645000000 | C B SLABAUGH | CYPRESS CRK | IRRG | 40 | 30 | | 68-AC TR, SC, AMEND 11/12/84 |
| 3978-000 | 1 | Real | 9421000000 | N M FITZGERALD JR ESTATE | FLYNN CRK | IRRG | 187 | 63 | | 156.95-AC TR, SC |
| 4008-000 | 1 | Real | 9172500000 | DOUGLAS B & MARGARET MARSHALL | NUECES RIVER | IRRG | 400 | 200 | | AMEND 12/15/81 INCR AC-FT, ACRES, CFS |
| 4094-000 | 1 | Real | 3905500000 | GEORGE S HAWN INTERESTS ET AL | W FRIO RIVER | IRRG | 56 | 28 | 9 | OUT OF 1118 ACRES |
| 4169-000 | 1 | Real | 7910000000 | ROARING SPRINGS RANCH INC | CAMP WOOD CRK | IRRG | 15 | 10 | 41 | 6 RES & REC |
| 4169-000 | 1 | Real | 7910000000 | ROARING SPRINGS RANCH INC | CAMP WOOD CRK | MUNI | 15 | | | |
| 4405-000 | 1 | Real | 7760000000 | CITY OF CAMP WOOD | UNNAMED TRIB NUECES RIVER | MUNI | 1000 | | | |
| 4405-000 | 1 | Real | 7760000000 | CITY OF CAMP WOOD | UNNAMED TRIB NUECES RIVER | IRRG | 83 | 16 | | |
| 4413-000 | 1 | Real | 8240000000 | WILLIAM C SUTTON ET UX | CAMP WOOD CRK | REC | | | 2 | |
| 5009-000 | 1 | Real | 3830000000 | JACKSON L BABB ET AL | W FRIO RIVER | IRRG | 60 | 30 | | |
| 2653-000 | 6 | Val Verde | 4950000000 | PHIL B FOSTER | CIENEGAS CRK &/OR THE RIO GRANDE | IRRG | 122.25 | 61.13 | | AMEND 10/15/91 |
| 2653-000 | 6 | Val Verde | 4950000000 | DAVID B TERK ET AL | CIENEGAS CRK | IRRG | 27.75 | 13.87 | | AMEND 10/15/91 |
| 2654-000 | 6 | Val Verde | 4950000000 | THURMAN W OWENS | CIENEGAS CRK | IRRG | 26 | 13 | | RATE SEE 23-2653 |

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 2655-000 | 6 | Val Verde | 4950000000 | JOSE C OVIEDO ET UX | CIENEGAS CRK | IRRG | 28 | 14 | | RATE SEE 23-2653 |
| 2656-000 | 6 | Val Verde | 4950000000 | RANDOLPH J N & SHARON M ABBEY | CIENEGAS CRK | IRRG | 68 | 43 | | RATE SEE 23-2653 |
| 2657-000 | 6 | Val Verde | 4950000000 | RONALD J PERSYN ET UX | CIENEGAS CRK | IRRG | 150 | 75 | | RATE SEE 23-2653 |
| 2657-000 | 6 | Val Verde | 4950000000 | RONALD J. PERSYN, ET UX | CIENEGAS CRK | IRRG | 150 | 68 | | SEE 23-2653 RATE; AMEND 10/89 |
| 2657-000 | 6 | Val Verde | 4950000000 | RONALD J. PERSYN, ET UX | CIENEGAS CRK | IRRG | | 89 | | AMEND 8/2/94 |
| 2659-000 | 6 | Val Verde | 4950000000 | JOHN F QUALIA | CIENEGAS CRK | IRRG | 112 | 56 | | FOR RATE SEE 23-2653 |
| 2660-000 | 6 | Val Verde | 4950000000 | JOSE A CORTINAS ET AL | CIENEGAS CRK | IRRG | 16 | 5 | | |
| 2660-000 | 6 | Val Verde | 4950000000 | LJB ENTERPRISES | CIENEGAS CRK | IRRG | 296 | 99 | | |
| 2661-000 | 6 | Val Verde | 4950000000 | BARBARA GULICK RATHKE, ET AL | CIENEGAS CRK | IRRG | 120 | 40 | 10 | |
| 2662-000 | 6 | Val Verde | 4950000000 | CAPITOL AGGREGATES INC | CIENEGAS CRK | MINE | 166 | 17 | | AMEND 11/2/87 |
| 2663-000 | 6 | Val Verde | 4950000000 | ALFREDO GUTIERREZ JR | CIENEGAS CRK | IRRG | 24 | 8 | | |
| 2664-000 | 6 | Val Verde | 4950000000 | SAN FELIPE A MFG & I COMPANY | SAN FELIPE CRK | IRRG | 4950 | 1700 | | AMEND 12/16/88, 10/31/94 |
| 2664-000 | 6 | Val Verde | 4950000000 | SAN FELIPE A MFG & I COMPANY | SAN FELIPE CRK | IRRG | 6 | | 6 | IMPOUNDMENT #1 |
| 2664-000 | 6 | Val Verde | 4950000000 | SAN FELIPE A MFG & I COMPANY | SAN FELIPE CRK | IRRG | 6 | | 6 | IMPOUNDMENT #2 |
| 2664-000 | 6 | Val Verde | 4950000000 | SAN FELIPE A MFG & I COMPANY | SAN FELIPE CRK | INDU | 50 | | | AMENDMENT EXP 12/31/96 |
| 2665-000 | 6 | Val Verde | 4950000000 | JOSE OVIEDO JR ET UX | SAN FELIPE CRK | IRRG | 60 | 40 | | AMENDED 9/13/96 |
| 2666-000 | 6 | Val Verde | 4950000000 | PETRA ABREGO MUNOZ | SAN FELIPE CRK | IRRG | 23.56 | 7.85 | | |
| 2669-000 | 6 | Val Verde | 4950000000 | RODOLFO MOTA | SAN FELIPE CRK | IRRG | 6 | 2 | | |
| 2670-000 | 6 | Val Verde | 4950000000 | VICTOR D BOLNER | SAN FELIPE CRK | IRRG | 6 | 3 | | |
| 2672-000 | 6 | Val Verde | 4950000000 | CITY OF DEL RIO | SAN FELIPE CRK | MUNI | 4416 | | | |
| 2672-000 | 6 | Val Verde | 4950000000 | CITY OF DEL RIO | SAN FELIPE CRK | MUNI | 7000 | | | |
| 2811-000 | 6 | Val Verde | 4950000000 | RIO BRAVO INC | CIENEGAS CRK &/OR THE RIO GRANDE | IRRG | 51.08 | 997.97 | 47 | & REC/DOM, AMEND 1/84,6/91 |
| 2811-000 | 6 | Val Verde | 4950000000 | DAVID B TERK | CIENEGAS CRK | IRRG | 114.64 | 95.38 | | |
| 2912-000 | 6 | Val Verde | 4950000000 | MOODY RANCHES INC | SAN FELIPE CRK | IRRG | 800 | 400 | 10 | |

| Water Right Number | Type | County | River Order Permit | Name | Stream | Use | Amount in Ac-Ft/Yr | Acreage | Res Cap in Ac-Ft | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 3880-000 | 1 | Val Verde | 4950000000 | SOUTH TEXAS ELECTRIC CO-OP INC | RIO GRANDE | HYDRO | 1500000 | | | AMEND 12/14/87. POWER POOL WITH MEDINA. |
| 3880-000 | 1 | Val Verde | 4950000000 | MEDINA ELECTRIC CO-OP INC | RIO GRANDE | HYDRO | | | | AMEND 12/14/87. POWER POOL WITH S.TX.EL. |
| 5506-000 | 1 | Val Verde | 4950000000 | DEL RIO, CITY OF | SAN FELIPE CRK | REC | | | 0.19 | WATER PARK LANDING POOL |

# CHAPTER 4
# IDENTIFICATION OF WATER NEEDS

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# 4 IDENTIFICATION OF WATER NEEDS

Chapter 4 provides projections (Table 4-1) of water supply surpluses or deficits by decade based on a comparison of projected water demands by decade for each water-use entity from Chapter 2 with water supplies available to meet those demands from Chapter 3. Entities are then identified that, in any decade within the 50-year planning period, develop a water-supply need (deficit) that is greater than that entity's ability to provide a supply to meet that need. A water-supply deficit may develop for individual water-use entities for numerous reasons including supply availability limits, infrastructure limitations, or legal limits. Table 4-2 provides the WUG's needs/surpluses analyses by category of use. Tables 4-3 and 4-4 provide a similar analysis by Major Water Providers (Del Rio Utilities Commission) and by category of use by the Major Water Provider.

Municipal water supply deficits are identified for Bandera County FWSD 1, Camp Wood, City of Del Rio, Laughlin Air Force Base, Rocksprings and County-Other (rural) in Bandera and Kerr Counties. Irrigation shortages are shown in Bandera County; mining shortages in Edwards, Kerr, and Val Verde Counties; and livestock shortages in Bandera, Kerr and Kinney Counties. Water management strategies developed for this *Plan* are intended to meet all projected water supply shortages.

A second tier water needs analysis for all water user groups and major water providers for which conservation or direct reuse water management strategies are recommended is provided in the TWDB Database-22 tables in the Executive Summary Appendix (WUG Second-Tier Identified Water Needs). This second tier water needs analysis calculates the water needs that would remain after assuming all recommended conservation and reuse water management strategies are fully implemented. Del Rio Utilities Commission is listed in these tables as both a WUG and MWP and is therefore listed in the above TWDB table in the Executive Summary. Unmet needs resulting from insufficient supplies to meet certain strategies is also included in the TWDB tables in the Executive Summary.

Water supply strategy recommendations are then made in Chapter 5 for those water users that have projected water supply deficits based on the comparison between demand and supply. In addition, strategies are also developed for specific entities that although they are not projected to have future shortages, they do have anticipated water-supply projects that deserve to be recognized in the *Regional Plan*. A socioeconomic impact of unmet water needs analysis prepared by the Texas Water Development Board is provided in Appendix 6A.

It is important to note that the methodology used to estimate water needs/surpluses for County-Other use depicts water supply available to County-Other (as a whole), except in portions of counties where sub-WUGs have been identified. The methodology assumes that all County-Other water supply is available to satisfy demand, whereas, in reality, County-Other population and water demand are often concentrated in smaller areas of the county such as unincorporated communities, subdivisions and mobile home parks which cannot access water supply available in other areas of the county. The reflected surplus depicted in the tables may or may not be an accurate estimate depending on population densities. Increasing population density increases water demand by straining available local water supply resources though the County-Other (as a whole) reflects adequate supply.

**Table 4-1. Identified Water (Needs)/Surpluses**
**(Acre Feet per Year)**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Bandera County** | | | | | | |
| **Guadalupe Basin** | | | | | | |
| County-Other | 21 | 20 | 19 | 19 | 19 | 19 |
| Livestock | (2) | (2) | (2) | (2) | (2) | (2) |
| **Nueces Basin** | | | | | | |
| County-Other | 321 | 308 | 301 | 299 | 297 | 296 |
| Livestock | (3) | (3) | (3) | (3) | (3) | (3) |
| Irrigation | 102 | 102 | 102 | 102 | 102 | 102 |
| **San Antonio Basin** | | | | | | |
| Bandera | 192 | 151 | 130 | 121 | 115 | 111 |
| Bandera County FWSD 1 | (66) | (83) | (92) | (96) | (99) | (100) |
| County-Other \| Bandera River Ranch 1 | (28) | (39) | (44) | (46) | (48) | (49) |
| County-Other \| Lake Medina Shores | (196) | (225) | (239) | (244) | (248) | (251) |
| County-Other \| Medina WSC | (35) | (46) | (51) | (53) | (54) | (55) |
| County-Other | 2,970 | 2,770 | 2,669 | 2,633 | 2,603 | 2,586 |
| Livestock | 11 | 11 | 11 | 11 | 11 | 11 |
| Irrigation | (75) | (75) | (75) | (75) | (75) | (75) |
| **Bandera County Total Needs/Surplus** | **3,212** | **2,889** | **2,726** | **2,666** | **2,618** | **2,590** |
| **Edwards County** | | | | | | |
| **Colorado Basin** | | | | | | |
| Rocksprings | 673 | 677 | 680 | 681 | 681 | 681 |
| County-Other | 42 | 43 | 43 | 43 | 43 | 43 |
| Mining | (12) | (12) | (12) | (12) | (12) | (12) |
| Livestock | 365 | 365 | 365 | 365 | 365 | 365 |
| Irrigation | 44 | 44 | 44 | 44 | 44 | 44 |
| **Nueces Basin** | | | | | | |
| Rocksprings | (98) | (96) | (94) | (94) | (94) | (94) |
| County-Other \| Barksdale WSC | 81 | 82 | 83 | 84 | 84 | 84 |
| County-Other | 120 | 122 | 124 | 124 | 124 | 124 |
| Mining | (16) | (16) | (16) | (16) | (16) | (16) |
| Livestock | 14 | 14 | 14 | 14 | 14 | 14 |
| Irrigation | 114 | 114 | 114 | 114 | 114 | 114 |
| **Rio Grande Basin** | | | | | | |
| County-Other | 22 | 22 | 23 | 23 | 23 | 23 |
| Mining | (31) | (31) | (31) | (31) | (31) | (31) |
| Livestock | 11 | 11 | 11 | 11 | 11 | 10 |
| Irrigation | 10 | 10 | 10 | 10 | 10 | 10 |
| **Edwards County Total Needs/Surplus** | **1,339** | **1,349** | **1,358** | **1,360** | **1,360** | **1,360** |
| **Kerr County** | | | | | | |
| **Colorado Basin** | | | | | | |
| County-Other | 21 | 20 | 20 | 20 | 19 | 18 |
| Mining | (11) | (12) | (15) | (16) | (17) | (19) |
| Livestock | (119) | (119) | (119) | (119) | (119) | (119) |
| Irrigation | 31 | 31 | 31 | 31 | 31 | 31 |

**Table 4-1. (Continued) Identified Water (Needs)/Surpluses**
**(Acre Feet per Year)**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Kerr County** | | | | | | |
| **Guadalupe Basin** | | | | | | |
| Kerrville | 1,551 | 1,475 | 1,455 | 1,396 | 1,328 | 1,269 |
| Kerrville South Water | 46 | 41 | 40 | 35 | 29 | 24 |
| County-Other \| Center Point | (3) | (3) | (3) | (3) | (3) | (4) |
| County-Other \| Center Point North Water System | 1 | 1 | 1 | 1 | 0 | 0 |
| County-Other \| Center Point Taylor System | (2) | (2) | (3) | (3) | (4) | (5) |
| County Other \| Hills and Dales Estates | 1 | 1 | 1 | 0 | 0 | 0 |
| County-Other \| Nickerson Farm Water System | 5 | 5 | 5 | 5 | 4 | 4 |
| County-Other \| Oak Forest South Water | 24 | 23 | 23 | 22 | 21 | 20 |
| County-Other \| Park Place Subdivision | 3 | 3 | 3 | 3 | 3 | 2 |
| County-Other \| Pecan Valley | 2 | 1 | 1 | 1 | 1 | 1 |
| County-Other \| Rustic Hills Water | 2 | 2 | 2 | 2 | 2 | 2 |
| County-Other \| Verde Park Estates | 1 | 1 | 1 | 1 | 0 | 0 |
| County-Other \| Westwood Water System | 5 | 5 | 5 | 5 | 4 | 4 |
| County-Other | 6,525 | 6,493 | 6,489 | 6,458 | 6,420 | 6,387 |
| Manufacturing | 28 | 27 | 27 | 27 | 27 | 27 |
| Mining | 60 | 57 | 40 | 39 | 31 | 24 |
| Livestock | (173) | (173) | (173) | (173) | (173) | (173) |
| Irrigation | 421 | 421 | 421 | 421 | 421 | 421 |
| **Nueces Basin** | | | | | | |
| County-Other | (1) | (1) | (1) | (1) | (1) | (1) |
| Livestock | (6) | (6) | (6) | (6) | (6) | (6) |
| **San Antonio Basin** | | | | | | |
| County-Other | 238 | 238 | 237 | 237 | 237 | 236 |
| Livestock | (27) | (27) | (27) | (27) | (27) | (27) |
| Irrigation | 21 | 21 | 21 | 21 | 21 | 21 |
| **Kerr County Total Needs/Surplus** | **8,644** | **8,523** | **8,476** | **8,377** | **8,249** | **8,137** |
| **Kinney County** | | | | | | |
| **Nueces Basin** | | | | | | |
| County-Other | 23 | 23 | 23 | 23 | 24 | 24 |
| Livestock | (27) | (27) | (27) | (27) | (27) | (27) |
| Irrigation | 1,057 | 1,057 | 1,057 | 1,057 | 1,057 | 1,057 |
| **Rio Grande Basin** | | | | | | |
| Brackettville | 37 | 43 | 51 | 52 | 53 | 53 |
| Fort Clark Springs MUD | 753 | 755 | 759 | 761 | 762 | 762 |
| County-Other | 112 | 113 | 114 | 114 | 114 | 114 |
| Livestock | 197 | 197 | 197 | 197 | 197 | 197 |
| Irrigation | 5,580 | 5,580 | 5,580 | 5,580 | 5,580 | 5,580 |
| **Kinney County Needs/Surplus** | **7,732** | **7,741** | **7,754** | **7,757** | **7,760** | **7,760** |

**Table 4-1. (Continued) Identified Water (Needs)/Surpluses**
**(Acre Feet per Year)**

| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Real County** | | | | | | |
| **Colorado Basin** | | | | | | |
| County-Other | 11 | 11 | 12 | 12 | 12 | 12 |
| Livestock | 5 | 5 | 5 | 5 | 5 | 5 |
| Irrigation | 176 | 176 | 176 | 176 | 176 | 176 |
| **Nueces Basin** | | | | | | |
| Camp Wood | (143) | (139) | (136) | (135) | (135) | (135) |
| Leakey | 105 | 112 | 118 | 120 | 121 | 121 |
| County-Other | 352 | 356 | 359 | 361 | 361 | 361 |
| Livestock | 38 | 38 | 38 | 38 | 38 | 38 |
| Irrigation | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 |
| **Real County Total Needs/Surplus** | **2,224** | **2,239** | **2,252** | **2,257** | **2,258** | **2,258** |
| **Val Verde County** | | | | | | |
| **Rio Grande Basin** | | | | | | |
| Del Rio Utilities Commission | (4,423) | (4,918) | (5,419) | (5,995) | (6,598) | (7,191) |
| Laughlin AFB | (87) | (183) | (284) | (346) | (345) | (345) |
| County-Other | 1,388 | 1,057 | 727 | 362 | (12) | (377) |
| Mining | (151) | (210) | (220) | (184) | (153) | (132) |
| Livestock | 96 | 96 | 96 | 96 | 96 | 96 |
| Irrigation | 4,267 | 4,267 | 4,267 | 4,267 | 4,267 | 4,267 |
| **Val Verde County Total Needs/Surplus** | **1,090** | **109** | **(833)** | **(1,800)** | **(2,745)** | **(3,682)** |
| **Region J Total Needs/Surplus** | **24,241** | **22,850** | **21,733** | **20,617** | **19,500** | **18,423** |

**Table 4-2. Identified Water (Needs)/Surpluses by Category**

| WUG COUNTY | WUG CATEGORY | WUG WATER SUPPLY (NEED)/ SURPLUS 2020 | WUG WATER SUPPLY (NEED)/ SURPLUS 2030 | WUG WATER SUPPLY (NEED)/ SURPLUS 2040 | WUG WATER SUPPLY (NEED)/ SURPLUS 2050 | WUG WATER SUPPLY (NEED)/ SURPLUS 2060 | WUG WATER SUPPLY (NEED)/ SURPLUS 2070 |
|---|---|---|---|---|---|---|---|
| Bandera | Municipal | 3,179 | 2,856 | 2,693 | 2,633 | 2,585 | 2,557 |
| | Irrigation | 27 | 27 | 27 | 27 | 27 | 27 |
| | Livestock | 6 | 6 | 6 | 6 | 6 | 6 |
| Edwards | Municipal | 840 | 850 | 859 | 861 | 861 | 861 |
| | Irrigation | 168 | 168 | 168 | 168 | 168 | 168 |
| | Livestock | 390 | 390 | 390 | 390 | 390 | 390 |
| | Mining | (59) | (59) | (59) | (59) | (59) | (59) |
| Kerr | Municipal | 8,419 | 8,303 | 8,276 | 8,179 | 8,060 | 7,957 |
| | Irrigation | 473 | 473 | 473 | 473 | 473 | 473 |
| | Livestock | (325) | (325) | (325) | (325) | (325) | (325) |
| | Manufacturing | 28 | 27 | 27 | 27 | 27 | 27 |
| | Mining | 49 | 45 | 25 | 23 | 14 | 5 |
| Kinney | Municipal | 925 | 934 | 947 | 950 | 953 | 953 |
| | Irrigation | 6,637 | 6,637 | 6,637 | 6,637 | 6,637 | 6,637 |
| | Livestock | 170 | 170 | 170 | 170 | 170 | 170 |
| Real | Municipal | 325 | 340 | 353 | 358 | 359 | 359 |
| | Irrigation | 1,856 | 1,856 | 1,856 | 1,856 | 1,856 | 1,856 |
| | Livestock | 43 | 43 | 43 | 43 | 43 | 43 |
| Val Verde | Municipal | (3,122) | (4,044) | (4,976) | (5,979) | (6,955) | (7,913) |
| | Irrigation | 4,267 | 4,267 | 4,267 | 4,267 | 4,267 | 4,267 |
| | Livestock | 96 | 96 | 96 | 96 | 96 | 96 |
| | Mining | -151 | -210 | -220 | -184 | -153 | -132 |

**Table 4-3. Del Rio Major Water Provider Identified Water (Needs)/Surpluses**

| County | Basin | Major Water Provider | Receiving Entity | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|---|---|
| Val Verde | Rio Grande | Del Rio Utilities | City of Del Rio | (4,423) | (4,918) | (5,419) | (5,995) | (6,598) | (7,191) |
| | | | Laughlin AFB | (87) | (183) | (284) | (346) | (345) | (345) |
| | | | County Other | 1,388 | 1,057 | 727 | 362 | (12) | (377) |

**Table 4-4. Del Rio Major Water Provider Identified Water (Needs)/Surpluses by Category**

| County | Basin | Use Category | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|---|
| Val Verde | Rio Grande | Municipal | (3,122) | (4,044) | (4,976) | (5,979) | (6,955) | (7,913) |
| | | Manufacturing | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Irrigation | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Mining | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Livestock | 0 | 0 | 0 | 0 | 0 | 0 |

# CHAPTER 5

# WATER MANAGEMENT STRATEGIES AND CONSERVATION RECOMMENDATIONS

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# 5 WATER MANAGEMENT STRATEGIES AND CONSERVATION RECOMMENDATIONS

The Plateau Water Planning Group (PWPG) has identified and evaluated a total of 67 water management strategies for the *2021 Plateau Region Water Plan*. Water management strategies are developed for entities where future water supply needs exist (as required by statute and administrative rules 31 TAC §357.34; 357.35). A need for water is identified when existing water supplies are less than projected water demands for that same WUG within any planning decade. In addition, water management strategies were developed for other entities requesting specific water supply projects, even though these entities did not have a projected water supply shortage.

## 5.1 IDENTIFICATION OF POTENTIALLY FEASIBLE WATER MANAGEMENT STRATEGIES

The first step in developing a list of recommended water management strategies is to take a "big picture" look at possible projects that could reasonably be expected to result in water-supply improvements. As required by TWC §16.053(e)(3), and 31 TAC §357.34(c) the Regional Water Planning Groups shall consider, **but not be limited to considering**, the following types of water management strategies for all identified water needs:

1. Conservation
2. Drought management
3. Reuse
4. Management of existing water supplies
5. Conjunctive use
6. Acquisition of available existing water supplies
7. Development of new water supplies
8. Developing regional water supply facilities or providing regional management of water supply facilities
9. Developing large-scale desalination facilities for seawater or brackish groundwater that serve local or regional brackish groundwater production zones identified and designated under TWC §16.060(b)(5)34
10. Developing large-scale desalination facilities for marine seawater that serve local or regional entities
11. Voluntary transfer of water within the region using, but not limited to, contracts, water marketing, regional water banks, sales, leases, options, subordination agreements, and financing agreements
12. Emergency transfer of water under TWC §11.139
13. Interbasin transfers of surface water
14. System optimization
15. Reallocation of reservoir storage to new uses
16. Enhancements of yields
17. Improvements to water quality
18. New surface water supply
19. New groundwater supply
20. Brush control
21. Precipitation enhancement
22. Aquifer storage and recovery
23. Cancellation of water rights
24. Rainwater harvesting

Other potential projects considered for the initial list included:

- appropriate strategies from the *2016 Plan*
- water-loss audits and line replacement
- projects suggested by municipalities through a survey
- projects that are currently or have recently applied to the TWDB for funding

The following process was used by the PWPG to identify *potentially feasible water management strategies.*

1. Receive a *Needs Analysis Report* from the TWDB, which provides a comparison of existing water supplies and projected water demands for each water user group (WUG) and wholesale water provider (WWP) in the Region. Based on this comparison, the report identifies WUGs and WWPs that are expected to experience needs for additional water supplies within the 50-year time frame of the *Regional Water Plan*. Using the following process, identify and select potentially feasible water management strategies for each of these entities.
   2. Review and consider recommended water management strategies adopted by the water planning group for the *2016 Plateau Region Water Plan.*
   3. Review and consider any issues identified in the most current TWDB Water Loss Audit Report, including leak detection and supply side analysis.
   4. Solicit current water planning information, including specific water management strategies of interest from WUGs and WWPs with identified needs.
   5. Review and consider the most recent Water Supply Management, Water Conservation, and/or Drought Contingency Plans, where available, from WUGs and WWPs with identified needs.
   6. Consider potentially feasible water management strategies that may include, but are not limited to (Chapter 357 Subchapter C §357.34):
      - Extended use of existing supplies including:
        a. System optimization and conjunctive use of water resources
        b. Reallocation of reservoir storage to new uses
        c. Voluntary redistribution of water resources including contracts, water marketing, regional water banks, sales, leases, options, subordination agreements, and financing agreements
        d. Subordination of existing water rights through voluntary agreements
        e. Enhancement of yields of existing sources
        f. Improvement of water quality including control of naturally occurring chlorides
        g. Drought management
      - New supply development including:
        a. Construction and improvement of surface water and groundwater resources
        b. Brush control
        c. Precipitation enhancement
        d. Desalination
        e. Water supply that could be made available by cancellation of water rights
        f. Rainwater harvesting
        g. Aquifer storage and recovery
      - Conservation and drought management measures including demand management
      - Reuse of wastewater

- Interbasin transfers of surface water
- Emergency transfers of surface water

7. Consider other potentially feasible water management strategies suggested by planning group members, stakeholders, and the public.
8. Based on the above reviews and considerations, establish a preliminary list of potentially feasible water management strategies. At a discussion level, consider the following feasibility concerns for each strategy:
   - Water supply source availability during drought-of-record conditions
   - Cost/benefit
   - Water quality
   - Threats to agriculture and natural resources
   - Impacts to the environment, other water resources, and basin transfers
   - Socio-economic impacts
9. Based on the above discussion level analysis, select a final list of potentially feasible water management strategies for further technical evaluation using detailed analysis criteria.

Using the above criteria and process, the PWPG selected the initial potentially feasible water management strategies listed in Table 5-1 for further detailed analysis. All strategy analyses recognize and protect existing water rights, water contracts, and option agreements. As the water management strategy analysis progressed, it became evident that the initial list would require modification of project descriptive names, and the possible addition of new strategies and the elimination or transfer of others. Much time was spent in communication with individual WUGs (municipalities, irrigation districts, etc.) to ensure that the strategies discussion met with their approval. The evaluation and final recommendation of water management strategies are provided in Appendix 5A at the end of this chapter.

Although these strategy types were considered by the PWPG, not all of them were considered viable options for addressing long-term needs in the region. The PWPG does not consider drought management as a feasible strategy to meet long-term growth in demands or current needs. This strategy is considered a temporary measure aimed at conserving available water supplies during times of drought or emergencies. Drought management is most adequately addressed in the region through the implementation of local drought contingency plans. The PWPG is supportive of the development and use of these plans during periods of drought or emergency water needs.

**Table 5-1. Potentially Feasible Water Management Strategies**

| County | Water User Group | Strategy Source Basin | Water Management Strategy |
|---|---|---|---|
| Bandera | City of Bandera | San Antonio | Reuse treated wastewater effluent for irrigation use |
| | | | Promote, design & install rainwater harvesting systems |
| | | | Additional Lower Trinity well and lay necessary pipeline |
| | | | Additional Middle Trinity wells within city infrastructure |
| | | | Surface water acquisition, treatment and ASR |
| | *Bandera County FWSD#1 | San Antonio | Conservation |
| | | | New strategy - Additional groundwater well |
| | *Bandera County Other (Bandera River Ranch #1) | San Antonio | Water loss audit and main-line repair |
| | *Bandera County Other (Lake Medina Shores) | San Antonio | Conservation |
| | | | Additional groundwater wells |
| | *Bandera County Other (Medina WSC) | San Antonio | Conservation |
| | | | Additional groundwater well for the Town of Medina |
| | Bandera County Other | San Antonio | Drought management (BCRAGD) |
| | | | Additional groundwater well for Pebble Beach Subdivision |
| | | | Additional groundwater wells to provide emergency supply to VFD |
| | | | Water loss audit and main-line repair for Enchanted River Estates |
| | | | **Vegetative Management |
| | | Nueces | Drought management (BCRAGD) |
| | *Bandera County Irrigation | San Antonio | Conservation |
| | | | Additional groundwater wells |
| | *Bandera County Livestock | *Guadalupe | Conservation |
| | | | Additional groundwater well |
| | | *Nueces | Conservation |
| | | | Additional groundwater well |
| Edwards | *City of Rocksprings | *Nueces | Conservation |
| | | | Additional groundwater well |
| | Edwards County Other (Barksdale WSC) | Nueces | Additional groundwater well in the Nueces River Alluvium |
| | Edwards County Other | Nueces | **Vegetative Management |
| | *Edwards County Mining | *Nueces | Conservation |
| | | | Additional groundwater wells |
| | | *Colorado | Conservation |
| | | | Additional groundwater wells |
| | | *Rio Grande | Conservation |
| | | | Additional groundwater wells |
| Kerr | *City of Kerrville | Guadalupe | Increase wastewater reuse |
| | | | Water loss audit and main-line repair |
| | | | Explore and develop potable reuse |

**Table 5-1. (Continued) Potentially Feasible Water Management Strategies**

| County | Water User Group | Strategy Source Basin | Water Management Strategy |
|---|---|---|---|
| Kerr | *City of Kerrville | Guadalupe | Explore and develop new Ellenburger Aquifer well supply |
| | | | Purchase Guadalupe River water rights |
| | | | Increased water treatment and ASR capacity |
| Kerr | Kerr County Other *(Center Point) | Guadalupe | *** EKCRWSP |
| | Kerr County Other (Center Point North WS) | Guadalupe | *** EKCRWSP |
| | Kerr County Other *(Center Point Taylor | Guadalupe | *** EKCRWSP |
| | Kerr County Other (Hills and Dales Estate) | Guadalupe | *** EKCRWSP |
| | Kerr County Other (Nickerson Farm WS) | Guadalupe | *** EKCRWSP |
| | Kerr County Other (Oak Forest South Water) | Guadalupe | *** EKCRWSP |
| | Kerr County Other (Park Place Subdivision) | Guadalupe | *** EKCRWSP |
| | Kerr County Other (Pecan Valley) | Guadalupe | *** EKCRWSP |
| | Kerr County Other (Rustic Hills Water) | Guadalupe | *** EKCRWSP |
| | Kerr County Other (Verde Park Estates) | Guadalupe | Water loss audit and main-line repair for Verde Park Estates |
| | | | *** EKCRWSP |
| | Kerr County Other (Westwood WS) | Guadalupe | *** EKCRWSP |
| | *Kerr County Other | *Nueces | Conservation: Public information and education - Water shortage met with Guadalupe Basin strategies |
| | | Guadalupe | Water loss audit and main-line repair for Community Water Group WSC |
| | | | **Vegetative management - UGRA |
| | *Kerr County Irrigation | San Antonio | Conservation |
| | | | Additional groundwater well |
| | *Kerr County Livestock | *Colorado | Conservation |
| | | | Additional groundwater wells |
| | | *Guadalupe | Conservation |
| | | | Additional groundwater wells |
| | | *San Antonio | Conservation |
| | | | Additional groundwater well |
| | | *Nueces | Conservation |
| | | | Additional groundwater well |
| | *Kerr County Mining | Colorado | Conservation |
| | | | Additional groundwater well |
| Kinney | City of Brackettville | Rio Grande | Increase supply to Spofford with new water line |
| | | | Increase storage facility |
| | Fort Clark Springs MUD | Rio Grande | Water loss audit and main-line repair |

**Table 5-1. (Continued) Potentially Feasible Water Management Strategies**

| County | Water User Group | Strategy Source Basin | Water Management Strategy |
|---|---|---|---|
| Kinney | Fort Clark Springs MUD | Rio Grande | Increase storage facility |
| | Kinney County Other | Rio Grande | **Vegetative Management |
| | | Nueces | **Vegetative Management |
| Real | *City of Camp Wood | Nueces | Conservation: Public information and education - Water shortage met with Guadalupe Basin strategies |
| | | | Additional groundwater wells |
| | *City of Leakey | Nueces | Conservation |
| | | | Additional groundwater well |
| | | | Develop interconnections between wells within the City |
| | Real County Other | Nueces | Water loss audit and main-line repair for Real WSC |
| | | | **Vegetative Management |
| | | | Additional groundwater well for Oakmont Saddle WSC |
| Val Verde | City of Del Rio | Rio Grande | Water loss audit and main-line repair |
| | | | Additional groundwater well |
| | | | Water treatment plant expansion |
| | | | Develop a wastewater reuse program |
| | Val Verde County Other | Rio Grande | Water loss audit and main-line repair for Val Verde County WCID Comstock |
| | | | Water loss audit and main-line repair for San Pedro Canyon Subdivision (Upper) |
| | | | Water loss audit and main-line repair for Tierra Del Lago |
| | | | **Vegetative Management |
| | *Val Verde County Mining | Rio Grande | Conservation |
| | | | Additional groundwater well |

* WUG with a supply need.

** Vegetative Management has an availability of zero.

***** Eastern Kerr County Regional Water Supply Project Strategies**

| | | |
|---|---|---|
| East Kerr County Regional Water Supply Project | Guadalupe | UGRA acquisition of surface water rights |
| | | KCCC acquisition of surface water rights |
| | | Construction of an off-channel surface water storage |
| | | Construction of surface water treatment facilities and main distribution |
| | | Construction of an ASR facility |
| | | Construction of a wellfield for dense rural areas |
| | | Construction of a brackish groundwater desalination facility |
| | | Construction of an Ellenburger Aquifer water supply source |
| | | Conservation |

# 5.2 EVALUATION AND RECOMMENDATION OF WATER MANAGEMENT STRATEGIES

## 5.2.1 Strategy Evaluation Procedure

The strategy evaluation procedure is designed to provide a side-by-side comparison such that all strategies can be assessed based on the same quantifiable factors as shown in Tables 5-2, 5-3 and 5-4. An explanation of the qualitative and quantifiable rankings is provided in Appendix 5C. All strategy analyses recognize and protect existing water rights, water contracts, and option agreements. For planning purposes, it is assumed that all strategies experience a two percent water loss over the life of the strategy project. Specific factors considered in each Table were:

<u>Table 5-2</u>

Quantity

Quality

Reliability

Impacts to water, agricultural, and natural resources.

<u>Table 5-3</u>

Financial cost (total capital cost, annual cost, and cost per acre-foot)

<u>Table 5-4</u>

Environmental impacts

- Environmental water needs
- Wildlife habitat
- Cultural resources
- Environmental water quality
- Inflows to bays and estuaries

Cost evaluations for all strategies include capital cost, debt service, and annual operating and maintenance (O&M) expenses. Capital costs are estimated based on September 2018 US dollars. Capital costs consider construction costs, engineering and feasibility studies, legal assistance, financing, bond counsel and contingencies, permitting and mitigation, land purchase not associated with mitigation, easement costs, and purchase of water rights. The length of debt service is 20 years unless otherwise stated. An annual unit cost is also calculated based on the O&M cost per acre-foot of water supplied. The TWDB Unified Costing tool was used for all strategy evaluations except for when specific municipalities provided engineering design studies that included cost estimates.

Water quality is recognized as an important component in this 50-year water plan. 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 management strategies and water quality impacts. Development of water management strategies were also guided by the principal that the designated water quality and related water uses described in the Water Quality Management Plans (WQMPs) of TCEQ and the Texas State Soil and Water Conservation Board (TSSWCB) were improved or maintained. 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 (TMDLs), nonpoint source management controls, identification of designated management agencies, and ground water 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 measures, and technologies.

The PWPG relied on Management Supply Factors calculated and supplied by TWDB in the consideration of water-supply needs to be generated in the development of water management strategies. A Management Supply Factor is the combined total of existing and future supply divided by the total projected demand and may be used to consider uncertainties in population, water supply and demand, and other impactful conditions. Management Supply Factors are shown for all WUGs in a table provided in the Executive Summary. Management Supply Factors for Del Rio Utilities, the lone Major Water Provider for this Region is as follows:

| **MWP Name** | **Management Supply Factor** | | | | | |
|---|---|---|---|---|---|---|
| | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| Del Rio Utilities | 1.6 | 1.6 | 1.5 | 1.4 | 1.4 | 1.3 |

The development of water management strategies is intended to assist entities with their future water supply needs based on drought-of-record conditions. Recommendations of the Drought Preparedness Council are considered in this *Plan* and consist of four activities: (1) Drought Monitoring; (2) Impact Assessment; (3) Research and Educational Programs; and (4) Drought Mitigation Strategies. Also, WUGs conservation and drought management plans (see Chapters 6 and 7) were reviewed to identify potential strategies that are currently under consideration by the entity.

Several strategies are considered integral or interconnected to the new supply goal for a specified WUG or cooperation between WUGs. Strategy J-45 lists several projects that may serve the small communities and rural population of eastern Kerr County. Strategies J-64 and J-65 combined will serve to produce a new water supply for the Spoford area of southern Kinney County. These strategies are developed independently, and their interactions do not impact the water supply availability and yield associated with each individual strategy.

### 5.2.2 Emphasis on Conservation and Reuse

In terms of recommending strategies to meet future water needs, it is most practical and often most economical to consider potential conservation and reuse projects. Conservation generally includes best management practices that are undertaking either voluntarily by water customers or as mandated by a water suppliers. Existing WUG conservation and drought management plans were reviewed, and conservation strategies selected for this *Plan* were often identified from these plans. Water conservation is discussed in further detail in Section 5.3 of this chapter. The following paragraph is assigned to all Public Conservation Education strategies:

Public information programs, even though they may not be directly related to any equipment or operational change, can result in both short- and long-term water savings. Behavioral changes by customers will only occur if a reasonable, yet compelling cause can be presented with sufficient frequency to be recognized and absorbed by the customers. There are many resources that can be consulted to provide insight into implanting effective information programs. Like any marketing or public information program, to be effective, water conservation public information should be planned out and implemented in a consistent and continual manner. A more detailed description of conservation best management practices that might be encouraged is available in TWDB Report 362, Water Conservation Best Management Practices Guide. An updated version of this report is available at: http://www.twdb.texas.gov/conservation/BMPs/index.asp.

### 5.2.3 Water Loss Audit Strategies

In 2003, the 78th Texas Legislature, 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 retail public utilities providing water within Texas file a standardized water audit once every five years with the Texas Water Development Board (TWDB). See Section 1.6 in Chapter 1 of this Plan for a more detailed discussion. Eleven entities reporting more than a 10 percent water loss were selected to receive a water-loss audit and main line repair strategy. Volume of savings is calculated as percent total loss of the true real loss as shown in the graphic below:

| Public Water System | Report Year | Reported Breaks Leaks | Unreported Loss | Total Real Losses | Cost of Real Losses | Total Loss Percent | Savings (ac-ft/yr.) |
|---|---|---|---|---|---|---|---|
| Bandera River Ranch 1 | 2015 | 364,487 | 4,426,897 | 4,791,384 | 3,656 | 27.9 | 4 |
| City of Kerrville | 2017 | 13,534,319 | 224,001,131 | 237,535,450 | 539,443 | 18.4 | 134 |
| Community Water Group WSC | 2015 | 1,252,104 | 663,788 | 1,915,892 | 1,341 | 20.3 | |
| Del Rio Utilities Commission | 2016 | 1,540,400 | 33,261,796 | 34,802,196 | 144,777 | 11.4 | 12 |
| Enchanted River Estates | 2015 | 1,667,400 | 365,663 | 2,033,063 | 1,789 | 11.7 | 1 |
| Fort Clark Springs MUD | 2015 | 0 | 62,273,567 | 62,273,567 | 9,341 | 41.1 | 79 |
| Real WSC | 2015 | 100,000 | 1,533,416 | 1,633,416 | 1,111 | 32.3 | 2 |
| San Pedro Canyon Subdivision - Upper | 2016 | 0 | 5,394,010 | 5,394,010 | 2,551 | 40.0 | 7 |
| Tierra Del Lago | 2016 | 0 | 2,471,426 | 2,471,426 | 989 | 54.9 | 4 |
| Val Verde County WCID Comstock | 2015 | 20,000 | 1,534,206 | 1,554,206 | 894 | 16.4 | 1 |
| Verde Park Estates | 2015 | 32,000 | 630,140 | 662,140 | 2,715 | 15.5 | 0 |

### 5.2.4 Recommended Water Management Strategies

The strategy evaluation procedure, as described in Section 5.2.1 above, was followed on each of the potentially feasible strategies selected in Table 5-1. Some potential strategies were determined to not meet guideline standards and were thus eliminated. Also, several new strategies were introduced and were subsequently evaluated. Upon completion of the evaluation phase, the PWPG reviewed evaluation criteria and selected the final water management strategies listed in Table 5-2.

Seawater desalination, a major alternative water management solution for the coastal portion of Texas, was not selected for consideration in the Plateau Water Planning Region as the nearest direct point of origin for a seawater source is more than 150 miles from the easternmost border of the Plateau Region, and is thus not rationally economically feasible.

Third-party social and economic impacts resulting from voluntary redistributions of water, including impacts of moving water from rural and agricultural areas were considered; however, no strategies were recommended that resulted in moving water from such areas.

Table 5-2 provides a comparative listing of all the recommended water management strategies that the PWPG subsequently evaluated for inclusion in the *2021 Plateau Region Water Plan*. Table 5-3 provides a breakdown of the cost estimate for each strategy. Where applicable, capital costs, based on September 2018 US dollars, include the following:

- Construction, engineering and feasibility studies, legal assistance, financing, bond council, and contingencies;
- Environmental and archaeology studies and mitigation;
- Land acquisition and surveying; and

Interest during construction. The total capital cost for development of the 67 water management strategies is $230,456,000. Annual costs (listed in Table 5-3) include operations and maintenance, energy cost at 0.08 $per kilowatt-hour, and debt service at 3.5 percent over 20 years (40 years for reservoirs).

Table 5-4 shows the potential impacts on the environment of enacting each strategy. Strategy evaluations are presented in Appendix 5A at the end of this chapter. Appendix 5B provides a matrix procedure for measuring the quantitative and qualitative potential for each water management strategy.

Alternate water management strategies are projects that are not part of the package of Recommended strategies but can be substituted for any Recommended strategy that is later determined to be non-viable. Alternate water management strategies are evaluated in the same way as Recommended strategies based on criteria specified in [31 TAC §357.7(a)(7-9, 12)] and are tabulated along with “Recommended” strategies in Tables 5-2, 5-3 and 5-4. Upon conclusion of a thorough evaluation process, the Plateau Water Planning Group identified seven Alternate water management strategies.

### 5.2.5 Assessment of ASR Potential

Texas Water Code §16.053(e)(10) requires that “if a RWPA has significant identified water needs, the RWPG shall provide a specific assessment of the potential for aquifer storage and recovery (ASR) projects to meet those needs”. The PWPG considers municipal utilities as the only WUGs in the Plateau Region that would have the resources available to initiate an ASR project; and that the threshold for “significant” identified water needs are defined by the PWPG as any municipal utility with greater than 800 acre-feet per year need over the 50-year planning horizon. This horizon only occurs with the City of Del Rio. All other municipal water needs are at a far less significant level. However, the PRPG has recommended ASR water management strategies for the Cities of Bandera and Kerrville, and the Eastern Kerr County Regional Project.

An assessment of ASR potential for Del Rio Utilities considers both source-supply availability and hydrologic capability of the underlying rock formations to perform the necessary storage function of the ASR process. Del Rio Utilities is primarily reliant on its water supply from San Felipe Creek, a tributary of the Rio Grande. The Utility captures its full permitted supply at San Felipe Springs, the principal headwaters of the Creek. Without acquiring additional water rights, the Utility is limited to its current supply availability. The Utility does not have access to water available in nearby Amistad Reservoir on the Rio Grande.

The hydrogeologic nature of the underlying rock units of the Edwards Limestone is only partially understood in the Del Rio area. The upper portion of the formation is highly karstic resulting in the extensive flow paths leading to San Felipe Springs. An ASR reservoir would not likely be feasible in this upper horizon as stored water would not likely remain in place. Lower aquifer reservoirs have not adequately been tested for their ability to store and release injected water. Below the Edwards, the Trinity is likely brackish and probably far less permeable. Depth and reservoir capacity may thus limit the Trinity for its ASR function.

The PWPG considers that there is currently insufficient justification for designating an ASR water management strategy option for Del Rio Utilities in this 2021 Plan. However, the PWPG feels that ASR for the Del Rio area should remain as a research topic worthy of future consideration.

### 5.2.6 Unqualified Strategies

The TWDB requires that water management strategies listed in regional water plans develop "new" water supplies to be applicable for SWIFT funding. Projects that involve items such as; replacing and/or repairing old infrastructure, and wastewater collection and treatment do not qualify. However, the TWDB offers many other types of financing options. Additional details pertaining to the different types of grants and loans offered can be accessed here: https://www.twdb.texas.gov/financial/index.asp.

### 5.2.7 Vegetative Management and Land Stewardship

Vegetative management and land stewardship are not qualified as water management strategies under regional water planning guidelines as they are not considered to reduce demand. However, the PWPG strongly believes that the concept of properly managing rural range 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. The PRWPG has selected vegetative management as an appropriate water management strategy for each river basin within each county in the Plateau Region.

**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. Ashe Juniper 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 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.

Brush management is a difficult issue to deal with on a planning level since much of the work that needs to be done is on private property with landowners having varied interests. From literature on the subject many authors note that brush management includes both removing the brush, but also providing land management through replacement with other native species that will prevent erosion and hold moisture. However, as a strategy brush management does show potential for enhancing ground water supplies and subsequent base flow to surface water bodies.

**Vegetative management of Giant River Cane (*Arundo donax*)** has become a significant problem throughout the Plateau Region. The problems with the Giant Cane are a direct result of its incredible growth potential. Individual shoots can grow upwards of 4 inches per day and a mature stand, or River Cane, 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.

An HDR consultant memo to the Brazos G Regional Water Plan (2014) provides projected water supply benefits from feasibility studies (Table 2). According to the memo, the increase in in water yield referenced is an increase in the average annual runoff from the treated watershed and should not be confused with a firm yield supply of water. Under most circumstances, the additional runoff or recharge attained from brush control projects are not sustained during a prolonged drought, and thus the supply benefit under these conditions will be zero. For the Bandera County / Edwards Aquifer / Medina River study, the estimated average annual volume of water supplied is 0.5166 acre-feet per acre.

**Table 5-2. Summary of Recommended and Alternate Water Management Strategy Evaluation**

| County | Water User Group | Strategy Source Basin | Strategy | Source | Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost | Quantity [a] | Quality [b] | Reliability [c] | Strategy Impacts[d] Water Resources | Strategy Impacts[d] Agricultural Resources | Strategy Impacts[d] Natural Resources |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | | (1-3) | (1-3) | (1-3) | (1-5) | (1-5) | (1-5) |
| Bandera | City of Bandera | San Antonio | Reuse treated wastewater effluent for irrigation of public spaces | Direct Non-Potable Reuse | J-1 | 0 | 310 | 310 | 310 | 310 | 310 | $1,496,000 | na | 3 | 1 | 1 | 2 | 2 |
| | | | Promote, design & install rainwater harvesting systems on public buildings | Demand Reduction | J-2 | 0 | 1 | 1 | 1 | 1 | 1 | $56,000 | na | 3 | 2 | 1 | 2 | 1 |
| | | | Additional Lower Trinity well and lay necessary pipeline **ALTERNATE** | Lower Trinity Aquifer | J-3 | 0 | 403 | 403 | 403 | 403 | 403 | $3,298,000 | na | 1 | 1 | 4 | 2 | 2 |
| | | | Additional Middle Trinity wells within City water infrastructure area | Middle Trinity Aquifer | J-4 | 161 | 161 | 161 | 161 | 161 | 161 | $625,000 | na | 1 | 1 | 3 | 2 | 3 |
| | | | Surface water acquisition, treatment and ASR | Medina River | J-5 | 0 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | $34,188,000 | na | 2 | 2 | 3 | 2 | 2 |
| | *Bandera County FWSD #1 | San Antonio | Public conservation education | Demand Reduction | J-6 | 2 | 2 | 2 | 2 | 2 | 2 | $0 | 3 | na | na | na | na | na |
| | | | Additional groundwater well | Middle Trinity Aquifer | J-7 | 100 | 100 | 100 | 100 | 100 | 100 | $990,000 | 1 | 1 | 1 | 3 | 2 | 3 |
| | *Bandera County Other - Bandera River Ranch #1 | San Antonio | Water loss audit and main-line repair for | Demand Reduction | J-8 | 4 | 4 | 4 | 4 | 4 | 4 | $902,000 | na | na | na | 2 | 2 | 2 |
| | *Bandera County Other - Lake Medina Shores | San Antonio | Public conservation education | Demand Reduction | J-9 | 3 | 3 | 3 | 3 | 3 | 3 | $0 | 3 | na | na | na | na | na |
| | | | Additional groundwater wells **ALTERNATE** | Lower Trinity Aquifer | J-10 | 251 | 251 | 251 | 251 | 251 | 251 | $1,477,000 | 1 | 1 | 1 | 3 | 2 | 3 |
| | *Bandera County Other - Medina WSC | San Antonio | Public conservation education | Demand Reduction | J-11 | 1 | 1 | 1 | 1 | 1 | 1 | $0 | 3 | na | na | na | na | na |
| | | | Additional groundwater well | Lower Trinity Aquifer | J-12 | 55 | 55 | 55 | 55 | 55 | 55 | $1,417,000 | 1 | 1 | 1 | 3 | 2 | 3 |
| | Bandera County Other | San Antonio | Drought management (BCRAGD) | Demand Reduction | J-14 | 441 | 491 | 516 | 525 | 533 | 537 | $0 | na | na | na | 2 | 2 | 2 |
| | Bandera County Other - Volunteer Fire Dept. | San Antonio | Additional groundwater wells to provide emergency supply **ALTERNATE** | Trinity Aquifer | J-16 | 189 | 189 | 189 | 189 | 189 | 189 | $4,280,000 | na | 1 | 2 | 3 | 2 | 3 |
| | Bandera County Other - Enchanted River Estates | San Antonio | Water loss audit and main-line repair | Demand Reduction | J-17 | 1 | 1 | 1 | 1 | 1 | 1 | $117,000 | na | na | na | 2 | 2 | 2 |
| | Bandera County Other | Nueces | Drought management (BCRAGD) | Demand Reduction | J-18 | 23 | 26 | 27 | 28 | 28 | 28 | $0 | na | na | na | 2 | 2 | 2 |
| | *Bandera County Irrigation | San Antonio | Irrigation scheduling | Demand Reduction | J-20 | 36 | 36 | 36 | 36 | 36 | 36 | $0 | 3 | na | na | 2 | 2 | 2 |
| | | | Additional groundwater wells | Trinity Aquifer | J-21 | 75 | 75 | 75 | 75 | 75 | 75 | $291,000 | 1 | 3 | 1 | 2 | 2 | 3 |
| | *Bandera County Livestock | Guadalupe | Livestock conservation | Demand Reduction | J-22 | 1 | 1 | 1 | 1 | 1 | 1 | $0 | 3 | na | na | 2 | 2 | 2 |
| | | | Additional groundwater well | Middle Trinity Aquifer | J-23 | 2 | 2 | 2 | 2 | 2 | 2 | $135,000 | 1 | 1 | 1 | 3 | 2 | 3 |
| | | Nueces | Livestock conservation | Demand Reduction | J-24 | 1 | 1 | 1 | 1 | 1 | 1 | $0 | 3 | na | na | 2 | 2 | 2 |
| | | | Additional groundwater well | Middle Trinity Aquifer | J-25 | 3 | 3 | 3 | 3 | 3 | 3 | $126,000 | 1 | 1 | 1 | 3 | 2 | 3 |
| Edwards | City of Rocksprings | Nueces | Public conservation education | Demand Reduction | J-26 | 1 | 1 | 1 | 1 | 1 | 1 | $0 | na | na | na | na | na | na |
| | | | Additional groundwater well | Edwards-Trinity (Plateau) Aquifer | J-27 | 121 | 121 | 121 | 121 | 121 | 121 | $681,000 | na | 1 | 1 | 2 | 2 | 3 |

**Table 5-2. (continued) Summary of Recommended and Alternate Water Management Strategy Evaluation**

| County | Water User Group | Strategy Source Basin | Strategy | Source | Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost | Quantity [a] | Quality [b] | Reliability [c] | Strategy Impacts[d] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | | (1-3) | (1-3) | (1-3) | Water Resources (1-5) | Agricultural Resources (1-5) | Natural Resources (1-5) |
| Edwards | Edwards County Other (Barksdale WSC) | Nueces | Additional well in the Nueces River Alluvium Aquifer and RO wellhead treatment | Nueces River Alluvium | J-28 | 54 | 54 | 54 | 54 | 54 | 54 | $178,000 | na | 1 | 2 | 3 | 2 | 3 |
| | *Edwards County Mining | Nueces | Additional groundwater well | Edwards-Trinity (Plateau) Aquifer | J-31 | 16 | 16 | 16 | 16 | 16 | 16 | $125,000 | 1 | 1 | 1 | 3 | 2 | 3 |
| | | Colorado | Additional groundwater well | Edwards-Trinity (Plateau) Aquifer | J-33 | 12 | 12 | 12 | 12 | 12 | 12 | $73,000 | 1 | 1 | 1 | 3 | 2 | 3 |
| | | Rio Grande | Additional groundwater wells | Edwards-Trinity (Plateau) Aquifer | J-35 | 31 | 31 | 31 | 31 | 31 | 31 | $132,000 | 1 | 1 | 1 | 3 | 2 | 3 |
| Kerr | *City of Kerrville | Guadalupe | Increase wastewater reuse | Treated wastewater reuse | J-36 | 2,500 | 2,500 | 2,500 | 2,500 | 2,500 | 2,500 | $12,570,000 | | 3 | 1 | 1 | 2 | 2 |
| | | | Water loss audit and main-line repair | Conservation | J-37 | 134 | 134 | 134 | 134 | 134 | 134 | $12,636,000 | 3 | na | na | 2 | 2 | 2 |
| | | | Explore and develop new Ellenburger Aquifer well supply | Ellenburger-San Saba Aquifer | J-39 | 1,156 | 1,156 | 1,156 | 1,156 | 1,156 | 1,156 | $14,493,000 | 1 | unknown | unknown | unknown | 2 | 2 |
| | | | Increased water treatment and ASR capacity | Guadalupe River and Trinity Aquifer | J-41 | 0 | 3,360 | 3,360 | 3,360 | 3,360 | 3,360 | $15,393,000 | 1 | 2 | 2 | 2 | 2 | 2 |
| | Kerr County Other -Eastern Kerr County Regional Water Supply Project | Guadalupe | Project 1. Construction of an Ellenburger Aquifer water supply well | Ellenburger-San Saba Aquifer | J-45 | 0 | 108 | 108 | 108 | 108 | 108 | $652,000 | na | na | na | unknown | 2 | 2 |
| | | | Project 2. Construction of off-channel surface water storage | Guadalupe River | | 0 | 1,121 | 1,121 | 1,121 | 1,121 | 1,121 | $25,231,000 | na | na | na | 2 | 2 | 1 |
| | | | Project 2. Construction of surface water treatment facilities and transmission lines | Guadalupe River | | | | | | | | $22,829,000 | na | na | na | 2 | 2 | 2 |
| | | | Project 3. Construction of ASR facility | Trinity Aquifer | | 0 | 1,124 | 1,124 | 1,124 | 1,124 | 1,124 | $1,461,000 | na | na | na | 2 | 2 | 2 |
| | | | Project 4. Construction of Trinity Aquifer wellfield for dense, rural areas | Trinity Aquifer | | 0 | 860 | 860 | 860 | 860 | 860 | $8,367,000 | na | na | na | 4 | 2 | 2 |
| | | | Project 4. Construction of desalination plant | Trinity Aquifer | | | | | | | | $21,162,000 | na | na | na | na | na | na |
| | Kerr County Other - *Center Point | Guadalupe | Public conservation education | Demand Reduction | J-54 | 1 | 1 | 1 | 1 | 1 | 1 | $0 | na | na | na | na | na | na |
| | | | Purchase water from EKCRWSP | Guadalupe River and Trinity Aquifer | J-46 | 11 | 11 | 11 | 11 | 11 | 11 | $0 | 1 | 1 | 1 | na | na | na |
| | Kerr County Other - *Center Point Taylor System | Guadalupe | Public conservation education | Demand Reduction | J-55 | 1 | 1 | 1 | 1 | 1 | 1 | $0 | na | na | na | na | na | na |
| | | | Purchase water from EKCRWSP | Guadalupe River and Trinity Aquifer | J-47 | 43 | 43 | 43 | 43 | 43 | 43 | $0 | 1 | 1 | 1 | na | na | na |
| | Kerr County Other - Verde Park Estates | Guadalupe | Water loss audit and main-line repair | Demand Reduction | J-42 | 1 | 1 | 1 | 1 | 1 | 1 | $155,000 | na | na | na | 2 | 2 | 2 |
| | *Kerr County Other | Nueces | Public conservation education | Demand Reduction | J-43 | 1 | 1 | 1 | 1 | 1 | 1 | $0 | na | na | na | na | na | na |
| | *Kerr County Livestock | Colorado | Livestock conservation | Demand Reduction | J-56 | 24 | 24 | 24 | 24 | 24 | 24 | $0 | 3 | na | na | 2 | 2 | 2 |

**Table 5-2. (continued) Summary of Recommended and Alternate Water Management Strategy Evaluation**

| County | Water User Group | Strategy Source Basin | Strategy | Source | Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost | Quantity [a] | Quality [b] | Reliability [c] | Strategy Impacts[d] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | | (1-3) | (1-3) | (1-3) | Water Resources (1-5) | Agricultural Resources (1-5) | Natural Resources (1-5) |
| Kerr | *Kerr County Livestock | Colorado | Additional groundwater wells **ALTERNATE** | Edwards-Trinity (Plateau) Aquifer | J-57 | 119 | 119 | 119 | 119 | 119 | 119 | $985,000 | 1 | 3 | 1 | 3 | 2 | 3 |
| | | Guadalupe | Livestock conservation | Demand Reduction | J-58 | 35 | 35 | 35 | 35 | 35 | 35 | $0 | 3 | na | na | 2 | 2 | 2 |
| | | | Additional groundwater wells **ALTERNATE** | Edwards-Trinity (Plateau) Aquifer | J-59 | 173 | 173 | 173 | 173 | 173 | 173 | $370,000 | 1 | 3 | 1 | 3 | 2 | 3 |
| | | San Antonio | Livestock conservation | Demand Reduction | J-60 | 5 | 5 | 5 | 5 | 5 | 5 | $0 | 3 | na | na | 2 | 2 | 2 |
| | | | Additional groundwater well **ALTERNATE** | Edwards-Trinity (Plateau) Aquifer | J-61 | 27 | 27 | 27 | 27 | 27 | 27 | $79,000 | 1 | 3 | 1 | 3 | 2 | 3 |
| | | Nueces | Livestock conservation | Demand Reduction | J-62 | 1 | 1 | 1 | 1 | 1 | 1 | $0 | 3 | na | na | 2 | 2 | 2 |
| | | | Additional groundwater well **ALTERNATE** | Edwards-Trinity (Plateau) Aquifer | J-63 | 6 | 6 | 6 | 6 | 6 | 6 | $66,000 | 1 | 1 | 1 | 3 | 2 | 3 |
| | *Kerr County Mining | Colorado | Additional groundwater wells | Edwards-Trinity (Plateau) Aquifer | J-65 | 19 | 19 | 19 | 19 | 19 | 19 | $197,000 | 1 | 1 | 1 | 3 | 2 | 3 |
| Kinney | City of Brackettville | Rio Grande | Increase supply to Spofford with new water line | Edwards-Trinity (Plateau) Aquifer | J-66 | 0 | 3 | 3 | 3 | 3 | 3 | $4,271,000 | na | 1 | 1 | 2 | 2 | 2 |
| | | | Increase storage facility | Edwards-Trinity (Plateau) Aquifer | J-67 | 0 | 3 | 3 | 3 | 3 | 3 | $1,272,000 | na | na | na | na | 2 | 2 |
| | Fort Clark Springs MUD | Rio Grande | Water loss audit and main-line repair | Demand Reduction | J-68 | 79 | 79 | 79 | 79 | 79 | 79 | $1,531,000 | na | na | na | na | na | na |
| | | | Increase storage facility | Edwards-Trinity (Plateau) Aquifer | J-69 | 0 | 620 | 620 | 620 | 620 | 620 | $1,501,000 | na | na | na | na | 2 | 2 |
| Real | *City of Camp Wood | Nueces | Public conservation education | Demand Reduction | J-72 | 1 | 1 | 1 | 1 | 1 | 1 | $0 | 3 | na | na | na | na | na |
| | | | Additional groundwater wells | Edwards-Trinity (Plateau) Aquifer | J-73 | 143 | 143 | 143 | 143 | 143 | 143 | $1,709,000 | 1 | 1 or 2 | 1 or 2 | 3 | 2 | 3 |
| | City of Leakey | Nueces | Additional groundwater well | Lower Trinity Aquifer | J-75 | 91 | 91 | 91 | 91 | 91 | 91 | $189,000 | na | 1 or 2 | 1 or 2 | 3 | 2 | 3 |
| | | | Develop interconnections between wells within the City | Frio River Alluvium Aquifer | J-76 | 0 | 81 | 81 | 81 | 81 | 81 | $202,000 | na | na | na | na | 2 | 2 |
| | Real County Other - Real WSC | Nueces | Water loss audit and main-line repair | Demand Reduction | J-77 | 2 | 2 | 2 | 2 | 2 | 2 | $482,000 | na | na | na | na | na | na |
| | Real County Other - Oakmont Saddle Mountain WSC | Nueces | Additional groundwater well | Frio River Alluvium Aquifer | J-79 | 54 | 54 | 54 | 54 | 54 | 54 | $417,000 | na | 1 | 1 | 2 | 2 | 3 |
| Val Verde | *City of Del Rio | Rio Grande | Water loss audit and main-line repair | Demand Reduction | J-80 | 12 | 12 | 12 | 12 | 12 | 12 | $5,672,000 | 3 | na | na | na | na | na |
| | | | Additional groundwater well | Edwards-Trinity (Plateau) Aquifer | J-81 | 7,191 | 7,191 | 7,191 | 7,191 | 7,191 | 7,191 | $12,695,000 | 1 | 1 | 1 | 3 | 2 | 3 |
| | | | Water treatment plant expansion | Direct Non-Potable Reuse | J-82 | 0 | 943 | 943 | 943 | 943 | 943 | $8,646,000 | 3 | 2 | 1 | 3 | 2 | 2 |
| | | | Develop a wastewater reuse program | Direct Non-Potable Reuse | J-83 | 0 | 3,092 | 3,092 | 3,092 | 3,092 | 3,092 | $2,846,000 | 3 | 3 | 1 | 1 | 2 | 2 |
| | Laughlin Air Force Base | Rio Grande | Purchase water from City of Del Rio | Rio Grande Run of River | J-87 | 87 | 183 | 284 | 346 | 345 | 345 | $0 | 1 | 1 | 1 | na | na | na |

**Table 5-2. (continued) Summary of Recommended and Alternate Water Management Strategy Evaluation**

| County | Water User Group | Strategy Source Basin | Strategy | Source | Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost | Quantity [a] | Quality [b] | Reliability [c] | Strategy Impacts[d] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | | (1-3) | (1-3) | (1-3) | Water Resources (1-5) | Agricultural Resources (1-5) | Natural Resources (1-5) |
| Val Verde | Val Verde County Other - Val Verde County WCID Comstock | Rio Grande | Water loss audit and main-line repair | Demand Reduction | J-84 | 1 | 1 | 1 | 1 | 1 | 1 | $406,000 | na | na | na | na | na | na |
| | Val Verde County Other - San Pedro Canyon Upper Subdivision | Rio Grande | Water loss audit and main-line repair | Demand Reduction | J-85 | 7 | 7 | 7 | 7 | 7 | 7 | $142,000 | na | na | na | na | na | na |
| | Val Verde County Other - Tierra Del Lago | Rio Grande | Water loss audit and main-line repair | Demand Reduction | J-86 | 4 | 4 | 4 | 4 | 4 | 4 | $146,000 | na | na | na | na | na | na |
| | *Val Verde County Mining | Rio Grande | Additional groundwater wells | Edwards-Trinity (Plateau) Aquifer | J-89 | 242 | 242 | 242 | 242 | 242 | 242 | $1,096,000 | 2 | 3 | 1 | 3 | 2 | 3 |

* WUGs with a projected future supply deficit. *(See Table 4-1 for list of shortages)*

*See Appendix 5B for quantification description of impact ranges.*

a Quantity Range: 1 = Meets 100% of shortage; 2 = Meets 50 to 99% of shortage; 3 = Meets <50% of shortage *(See Table 4-1 for list of shortages)*

b Quality Range: 1 = Meets safe drinking-water standards; 2 = Must be treated or mixed to meet safe drinking-water standards; 3 = Usable for intended use

c Reliability Range: 1 = Sustainable; 2 = Provides firm supply, but may be partially impacted during drought conditions; 3 = Non-sustainable

d Strategy Impact Range: 1 = Positive, 2 = No New; 3 = Minimal Negative; 4 = Moderate Negative; 5 = Significant Negative

**Table 5-3. Summary of Recommended and Alternate Water Management Strategy Cost**

| County | Water User Group | Strategy | Strategy ID | Total Capital Cost | Annual Cost/Year | | | | | | Cost per Acre-Foot/Year | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Bandera | City of Bandera | Reuse treated wastewater effluent for irrigation | J-1 | $1,496,000 | $0 | $131,000 | $131,000 | $26,000 | $26,000 | $26,000 | $0 | $423 | $423 | $84 | $84 | $84 |
| | | Promote, design & install rainwater harvesting systems | J-2 | $56,000 | $0 | $4,000 | $4,000 | $0 | $0 | $0 | $0 | $12 | $12 | $0 | $0 | $0 |
| | | Additional Lower Trinity well and lay necessary pipeline **ALTERNATE** | J-3 | $3,298,000 | $0 | $315,000 | $315,000 | $83,000 | $83,000 | $83,000 | $0 | $782 | $782 | $206 | $206 | $206 |
| | | Additional Middle Trinity wells within City water infrastructure | J-4 | $625,000 | $54,000 | $54,000 | $10,000 | $10,000 | $10,000 | $10,000 | $335 | $335 | $62 | $62 | $62 | $62 |
| | | Surface water acquisition, treatment and ASR | J-5 | $34,188,000 | $0 | $2,418,000 | $2,418,000 | $12,000 | $12,000 | $12,000 | $0 | $1,612 | $1,612 | $8 | $8 | $8 |
| | *Bandera County FWSD #1 | Public conservation education | J-6 | $0 | $340 | $391 | $419 | $431 | $438 | $442 | $170 | $195 | $210 | $216 | $219 | $221 |
| | | Additional groundwater well | J-7 | $990,000 | $103,000 | $103,000 | $33,000 | $33,000 | $33,000 | $33,000 | $1,030 | $1,030 | $330 | $330 | $330 | $330 |
| | *Bandera County Other - Bandera River Ranch #1 | Water loss audit and main-line repair for Bandera River Ranch #1 | J-8 | $902,000 | $71,000 | $71,000 | $7,000 | $7,000 | $7,000 | $7,000 | $17,275 | $17,275 | $1,703 | $1,703 | $1,703 | $1,703 |
| | *Bandera County Other - Lake Medina Shores | Public conservation education | J-9 | $0 | $1,208 | $1,391 | $1,493 | $1,534 | $1,559 | $1,572 | $403 | $464 | $498 | $511 | $520 | $524 |
| | | Additional groundwater wells **ALTERNATE** | J-10 | $1,477,000 | $146,000 | $146,000 | $42,000 | $42,000 | $42,000 | $42,000 | $582 | $582 | $167 | $167 | $167 | $167 |
| | *Bandera County Other - Medina WSC | Public conservation education | J-11 | $0 | $448 | $516 | $554 | $569 | $578 | $583 | $448 | $516 | $554 | $569 | $578 | $583 |
| | | Additional groundwater well for the Town of Medina | J-12 | $1,417,000 | $142,000 | $142,000 | $42,000 | $42,000 | $42,000 | $42,000 | $2,582 | $2,582 | $764 | $764 | $764 | $764 |
| | Bandera County Other | Drought Management (BCRAGD) | J-14 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | Additional wells to provide emergency supply to VFD **ALTERNATE** | J-16 | $4,280,000 | $358,000 | $358,000 | $57,000 | $57,000 | $57,000 | $57,000 | $1,894 | $1,894 | $302 | $302 | $302 | $302 |
| | | Water loss audit and main-line repair for Enchanted River Estates | J-17 | $117,000 | $9,000 | $9,000 | $1,000 | $1,000 | $1,000 | $1,000 | $12,329 | $12,329 | $1,370 | $1,370 | $1,370 | $1,370 |
| | | Drought Management (BCRAGD) | J-18 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | *Bandera County Irrigation | Conservation - Irrigation scheduling | J-20 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | Additional groundwater wells | J-21 | $291,000 | $25,000 | $25,000 | $5,000 | $5,000 | $5,000 | $5,000 | $333 | $333 | $67 | $67 | $67 | $67 |
| | *Bandera County Livestock | Livestock conservation | J-22 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | Additional groundwater well | J-23 | $135,000 | $10,000 | $10,000 | $1,000 | $1,000 | $1,000 | $1,000 | $5,000 | $5,000 | $500 | $500 | $500 | $500 |
| | | Livestock conservation | J-24 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | Additional groundwater well | J-25 | $126,000 | $10,000 | $10,000 | $1,000 | $1,000 | $1,000 | $1,000 | $3,333 | $3,333 | $333 | $333 | $333 | $333 |
| Edwards | City of Rocksprings | Public conservation education | J-26 | $0 | $208 | $208 | $208 | $208 | $208 | $208 | $208 | $208 | $208 | $208 | $208 | $208 |
| | | Additional groundwater well | J-27 | $681,000 | $71,000 | $71,000 | $23,000 | $23,000 | $23,000 | $23,000 | $587 | $587 | $190 | $190 | $190 | $190 |
| | Edwards County Other (Barksdale WSC) | Additional well in the Nueces River Alluvium Aquifer | J-28 | $178,000 | $46,000 | $46,000 | $33,000 | $33,000 | $33,000 | $33,000 | $852 | $852 | $611 | $611 | $611 | $611 |
| | *Edwards County Mining | Additional groundwater wells | J-31 | $125,000 | $11,000 | $11,000 | $2,000 | $2,000 | $2,000 | $2,000 | $688 | $688 | $125 | $125 | $125 | $125 |
| | | Additional groundwater wells | J-33 | $73,000 | $6,000 | $6,000 | $1,000 | $1,000 | $1,000 | $1,000 | $500 | $500 | $83 | $83 | $83 | $83 |
| | | Additional groundwater wells | J-35 | $132,000 | $12,000 | $12,000 | $3,000 | $3,000 | $3,000 | $3,000 | $387 | $387 | $97 | $97 | $97 | $97 |
| Kerr | *City of Kerrville | Increase wastewater reuse | J-36 | $12,570,000 | $722,000 | $722,000 | $133,000 | $133,000 | $133,000 | $133,000 | $289 | $289 | $53 | $53 | $53 | $53 |
| | | Water loss audit and main-line repair | J-37 | $12,636,000 | $984,000 | $984,000 | $95,000 | $95,000 | $95,000 | $95,000 | $3,979 | $3,979 | $384 | $384 | $384 | $384 |

**Table 5-3. (continued) Summary of Recommended and Alternate Water Management Strategy Cost**

| County | Water User Group | Strategy | Strategy ID | Total Capital Cost | Annual Cost/Year | | | | | | Cost per Acre-Foot/Year | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Kerr | *City of Kerrville | Explore and develop new Ellenburger Aquifer well supply | J-39 | $14,493,000 | $1,243,000 | $1,243,000 | $223,000 | $223,000 | $223,000 | $223,000 | $1,075 | $1,075 | $193 | $193 | $193 | $193 |
| | | Increased water treatment and ASR capacity | J-41 | $15,393,000 | $0 | $1,943,000 | $1,943,000 | $860,000 | $860,000 | $860,000 | $0 | $578 | $578 | $256 | $256 | $256 |
| | Kerr County Other -Eastern Kerr County Regional Water Supply Project | Project 1. Construction of an Ellenburger Aquifer water supply well | J-45 | $652,000 | $0 | $72,000 | $72,000 | $26,000 | $26,000 | $26,000 | $0 | $667 | $667 | $241 | $241 | $241 |
| | | Project 2. Construction of an Off-Channel Surface Water Storage | | $25,231,000 | $0 | $1,327,000 | $1,327,000 | $146,000 | $146,000 | $146,000 | $0 | $1,184 | $1,184 | $130 | $130 | $130 |
| | | Project 2. Construction of surface water treatment facilities and transmission lines | | $22,829,000 | $0 | $2,559,000 | $2,559,000 | $953,000 | $953,000 | $953,000 | $0 | $2,283 | $2,283 | $850 | $850 | $850 |
| | | Project 3. Construction of ASR facility | | $1,461,000 | $0 | $114,000 | $114,000 | $11,000 | $11,000 | $11,000 | $0 | $101 | $101 | $10 | $10 | $10 |
| | | Project 4. Construction of Well field for dense, rural areas | | $8,367,000 | $0 | $842,000 | $842,000 | $253,000 | $253,000 | $253,000 | $0 | $979 | $979 | $294 | $294 | $294 |
| | | Project 4. Construction of Desalination plant | | $21,162,000 | $0 | $3,105,000 | $3,105,000 | $1,616,000 | $1,616,000 | $1,616,000 | $0 | $3,610 | $3,610 | $1,879 | $1,879 | $1,879 |
| | Kerr County Other - *Center Point | Public conservation education | J-54 | $0 | $128 | $136 | $141 | $146 | $149 | $152 | $128 | $136 | $141 | $146 | $149 | $152 |
| | | Purchase water from EKCRWSP | J-46 | $0 | $4,400 | $4,400 | $4,400 | $4,400 | $4,400 | $4,400 | $400 | $400 | $400 | $400 | $400 | $400 |
| | Kerr County Other - *Center Point Taylor System | Public conservation education | J-55 | $0 | $265 | $282 | $293 | $303 | $310 | $316 | $265 | $282 | $293 | $303 | $310 | $316 |
| | | Purchase water from EKCRWSP | J-47 | $0 | $17,200 | $17,200 | $17,200 | $17,200 | $17,200 | $17,200 | $400 | $400 | $400 | $400 | $400 | $400 |
| | Kerr County Other - Verde Park Estates | Water loss audit and main-line repair for Verde Park Estates WWW | J-42 | $155,000 | $12,000 | $12,000 | $1,000 | $1,000 | $1,000 | $1,000 | $12,000 | $12,000 | $1,000 | $1,000 | $1,000 | $1,000 |
| | *Kerr County Other | Public conservation education | J-43 | $0 | $3 | $4 | $4 | $4 | $4 | $4 | $3 | $4 | $4 | $4 | $4 | $4 |
| | *Kerr County Livestock | Livestock conservation | J-56 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | Additional groundwater wells **ALTERNATE** | J-57 | $985,000 | $84,000 | $84,000 | $15,000 | $15,000 | $15,000 | $15,000 | $706 | $706 | $126 | $126 | $126 | $126 |
| | | Livestock conservation | J-58 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | Additional groundwater wells **ALTERNATE** | J-59 | $370,000 | $41,000 | $41,000 | $15,000 | $15,000 | $15,000 | $15,000 | $237 | $237 | $87 | $87 | $87 | $87 |
| | | Livestock conservation | J-60 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | Additional groundwater wells **ALTERNATE** | J-61 | $79,000 | $9,000 | $9,000 | $3,000 | $3,000 | $3,000 | $3,000 | $333 | $333 | $111 | $111 | $111 | $111 |
| | | Livestock conservation | J-62 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | Additional groundwater wells **ALTERNATE** | J-63 | $66,000 | $5,000 | $5,000 | $0 | $0 | $0 | $0 | $833 | $833 | $0 | $0 | $0 | $0 |
| | *Kerr County Mining | Additional groundwater well | J-65 | $197,000 | $16,000 | $16,000 | $2,000 | $2,000 | $2,000 | $2,000 | $842 | $842 | $105 | $105 | $105 | $105 |
| Kinney | City of Brackettville | Increase supply to Spoford with new water line | J-66 | $4,271,000 | $0 | $330,000 | $330,000 | $29,000 | $29,000 | $29,000 | $0 | $117,857 | $117,857 | $10,357 | $10,357 | $10,357 |
| | | Increase storage facility | J-67 | $1,272,000 | $0 | $99,000 | $99,000 | $9,000 | $9,000 | $9,000 | $0 | $35,357 | $35,357 | $3,214 | $3,214 | $3,214 |
| | Fort Clark Springs MUD | Water loss audit and main-line repair | J-68 | $1,531,000 | $119,000 | $119,000 | $11,000 | $11,000 | $11,000 | $11,000 | $1,515 | $1,515 | $140 | $140 | $140 | $140 |
| | | Increase storage facility | J-69 | $1,501,000 | $0 | $117,000 | $117,000 | $11,000 | $11,000 | $11,000 | $0 | $189 | $189 | $18 | $18 | $18 |
| Real | *City of Camp Wood | Public conservation education | J-72 | $0 | $374 | $374 | $374 | $374 | $374 | $374 | $374 | $374 | $374 | $374 | $374 | $374 |

**Table 5-3. (continued) Summary of Recommended and Alternate Water Management Strategy Cost**

| County | Water User Group | Strategy | Strategy ID | Total Capital Cost | Annual Cost/Year | | | | | | Cost per Acre-Foot/Year | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Real | *City of Camp Wood | Additional groundwater wells | J-73 | $1,709,000 | $139,000 | $139,000 | $19,000 | $19,000 | $19,000 | $19,000 | $972 | $972 | $133 | $133 | $133 | $133 |
| Real | City of Leakey | Additional groundwater well | J-75 | $189,000 | $34,000 | $34,000 | $21,000 | $21,000 | $21,000 | $21,000 | $374 | $374 | $231 | $231 | $231 | $231 |
| Real | City of Leakey | Develop interconnections between wells within the City | J-76 | $202,000 | $0 | $15,000 | $15,000 | $1,000 | $1,000 | $1,000 | $0 | $185 | $185 | $12 | $12 | $12 |
| Real | Real County Other | Water loss audit and main-line repair for Real WSC | J-77 | $482,000 | $38,000 | $38,000 | $4,000 | $4,000 | $4,000 | $4,000 | $23,457 | $23,457 | $2,469 | $2,469 | $2,469 | $2,469 |
| Real | Real County Other | Additional well for Oakmont Saddle WSC | J-79 | $417,000 | $32,000 | $32,000 | $29,000 | $29,000 | $29,000 | $29,000 | $593 | $593 | $56 | $56 | $56 | $56 |
| Val Verde | *City of Del Rio | Water loss audit and main-line repair | J-80 | $5,672,000 | $441,000 | $441,000 | $42,000 | $42,000 | $42,000 | $42,000 | $13,960 | $13,960 | $1,330 | $1,330 | $1,330 | $1,330 |
| Val Verde | *City of Del Rio | Additional groundwater well | J-81 | $12,695,000 | $1,451,000 | $1,451,000 | $558,000 | $558,000 | $558,000 | $558,000 | $202 | $202 | $78 | $78 | $78 | $78 |
| Val Verde | *City of Del Rio | Water treatment plant expansion | J-82 | $8,646,000 | $0 | $1,231,000 | $1,231,000 | $623,000 | $623,000 | $623,000 | $0 | $1,305 | $1,305 | $661 | $661 | $661 |
| Val Verde | *City of Del Rio | Develop a wastewater reuse program | J-83 | $2,846,000 | $0 | $219,000 | $219,000 | $19,000 | $19,000 | $19,000 | $0 | $71 | $71 | $6 | $6 | $6 |
| Val Verde | Laughlin Air Force Base | Purchase water from City of Del Rio | J-87 | $0 | $326 | $326 | $326 | $326 | $326 | $326 | $616 | $616 | $616 | $616 | $616 | $616 |
| Val Verde | Val Verde County Other | Water loss audit and main-line repair for Val Verde County WCID Comstock | J-84 | $406,000 | $32,000 | $32,000 | $3,000 | $3,000 | $3,000 | $3,000 | $41,026 | $41,026 | $3,846 | $3,846 | $3,846 | $3,846 |
| Val Verde | Val Verde County Other | Water loss audit and main-line repair for San Pedro Canyon Subdivision (Upper) | J-85 | $142,000 | $11,000 | $11,000 | $1,000 | $1,000 | $1,000 | $1,000 | $5,500 | $5,500 | $500 | $500 | $500 | $500 |
| Val Verde | Val Verde County Other | Water loss audit and main-line repair for Tierra Del Lago | J-86 | $146,000 | $11,000 | $11,000 | $1,000 | $1,000 | $1,000 | $1,000 | $2,072 | $2,072 | $188 | $188 | $188 | $188 |
| Val Verde | *Val Verde County Mining | Additional groundwater well | J-89 | $1,096,000 | $93,000 | $93,000 | $16,000 | $16,000 | $16,000 | $16,000 | $384 | $384 | $66 | $66 | $66 | $66 |

* WUGs with a projected future supply deficit. *(See Table 4-1 for list of shortages)*

Where applicable, capital costs include: construction, engineering, and easement, environmental, interest during construction, and purchased water.

Engineering, contingency, construction management, financial and leagal costs are estimated at 30 percent of construction costs for pipelines and 35 percent for pump stations and treatment facilities.

Permitting and mitigation for transmission and treatment projects are estimated at 1 percent of total construction costs.

Surface water treatment costs are estimated at $0.35 per 1,000 gallons for a conventional plant.

Annual costs include operations and maintenance, power cost, and debt service at 6% over 20 years.

Capital costs are estimated based on September 2018 US dollars.

**Table 5-4. Summary of Recommended and Alternate Water Management Strategy Environmental Assessment**

| County | Water User Group | Water Management Strategy | Strategy ID | Environmental Impact Factor ** Envir. Water Needs (1-5) | Wildlife Habitat (1-5) | Cultural Resources (1-5) | Envir. Water Quality (1-5) | Bays & Estuaries *** | Comments |
|---|---|---|---|---|---|---|---|---|---|
| Bandera | City of Bandera | Reuse treated wastewater effluent for irrigation use | J-1 | 2 | 2 | 2 | 2 | na | Reduces dependence on new groundwater. |
| | | Promote, design & install rainwater harvesting systems | J-2 | 1 | 1 | 2 | 1 | na | Provides sustainable supplemental fresh water. |
| | | Additional Lower Trinity well and lay necessary pipeline **ALTERNATE** | J-3 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow BCRAGD regulations. |
| | | Additional Middle Trinity wells within City water infrastructure | J-4 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow BCRAGD regulations. |
| | | Surface water acquisition, treatment and ASR | J-5 | 4 | 2 | 2 | 2 | na | Construction of facilities will displace a small segment of natural habitat. Flow in Medina River would be reduced during periods of diversion. |
| | *Bandera County FWSD#1 | Public conservation education | J-6 | na | na | na | na | na | Reduces dependence on existing supply sources. |
| | | Additional groundwater well | J-7 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow BCRAGD regulations. |
| | *Bandera County Other - Bandera River Ranch #1 | Water loss audit and main-line repair for Bandera River Ranch #1 | J-8 | 2 | 2 | 2 | 2 | na | Reduces water loss. |
| | *Bandera County Other - Lake Medina Shores | Public conservation education | J-9 | na | na | na | na | na | Reduces dependence on existing supply sources. |
| | | Additional groundwater wells **ALTERNATE** | J-10 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow BCRAGD regulations. |
| | *Bandera County Other - Medina WSC | Public conservation education | J-11 | na | na | na | na | na | Reduces dependence on existing supply sources. |
| | | Additional groundwater well for the Town of Medina | J-12 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow BCRAGD regulations. |
| | Bandera County Other | Drought Management (BCRAGD) | J-14 | na | na | na | na | na | Reduces dependence on existing supply sources. |
| | | Additional wells to provide emergency supply to VFD **ALTERNATE** | J-16 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow BCRAGD regulations. |
| | | Water loss audit and main-line repair for Enchanted River Estates | J-17 | 2 | 2 | 2 | 2 | na | Reduces water loss. |
| | | Drought Management (BCRAGD) | J-18 | na | na | na | na | na | Reduces dependence on existing supply sources. |
| | *Bandera County Irrigation | Conservation - Irrigation scheduling | J-20 | na | na | na | na | na | Reduces dependence on existing supply sources. |
| | | Additional groundwater wells | J-21 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow BCRAGD regulations. |
| | *Bandera County Livestock | Livestock conservation | J-22 | 2 | 1 | 2 | 2 | na | Reduces dependence on existing supply sources. |
| | | Additional groundwater well | J-23 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow BCRAGD regulations. |
| | | Livestock conservation | J-24 | 2 | 1 | 2 | 2 | na | Reduces dependence on existing supply sources. |
| | | Additional groundwater well | J-25 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow BCRAGD regulations. |
| Edwards | City of Rocksprings | Public conservation education | J-26 | na | na | na | na | na | Reduces dependence on existing supply sources. |
| | | Additional groundwater well | J-27 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow RECRD regulations. |
| | Edwards County Other (Barksdale WSC) | Additional well in the Nueces River Alluvium Aquifer and treatment plant | J-28 | 2 | 2 | 2 | 2 | na | Caution is necessary to not overexploit the aquifer. |
| | *Edwards County Mining | Additional groundwater wells | J-31 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow RECRD regulations. |
| | | Additional groundwater wells | J-33 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow RECRD regulations. |
| | | Additional groundwater wells | J-35 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow RECRD regulations. |
| Kerr | *City of Kerrville | Increase wastewater reuse | J-36 | 2 | 2 | 2 | 2 | na | Reduces dependence on existing supply sources. |
| | | Water loss audit and main-line repair | J-37 | 2 | 2 | 2 | 2 | na | Reduces water loss. |
| | | Explore and develop new Ellenburger Aquifer well supply | J-39 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow HGCD regulations. |
| | | Increased water treatment and ASR capacity | J-41 | 2 | 2 | 2 | 2 | na | Reduces dependence on new groundwater. |
| | Kerr County Other - EKCRWSP | Project 1. Construction of an Ellenburger Aquifer water supply well | J-45 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow HGCD regulations. |
| | | Project 2. Construction of an off-channel surface water storage | | 2 | 1 | 2 | 2 | na | Provides temporary birding habitat. |
| | | Project 2. Construction of surface water treatment facilities and transmission lines | | 2 | 3 | 2 | 2 | na | Construction of facilities will displace a small segment of natural habitat. |
| | | Project 3. Construction of ASR facility | | 2 | 2 | 2 | 2 | na | Well construction and operation to follow HGCD regulations. |

**Table 5-4. (continued) Summary of Recommended and Alternate Water Management Strategy Environmental Assessment**

| County | Water User Group | Water Management Strategy | Strategy ID | Environmental Impact Factor ** Envir. Water Needs (1-5) | Wildlife Habitat (1-5) | Cultural Resources (1-5) | Envir. Water Quality (1-5) | Bays & Estuaries *** | Comments |
|---|---|---|---|---|---|---|---|---|---|
| Kerr | Kerr County Other - EKCRWSP | Project 4. Construction of wellfield for dense, rural areas | J-45 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow HGCD regulations. |
| | | Project 4. Construction of desalination plant | | 2 | 3 | 2 | 2 | na | Construction of facilities will displace a small segment of natural habitat. |
| | *Kerr County Other - Center Point | Public conservation education | J-54 | na | na | na | na | na | Reduces dependence on existing supply sources. |
| | | Purchase water from EKCRWSP | J-46 | na | na | na | na | na | Efficiency of supply through a regional project |
| | *Kerr County Other - Center Point Taylor System | Public conservation education | J-55 | na | na | na | na | na | Reduces dependence on existing supply sources. |
| | | Purchase water from EKCRWSP | J-47 | na | na | na | na | na | Efficiency of supply through a regional project |
| | *Kerr County Other - Verde Park Estates | Water loss audit and main-line repair for Verde Park Estates WWW | J-42 | 2 | 2 | 2 | 2 | na | Reduces water loss. |
| | *Kerr County Other | Public conservation education | J-43 | na | na | na | na | na | Reduces dependence on existing supply sources. |
| | *Kerr County Livestock | Livestock conservation | J-56 | 2 | 1 | 2 | 2 | na | Reduces dependence on existing supply sources. |
| | | Additional groundwater wells **ALTERNATE** | J-57 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow HGCD regulations. |
| | | Livestock conservation | J-58 | 2 | 1 | 2 | 2 | na | Reduces dependence on existing supply sources. |
| | | Additional groundwater wells **ALTERNATE** | J-59 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow HGCD regulations. |
| | | Livestock conservation | J-60 | 2 | 1 | 2 | 2 | na | Reduces dependence on existing supply sources. |
| | | Additional groundwater wells **ALTERNATE** | J-61 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow HGCD regulations. |
| | | Livestock conservation | J-62 | 2 | 1 | 2 | 2 | na | Reduces dependence on existing supply sources. |
| | | Additional groundwater wells **ALTERNATE** | J-63 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow HGCD regulations. |
| | *Kerr County Mining | Additional groundwater well | J-65 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow HGCD regulations. |
| Kinney | City of Brackettville | Increase supply to Spoford with new water line | J-66 | 2 | 2 | 2 | 2 | na | Temporary land disburbance during excavation for new pipeline. |
| | | Increase storage facility | J-67 | 2 | 3 | 2 | 2 | na | Temporary land disturbance during facility construction. |
| | Fort Clark Springs MUD | Water loss audit and main-line repair | J-68 | 2 | 2 | 2 | 2 | na | Reduces water loss. |
| | | Increase storage facility | J-69 | 2 | 3 | 2 | 2 | na | Temporary land disturbance during facility construction. |
| Real | *City of Camp Wood | Public conservation education | J-72 | na | na | na | na | na | Intended to reduce water use. |
| | | Additional groundwater wells | J-73 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow RECRD regulations. |
| | City of Leakey | Additional groundwater well | J-75 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow RECRD regulations. |
| | | Develop interconnections between wells within the City | J-76 | 2 | 2 | 2 | 2 | na | Temporary land disburbance during excavation for new pipeline. |
| | Real County Other | Water loss audit and main-line repair for Real WSC | J-77 | 2 | 2 | 2 | 2 | na | Reduces water loss. |
| | | Additional well for Oakmont Saddle WSC | J-79 | 2 | 2 | 2 | 2 | na | Well construction and operation to follow RECRD regulations. |

**Table 5-4. (continued) Summary of Recommended and Alternate Water Management Strategy Environmental Assessment**

| County | Water User Group | Water Management Strategy | Strategy ID | Environmental Impact Factor ** | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Envir. Water Needs (1-5) | Wildlife Habitat (1-5) | Cultural Resources (1-5) | Envir. Water Quality (1-5) | Bays & Estuaries *** | |
| Val Verde | City of Del Rio | Water loss audit and main-line repair | J-80 | 2 | 2 | 2 | 2 | na | Reduces water loss. |
| | | Additional groundwater well | J-81 | 2 | 2 | 2 | 2 | na | Temporary land disturbance during drilling, completion, and pipeline connection. |
| | | Water treatment plant expansion | J-82 | 2 | 3 | 2 | 2 | na | Temporary land disturbance during facility construction. |
| | | Develop a wastewater reuse program | J-83 | 1 | 2 | 2 | 2 | na | Temporary land disturbance during placement of new resue distribution pipelines. |
| | Val Verde County Other | Water loss audit and main-line repair for Val Verde County WCID Comstock | J-84 | 2 | 2 | 2 | 2 | na | Reduces water loss. |
| | | Water loss audit and main-line repair for San Pedro Canyon Subdivision (Upper) | J-85 | 2 | 2 | 2 | 2 | na | Reduces water loss. |
| | | Water loss audit and main-line repair for Tierra Del Lago | J-86 | 2 | 2 | 2 | 2 | na | Reduces water loss. |
| | Val Verde County Mining | Additional groundwater well | J-89 | 2 | 2 | 2 | 2 | na | Temporary land disturbance during drilling and completion of well. |

* WUGs with a projected future water supply deficit. *(See Table 4-1 for list of shortages)*

*See Appendix 5B for quantification description of impact ranges.*
** Strategy impact range: 1 = Positive; 2 = No New; 3 = Minimal Negative; 4 = Moderate Negative; 5 = Significant Negative
*** All strategies occur beyond the distance of potential impact to flows into the coastal bay and estuary systems.

# 5.3 WATER CONSERVATION

Water conservation is one of the most important components of water supply management. Recognizing its impact, setting realistic goals, and aggressively enforcing implementation may significantly extend the time when new supplies and associated infrastructure are needed. This chapter explores conservation opportunities and best management practices and provides a road map for integrating conservation planning into long-range water supply management goals.

## 5.3.1 State Water Conservation Overview

The Texas Water Development Board (TWDB) defines "conservation" as those practices, techniques, programs, and technologies that will protect water resources, reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling or reuse of water so that a water supply is made available for future or alternative uses. Water conservation management strategies recommended in Chapter 5 include water loss audits to reduce distribution losses, public conservation awareness, and brush management.

Effective conservation programs implement best management practices to try to meet the targets and goals identified within the *Plan* and are important to water conservation planning for all entities such as: municipal, agricultural, industrial, and commercial. Water conservation management planning currently implemented by municipalities, agricultural and commercial interests, and other water users supersede recommendations in this *Plan* and are considered consistent with this *Plan.*

The TWDB and the Texas State Soil and Water Conservation Board (TSSWCB) jointly conducted a study of ways to improve or expand water conservation efforts in Texas. The results of that study are available in a joint 2018 report titled "An Assessment of Water Conservation in Texas, Prepared for the 85th Texas Legislature" http://www.twdb.texas.gov/publications/reports/special_legislative_reports/doc/TWDB_TSSWCB_85th.pdf?d=1555509508342 and contains the following:

- An assessment of both agricultural and municipal water conservation issues;
- Information on existing conservation efforts by the TWDB and the TSSWCB;
- Information on existing conservation efforts by municipalities receiving funding from the TWDB, as specified in water conservation plans submitted by the municipalities as part of their applications for assistance;
- A discussion of future conservation needs;
- An analysis of programmatic approaches and funding for additional conservation efforts;
- An assessment of existing statutory authority and whether changes are needed to more effectively promote and fund conservation projects; and
- An assessment of the TWDB's agricultural water conservation program.

The implementation of water conservation programs that are cost effective, meet state mandates, and result in permanent real reductions in water use will be a challenge for the citizens of the Plateau Region. Smaller communities that lack financial and technical resources will be particularly challenged and will look to the State for assistance.

Since portions of the Region are particularly susceptible to water-supply shortages during periods of drought conditions, these areas are especially encouraged to develop conservation-oriented management plans. Likewise, water-user entities within these areas should become actively involved in the regional water planning activities associated with this *Plan.*

The PWPG considers all groundwater sources recognized in this P*lan* as being critical to the future health and economic welfare of the Plateau Region. Due to the Region's reliance on groundwater to meet current and future water needs, the PWPG recommends that local groundwater conservation districts be formed throughout the entire Region to administer sound, reasonable, and scientifically-based management objectives; and that these districts play a major role in the regional water planning process.

It is generally recognized that brush infestations are the symptom of deeper ecological disturbances such as fire control, drought, grazing mismanagement, wildlife overpopulations and other causes. Selective Brush Management, as a tool to improve watershed yields and water quality, is a conservation management strategy of great interest in the Plateau Region, as well as in surrounding planning regions. A program is in place and administered through the Texas State Soil and Water Conservation Board to provide a cost-share funding program to landowners in the targeted watersheds for the Selective Brush Management. Funding for this program should be targeted on selected areas identified through modeling.

The PWPG joins with the Rio Grande Region (M) and the Far West Texas Region (E) in encouraging funding for projects aimed at the eradication and long-term suppression of salt cedar and other nuisance phreatophytes in the Rio Grande watershed.

### 5.3.2 Model Water Conservation Plans

Water Conservation Plan forms are available from TCEQ in WordPerfect and PDF formats. The forms for the following entity types listed below are available at: https://www.tceq.texas.gov/permitting/water_rights/wr_technical-resources/conserve.html. You can receive a print copy of a form by calling 512/239-4691 or by email to wcp@tceq.texas.gov.

**Municipal Use** – Utility Profile and Water Conservation Plan Requirements for Municipal Water Use by Public Water Suppliers (TCEQ-10218)

**Wholesale Public Water Suppliers** – Profile and Water Conservation Plan Requirements for Wholesale Public Water Suppliers (TCEQ-20162)

**Industrial** – Industrial Water Conservation Plan (TCEQ-20839)

**Mining Use** – Mining Water Conservation Plan (TCEQ-20840)

**Agricultural Uses** – Agriculture Water Conservation Plan-Non-Irrigation (TCEQ-10541)

System Inventory and Water Conservation Plan for Individually Operated Irrigation Systems (TCEQ-10238)

System Inventory and Water Conservation Plan for Agricultural Water Suppliers Providing Water to More Than One User (TCEQ-10244)

### 5.3.3 State Water Conservation Programs and Guides

The TWDB provides a significant amount of information and services pertaining to water conservation that can be accessed at: http://www.twdb.texas.gov/conservation/municipal/plans/index.asp

Likewise, water conservation tips developed by the TCEQ and made available through their Take Care of Texas educational campaign can be accessed at the following website: http://takecareoftexas.org/conservation-tips/conserve-our-water

#### Water-Saving Plumbing Fixture Program

The Texas Legislature created the Water-Savings Plumbing Fixture Program on Jan. 1, 1992 to promote water conservation. Manufacturers of plumbing fixtures sold in Texas must comply with the Environmental Performance Standards for Plumbing Fixtures, which requires all plumbing fixtures such as showerheads, toilets and faucets sold in Texas to conform to specific water use efficiency standards.

As of January 1, 2014, Texas (House Bill 2667) mandates all toilets and urinals sold in Texas must meet new efficiency standards.

- Bath faucets cannot exceed 2.2 gallons per minute (GPM)
- Showerheads cannot exceed 2.5 gallons per minute (GPM)
- Kitchen faucets cannot exceed 2.2 gallons per minute (GPM)
- Toilets cannot exceed 1.28 gallons per flush (GPF)
- Urinals cannot exceed 0.5 gallons per flush (GPF)

Since more water is used in the bathroom than any other place in the home, water-efficient plumbing fixtures play an integral role in reducing water consumption, wastewater production, and consumers' water bills. It is estimated that switching to water-efficient fixtures can save the average household between $50 and $100 per year on water and sewer bills. Many hotels and office buildings find that water-efficient fixtures can save 20 percent on water and wastewater costs.

The EPA's WaterSense program labels water-efficient products that meet most of the criteria above, and on average are certified to use at 20 percent less water than legacy fixtures. Their website also provides a product search tool and a rebate finder, and can be accessed here: https://www.epa.gov/watersense

#### Water Conservation Best Management Practices

The 78th Texas Legislature under Senate Bill 1094 created the Texas Water Conservation Implementation Task Force and charged the group with reviewing, evaluating, and recommending optimum levels of water use efficiency and conservation for the state. TWDB Report 362, Water Conservation Best Management Practices Guide was prepared in partial fulfillment of this charge. TWDB Report 362 is now considered outdated and a more current list of BMPs is available at: https://www.twdb.texas.gov/conservation/BMPs/index.asp

#### Public Water Conservation Education

Public education may be one of the most productive actions that can result in the greatest amount of water savings. Most citizens are willing to actively do their part to conserve water once the need is communicated and how to accomplish the most benefit is explained. Numerous state, county, and academic agencies provide educational material and demonstrations. Groundwater conservation districts also provide water conservation activities.

The TWDB provides a significant amount of information and services pertaining to water conservation that can be accessed at: http://www.twdb.texas.gov/conservation/municipal/plans/index.asp

Likewise, water conservation tips developed by the TCEQ and made available through their Take Care of Texas educational campaign can be accessed at the following website: http://takecareoftexas.org/conservation-tips/conserve-our-water

TPWD also offers programs geared toward the appreciation and conservation of the state's outdoor natural resources ( https://tpwd.texas.gov/landwater/water/conservation/ /) which include:

- Freshwater Inflows and Estuaries
- Coastal Studies
- River Studies
- Texas Gulf Ecological Management Sites

Education of our youth may be one of the best ways to spread the word about conservation of water. The TWDB provides excellent educational programs for all grade levels K-12th. Information pertaining to this program can be accessed at: https://www.twdb.texas.gov/conservation/education/kids/index.asp.

The Groundwater Conservation Districts in the Plateau Region have water conservation management goals that include:

- Publishing conservation articles in local newspapers;
- Providing conservation presentations and demonstrations at county shows;
- Conducting school programs relating to conservation issues; and
- Working with river authorities to promote the clean rivers program.

## Watershed Best Management Practices

Watershed best management practices are activities taken to manage, protect, and restore the quality of water resources. Best management practices are designed to consider a variety of water uses and maximize conservation. The Environmental Protection Agency has put together a list of fourteen recommended BMPs and have developed a siting tool which identifies potential suitable locations for implementing different types of BMPs ( https://www.epa.gov/water-research/best-management-practices-bmps-siting-tool) that have proven to be helpful in water conservation efforts. Several of these practices are discussed further for being cost effective, practical and efficient for the Plateau Region.

## Brush Management

A potential means of increasing water supply is to reduce the amount of water consumed by shrubs and trees on rangelands. The density and coverage of shrubs has increased dramatically during the past century as former grasslands have now converted to shrub-lands or closed-canopy woodlands. A total loss of herbaceous vegetation cover will increase water yields in the form of surface runoff. However, this process will accelerate erosion, degrade water quality, and damage aquatic ecosystems. A more desirable way of increasing water yield is to manage vegetation to decrease evapotranspiration, which will generally increase the amount of water that percolates below the root zone into groundwater and eventually back into streams. Researchers* believe it is appropriate to broaden the issue from solely focusing on *"brush control for increasing water yield"* to *"best management practices for watershed health and sustainability"*. See Section 5.3.9 of this chapter for further discussion on vegetative management as water management strategy.

** Wilcox, B.P., Dugas, W.A., Owens, M.K., Ueckert, D.N., and Hart, C.R., 2005, Shrub Control and Water Yield on Texas Rangelands, Current State of Knowledge: Texas Agricultural Experiment Station Research Report 05-1.* http://twri.tamu.edu/reports/2005/taesresearchreport_shrub.pdf

## Rainwater Harvesting

The following discussion on Rainwater Harvesting is taken from the Texas Water Development Board's 'The Texas Manual on Rainwater Harvesting', 3rd Edition. This manual can be accessed at: http://www.twdb.texas.gov/publications/brochures/conservation/doc/RainwaterHarvestingManual_3rdedition.pdf

Rainwater is valued for its purity and softness. It has a nearly neutral pH, and is free from disinfection by-products, salts, minerals, and other natural man-made contaminants. Plants thrive under irrigation with stored rainwater. Appliances last longer when free from the corrosive or scale effects of hard water. Users with potable systems prefer the superior taste and cleansing properties of rainwater. Rainwater harvesting, in its essence, is the collection, conveyance, and storage of rainwater.

Rainwater harvesting systems can be as simple as a rain barrel for garden irrigation at the end of a downspout, or as complex as a domestic potable system or a multiple end-use system at a large corporate campus. Advantages and benefits of rainwater harvesting are numerous (Krishna, 2003):

- The water is free; the only cost is for collection and use.
- The end use of harvested water is located close to the source, eliminating the need for complex and costly distribution systems.
- Rainwater provides a water source when groundwater is unacceptable or unavailable, or it can augment limited groundwater supplies.
- The zero hardness of rainwater helps prevent scale on appliances, extending their use; rainwater eliminates the need for a water softener and the salts added during the softening process.
- Rainwater is sodium free, important for persons on low sodium diets.
- Rainwater is superior for landscape irrigation.
- Rainwater harvesting reduces flow to storm water drains and reduces non-point source pollution.
- Rainwater harvesting helps utilities reduce the summer demand peak and delay expansion of existing water treatment plants.
- Rainwater harvesting reduces consumers' utility bills.

The TWDB has a rainwater harvesting webpage that focuses on rainwater projects, training, the Texas Rain Catcher Award and FAQs: http://www.twdb.texas.gov/innovativewater/rainwater/index.asp

## Landscape Maintenance

A significant amount of water is used each year in the maintenance of residential and non-residential landscapes. Landscape irrigation conservation practices are an effective method of accounting for and reducing outdoor water usage while maintaining healthy landscapes and avoiding runoff. Water wise landscape programs should follow the seven principals of xeriscape:

- Planning and design
- Soil analysis and improvement
- Appropriate plant selection
- Practical turf area
- Efficient irrigation
- Use of mulch
- Appropriate maintenance

Additional detail on this subject is available in TWDB Report 362 ‘Water Conservation Best Management Practices Guide’:
http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R362_BMPGuide.pdf

## Water Loss Audit

Reported municipal use generally includes a variable amount of water that does not reach the intended consumer due to water leaks in the distribution lines, unauthorized consumption, storage tank overflows, and other wasteful factors. For some communities, attending to these issues can be a proactive conservation strategy that may result in significant water savings.

To address the lack of information on water loss, the 78th Texas Legislature passed House Bill 3338, which required retail public utilities that provide potable water to perform and file with the TWDB a water audit computing the utility's most recent annual system water loss every five years. In response to the mandate of House Bill 3338, TWDB developed a water audit methodology for utilities to quantify water losses, standardize water loss reporting and help measure water efficiency. This TWDB report 367 titled ‘Water Loss Audit Manual for Texas Utilities’ can be accessed at:
http://www.twdb.texas.gov/publications/brochures/conservation/doc/WaterLossManual_2008.pdf

The TWDB provides a significant amount of information and services pertaining to water loss audit that can be accessed at: http://www.twdb.texas.gov/conservation/municipal/waterloss/index.asp

- Additional resources and appropriate forms provided by TWDB include:
- Water Audit Worksheet Instructions
- Water Loss Guidance
- Guidelines for Setting a Target Infrastructure Leakage Index (ILL)
- Water Loss Manual for Texas Utilities (Updated March 2008)
- Main Line Water Loss Calculator
- Monthly Water Loss Report
- Leak Detection Loan Form
- Ultrasonic Flow Meter Equipment Loan Form

### 5.3.4 Regional Conservation Water Management Strategies

Many of the recommended water management strategies listed in are classified as “Conservation” and are first to be considered in meeting future water supply needs. These strategies compiled are listed in Table 5-5 and include:

- Water loss audit and main-line repair
- Drought management
- On-site reuse
- Public conservation awareness
- Specified activities for irrigation and livestock use

**Table 5-5. Conservation Water Management Strategies**

| County | Water User Group | Source Basin | Strategy | Strategy ID |
|---|---|---|---|---|
| | Bandera County FWSD #1 | San Antonio | Public conservation education | J-6 |
| | Bandera County Other<br>Bandera River Ranch #1 | San Antonio | Water loss audit and main-line repair | J-8 |
| | Bandera County Other<br>Lake Medina Shores | San Antonio | Public conservation education | J-9 |
| | Bandera County Other<br>Medina WSC | San Antonio | Public conservation education | J-11 |
| | Bandera County Other | San Antonio | Drought management | J-14 |
| | | | Water loss audit and main-line repair | J-17 |
| | | Nueces | Drought management | J-18 |
| | Bandera County Irrigation | San Antonio | Irrigation conservation - Irrigation scheduling | J-20 |
| | Bandera County Livestock | Guadalupe | Livestock conservation | J-22 |
| | | Nueces | Livestock conservation | J-24 |
| Edwards | City of Rocksprings | Nueces | Public conservation education | J-26 |
| | Edwards County Mining | Nueces | Mining Conservation - On-site reuse | J-30 |
| | | Colorado | Mining Conservation - On-site reuse | J-32 |
| | | Rio Grande | Mining Conservation - On-site reuse | J-34 |
| Kerr | City of Kerrville | Guadalupe | Water loss audit and main-line repair | J-37 |
| | Kerr County Other:<br>Verde Park Estates | Guadalupe | Water loss audit and main-line repair | J-42 |
| | Kerr County Other | Nueces | Public conservation education | J-43 |

**Table 5-5. (Continued) Conservation Water Management Strategies**

| County | Water User Group | Source Basin | Strategy | Strategy ID |
|---|---|---|---|---|
| Kerr | Kerr County Other - Center Point | Guadalupe | Public conservation education | J-54 |
| | Kerr County Other - Center Point Taylor System | Guadalupe | Public conservation education | J-55 |
| | Kerr County Livestock | Colorado | Livestock conservation | J-56 |
| | | Guadalupe | Livestock conservation | J-58 |
| | | San Antonio | Livestock conservation | J-60 |
| | | Nueces | Livestock conservation | J-62 |
| | Kerr County Mining | Colorado | Mining conservation - On-site reuse | J-64 |
| Kinney | Fort Clark Springs MUD | Rio Grande | Water loss audit and main-line repair | J-68 |
| Real | City of Camp Wood | Nueces | Public conservation education | J-72 |
| | City of Leakey | Nueces | Public conservation education | J-74 |
| | Real County Other | Nueces | Water loss audit and main-line repair for Real WSC | J-77 |
| Val Verde | City of Del Rio | Rio Grande | Water loss audit and main-line repair | J-80 |
| | Val Verde County Other | Rio Grande | Water loss audit and main-line repair for Val Verde County WCID Comstock | J-84 |
| | | | Water loss audit and main-line repair for San Pedro Canyon Subdivision (Upper) | J-85 |
| | | | Water loss audit and main-line repair for Tierra Del Lago | J-86 |
| | Val Verde County Mining | Rio Grande | Mining conservation - On-site reuse | J-88 |

### 5.3.5 Municipal Conservation Programs

Texas Water Code §11.1271 requires water conservation plans for all municipal and industrial water users with surface water rights of 1,000 acre-feet per year or more and irrigation water users with surface water rights of 10,000 acre-feet per year or more. Also, all entities with 3,300 or more connections and/or a financial obligation with TWDB greater than $500,000 are required to submit water conservation plans. Water conservation plans have been developed for the cities of Kerrville and Del Rio, which meet these criteria. The Upper Guadalupe River Authority, which also has water rights that meet the criteria, is not currently providing water and therefore has not developed a conservation plan under the above TWC requirement. However, UGRA does have a Water Conservation/Drought Management Plan, which was adopted in 1993. Water conservation plans are also required for all other water users applying for a State water right and may also be required for entities seeking State funding for water supply projects.

### 5.3.6 Gallons Per Capita Daily Goals

Effective municipal conservation can best be monitored in terms of reduction in gallons per day per capita (GPCD). The PWPG recommends the GPCD reduction goals listed in Table 5-6, which provides a listing of projected GPCD reductions anticipated as water efficiency and recommended conservation savings occur on a decadal basis. Entities listed in the table with higher GPCDs than 200 are likely impacted by water loss issues in their distribution systems. It is highly recommended that these entities take advantage of a water-loss audit to guide needed repairs.

**Table 5-6. Gallons Per Capita Daily Goals (Source – TWDB Conservation Database)**

| Water User Group | 2020 Adjusted GPCD | 2030 Adjusted GPCD | 2040 Adjusted GPCD | 2050 Adjusted GPCD | 2060 Adjusted GPCD | 2070 Adjusted GPCD |
|---|---|---|---|---|---|---|
| Bandera | 162 | 158 | 155 | 155 | 154 | 154 |
| Bandera County FWSD 1 | 185 | 180 | 178 | 177 | 177 | 177 |
| Brackettville | 251 | 247 | 243 | 242 | 242 | 242 |
| Camp Wood | 169 | 165 | 161 | 160 | 160 | 160 |
| County-Other, Bandera | 93 | 90 | 88 | 87 | 87 | 87 |
| County-Other, Edwards | 97 | 93 | 89 | 89 | 88 | 88 |
| County-Other, Kerr | 75 | 71 | 69 | 68 | 67 | 67 |
| County-Other, Kinney | 120 | 117 | 115 | 114 | 114 | 114 |
| County-Other, Real | 92 | 89 | 87 | 85 | 85 | 85 |
| County-Other, Val Verde | 116 | 113 | 111 | 110 | 110 | 110 |
| Del Rio Utilities Com. | 247 | 243 | 240 | 239 | 238 | 238 |
| Fort Clark Springs MUD | 438 | 434 | 431 | 430 | 429 | 429 |
| Kerrville | 172 | 168 | 165 | 163 | 163 | 163 |
| Kerrville South Water | 107 | 103 | 100 | 99 | 99 | 99 |
| Laughlin Air Force Base | 514 | 510 | 509 | 509 | 509 | 509 |
| Leakey | 122 | 117 | 114 | 112 | 112 | 112 |
| Rocksprings | 209 | 205 | 201 | 201 | 201 | 201 |

Significantly more restrictive measures should be initiated in response to varying degrees of drought conditions such as:

- Mild Drought (Stage 1) – 10% reduction
- Moderate Drought (Stage 2) – 20% reduction
- Severe Drought (Stage 3) – 30% reduction
- Extreme Drought (Stage 4) – 40% reduction

### 5.3.7 Groundwater Conservation District Management Plans

The Texas Legislature has established a process for local management of groundwater resources through Groundwater Conservation Districts. The districts are charged with managing groundwater by providing for the conservation, preservation, protection, recharging and prevention of waste of groundwater within their jurisdictions. An elected 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 planning region.

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

In recent sessions, the Texas Legislature has redefined the way groundwater is to be managed by establishing a process referred to as Groundwater Management Areas http://www.twdb.texas.gov/groundwater/management_areas/index.asp. This new process is summarized in Chapter 1, Section 1.1.2. The Real-Edwards and a portion of Kinney districts are in GMA 7; while the Bandera and Kerr (Headwaters) districts are in GMA 9. A portion of the Kinney district is in GMA 10.

As part of the joint planning process, groundwater conservation districts are responsible for determining the *desired future conditions* of principal aquifers within a management area. *Desired future conditions* are defined in Title 31, Part 10, §35601. (6) of the Texas Administrative Code as "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." *Desired future conditions* are implemented to help meet the planning goal for the conservation of water that is to be used for future uses. The following link provides information on desired future conditions: http://www.twdb.texas.gov/groundwater/management_areas/DFC.asp

Based on adopted *desired future conditions*, the TWDB estimates the amount of withdrawals that can occur over a specified time (*modeled available groundwater*) that does not deplete the aquifer beyond the stated *desired future condition*. As of 2018, desired future conditions have been adopted and modeled available groundwater has been determined for the following aquifers in the Plateau Region: Trinity, Edwards Group of the Edwards Trinity (Plateau), Edwards BFZ, and Edwards-Trinity (Plateau).

### Bandera County River Authority and Groundwater District

The Bandera County River Authority and Groundwater District http://www.bcragd.org/ was originally the Bandera County River Authority, created by the Texas legislature in 1971, and the Springhills Water Management District, created by the legislature in 1989. The authority of the Bandera County River Authority was incorporated into the Springhills Water Management District, and in 2003 the TCEQ authorized changing the District's name to Bandera County River Authority and Groundwater District. The District includes all of Bandera County within its jurisdiction. The mission of the District is to manage, protect and conserve the County's water and natural resources, while protecting private property rights. The most current District management plan was adopted in April of 2010 and amended in April 2013. The plan can be accessed at:

http://www.twdb.texas.gov/groundwater/docs/GCD/bcragwd/bcragwd_mgmt_plan2013.pdf

**Adopted Future Conditions for Bandera County**

| **Aquifer** | Edwards Group of the Edwards-Trinity (Plateau) | Trinity |
|---|---|---|
| **DFC** | No net increase in average drawdown through 2070 | Increase in average drawdown of approximately 30 feet through 2060 |

### Headwaters Groundwater Conservation District

The Headwaters Groundwater Conservation District http://www.hgcd.org/ is part of the Hill Country Priority Groundwater Management Area (9) and was created by the Texas legislature in 1991 (HB 1463). The District includes all of Kerr County within its jurisdiction. The District's revised 2016 Management Plan can be accessed at: https://hgcd.org/wp-content/uploads/2015/06/District-Management-Plan.pdf

The purpose of the District is to provide for the conservation, preservation, protection, recharging and prevention of waste of groundwater reservoirs or their subdivisions within the defined boundaries of the District. The District is responsible for registering and permitting wells drilled in the county, along with conducting aquifer analysis to help determine appropriate plans for future development.

Adopted DFCs for the aquifers in Kerr County are shown below. With regards to the Edwards Group of the Edwards-Trinity (Plateau) Aquifer, GMA 9 declares it 'non-relevant'. Districts in a groundwater management area may, as part of the process for adopting and submitting desired future conditions, propose classification of a portion or portions of a relevant aquifer as non-relevant (31 Texas Administrative Code 356.31 (b)). This classification of an aquifer is made if the districts determine that aquifer characteristics, groundwater demands, and current groundwater uses do not warrant adoption of a desired future condition. Further details explaining 'non-relevant' aquifers can be at TWDB website: http://www.twdb.texas.gov/groundwater/docs/How_will_TWDB_Evaluate_DFCs_June_2013.pdf

**Adopted Desired Future Conditions for Kerr County**

| **Aquifer** | Edwards Group of the Edwards-Trinity (Plateau) | Trinity |
|---|---|---|
| **DFC** | Non-relevant | Increase in average drawdown of approximately 30 feet through 2060. |

## Kinney County Groundwater Conservation District

The Kinney County Groundwater Conservation District was created by the legislature in 2001 (HB 3243), and was confirmed by the voters of Kinney County in 2002. The District includes all of Kinney County within its jurisdiction. The District was created to develop, promote, and implement water conservation and management strategies to conserve, preserve, protect groundwater supplies within the District, protect and enhance recharge, prevent waste and pollution, and to promote the efficient use of groundwater within the District. The 2018 approved Management Plan includes goals such as: provide the most efficient and sustainable use of groundwater; address conjunctive surface water management issues; address drought conditions and participate in the development of desired future conditions of aquifers.

**Adopted Desired Future Conditions for Kinney County (GMA 7)**

| **Aquifer** | Edwards-Trinity (Plateau) | Trinity |
|---|---|---|
| **DFC** | Drawdown which is consistent with maintaining an annual flow at Los Moras Springs of 23.9 cfs and median flow of 24.4 cfs. | |

**Adopted Desired Future Conditions for Kinney County (GMA 10)**

| **Aquifer** | Edwards BFZ (GMA10) | Edwards-Trinity (Plateau) |
|---|---|---|
| **DFC** | Water level in well 70-38-902 (J-17) shall not fall below 1,184 feet MSL as mandated by Edwards Aquifer Authority legislation. | |

## Real-Edwards Conservation and Reclamation District

The Real-Edwards Conservation and Reclamation District http://www.recrd.org/ was formed by the Texas legislature in 1959 (HB 447) and includes all of Real and Edwards Counties within its jurisdiction. The District was created to provide for the conservation preservation, protection, recharge and prevention of waste of the underground water reservoirs located under the District. The District strives to bring about conservation, preservation and the efficient, beneficial and wise use of water for the benefit of the citizens and the economy of the District through monitoring and protecting the quantity and quality of the groundwater. The District also aims to maintain groundwater ownership and rights of the landowners.

District activities include regulating groundwater withdrawals by means of spacing and production limits, using the Texas Water Development Board's observation network to monitor changing storage conditions of groundwater supplies within the District, undertaking, as necessary, and cooperating with investigations of the groundwater resources within the District and making the results of investigations available to the public upon adoption by the Board, and potentially requiring reduction of groundwater withdrawals to amounts which will not cause harm to the aquifer.

**Adopted Desired Future Conditions for Real and Edwards Counties (GMA 7)**

| **Aquifer** | Edwards-Trinity (Plateau) | Trinity (Real County) |
|---|---|---|
| **DFC** | Average drawdown not to exceed 2 feet in Edwards County and not to exceed 4 feet in Real County by 2070. These have been combined into one model so the DFC is for both is 7 feet. | |

### 5.3.8 Upper Guadalupe River Authority Conservation Program

The Upper Guadalupe River Authority (UGRA) provides a significant conservation outreach program serving citizens of Kerr County (http://www.ugra.org). Two full-time employees focus on public education programs and activities with emphasis on water conservation. Recent water conservation programs and activities include:

- Working with TPWD on the Healthy Creeks Initiative, assisting landowners with control and management of giant cane (*Arundo doanx*);
- Partnering with the Hill Country Master Gardeners on planning, design, and maintenance of the UGRA EduScape, which is a major landscape project providing educational venues demonstrating water conservation, low maintenance plants, pervious walkway options, and rainwater collection;
- Partnership with the Riverside Nature Center to provide "UGRA 2nd grade Science Day" field trip to all Kerr County 2nd graders;
- Annual River Clean Up event and assistance with cleanups coordinated by other groups;
- Water Enhancement Cost Share Program provides additional reimbursement to landowners enrolled in USDA Natural Resources Conservation Service (NRCS) or Texas State Soil and Water Conservation Board (TSSWCB) brush management programs. Landowners in the Guadalupe River watershed in Kerr County can receive 25% of the amount reimbursed by NRCS or TSSWCB once they have completed brush management activities;
- Water and sediment control basin structures have been constructed at seven locations in the upper Guadalupe River watershed. The structures function to slow runoff during rain events to reduce flooding and sediment loading into the river;
- Rebates up to $200 are issued to Kerr County residents on their purchases of rainwater catchment system equipment;

- The Rainwater Catchment System Cost Assistance Program annually awards one $2,500 payment to incentivize the construction of larger rainwater catchment systems. The program is open to anyone in Kerr County, but the applications submitted by entities that promote water conservation education to the public will be given a higher priority;
- Additional opportunities to provide information to the public on water conservation are made available through presentations to students and adults, radio public service announcements, routine newspaper articles, and advertisements in local publications.

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# APPENDIX 5A
# RECOMMENDED WATER MANAGEMENT STRATEGIES

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# INTRODUCTION

Water Management Strategies described in this appendix are proposed recommended projects to meet projected water supply shortages in future decades, and projects of specific interest by water-user entities participating in this planning process. The strategy evaluation procedure is designed to provide a side-by-side comparison such that all strategies can be assessed based on the same quantifiable factors as shown in Chapter 5 Tables 5-2, 5-3 and 5-4. Specific factors considered in each Table were:

Table 5-2

Quantity adequacy

Quality adequacy

Reliability

Impacts to water, agricultural, and natural resources

Table 5-3

Financial cost (total capital cost, annual cost, and cost per acre-foot)

Table 5-4

Environmental impacts

- Environmental water needs
- Wildlife habitat
- Cultural resources
- Environmental water quality
- Inflows to bays and estuaries

Qualitative and quantifiable impacts resulting from the implementation of projects are an important aspect of the overall analysis of the viability of water management strategies. The Tables above provide a coded ranking of impacts to designated required analysis categories. An explanation of the qualitative and quantifiable rankings listed in the Tables is provided in Appendix 5B. It is recognized that all strategies that require constructed infrastructure, including pipelines, will have either a temporary or permanent land disturbance on the footprint of the project.

Cost evaluations for all strategies include capital cost, debt service, and annual operating and maintenance (O&M) expenses. Capital costs are estimated based on September 2018 US dollars. The length of debt service is 20 years unless otherwise stated. An annual unit cost is also calculated based on the O&M cost per acre-foot of water supplied.

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# 5A-1 WATER MANAGEMENT STRATEGIES FOR THE CITY OF BANDERA

The City of Bandera and many other residents of Bandera County rely on the Lower Trinity Aquifer for municipal, domestic, livestock, and irrigation water supply needs, and the demand from the Lower Trinity is projected to increase as the population increases. Because the water level in the Lower Trinity has declined about 350 feet in City of Bandera wells since pumping started in the 1950s, there is concern that continued withdrawals from the Aquifer may negatively impact the Aquifer's ability to meet the long-term water supply needs of the area.

Although the supply-demand analysis does not project a future water supply deficit for the City of Bandera, the following water management strategies are recommended to enhance the reliability of the City's future water supply availability:

- (J-1) Reuse treated wastewater effluent for irrigation of public spaces
- (J-2) Promote, design, and install rainwater harvesting systems on public buildings
- (J-3) Additional Lower Trinity Aquifer well outside the current cone-of-depression and lay necessary pipeline **(ALTERNATE)**
- (J-4) Additional Middle Trinity Aquifer wells within City water infrastructure area
- (J-5) Acquire surface water supply, build required treatment facilities, connect to distribution network, and inject unused supply into underlying Lower Trinity Aquifer (ASR)

The City of Bandera has been active in promoting water conservation during the current drought and has committed to using water conservation as a long-term water management strategy. Conservation practices that the City has adopted include tiered water rates; providing the public with water conservation information; meter change out program and water line replacement program to reduce unaccounted for water loss. The City has also been working with residential and commercial water customers to identify BMPs that can be used to reduce water consumption as well as evaluating the potential for installing rainwater harvesting systems on public buildings. The City of Bandera has adopted the Bandera County River Authority and Groundwater District Drought Contingency Plan. The City has been in drought stage in the past and has implemented various stages of the plan. The various stages of drought management have reduced water use and heightened public awareness of the need to conserve water.

## J-1 Reuse Treated Wastewater Effluent for Irrigation of Public Spaces

The City of Bandera has requested funding through the Texas Water Development Board to study the potential of using treated wastewater effluent for irrigation of public parks and athletic fields. The importance of this effort is that the treated wastewater effluent is a known constant and can provide a new source of water for these uses. All current public supplies come predominantly from the Lower Trinity Aquifer, and as a consequence a significant aquifer cone-of-depression has resulted underlying the City of Bandera and surrounding area. If demands can be reduced it will potentially have a positive impact on water levels within the Aquifer.

**Quantity, Reliability, and Cost** – The quantity and reliability of this source is known through current wastewater discharges allowed under the City's wastewater discharge permit. Average daily flow from the wastewater plant is approximately 277,000 gallons/day (310 acre-feet/year). Based on the positive recommendation from the feasibility study, construction of this project will include amending the current discharge permit, potentially upgrading the wastewater treatment plant, a pump station, storage tanks and piping to deliver water. Total estimated capital cost for this project is approximately $1,496,000.

## J-2 Promote, Design, and Install Rainwater Harvesting Systems on Public Buildings

Rainwater harvesting is a practical and valuable method for supplying water for multiple uses including household, landscape, livestock and agricultural. A renewed interest in this approach is emerging due to escalating environmental and economic costs associated with the traditional centralized water systems or the drilling of wells. The State has devoted a considerable amount of attention to rainwater harvesting and has enacted many laws regulating this practice. Three specific pieces of legislation support the collection of rainwater: Texas Tax Code 151.355 which allows for a state sales tax exemption on rainwater harvesting equipment, Texas Property Code 202.007 prevents homeowners' associations from banning rainwater harvesting installations, and Texas House Bill 3391 which requires designs of new state buildings to include rainwater harvesting system technology.

The City of Bandera and the Bandera County River Authority and Groundwater District (BCRAGD) is actively involved in the conservation of water through rainwater harvesting. In 2013, Bandera High School was the recipient of the Texas Water Development Board's Texas Rain Catcher Award. This program is established to promote technology, educate the public, and to recognize excellence in the application of rainwater harvesting systems in Texas.

The City of Bandera, with the recommendation from the BCRAGD, has plans to develop a rainwater collection system utilizing rooftops located in the downtown area. This strategy assumes that the system will be gravity fed and used for local irrigation purposes. This project is designed to collect rainwater from two commercial sized roofs and store the water in fiberglass tanks at the respective locations. The strategy includes a fiberglass tank as opposed to a steel tank, since the steel tank would cost considerably more.

**Quantity, Reliability, and Cost** – This strategy will provide an additional one acre-foot per year. The total estimated capital cost for this project is approximately $56,000. This project will provide a firm supply of water even though some impact would be expected during drought conditions.

## J-3 Additional Lower Trinity Aquifer Well Outside the Current Cone-of-Depression and Lay Necessary Pipeline (ALTERNATE)

The City of Bandera obtains its water from the Trinity Aquifer and serves a growing population. The projected population growth is expected to increase from 1,875 in 2020; to 2,4421 by 2070. In order to keep pace with the growing water demands, the City of Bandera, with the recommendation from the (BCRAGD) has plans to develop additional groundwater from the Lower Trinity Aquifer.

The development of additional supplies from the Lower Trinity Aquifer includes one new well located approximately four miles north of town. It is assumed that the City will purchase the necessary property, costing approximately $10,000 per acre, along with the associated water rights and develop the infrastructure needed to pipe the water back to the City. This well will produce water from approximately 800 feet below the surface.

**Quantity, Reliability, and Cost** – The strategy supply is estimated at 403 acre-feet per year. The Lower Trinity Aquifer has shown that it can be considered reliable as a water supply if properly developed and is not compromised by additional demands. Care will need to be taken to find a suitable site for the new well to prevent any overlapping of existing aquifer cones-of-depression. The cost to develop a water well in the Lower Trinity Aquifer is significant, along with the necessary infrastructure to store and pump the water back to the City of Bandera. The total estimated capital cost for this project is approximately $3,298,000.

## J-4 Additional Middle Trinity Aquifer Wells within City Water Infrastructure Area

The City of Bandera with the recommendation from BCRAGD has identified the Middle Trinity Aquifer as a potential source of supply for meeting future water demands. Currently, this source is not being used for municipal purposes. Development of this Aquifer may provide a source of water that could potentially reduce peak demands on existing wells in the Lower Trinity Aquifer.

The proposed two wells will be located near the Medina River where more recharge might be anticipated and will produce water from approximately 550 feet below the surface. This strategy assumes that the supply from the Middle Trinity Aquifer would require minimal treatment such as chlorine disinfection. In addition, this strategy assumes 1,500 feet of connection piping.

**Quantity, Reliability, and Cost** – The quantity of water available in the Middle Trinity Aquifer is less than that of the Lower Trinity Aquifer. However, the wells can be pumped at a sustainable rate that does not exceed the MAG allowable. The reliability of water from this source is expected to be approximately 50 gpm. However, the Middle Trinity Aquifer has not been developed for municipal water supply in Bandera. The two wells are expected to yield approximately 161 acre-feet per year. The cost to develop a municipal water well in the Middle Trinity Aquifer is anticipated to be less since the City will not have to drill as deep. Furthermore, this strategy assumes that the new wells will be located within the City limits, minimizing project costs associated with the amount of connection piping required to meet the existing distribution system. The total estimated capital cost for this project is approximately $625,000.

## J-5 Acquire Surface Water Supply, Build Required Treatment Facilities, Connect to Distribution Network, and Inject Unused Supply into Underlying Lower Trinity Aquifer (ASR)

The City of Bandera has considered the feasibility of constructing a water treatment facility to treat surface water from the Medina River. As much of the treated water as is needed will go directly into customer distribution, with the excess being injected into existing public supply wells for future retrieval (ASR). A May 2009 study report titled *'ASR Feasibility in Bandera County'* was prepared for the Plateau Region Water Planning Group and can be accessed at the following link for more strategy detail: http://www.ugra.org/pdfs/BanderaReportMay09.pdf.
https://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0704830695_RegionJ/ASR-Feasibility-Bandera-County_finalreport-August2009.pdf

Bandera County currently has a Water Supply Agreement with Bandera-Medina-Atascosa WCID #1 (BMA WCID#1) for the option of up to 5,000 acre-feet per year. The BMA WCID#1 owns Certificate of Adjudication CA-19-2130, which authorizes the District to divert up to 65,830 acre-feet per year for irrigation, municipal and industrial uses; up to 750 acre-feet per year specifically for domestic and livestock purposes; and up to 170 acre-feet per year specifically for municipal use.

Under CA-19-2130, BMA WCID#1 is authorized to divert water from Medina Lake and Diversion Dam. However, it is anticipated that the surface water purchased by Bandera County for local use and the potential ASR project will be diverted in the vicinity of the City of Bandera, upstream of Medina Lake. As a result, an amendment of the existing water right owned by BMA WCID#1 is required and the addition of an upstream diversion point will likely be subject to additional bypass requirements related to adopted Senate Bill 3 (SB 3) environmental flow standards.

**Quantity, Reliability, and Cost** – The reliability of the addition of an upstream river diversion was calculated with the official Run 3 version of the Water Availability Model (WAM) of the Guadalupe-San Antonio Basin dated October 2014, provided by the TCEQ. Assumptions of the Run 3 version include adherence to strict prior appropriation; maximum use and storage; no return flows; a hydrologic simulation period of 1934-1989; and application of downstream SB 3 environmental flow standards as adoped and implemented by the TCEQ. The version as received from the TCEQ includes updates for Lake Medina/Diversion Lake and the addition of channel loss factors to all main stem water rights in the Guadalupe and San Antonio River Basins. Based on these modeled characteristics, the average diversion available from the modeled upstream diversion over the historical period (1934-1989) is 4,761 acre-feet per year.

An initial facility will provide 500 acre-feet per year of treated water. As much as is needed will go directly into customer distribution, with the excess being injected into existing public supply wells. In 2040 the facility will increase capacity to 1,000 acre-feet per year, and in 2060 the capacity increases to 1,500 acre-feet per year. To be conservative, a diversion of 85 percent of the average WAM 3 supply or 3,100 acre-feet per year is assumed to be reliably available for planning purposes. The total estimated capital cost for this project is approximately $34,188,000.

# 5A-2 WATER MANAGEMENT STRATEGIES FOR BANDERA COUNTY-OTHER

Bandera County-Other has less than 23,000 in population, including individuals living outside of a named water user group. This compilation of users known as County-Other is self-supplied and relies predominately on the Trinity Aquifer for their water supply needs, either on private wells or privately owned water supply systems. In a few locations, the Edwards-Trinity (Plateau) is a modest source of supply.

Although the supply-demand analysis does not project a future water supply deficit for Bandera County-Other, the following water management strategies are recommended to enhance the reliability of the future water supply availability for Bandera County Other:

- (J-6) Public conservation education - Bandera County FWSD #1
- (J-7) Additional groundwater well for Bandera County FWSD #1
- (J-8) Water loss audit and main-line repair for Bandera River Ranch #1
- (J-9) Public conservation education – Lake Medina Shores
- (J-10) Additional groundwater well for Lake Medina Shores **(ALTERNATE)**
- (J-11) Public conservation education – Medina WSC
- (J-12) Additional groundwater well - Medina WSC
- (J-14) Drought management – San Antonio Basin
- (J-16) Additional groundwater wells to provide emergency supply near the volunteer fire department
- (J-17) Water loss audit and main-line repair for Enchanted River Estates
- (J-18) Drought management – Nueces Basin

## J-6 Public Conservation Education - Bandera County FWSD #1

Bandera County FWSD#1 is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which will result in a water savings of approximately 2 acre-feet per year. The annual cost of this project is estimated to be $4,949.

## J-7 Additional Groundwater Well for Bandera County FWSD #1

This strategy assumes that one new water well be drilled in the Lower Trinity Aquifer, approximately 600 feet in depth. It is anticipated that the well will be cased with either 8- or 12-inch PVC or steel pipe. A 65 gpm electric submersible pump will be installed. In addition, a chlorinator for disinfection purposes will be installed and housed in a small building located on-site. The proposed well-site will include a new 30,000-gallon groundwater storage tank and a dual pump station. A 6-inch water line will be installed to convey water from the well-head to the storage tank, and ultimately to the nearby potable water distribution system.

**Quantity, Reliability, and Cost** – The quantity of water from the Trinity Aquifer is deemed to be sufficient to meet future demands if a site outside of the existing cone-of-depression can be found. The Aquifer has shown that it can be considered reliable as a water supply if properly developed and is not compromised by additional water demands. It is anticipated that this strategy will provide an additional 100 acre-feet per year. The total estimated capital cost for this project is approximately $990,000.

## J-8 Water Loss Audit and Main-line Repair for Bandera River Ranch #1

According to the 2015 TWDB Public Water System Water Loss Survey, Bandera River Ranch #1 had a total water loss of approximately 791,384 gallons per year due to leaking distribution lines and/or faulty meters. This amount of water loss is the sum of reported breaks and leaks and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the water supply system can reduce the unaccounted-for water and get a more accurate look at water consumption.

This strategy assumes a potential savings of approximately 4 acre-foot per year (338,234 gallons/year). It is assumed that a leak testing program will be implemented prior to replacing portions of the existing main-line leaks. This strategy assumes 3.6 miles of 6-inch diameter main-line will be replaced, with a total project capital cost of approximately $902,000.

## J-9 Public Conservation Education - Lake Medina Shores

Lake Medina Shores is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which will result in a water savings of approximately 3 acre-feet per year. The annual cost of this project in 2020 is estimated to be $1,208.

## J-10 Additional Groundwater Well for Lake Medina Shores (ALTERNATE)

This strategy assumes that one new water well be drilled in the Lower Trinity Aquifer, approximately 900 feet in depth. It is anticipated that the well will be cased with either 8- or 12-inch PVC or steel pipe. A 250 gpm electric submersible pump will be installed. In addition, a chlorinator for disinfection purposes will be installed and housed in a small building located on-site. The proposed well site will include a new 30,000-gallon groundwater storage tank and a dual pump station. A 6-inch water line will be installed to convey water from the well head to the storage tank, and ultimately to the nearby potable water distribution system.

**Quantity, Reliability, and Cost** – The quantity of water from the Trinity Aquifer is deemed to be sufficient to meet future demands if a site outside of the existing cone-of-depression can be found. The Aquifer has shown that it can be considered reliable as a water supply if properly developed and is not compromised by additional water demands. It is anticipated that this strategy will provide an additional 251 acre-feet per year. The total estimated capital cost for this project is approximately $1,477,000.

## J-11 Public Conservation Education - Medina WSC

Medina WSC is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which will result in a water savings of approximately 1 acre-feet per year. The annual cost of this project in 2020 is estimated to be $448.

## J-12 Additional Groundwater Well – Medina WSC

This strategy assumes that one new water well be drilled in the Lower Trinity Aquifer, approximately 800 feet in depth. It is anticipated that the well will be cased with either 8- or 12-inch PVC or steel pipe. A 250 gpm electric submersible pump will be installed. In addition, a chlorinator for disinfection purposes will be installed and housed in a small building located on-site. The proposed well-site will include a new 30,000-gallon groundwater storage tank and a dual pump station. A 6-inch water line will be installed to convey water from the well head to the storage tank, and ultimately to the nearby potable water distribution system.

**Quantity, Reliability, and Cost** – The quantity of water from the Trinity Aquifer is deemed to be sufficient to meet future demands if a site outside of the existing cone-of-depression can be found. The Aquifer has shown that it can be considered reliable as a water supply if properly developed and is not compromised by additional water demands. It is anticipated that this strategy will provide an additional 55 acre-feet per year. The total estimated capital cost for this project is approximately $1,417,000.

## J-14 Drought Management – San Antonio Basin

The Bandera County River Authority and Groundwater District (BCRAGD) has implemented a drought management plan (see Chapter 7 Section 7.2.6.1) to aid in groundwater conservation during declared drought conditions. Stages are triggered by the U.S. Drought Monitor, but can be adjusted at the discretion of the District when aquifer levels, rainfall and river flow conditions warrant. Drought stages are mandated pumping restrictions for permitted wells and recommended restrictions for exempt wells. This strategy recommends that the BCRAGD declare a minimum of Stage 2 (20-percent reduction) on specified wells in the Bandera County San Antonio River Basin to reduce aquifer supply demand by 20 percent. The resulting pumpage reduction will decrease water supply demand in the San Antonio Basin by: 441 acre-feet/year in 2020; 491 acre-feet/year in 2030; 516 acre-feet/year in 2040; 525 acre-feet/year in 2050; 533 acre-feet/year in 2060; and 537 acre-feet/year in 2070.

## J-16 Additional Groundwater Wells to Provide Emergency Supply near Volunteer Fire Department

Bandera County River Authority & Groundwater District (BCRAGD) has plans to develop a Regional Project designed to offer relief to residents impacted by severe drought conditions, and to provide a source of water to be potentially used by Fire Departments for emergency firefighting. This strategy assumes that public supply wells will be drilled in strategic locations and outfitted with a 30,000-gallon storage tank per site, which will be connected to the wells by 500 feet of connection piping. In addition, this strategy will be monitored by the BCRAGD to document aquifer conditions, conduct scientific studies such as determining aquifer recharge from rainfall, DFC compliance and regional planning. It is estimated that two new wells will be drilled in the Lower Trinity Aquifer. One well will be drilled in Eastern Bandera County approximately 800 feet in depth, with a capacity of 75 gpm. The second well will be in Western Bandera County approximately 1,100 feet in depth, with a capacity of 100 gpm. The developed water will require minimal treatment such as chlorine disinfection for municipal purposes.

**Quantity, Reliability, and Cost** – It is anticipated that these two wells will yield a total of 189 acre-feet per year from the Lower Trinity Aquifer. The aquifer has shown that it can be considered reliable as a water supply if properly developed and is not compromised by additional water demands. The cost to develop water in the Lower Trinity Aquifer is significant. The total estimated capital cost for this project is approximately $4,280,000.

## J-17 Water Loss Audit and Main-line Repair for Enchanted River Estates

According to the 2015 TWDB Public Water System Water Loss Survey, Enchanted River Estates had a total water loss of approximately 2,033,063 gallons per year due to leaking distribution lines and/or faulty meters. This amount of water loss is the sum of reported breaks and leaks and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the water supply system can reduce the unaccounted for water and get a more accurate look at water consumption.

This strategy assumes a potential savings of approximately 1 acre-foot per year (238,072 gallons/year). It is assumed that a leak testing program will be implemented prior to replacing portions of the existing main-line leaks. This strategy assumes 0.5 miles of 6" diameter main-line will be replaced, with a total project capital cost of approximately $117,000.

## J-18 Drought Management – Nueces Basin

The Bandera County River Authority and Groundwater District (BCRAGD) has implemented a drought management plan (see Chapter 7 Section 7.3.6.1) to aid in groundwater conservation during declared drought conditions. Stages are triggered by the U.S. Drought Monitor, but can be adjusted at the discretion of the District when aquifer levels, rainfall and river flow conditions warrant. Drought stages are mandated pumping restrictions for permitted wells and recommended restrictions for exempt wells. Strategy J-69 recommends that the BCRAGD declare a minimum of Stage 2 (20-percent reduction) on specified wells in the Bandera County Nueces River Basin to reduce aquifer supply demand by 20 percent. The resulting pumpage reduction will decrease water supply demand in the Nueces Basin by 23 acre-feet/year in 2020; 26 acre-feet/year in 2030; 27 acre-feet/year in 2040; 28 acre-feet/year in 2050; 28 acre-feet/year in 2060; and 28 acre-feet/year in 2070.

# 5A-3 WATER MANAGEMENT STRATEGIES FOR BANDERA COUNTY IRRIGATION

Bandera County has approximately 75 acre-feet of irrigation shortage in the San Antonio River Basin over the planning horizon. Irrigation within the Plateau Region is generally limited in most of the counties due to arid conditions and lack of well-developed soils. Low well yields common throughout much of the Region also limit the development of large-scale irrigation. Bandera County generally irrigates less than 200 acres of land with Trinity Aquifer groundwater. In addition to groundwater, most of the diversions by water rights on both the Nueces River and the San Antonio River are used for irrigation purposes. However, surface water is commonly very limited during drought conditions. The following water management strategies are recommended to enhance the reliability of the future water supply availability for the irrigation needs within Bandera County:

- (J-20) Irrigation scheduling
- (J-21) Additional groundwater wells - San Antonio Basin

## J-20 Irrigation Scheduling

This strategy is intended for producers with an adequate supply of water throughout the growing season. It involves scheduling the time and amount of water that is applied to a crop based on the amount of water present in the crop root zone, the amount of water consumed by the crop since the last irrigation, and other considerations. Water savings are difficult to quantify and vary from year to year based on cropping practices, water quality, and quantity. It is estimated that 0.3 to 0.5 acre-feet of water per acre may be saved. (Modified from TWDB BMPs at: http://www.twdb.texas.gov/conservation/BMPs/Ag/index.asp)

**Quantity, Reliability and Cost -** According to the 2017 U.S. Ag Census, Bandera County had 55 farms with irrigated land in 2017 and with an average of 22 acres per farm. Assuming that scheduling would conserve 0.3 acre-feet per acre and that only six of the 55 farms in Bandera County might implement this conservation strategy, this results in a conservation savings of approximately six acre-feet per farm, or 36 acre-feet per year total. The estimated quantity of supply for this strategy is uncertain due to variability of potential users who might implement this strategy. The reliability of this supply is low due to uncertainty associated with estimated implementation of BMPs. There is no cost associated with implementing this strategy.

## J-21 Additional Groundwater Wells – San Antonio Basin

The Trinity Aquifer has been identified as a potential source of water to meet the irrigation shortages within the County. Water from this source is generally good. TDS levels increase as the depth to the Aquifer increases. The Trinity Aquifer is one of the most extensive and highly used groundwater sources in Texas. This strategy assumes that three new wells will be drilled to provide approximately 75 acre-feet per year. These wells will produce water from approximately 330 feet below the surface.

**Quantity, Reliability, and Cost** –The three new wells are assumed to supply an additional 75 acre-feet per year. The reliability of this supply is medium, based on competing demands. The total capital cost of this project is approximately $291,000.

# 5A-4 WATER MANAGEMENT STRATEGIES FOR BANDERA COUNTY LIVESTOCK

Bandera County has a projected 5 acre-feet per year of livestock water use shortage over the planning horizon. During times of prolonged drought, ranchers often reduce their stock inventory, which will naturally result in decreased supply demand.

Livestock within the County obtain supplies from both surface and groundwater sources. Surface water, such as local-supply tanks, is commonly used, but limited during drought. Groundwater from the Edwards-Trinity (Plateau) Aquifer and Trinity Aquifer are more reliable sources. The following water management strategies are recommended to enhance the reliability of the future water supply availability for livestock needs within Bandera County:

- (J-22) Livestock conservation – Guadalupe Basin
- (J-23) Additional groundwater well - Guadalupe Basin
- (J-24) Livestock conservation – Nueces Basin
- (J-25) Additional groundwater well - Nueces Basin

## J-22 Livestock Conservation – Guadalupe Basin

Rotational grazing consists of subdividing grazing pastures and rotating livestock from one pasture to another on a regular interval. This allows the watershed, soils, and vegetation to recover from the stress of continuous livestock grazing. A study by Texas A&M AgriLife Research at Vernon (Ledbetter, 2017) found that changing to a multi-pasture rotational livestock management system reduced surface runoff and sediment load in the local stream by 39 and 34 percent, respectively. The study also found that subsurface flow increased by 48 percent, primarily due to increased infiltration and soil water storage associated with rotational grazing. This strategy assumes a conservative 20 percent reduction of the projected supply need. One acre-foot per year is assumed for the Guadalupe Basin livestock conservation strategy. No capital cost is assigned to this strategy.

## J-23 Additional Groundwater Well – Guadalupe Basin

The Edwards-Trinity (Plateau) Aquifer has been identified as a potential source of water to meet the livestock shortages within the County and is a recommended strategy. Water from this source ranges from fresh to slightly saline in the outcrop areas, and brine water in subsurface portions. This strategy assumes that one new well will be drilled to approximately 700 feet below the surface.

**Quantity, Reliability, and Cost** –The one new well produce an additional 2 acre-feet per year, with a medium to high reliability based on competing demands. The total cost of this project will be approximately $135,000.

## J-24 Livestock Conservation – Nueces Basin

Rotational grazing consists of subdividing grazing pastures and rotating livestock from one pasture to another on a regular interval. This allows the watershed, soils, and vegetation to recover from the stress of continuous livestock grazing. A study by Texas A&M AgriLife Research at Vernon (Ledbetter, 2017) found that changing to a multi-pasture rotational livestock management system reduced surface runoff and sediment load in the local stream by 39 and 34 percent, respectively. The study also found that subsurface flow increased by 48 percent, primarily due to increased infiltration and soil water storage associated with rotational grazing. This strategy assumes a conservative 20 percent reduction of the projected supply need. One acre-foot per year is assumed for the Nueces Basin livestock conservation strategy. No capital cost is assigned to this strategy.

## J-25 Additional Groundwater Well – Nueces Basin

The Edwards-Trinity (Plateau) Aquifer has been identified as a potential source of water to meet the livestock shortages within the County and is a recommended strategy. Water from this source ranges from fresh to slightly saline in the outcrop areas, and brine water in subsurface portions. This strategy assumes that one new 20 gpm well will be drilled to approximately 860 feet below the surface.

**Quantity, Reliability, and Cost** – The one new well is assumed to supply an additional 3 acre-feet per year, with a medium to high reliability based on competing demands. The total cost of this project will be approximately $126,000.

# 5A-5 WATER MANAGEMENT STRATEGIES FOR THE CITY OF ROCKSPRINGS

The City of Rocksprings is the county seat for Edwards County, named from the natural springs that occur within the porous limestone rocks in the area. The City and many other residents of Edwards County rely on the Edwards-Trinity (Plateau) Aquifer for municipal, domestic, livestock and irrigation water supply needs. Some local surface water is used by livestock. However, much of the supply from these sources is nearly fully developed for current use.

The City of Rocksprings has no projected water supply deficit for this planning cycle. The following water management strategies are recommended to enhance the reliability of the City's future water supply availability:

- (J-26) Public Conservation Education
- (J-27) Additional Groundwater Wells

## J-26 Public Conservation Education

The City of Rocksprings is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which will result in a water savings of approximately 1 acre-feet per year. The annual cost of this project in 2020 is estimated to be $208.

## J-27 Additional Groundwater Wells

The City of Rocksprings has recently completed the construction of two new Edwards-Trinity (Plateau) Aquifer wells located approximately six blocks west from the existing overhead storage facility. The City will need to install approximately 500 feet of connection pipe to connect to the wells. This strategy assumes that the new wells will produce water approximately 480 feet below the surface, providing an estimated 121 acre-feet per year. Minimal advance treatment such as chlorine disinfection is required for municipal use.

**Quantity, Reliability, and Cost** – The two new wells, when brought on line, are assumed to supply an additional 121 acre-feet per year. The reliability of this supply is medium to high, based on competing demands. The total capital cost of this project is approximately $681,000.

# 5A-6 WATER MANAGEMENT STRATEGIES FOR BARKSDALE WATER SUPPLY CORPORATION

The Barksdale Water Supply Corporation is a Not for Profit 501 C Corporation that serves the small Community of Barksdale. Currently, the system has two small (40 gpm each) alluvial wells that pump water into the systems pressure tank, and is then distributed to 83 active connections in the system. Due to the small number of connections and relatively low water rates, the income of the system is not adequate to set aside funding for capital improvements. Therefore, over the years the infrastructure of the water supply corporation has deteriorated, and the system is in need of repair and upgrades. The system is currently at peak output, and the projected increase demands from new subdivisions in the area will require extensive upgrades, which will include two additional wells and a new larger capacity pressure tank. In full build-out, the subdivision will add an additional 28 connections or a 34 percent increase in system capacity. Although the supply-demand analysis does not project a future water supply deficit for Barksdale Water Supply Corporation, the following water management strategy is recommended to enhance the reliability of the Community's future water supply availability

## J-28 Additional Well in the Nueces River Alluvium Aquifer and RO Wellhead Treatment

Barksdale WSC with the recommendation from Real-Edwards Groundwater Conservation and Reclamation District has plans to drill one additional well in the Nueces River Alluvium Aquifer to help supplement the existing water system. This strategy assumes that the necessary groundwater pumping authorization and property will be obtained for the development of one new well, located a sufficient distance from the other municipal wells in the system to prevent overlapping cones-of-depression. This well is expected to maintain minimum production of 34 gpm. The new well will be drilled at a depth of 50 feet. In addition, this strategy includes 300 feet of six-inch connection pipeline and a reverse osmosis wellhead filter.

**Quantity, Reliability, and Cost** – The quantity of water from this source is expected to provide up to 54 acre-feet per year. Sufficient groundwater is available from the Nueces River Alluvium Aquifer without causing excessive water-level declines; however, some impact might be expected in a severe drought. The total capital cost for this project is estimated at $178,000.

# 5A-7 WATER MANAGEMENT STRATEGIES FOR EDWARDS COUNTY MINING

Edwards County has approximately 59 acre-feet of mining water supply shortage over the planning horizon. Local surface water in conjunction with groundwater from the Edwards-Trinity (Plateau) Aquifer, provide the water needed for industrial use within the County. The following water management strategies are recommended to enhance the reliability of the future water supply availability for the mining water-supply shortages within Edwards County:

- (J-31) Additional groundwater well (Nueces Basin)
- (J-33) Additional groundwater well (Colorado Basin)
- (J-35) Additional groundwater wells (Rio Grande Basin)

## J-31 Additional Groundwater Well (Nueces Basin)

The Edwards-Trinity (Plateau) Aquifer has been identified as a potential source of water to meet the mining water supply shortages within the County. The Aquifer consists of lower Cretaceous age, saturated limestones and dolomites of the Edwards and Trinity Groups that occur in the Edwards Plateau. Water from this source can be variable, with water quality ranging from fresh to slightly saline in the outcrop areas, and brine water in subsurface portions. Reported well yields commonly range from less than 50 gpm where saturated thickness is thin; to more than 1,000 gpm where large capacity wells are completed in jointed and cavernous limestone. This strategy assumes that one new well will be drilled to produce water from approximately 600 feet below the surface and produce at a rate of 40 gpm.

**Quantity, Reliability, and Cost** –The one new well is assumed to supply an additional 16 acre-feet per year, with a reliability of medium to high based on competing demands. The total capital cost of this project is approximately $125,000.

## J-33 Additional Groundwater Well – (Colorado Basin)

The Edwards-Trinity (Plateau) Aquifer has been identified as a potential source of water to meet the mining water supply shortages within the County. The Aquifer consists of lower Cretaceous age, saturated limestones and dolomites of the Edwards and Trinity Groups that occur in the Edwards Plateau. Water from this source can be variable, with water quality ranging from fresh to slightly saline in the outcrop areas, and brine water in subsurface portions. Reported well yields commonly range from less than 50 gpm where saturated thickness is thin; to more than 1,000 gpm where large capacity wells are completed in jointed and cavernous limestone. This strategy assumes that one new well will be drilled to produce water from approximately 350 feet below the surface and produce at a rate of 15 gpm.

**Quantity, Reliability, and Cost** – The one new well is assumed to supply an additional 12 acre-feet per year, with a reliability of medium to high based on competing demands. The total capital cost of this project is approximately $73,000.

## J-35 Additional Groundwater Wells (Rio Grande Basin)

The Edwards-Trinity (Plateau) Aquifer has been identified as a potential source of water to meet the mining water supply shortages within the County. The Aquifer consists of lower Cretaceous age, saturated limestones and dolomites of the Edwards and Trinity Groups that occur in the Edwards Plateau. Water from this source can be variable, with water quality ranging from fresh to slightly saline in the outcrop areas, and brine water in subsurface portions. Reported well yields commonly range from less than 50 gpm where saturated thickness is thin; to more than 1,000 gpm where large capacity wells are completed in jointed and cavernous limestone. This strategy assumes that two new wells will be drilled to produce water from approximately 335 feet below the surface and produce at a rate of 10 gpm.

**Quantity, Reliability, and Cost** – The two new wells are assumed to supply an additional 31 acre-feet per year, with a reliability of medium to high, based on competing demands. The total capital cost of this project is approximately $132,000.

# 5A-8 WATER MANAGEMENT STRATEGIES FOR THE CITY OF KERRVILLE

The City of Kerrville has developed a conjunctive-use policy for both surface water and groundwater and passed a comprehensive Water Management Plan in early 2004 (updated 2010). The policy specifies that: (1) surface water will be used to the maximum extent that it is available, (2) groundwater will be a supplemental source of supply, and (3) water consumption will be reduced through conservation.

The TCEQ Guadalupe River WAM 3 drought-of-record analysis yields 150 acre-feet per year of surface water from the Guadalupe River for municipal use and 75 acre-feet per year for irrigation as reliable for the City of Kerrville. For planning purposes, the City proposes to use this estimate of available surface water, even though the estimate is significantly less than the permitted amount based on availability during a drought-of-record. Kerrville will develop additional surface and groundwater supplies, storage options or modifications to the existing permits, and expansion of the aquifer storage and recovery (ASR) system if it can be shown that there are periods when the City will not be able to use the permitted water from the Guadalupe River.

The City of Kerrville has been operating an ASR system for the past several years. In this system, a portion of treated Guadalupe River surface water is injected into the Lower Trinity Aquifer during months of water surplus and recovered from the Aquifer for subsequent use during dry summer months. Currently, the ASR has two wells that serve for both injection and recovery. The capacity of the storage in the ASR is virtually unlimited, but the rates of injection and recovery are limited to 1 MGD in each of the two wells. A third well is in planning stages. As of December 2018, the total storage in the ASR was over 950 million gallons (2,915 acre-feet).

Assuming that a drought-of-record starts immediately, the maximum reliable supply for the City of Kerrville is 150 acre-feet per year using the volume stored in the Aquifer as of June 2010. Permit 1996 would provide an additional 150 acre-feet per year for municipal use, for a total of 300 acre-feet per year. However, the ASR storage does not recover quickly, and if there are multiple drought years, the ASR may not have enough storage for a reliable supply to cover the entire drought period. Therefore, a reliable surface water supply of 150 acre-feet per year for the City of Kerrville is recommended.

Based on current groundwater availability estimates, the firm yield of the Lower Trinity Aquifer is estimated at 4,250 acre-feet per year in the Kerrville area. The City of Kerrville uses approximately 3 MGD, or 3,360 acre-feet per year as an available groundwater supply during a drought year. The City continues to rely on the Lower Trinity Aquifer as a dependable source of water. Through the City's conjunctive use policy, groundwater is reserved for meeting peak demand in a normal year and base demand in a drought year. For planning purposes, the estimates of available groundwater are 5 MGD (5,600 acre-feet per year) for peak demand and 3 MGD (3,360 acre-feet per year) for average demand.

The City has identified the possibility of modifying its own existing water permits. Currently the City's ability to divert under its existing permits is dependent on whether more senior water right holders exercise their rights, and is also affected by the City's Special Conditions written into its permits. If the City had more reliability from the Guadalupe River and more latitude in its ability to divert during certain months of the year, the City could more fully utilize its ASR facility.

The City of Kerrville's water treatment capacity also limits its utilization of its ASR facility. The City needs excess treatment capacity to treat and store 4 MGD during periods of higher streamflow; the current

ASR system is limited to 2 MGD. The City has included the necessary project to increase the ASR system to 4 MGD in the ten-year capital improvement program.

The City is currently exploring the potential of the Ellenburger Aquifer to provide additional water supply. If the aquifer does not prove to be a viable source, the City is considering constructing an RO facility adjacent to the existing reuse pond and treating the water to potable standards.

The availability of water will become a factor limiting the growth of both Kerrville and Kerr County. Currently, the supply-demand analysis for the City of Kerrville projects a water-supply deficit of 874 acre-feet per year in 2020; increasing to 1,156 acre-feet per year by 2070. Water management strategies that the City can consider as possible future sources of supply include:

- (J-36) Increase wastewater reuse
- (J-37) Water loss audit and main-line repair for City of Kerrville
- (J-39) Explore and develop new Ellenburger Aquifer well supply
- (J-41) Increasing water treatment and ASR capacity

### J-36 Increase Wastewater Reuse

The City of Kerrville has completed construction of a 98-million-gallon detention pond at the City's existing WWTP to store treated effluent for reuse purposes. The design of this project is to also include a second detention pond to be constructed later when water demands warrant its construction. This strategy focuses solely on the construction of the second pond as a means of expanding the wastewater reuse system capacity.

**Quantity, Reliability, and Cost** – The quantity and reliability of water from this source is expected to be approximately 2,500 acre-feet per year. The reliability of this source is high. The total capital cost is approximately $12,570,000.

### J-37 Water Loss Audit and Main-line Repair for City of Kerrville

According to the 2017 TWDB Public Water System Water Loss Survey, the City of Kerrville had a water loss of approximately 237,535,450 gallons per year (18.4 percent) due to leaking distribution lines and/or faulty meters. This amount of water loss is the sum of reported breaks and leaks and unreported loss. Currently the City of Kerrville is replacing old inaccurate water meters with new remote read meters. With this increase in accuracy, the City hopes to reduce unaccounted for water, allowing for a more accurate look at water consumption.

**Quantity, Reliability, and Cost -** This strategy assumes a potential savings of 134 acre-feet per year. It is assumed that a leak testing program will be implemented prior to replacing portions of the existing main-line leaks. This strategy assumes 51 miles of 6" diameter main-line would be replaced, with a total project capital cost of $12,636,000.

### J-39 Explore and Develop new Ellenburger Aquifer Well Supply

This strategy assumes that two new water wells will be drilled in the Ellenburger-San Saba Aquifer, approximately 1,150 feet in depth. It is anticipated that the well will be cased with either 8- or 12-inch

PVC or steel pipe. A 600 gpm electric submersible pump will be installed. In addition, a chlorinator for disinfection purposes will be installed and housed in a small building located on-site. The proposed well site will include a new 30,000 gallon groundwater storage tank and a dual pump station. An 8-inch water line will be installed to convey water from the wellhead to the storage tank, and ultimately to the nearby potable water distribution system.

The Headwaters Groundwater Conservation District is currently drilling test wells into the Ellenburger-San Saba Aquifer to determine potential yield and chemical quality. The first test well produced favorable results. A second test well will be drilled soon within the City of Kerrville to determine its viability as a municipal source for the City. If the results from this second well are favorable, the City will likely proceed with this strategy.

**Quantity, Reliability, and Cost** – It is anticipated that this strategy will provide an additional 1,156 acre-feet per year. The total estimated capital cost for this project is approximately $14,493,000.

## J-41 Increasing Water Treatment and ASR Capacity

The City of Kerrville is planning on expanding its existing water treatment plant from its current capacity of 5 MGD to 7 MGD, and the ASR pumping and storage capacity of 2 MGD to 4 MGD. The capacity of the storage in the ASR is virtually unlimited, but the rates of injection and recovery are limited to 1 MGD in each of the two wells. A third and fourth well are in planning stages. As of December 2015, the total storage in the ASR was 600 million gallons (1,841 acre-feet).

The City is also evaluating the possibility of treating wastewater to drinking water standards and storing it in the ASR system. Wastewater is one of the most reliable sources of water during a drought and thus must be considered as a possible water supply. If it were decided to proceed with this project the City would need an additional 2-3 MGD of ASR capacity.

The City's current water treatment capacity limits its utilization of its ASR facility. The City has identified the need for an additional 2 MGD of treatment capacity to take care of peak use; take advantage of periods when higher stream flows occur in the Guadalupe River; and thus, fully utilize its ASR. The increased storage capacity provided by the expanded ASR operation will make available water supplies more reliable. However, during drought-of-record conditions, water available from the upper Guadalupe River may be limited or nonexistent. Treated Guadalupe River water is injected into the aquifer during non-drought conditions when surface water is plentiful and is retrieved at a later time as a supply source during drought-of-record conditions when surface water is scarce.

**Quantity, Reliability, and Cost** – The treated supply made available through this strategy is estimated to be 3,360 acre-feet per year. Because of the uncertainty involved with the development of this source for municipal use, the reliability of this strategy is considered moderate. The total capital cost is estimated at $15,393,000.

# 5A-9 WATER MANAGEMENT STRATEGIES FOR KERR COUNTY-OTHER

Kerr County-Other has a projected population of 24,165, excluding Kerrville and Kerrville South, in 2020, increasing to 28,949 by 2070. This compilation of users known as County-Other is self-supplied and relies predominately on groundwater from the Trinity Aquifer for their water supply needs. Although Kerr County-Other has a projected water supply deficit of only 10 acre-feet per year for the planning horizon, this shortage is spread over the entire County. The rural population is however, concentrated in the eastern portion of the County

Kerr County Commissioners' Court in partnership with the Upper Guadalupe River Authority (UGRA) has plans to develop several Eastern Kerr County Regional Water Supply projects to better serve expanding rural areas. These projects will offer reliable and sustainable sources of water for the growing water demands of numerous small utilities in the service region including Center Point and Center Point Taylor System.

Conservation will be a key factor in developing eastern Kerr County water needs in the future. The mission of UGRA is to "conserve and reclaim surface water through the preservation and distribution of the water resources for future growth to maintain and enhance the quality of life for all Kerr County citizens". Conservation measures are also recommended for Center Point, Center Point Taylor System, and Verde Park Estates.

The following water management strategies are recommended to enhance the reliability of the future water supply availability for Kerr County-Other:

- (J-45) Eastern Kerr County Regional Water Supply Project
- (J-54) Public conservation education – Center Point
- (J-46) Purchase water from EKCRWSP – Center Point
- (J-55) Public conservation education – Center Point Taylor System
- (J-47) Purchase water from EKCRWSP – Center Point Taylor System
- (J-42) Water loss audit and main-line repair for Verde Park Estates
- (J-43) Public conservation education (Nueces River Basin)

## J-45 Eastern Kerr County Regional Water Supply Project

Population growth in eastern Kerr County continues to increase, creating genuine concerns pertaining to the water availability needed to meet these growing demands. Kerr County Commissioners' Court (KCCC) in partnership with the Upper Guadalupe River Authority (UGRA) has plans to develop several Eastern Kerr County Regional Water Supply Projects (EKCRWSP) to provide for conjunctive use of surface water and groundwater in high density growth areas of eastern Kerr County outside of the area serviced by the City of Kerrville. A facility plan was completed in 2010 utilizing an EDAP grant from the TWDB for a wholesale surface water supply. Total capital cost for all projects associated with this regional strategy is $79,702,000. UGRA is the sponsor for this regional project.

The *2021 Plateau Region Water Plan* projects only a limited amount of water-supply shortage for the rural Guadalupe River Basin portion of Kerr County at large; however, it is recognized that a greater percentage of the rural population is concentrated in the eastern portion of the county (see Chapter 2,

Figure 2-3). To prepare for this concentrated water supply need the following water management projects are recommended to develop a regional water management strategy and enhance the reliability of the future water supply availability for the Kerr County Other category:

- Project 1. Ellenburger Aquifer water supply well
- Project 2a. Construction of an off-channel surface water storage
- Project 2b. Construction of surface water treatment facilities and transmission line
- Project 3. Construction of ASR facilities
- Project 4a. Trinity aquifer wellfield
- Project 4b. Construction of a desalination plant

### Project 1. Ellenburger Aquifer Water Supply Well

This strategy considers a new water supply well providing water to the Eastern Kerr County Regional Project. The single well will be drilled to a depth of approximately 1,000 feet and will tap the Ellenburger Aquifer. Although there are no Ellenburger supply wells in Kerr County, the aquifer is a significant groundwater source for the City of Fredericksburg immediately to the north in Gillespie County. Subsurface geology suggests that there is a strong potential that usable groundwater will be encountered in the Ellenburger in northern Kerr County. An initial pilot hole will be drilled to total depth to verify the existence of a groundwater supply prior to completing the well to its full capacity. The Headwaters Groundwater Conservation District will provide geotechnical guidance on the drilling of the well. Groundwater supplies produced from this well will be routed to the EKCRWSP distribution network or, if water quality treatment is necessary, to the desalination facility discussed in Project 2b.

**Quantity, Reliability, and Cost** – The Ellenburger Aquifer has been identified as a viable source, but the quantity and reliability of water from this source is unknown. For this *Plan*, one new well will be drilled at a depth of 1,000 feet below the surface to provide an additional 108 acre-feet per year of water. This strategy includes two miles of six-inch diameter transmission line. Minimal treatment, such as chlorine disinfection, will be required for municipal purposes. The total estimated capital cost for this project is $652,000.

### Project 2a. Construction of an Off-Channel Surface Water Storage

This Regional Project provides for the securing of one or more off-channel ground storage facilities. The strategy assumes that the facility will be lined with impervious material to prevent subsurface seepage loss. Guadalupe River water will be captured during excessive flow episodes. Following a period of time to allow for settling of sediment, the captured water will be diverted for treatment to drinking water quality to a facility site near the Community of Center Point (Project 2b). Water supply generated from this strategy will be combined with water supplies generated in Strategies J-45 and J-46 for public distribution.

**Quantity, Reliability, and Cost** – The reliability of the river diversion was calculated with the official Run 3 version of the Water Availability Model (WAM) of the Guadalupe-San Antonio Basin dated October 2014, provided by the TCEQ. Assumptions of the Run 3 version include adherence to strict prior appropriation; maximum use and storage; no return flows; a hydrologic simulation period of 1934-1989; and application of downstream Senate Bill 3 environmental flow standards as adopted and implemented by the TCEQ.

The volume of water this strategy will produce is estimated to average 1,121 acre-feet per year, which will generally only occur during high river flow episodes. During drought-of-record periods, the supply is likely unavailable. Because of the uncertainty involved with the development of this source for municipal use, the reliability of this strategy is considered moderate by itself; however, in combination with other more reliable supplies the project becomes more meaningful.

Total estimated capital cost for this project is $25,231,000, which includes 1,500-acre land purchase and survey cost of $5,763,000.

### Project 2b. Construction of Surface Water Treatment Facilities and Transmission Line

The construction of a surface water treatment facility to serve the unincorporated community of Center Point and other rural areas in eastern Kerr County includes a 1.8 mgd surface water treatment plant, an intake structure and pumping station, a 500,000 gallon elevated storage tank, and an assumed five miles of 10-inch diameter transmission line. Water supply sources for this facility are generated through Project 2a and possibly Project 1.

**Quantity, Reliability, and Cost** – In total, this strategy will provide treatment capacity for up to 1,121 acre-feet per year of water. The new supply of water will go directly into customer distribution. The estimated capital cost for a 1.8 MGD capacity source water treatment facility is $22,829,000. Treated supplies in excess of those that are of immediate use can be made available for storage in an ASR project (Project 3).

### Project 3. Construction of ASR Facility

The feasibility of constructing an ASR facility to provide additional water supplies to the eastern portion of Kerr County was evaluated by LBG-Guyton Associates and Freese and Nichols, Inc. during the 2011 planning period (*Water Rights Analysis and ASR Feasibility in Kerr County, 2010*.

**Quantity, Reliability, and Cost** – This strategy evaluation assumed a facility site near the Community of Center Point. This strategy assumes that 1,124 acre-feet per year of excess treated water from the Project 2b water treatment facility would be injected into the Lower Trinity Aquifer and recovered during times of supply shortage. The cost to construct and equip ASR wells capable of both injection and withdrawal is approximately $1,461,000. Because of the uncertainty involved with the development of this source for municipal use, the reliability of this strategy is considered moderate.

### Project 4a. Trinity Aquifer Wellfield

Part of the Regional Project is to develop a wellfield to provide a water supply to the densely populated rural areas of Eastern Kerr County. This strategy assumes four wells will be drilled in the Trinity Aquifer to provide an additional 860 acre-feet per year. These wells would produce water from 530 feet below the surface. This strategy assumes a five-mile, 10-inch diameter transmission line will transport the water from the wells to the distribution center. Minimal treatment, such as chlorine disinfection, will be required for municipal purposes. In addition, advanced treatment will be necessary for municipal purposes due to anticipated water quality issues. The wells must be permitted by the Headwaters Groundwater Conservation District and withdrawals must not exceed the Trinity Aquifer MAG limit.

**Quantity, Reliability, and Cost** – The quantity and reliability of water from this source is expected to be approximately 200 gpm. For this *Plan*, the four new wells are assumed to supply an additional 860 acre-feet per year, beginning in the 2030 decade. The Trinity Aquifer has shown that it can be considered reliable as a water supply if properly developed and is not compromised by additional water demands. The total estimated capital cost for this project is approximately $8,367,000.

### Project 4b Construction of a Desalination Plant

This strategy is contingent on Project 4a. Due to anticipated water quality issues (radon and sulfides) from the groundwater obtained in a newly developed well field or from an Ellenburger Aquifer supply well, advanced treatment will be necessary for municipal purposes. The brine concentrate from the wells will be disposed of using an evaporation pond.

**Quantity, Reliability, and Cost** –It is assumed that a 1.2 MGD brackish desalination treatment unit (for treatment of elevated TDS levels) as well as a simple filtration unit (for treatment of elevated radon and sulfides) would be necessary to treat the water for municipal use. It is anticipated that this strategy would provide an additional 860 acre-feet per year of water, beginning in the 2030 decade. The reliability of water from this source is expected to be medium to high based on competing demands. The total estimated capital cost for this project is $21,162,000.

### J-54 Public Conservation Education – Center Point

The Community of Center Point is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which will result in a water savings of approximately 1 acre-feet per year. The annual cost of this project in 2020 is estimated to be $128.

### J-46 Purchase Water from EKCRWSP – Center Point

Center Point is one of several small community utilities in Easter Kerr County that is expected to benefit from the construction of the Eastern Kerr County Regional Water Supply Project (Strategy J-45). Water supplies provided by the Project are derived from multiple sources and will be more reliable than existing individual sources. Although Center Point is projecting a 4 acre-feet per year water-supply need, the community will likely derive all its supply (11 acre-feet per year) from the Project in the future. The annual supply purchase cost is estimated at $400 per acre foot for a total annual cost of $4,400.

### J-55 Public Conservation Education – Center Point Taylor System

The Center Point Taylor System is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which will result in a water savings of approximately 1 acre-feet per year. The annual cost of this project in 2020 is estimated to be $265.

## J-47 Purchase Water from EKCRWSP – Center Point Taylor System

The Center Point Taylor System is one of several small community utilities in Easter Kerr County that is expected to benefit from the construction of the Eastern Kerr County Regional Water Supply Project (Strategy J-45). Water supplies provided by the Project are derived from multiple sources and will be more reliable than existing individual sources. Although the Center Point Taylor System is projecting a maximum of 5 acre-feet per year water-supply need by 2070, the utility will likely derive all its supply (43 acre-feet per year) from the Project in the future. The annual supply purchase cost is estimated at $400 per acre foot for a total annual cost of $17,200.

## J-42 Water Loss Audit and Main-line Repair for Verde Park Estates WWW

According to the 2015 TWDB Public Water System Water Loss Survey, Verde Park Estates had a total water loss of approximately 662,140 gallons per year due to leaking distribution lines and/or faulty meters. This amount of water loss (15.5 percent) is the sum of reported break and leaks and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the water supply system can reduce the unaccounted-for water and get a more accurate look at water consumption.

**Quantity, Reliability, and Cost -** This strategy assumes a potential savings of approximately 1 acre-foot per year. It is assumed that a leak testing program will be implemented prior to replacing portions of the existing main-line leaks. This strategy assumes 0.6 miles of 6” diameter main-line would be replaced, with a total project capital cost of $155,000.

## J-43 Public Conservation Education (Nueces Basin)

Kerr County-Other in the Nueces River Basin has a 2020-population of six and a water-supply deficit of one acre-foot per year. This deficit appears because of regional statistics and is inconsistent with the minimal population. A total of one percent reduction in demand is anticipated, which will result in a water savings of approximately 1 acre-feet per year. The annual cost of this project in 2020 is estimated to be $3.

# 5A-10 WATER MANAGEMENT STRATEGIES FOR KERR COUNTY LIVESTOCK

Kerr County is projected to have approximately 325 acre-feet of livestock water supply shortage over the planning horizon. Livestock within the County obtains supplies from both surface and groundwater sources. Surface water such as local supply is commonly used, but limited due to the recent drought. Groundwater from the Edwards-Trinity (Plateau) Aquifer and the Trinity Aquifer are more reliable sources.

- (J-56) Livestock conservation – Colorado Basin
- (J-57) Additional groundwater wells - Colorado Basin (ALTERNATE)
- (J-58) Livestock conservation - Guadalupe Basin
- (J-59) Additional groundwater wells - Guadalupe Basin (ALTERNATE)
- (J-60) Livestock conservation - San Antonio Basin
- (J-61) Additional groundwater well - San Antonio Basin (ALTERNATE)
- (J-62) Livestock conservation - Nueces Basin
- (J-63) Additional groundwater wells - Nueces Basin (ALTERNATE)

## J-56 Livestock Conservation (Colorado Basin)

Rotational grazing consists of subdividing grazing pastures and rotating livestock from one pasture to another on a regular interval. This allows the watershed, soils, and vegetation to recover from the stress of continuous livestock grazing. A study by Texas A&M AgriLife Research at Vernon (Ledbetter, 2017) found that changing to a multi-pasture rotational livestock management system reduced surface runoff and sediment load in the local stream by 39 and 34 percent, respectively. The study also found that subsurface flow increased by 48 percent, primarily due to increased infiltration and soil water storage associated with rotational grazing. This strategy assumes a conservative 20 percent reduction of the projected supply need. 24 acre-feet per year is assumed for the Colorado Basin livestock conservation strategy. No capital cost is assigned to this strategy.

## J-57 Additional Groundwater Wells (Colorado Basin) ALTERNATE

The Trinity Aquifer has been identified as a potential source of water to meet the irrigation shortages within Kerr County. The Aquifer is comprised of five different water-bearing units which are often in hydraulic communication and collectively should be considered a leaky-aquifer system. Water from this source is generally of acceptable quality for irrigation use. Recharge to the Lower Trinity in Kerr County likely occurs primarily by lateral underflow from the north and west. This strategy assumes that one new well will be drilled to approximately 360 feet below the surface. The wells must be permitted by the Headwaters Groundwater Conservation District and withdrawals must not exceed the Trinity Aquifer MAG limit.

**Quantity, Reliability, and Cost** –Fifteen new wells at 5 gpm each are assumed to supply an additional 119 acre-feet per year. The reliability of this supply is moderate, based on competing demands. The total cost of this project will be approximately $985,000.

## J-58 Livestock Conservation (Guadalupe Basin)

Rotational grazing consists of subdividing grazing pastures and rotating livestock from one pasture to another on a regular interval. This allows the watershed, soils, and vegetation to recover from the stress of continuous livestock grazing. A study by Texas A&M AgriLife Research at Vernon (Ledbetter, 2017) found that changing to a multi-pasture rotational livestock management system reduced surface runoff and sediment load in the local stream by 39 and 34 percent, respectively. The study also found that subsurface flow increased by 48 percent, primarily due to increased infiltration and soil water storage associated with rotational grazing. This strategy assumes a conservative 20 percent reduction of the projected supply need. 35 acre-feet per year is assumed for the Guadalupe Basin livestock conservation strategy. No capital cost is assigned to this strategy.

## J-59 Additional Groundwater Wells (Guadalupe Basin) ALTERNATE

The Edwards-Trinity (Plateau) Aquifer has been identified as a potential source of water to meet the livestock water supply shortages within the County. The Aquifer consists of lower Cretaceous age, saturated limestones and dolomites of the Edwards and Trinity Groups that occur in the Edwards Plateau. Water from this source can be variable, with water quality ranging from fresh to slightly saline in the outcrop areas, and brine water in subsurface portions. Reported well yields commonly range from less than 50 gpm where saturated thickness is thin; to more than 1,000 gpm where large capacity wells are completed in jointed and cavernous limestone. This strategy assumes that 4 new wells would need to be drilled to approximately 310 feet below the surface. The wells must be permitted by the Headwaters Groundwater Conservation District and withdrawals must not exceed the Trinity Aquifer MAG limit.

**Quantity, Reliability, and Cost** –Four new 40 gpm wells are assumed to supply an additional 173 acre-feet per year. The reliability of this supply is medium to high, based on competing demands and water quality issues. Total cost of this project will be approximately $370,000.

## J-60 Livestock Conservation (San Antonio Basin)

Rotational grazing consists of subdividing grazing pastures and rotating livestock from one pasture to another on a regular interval. This allows the watershed, soils, and vegetation to recover from the stress of continuous livestock grazing. A study by Texas A&M AgriLife Research at Vernon (Ledbetter, 2017) found that changing to a multi-pasture rotational livestock management system reduced surface runoff and sediment load in the local stream by 39 and 34 percent, respectively. The study also found that subsurface flow increased by 48 percent, primarily due to increased infiltration and soil water storage associated with rotational grazing. This strategy assumes a conservative 20 percent reduction of the projected supply need. Five acre-feet per year is assumed for the San Antonio Basin livestock conservation strategy. No capital cost is assigned to this strategy.

## J-61 Additional Groundwater Well (San Antonio Basin) ALTERNATE

The Trinity Aquifer has been identified as a potential source of water to meet the livestock shortages within Kerr County. The Aquifer is comprised of five different water-bearing units which are often in hydraulic communication and collectively should be considered a leaky-aquifer system. Water from this source is generally is generally of sufficient quality to meet Livestock consumption needs. Recharge to the Lower Trinity in Kerr County likely occurs primarily by lateral underflow from the north and west. This strategy assumes that one new well will be drilled to approximately 395 feet below the surface. The wells must be permitted by the Headwaters Groundwater Conservation District and withdrawals must not exceed the Trinity Aquifer MAG limit.

**Quantity, Reliability, and Cost** – The one new 17 gpm well is assumed to supply an additional 27 acre-feet per year. The reliability of this supply is medium to high, based on competing demands. Total cost of this project will be approximately $79,000.

## J-62 Livestock Conservation (Nueces Basin)

Rotational grazing consists of subdividing grazing pastures and rotating livestock from one pasture to another on a regular interval. This allows the watershed, soils, and vegetation to recover from the stress of continuous livestock grazing. A study by Texas A&M AgriLife Research at Vernon (Ledbetter, 2017) found that changing to a multi-pasture rotational livestock management system reduced surface runoff and sediment load in the local stream by 39 and 34 percent, respectively. The study also found that subsurface flow increased by 48 percent, primarily due to increased infiltration and soil water storage associated with rotational grazing. This strategy assumes a conservative 20 percent reduction of the projected supply need. One acre-foot per year is assumed for the Nueces Basin livestock conservation strategy. No capital cost is assigned to this strategy.

## J-63 Additional Groundwater Well (Nueces Basin) ALTERNATE

The Edwards-Trinity (Plateau) Aquifer has been identified as a potential source of water to meet the livestock water supply shortages within the County. The Aquifer consists of lower Cretaceous age, saturated limestones and dolomites of the Edwards and Trinity Groups that occur in the Edwards Plateau. Water from this source can be variable, with water quality ranging from fresh to slightly saline in the outcrop areas, and brine water in subsurface portions. Reported well yields commonly range from less than 50 gpm where saturated thickness is thin; to more than 1,000 gpm where large capacity wells are completed in jointed and cavernous limestone. This strategy assumes that 1 new well will be drilled to approximately 360 feet below the surface. The wells must be permitted by the Headwaters Groundwater Conservation District and withdrawals must not exceed the Trinity Aquifer MAG limit.

**Quantity, Reliability, and Cost** – The one new 5 gpm wells are assumed to supply an additional 6 acre-feet per year. The reliability of this supply is medium to high, based on competing demands and water quality issues. Total cost of this project is approximately $66,000.

# 5A-11 WATER MANAGEMENT STRATEGIES FOR KERR COUNTY MINING

Kerr County is projected to have approximately 21 acre-feet of mining water supply shortage over the planning horizon. Water rights diverted from the Guadalupe River in conjunction with groundwater from the Edwards-Trinity (Plateau) and Trinity Aquifers provide the water needed for mining use within the County. The following water management strategies are recommended to enhance the reliability of the future water supply availability for the mining water supply shortages within Kerr County:

- (J-65) Additional groundwater wells (Colorado Basin)

## J-65 Additional Groundwater Wells (Colorado Basin)

The Edwards-Trinity (Plateau) Aquifer has been identified as a potential source of water to meet the mining water supply shortages within the County. The Aquifer consists of lower Cretaceous age, saturated limestones and dolomites of the Edwards and Trinity Groups that occur in the Edwards Plateau. Water from this source can be variable, with water quality ranging from fresh to slightly saline in the outcrop areas, and brine water in subsurface portions. Reported well yields commonly range from less than 50 gpm where saturated thickness is thin; to more than 1,000 gpm where large capacity wells are completed in jointed and cavernous limestone. This strategy assumes that three new wells will be drilled to produce water from approximately 360 feet below the surface and produce at a rate of 10 gpm.

**Quantity, Reliability, and Cost** –Historical industrial and agricultural use indicates that the Edwards-Trinity (Plateau) outcrops may be a viable source. The 3 new 5 gpm wells are assumed to supply an additional 19 acre-feet per year. The reliability of this supply is medium to high, based on competing demands and water quality issues. Total cost of this project is approximately $197,000.

# 5A-12 WATER MANAGEMENT STRATEGIES FOR THE CITY OF BRACKETTVILLE

The City of Brackettville is the county seat of Kinney County, with a population projected at 1,958 in 2020; increasing to 1,971 by 2070. The City and many other residents of Kinney County rely primarily on groundwater from three different aquifers: Edwards-Trinity (Plateau), Edwards Balcones Fault Zone (BFZ), and the Austin Chalk. Combined, these sources support water use for municipal, domestic, livestock and irrigation purposes. Although the water demand for the City of Brackettville is not projected to increase over the planning horizon, the following water management strategies are recommended to enhance the reliability of the City's future water supply availability:

- (J-66) Increase supply to Spofford with new water line infrastructure
- (J-67) Increase storage facility

### J-66 Increase Supply to Spofford with New Water Line Infrastructure

The Kinney County Commissioners Court has plans to provide water through a 10.5-mile pipeline from the City of Brackettville to the Kinney County Union Pacific Facility, of which a portion of the line is already in place. This strategy includes an additional 250,000-gallon storage tank located at the end of the pipeline. The storage tank will provide an additional water supply for municipal and industrial purposes.

**Quantity, Reliability, and Cost** – This strategy will supply approximately 3 acre-feet of additional water available through transmission to the Kinney County Union Pacific Facility. The reliability of this strategy is high. The total capital cost of this strategy includes the construction of 10.5 miles of six-inch diameter transmission line and a 250,000-gallon storage tank. The total capital cost for this project is estimated at $4,271,000.

### J-67 Increase Storage Facility

The City of Brackettville has plans to construct a 125,000-gallon ground storage facility. This storage facility will ensure that adequate water is available to be piped to the Kinney County Union Pacific Facility in Spofford for municipal and industrial purposes (see Strategy J-66 above).

**Quantity, Reliability, and Cost** – It is assumed that this strategy will provide an additional 3 acre-feet per year of water. The total estimated capital cost for this project is approximately $1,272,000.

# 5A-13 WATER MANAGEMENT STRATEGIES FOR FORT CLARK SPRINGS MUD

Fort Clark Springs MUD is located next to the City of Brackettville and shares the Edwards-Trinity (Plateau) Aquifer for their municipal water supply needs. Although the Fort Clark Springs MUD water demand is not projected to increase over the planning horizon, the following water management strategy is recommended to enhance the reliability of the Community's future water supply availability:

- (J-68) Water Loss Audit and Main-line Repair for Fort Clark Springs MUD
- (J-69) Increase storage facility

Although the project does not meet SWIFT qualification requirements, Fort Clark Springs MUD is in need of repair or upgrade of pumps in existing wells and the distribution network.

## J-68 Water Loss Audit and Main-line Repair for Fort Clark Springs MUD

According to the 2015 TWDB Public Water System Water Loss Survey, Fort Clark Springs MUD had a total water loss of approximately 62,273,567 gallons per year due to leaking distribution lines and/or faulty meters. This amount of water loss (41.1%) is the sum of reported break and leaks and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the water supply system can reduce the unaccounted for water and get a more accurate look at water consumption.

This strategy assumes a potential savings of 79 acre-feet per year (25,594,436 gallons/year). It is assumed that a leak testing program will be implemented prior to replacing portions of the existing main-line leaks. This strategy assumes 6.2 miles of 6" diameter main-line will be replaced, with a total project capital cost of approximately $1,531,000.

## J-69 Increase Storage Facility

The Fort Clark Springs MUD (District) currently has 929 connections, an average daily usage of 0.5 MGD with 660,000 gallons of total storage and a well production capacity of 2 MGD. Additional supply is needed to ensure availability during drought-of-record conditions and to meet peek demands. While the District has the minimum amount of storage available, additional storage will provide the needed water supply. In order to achieve this goal, a 500,000-gallon ground storage tank will provide access to the new supply.

**Quantity, Reliability, and Cost** – This strategy is assumed to provide an additional 620 acre-feet per year of water. The total estimated capital cost for this project is approximately $1,501,000.

# 5A-14 WATER MANAGEMENT STRATEGIES FOR THE CITY OF CAMP WOOD

The City of Camp Wood derives all its municipal water from Old Faithful Spring (also known as Krueger Spring or Camp Wood Spring) that issues from alluvial gravel overlying the Glen Rose Limestone of the Edwards-Trinity (Plateau) Aquifer. The TCEQ Nueces River WAM (Run 3) results indicate that there is no reliable water available from the Spring during a repeat of the drought-of-record. However, Old Faithful did not cease to flow during the drought of the 1950s. Due to the recent drought the discharge from the spring has been insufficient in meeting all the current needs. For this reason, the City of Camp Wood is considering developing an alternate source of supply.

The City of Camp Wood in August of 2014 appeared on the TCEQ's Public Water Supply Limiting Water Use list seeking assistance for emergency funds earmarked for emergency groundwater supply wells. Currently the City remains on this list, which is updated weekly by the TCEQ's Drinking Water Technical Review and Oversight Team and can be found at the following link: https://www.tceq.texas.gov/drinkingwater/trot/droughtw.html.

The City of Camp Wood is projected to have a shortage in 2020 of 134 acre-feet per year; decreasing to 126 acre-feet per year by 2070. The following water management strategies are recommended to enhance the reliability of the City's future water supply availability:

- (J-72) Public conservation education
- (J-73) Additional well in the Edwards-Trinity (Plateau) Aquifer

## J-72 Public Conservation Education

The City of Camp Wood is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which will result in a water savings of approximately 1 acre-feet per year. The annual cost of this project in 2020 is estimated to be $374.

## J-73 Additional Well in the Edwards-Trinity (Plateau) Aquifer

As Old Faithful Spring can no longer be relied upon to provide a sufficient supply of public drinking water, the City of Camp Wood will need to develop a new water supply source from wells completed into the Edwards-Trinity (Plateau) Aquifer. The potential of constructing wells capable of producing at this desired rate is good, although exploratory drilling and testing will likely be needed before this strategy can be relied upon as a dependable source. Due to high levels of iron and manganese, advanced treatment will likely be required for municipal use. This strategy includes the construction of four new wells to be completed at 1,000 feet below the surface, each operating at a capacity of 40 gpm. The location of the additional wells is assumed to be near the City's current treatment plant. This project will require approximately 500 feet of six-inch diameter connection piping.

**Quantity, Reliability, and Cost** – Four new wells are assumed to supply an additional 143 acre-feet per year. The reliability of this supply is medium to high, based on competing demands. Total estimated capital cost for this project is $1,709,000.

# 5A-15 WATER MANAGEMENT STRATEGIES FOR THE CITY OF LEAKEY

The City of Leakey relies primarily on the Edwards-Trinity (Plateau) Aquifer and the Frio River Alluvium Aquifer for municipal water supply purpose. Small volumes of surface water are used to supplement the irrigation water supply needs of the City. Due to the recent drought, the City of Leakey in August of 2014 appeared on the TCEQ's Public Water Supply Limiting Water Use list, seeking assistance for emergency funds earmarked for emergency groundwater supply wells. Currently, the City remains on this list which is updated weekly by the TCEQ's Drinking Water Technical Review and Oversight Team and can be found at the following link: https://www.tceq.texas.gov/drinkingwater/trot

Although the supply-demand analysis does not project a future water supply deficit for the City of Leakey, drought like conditions continues to impact the City's water supplies. The following water management strategy is recommended to enhance the reliability of the City's future water supply availability:

- (J-75) Drill additional well in the Lower Trinity Aquifer
- (J-76) Develop interconnection between wells within the City of Leakey

## J-75 Drill Additional Well in the Lower Trinity Aquifer

The City of Leakey currently has a total of six Frio River Alluvium Aquifer wells, with the sixth well recently being completed in 2014. The City has plans to connect all the wells within their system in order for the public water supply system to become a more reliable future source of supply. During the recent drought, it appeared that the water level would drop to the point where one or more of these wells would no longer be viable. In consideration of this limited groundwater availability, the Real Edwards Conservation and Reclamation District passed an emergency rule that allowed for the immediate permitting of an additional well or other potential water source for the City of Leakey. In addition, the City is looking at a solid waste disposal system and it is anticipated that such a system will require additional water.

Sufficient groundwater is available from the Frio River Alluvium Aquifer without causing excessive water-level declines; however, in a severe drought alluvial aquifers are the first to go dry. For this reason, it is recommended that the new well be completed in the Lower Trinity Aquifer.

This strategy assumes that the construction of one new well will be drilled to a depth of 750 feet in order to access the additional aquifer supplies needed. The well is assumed to be operating at a capacity of 75 gpm. In addition, this strategy includes 500 feet of six-inch diameter connection piping. Minimal treatment, such as chlorine disinfection, will be required for municipal purposes.

**Quantity, Reliability, and Cost** –The Lower Trinity Aquifer is identified as a potential and viable source to meet water supply needs for the City of Leakey:however, water quality issues may require advanced treatment. For this *Plan*, the one new 75 gpm well is assumed to supply an additional 91 acre-feet per year. The reliability of the supply is medium based on water quantity issues. Total estimated capital cost for this project is approximately $189,000.

## J-76 Develop Interconnections between Wells within the City of Leakey

The City of Leakey has developed their current water supply system based on individual wells providing water to sections of the City. The current drought had a significant impact on the City's alluvial wells with some of the wells dropping to levels where they could not be pumped. This experience has demonstrated the need to integrate the system as both a conservation and water supply strategy. By interconnecting the independent systems, an additional 81 acre-feet per year of water can be pumped to other areas, thus reducing the demands on each individual well. This would potentially prevent the over drafting of wells during drought periods. The key well that would be incorporated into the system is Well #5. This strategy assumes approximately 3,500 feet of 6-inch line will need to be installed to connect all wells and the installation of a SCADA system is recommended.

**Quantity, Reliability, and Cost** – This strategy is assumed to supply an additional 81 acre-feet per year of water. The total estimated capital cost for this project is approximately $202,000.

# 5A-16 WATER MANAGEMENT STRATEGIES FOR REAL COUNTY-OTHER

The rural area of Real County Other has less than 1,170 in population including individuals living outside of Leakey and Camp Wood. This compilation of water users known as "County Other" is self-supplied and relies primarily on groundwater from the Nueces River Alluvium and Edwards-Trinity (Plateau) Aquifers for their water supply needs as produced from private domestic wells or by small public systems such as the Real Water Supply Corporation. A modest source of supply is also provided by the Edwards-Trinity (Plateau) Aquifer. Due to the recent drought, there is no availability for planning purposes in the Nueces River.

Much of the rural economy is based on ranching operations, which relies on local surface streams to provide water for their livestock. Natural flow in these streams is negatively influenced by the presence of non-native plant species.

Although the supply-demand analysis does not project a future water-supply deficit for Real County-Other, rural communities within the area have certainly suffered from extreme drought conditions. The following water management strategies are recommended to enhance the reliability of the future water supply for residents within rural Real County:

- (J-77) Water loss audit and main-line repair for Real Water Supply Corporation
- (J-79) Additional well for Oakmont Saddle Mountain Water Supply Corporation

### J-77 Water Loss Audit and Main-line Repair for Real Water Supply Corporation

According to the 2015 TWDB Public Water System Water Loss Survey, Real Water Supply Corporation (WSC) had a total water loss of approximately 1,633,416 gallons per year due to leaking distribution lines and/or faulty meters. This amount of water loss (32.3 percent) is the sum of reported breaks and leaks and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the water supply system can reduce the unaccounted for water and get a more accurate look at water consumption.

This strategy assumes a potential savings of 2 acre-feet per year (528,247 gallons/year). It is assumed that a leak testing program will be implemented prior to replacing portions of the existing main-line leaks. This strategy assumes 1.9 miles of 6" diameter main-line will be replaced, with a total project capital cost of approximately $482,000.

### J-79 Additional Well for Oakmont Saddle Mountain Water Supply Corporation

Due to the recent drought, Oakmont Saddle Mountain WSC has experienced the loss of production in supply well #1. Currently, the WSC is operating on water well #2, an unapproved temporary shallow well in the Frio River Alluvium Aquifer. Real County received a Disaster Relief Grant from the Texas Department of Agriculture on June 13, 2012 to benefit Oakmont Saddle Mountain WSC for a system improvement project that will replace well #1. Through a series of failed attempts to successfully reach a reliable water supply, the water supply corporation had to abandon efforts on the construction of two wells. Since then, the WSC has drilled an experimental fourth well five feet from one of the previous wells, which involved an excavation three feet in width, 40 feet in depth and 11 feet to bedrock. This was performed for the purpose of considering a filtration zone constructed through the removal of alluvial gravel and installation of an 8” PVC perforated pipe.

To bring this new supply on-line will require the construction of the well facility and its connection to the distribution system. This strategy assumes a spring water source with the construction of a water tight concrete basin, installation of pump and associated piping, electrical and all appurtenances. Authorization to construct this spring water source well was issued by TCEQ letter dated October 24, 2014.

**Quantity, Reliability, and Cost** – It is anticipated that this strategy will provide an additional 54 acre-feet per year of water. The total estimated project cost is $417,000. The reliability of this source is low to medium depending on the surface water availability. Shallow alluvium wells are typically the first water supply to become an unreliable source during drought like conditions.

# 5A-17 WATER MANAGEMENT STRATEGIES FOR THE CITY OF DEL RIO

The City of Del Rio is the only wholesale water provider in the Plateau Region. In addition to its own use, the City provides water to Laughlin Air Force Base and subdivisions outside of the City. Del Rio also provides water and wastewater services to two colonias: Cienegas Terrace and Val Verde Park Estates.

The City of Del Rio relies primarily on San Felipe Springs, which issues from the Edwards-Trinity (Plateau) Aquifer, but has also been designated as being under the influence of surface water by TCEQ. The water is collected through pumps set in the springs, treated with microfiltration and chlorine and then connected to the distribution system. The City of Del Rio has a water right authorizing it to divert 11,416 acre-feet per year from San Felipe Springs for municipal use. Elsewhere in the County, all known water wells produce water from the Salmon Peak and McKnight Formations of the Edwards Group.

The average discharge of San Felipe Springs since Lake Amistad was filled is about 110 cubic feet per second (cfs), approximately 80,000 acre-feet per year. During recent droughts, the spring discharge has fallen below 50 cfs, approximately 36,000 acre-feet per year. Although the supply-demand analysis does not project a future water supply deficit for the City of Del Rio, the diminished supply availability from the Springs during drought periods requires Del Rio to consider other water supply options. The following water management strategies are recommended to enhance the reliability of the City's future water supply availability:

- (J-80) Water loss audit and main-line repair for the City of Del Rio
- (J-81) Drill and equip new well and connect to distribution system
- (J-82) Water treatment plant expansion
- (J-83) Develop a wastewater reuse program

In addition to the recommended strategies listed above, the City of Del Rio has the following funded, water projects listed with the TWDB as of November 2014:

- Water main replacement
- Collection system reconstruction

## J-80 Water Loss Audit and Main-line Repair for the City of Del Rio

The City of Del Rio in 2001 completed a distribution system improvement project funded by the TWDB to replace leaking distribution lines. A 1999 water audit found more than 37 percent of the City's water unaccounted. Since these improvements, per the 2016 TWDB water loss audit, Del Rio has reduced the volume of unaccounted water to 11 percent, approximately 34,802,196 gallons per year total loss. This amount of water loss is the sum of reported breaks and leaks and unreported loss.

This strategy assumes a potential savings of 12 acre-feet per year. It is assumed that a leak testing program will be implemented prior to replacing portions of the existing main-line leaks. This strategy assumes 22.8 miles of 6" diameter main-line will be replaced, with a total project capital cost of approximately $5,672,000.

## J-81 Drill and Equip a New Well and Connect to Distribution System

The City of Del Rio currently has a total of three wells located north of town; however, due to complications with the production of these wells, all three wells are presently inactive. In order to alleviate the water demand from San Felipe Springs, Del Rio plans to locate an alternate source of supply. The Edwards-Trinity (Plateau) Aquifer has been identified as groundwater source for future water supplies. This source may require minimal treatment such as chlorine disinfection for municipal purposes. As the three existing inactive wells are not classified as being active water supply sources, the addition of a new well is considered a new supply source.

**Quantity, Reliability, and Cost** – This strategy assumes the development of one new well located near the existing wells, north of town. The well will be drilled at a depth of 650 feet and is anticipated to produce an additional 7,191 acre-feet per year. This strategy includes 0.5 miles of 24-inch diameter transmission line. The total capital cost is estimated to be approximately $12,695,000.

## J-82 Water Treatment Plant Expansion

The City of Del Rio uses a membrane treatment facility, which treats water pumped from San Felipe Springs. The treatment plant is approximately 15 years old and needs two additional pods to keep pace with the communities growing water demands. This strategy assumes costs associated with the 1 MGD treatment plant expansion which is anticipated to come on-line by 2030.

**Quantity, Reliability, and Cost** – It is expected that this project will supply an additional 943 acre-feet per year. The total capital cost for this project is approximately $8,646,000 with an estimated annual cost of $1,231,000.

## J-83 Develop a Wastewater Reuse Program

A long-term strategy for the City is to expand its wastewater effluent for irrigation of the municipal golf course, provide reuse water to Laughlin AFB, and eventually to irrigate public parks. Additional treated wastewater will be generated from improvements at the San Felipe and Silver Lake Wastewater Treatment Plants. The primary component of this strategy is the approximate 10-mile extension of the major transmission lines that convey the direct reuse supplies to the intended destinations.

**Quantity, Reliability, and Cost** – The current wastewater discharge permit for the City of Del Rio is 2.7 MGD (3,092 acre-feet per year). The effluent provided for reuse will be a continual supply available daily for municipal uses. It is expected that this project will supply an additional 3,092 acre-feet per year. The total capital cost for this project is approximately $2,846,000.

# 5A-18 WATER MANAGEMENT STRATEGIES FOR VAL VERDE COUNTY-OTHER

The rural area of Val Verde County has a population projected at 15,152 in 2020; increasing to 30,469 by 2070. This population includes individuals living outside of the City of Del Rio and Laughlin AFB. This compilation of water users known as "County Other" is partially supplied by Del Rio, but is mostly self-supplied and relies solely on the Edwards-Trinity (Plateau) Aquifer for their water supply needs either from private domestic wells, or privately owned water supply systems. Much of the rural economy is based on ranching operations, which relies on local surface streams to provide water for their livestock. Natural flow in these streams is negatively influenced by the presence of non-native plant species.

Although the supply-demand analysis does not project a future water supply deficit for Val Verde County-Other, the following water management strategies are recommended to enhance the reliability of the future water supply for residents within Val Verde County Other:

- (J-84) Water loss audit and main-line repair for Val Verde County WCID Comstock
- (J-85) Water loss audit and main-line repair for San Pedro Canyon Subdivision (Upper)
- (J-86) Water loss audit and main-line repair for Tierra del Lago

## J-84 Water Loss Audit and Main-line Repair for Val Verde County WCID Comstock

According to the 2015 TWDB Public Water System Water Loss Survey, Val Verde County WCID Comstock had a total water loss of approximately 1,554,206 gallons per year due to leaking distribution lines and/or faulty meters. This amount of water loss (16.4 percent) is the sum of reported breaks and leaks and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the water supply system can reduce the unaccounted for water and get a more accurate look at water consumption.

This strategy assumes a potential savings of 1 acre-foot per year. It is assumed that a leak testing program will be implemented prior to replacing portions of the existing main-line leaks. This strategy assumes 1.6 miles of 6" diameter main-line will be replaced, with a total project capital cost of approximately $406,000.

## J-85 Water Loss Audit and Main-line Repair for San Pedro Canyon Subdivision (Upper)

According to the 2016 TWDB Public Water System Water Loss Survey, San Pedro Canyon Subdivision (Upper) had a total water loss of approximately 5,394,010 gallons per year due to leaking distribution lines and/or faulty meters. This amount of water loss (40 percent) is the sum of reported breaks and leaks and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the water supply system can reduce the unaccounted for water and get a more accurate look at water consumption.

This strategy assumes a potential savings of 7 acre-feet per year (2,157,604 gallons per year). It is assumed that a leak testing program will be implemented prior to replacing portions of the existing main-line leaks. This strategy assumes 0.6 miles of 6” diameter main-line will be replaced, with a total project capital cost of approximately $142,000.

### J-86 Water Loss Audit and Main-line Repair for Tierra del Lago

According to the 2016 TWDB Public Water System Water Loss Survey, Tierra Del Lago had a total water loss of approximately 2,471,426 gallons per year due to leaking distribution lines and/or faulty meters. This amount of water loss (55 percent) is the sum of reported breaks and leaks and unreported loss. Taking the proper measures to identify and repair old infrastructure and inaccurate water meters, the water supply system can reduce the unaccounted for water and get a more accurate look at water consumption.

This strategy assumes a potential savings of 4 acre-feet per year. It is assumed that a leak testing program will be implemented prior to replacing portions of the existing main-line leaks. This strategy assumes 0.6 miles of 6” diameter main-line will be replaced, with a total project capital cost of approximately $146,000.

# 5A-19 WATER MANAGEMENT STRATEGY FOR LAUGHLIN AIR FORCE BASE

The U.S Laughlin Air Force Base east of Del Rio is a pilot training facility with an average military population of approximately 2,000. The Base maintains a groundwater well which is primarily used for landscape irrigation as most of the facility's treated drinking-water supply is purchased through a long-term contract with Del Rio Utilities Commission (City of Del Rio). The following water management strategy is recommended for Laughlin AFB to insure a continuation of this contracted supply.

- (J-87) Purchase Water from City of Del Rio

**J-87 Purchase Water from City of Del Rio**

Laughlin Air Force Base is under contract to receive its potable water supply from the City of Del Rio (Del Rio Utilities Commission) at $1.89 per thousand gallons. Additional supplies needed to meet future projected demand deficits (87 in 2020 increasing to 345 acre-feet per year in 2070) will continue to be delivered by Del Rio and may, on occasion, require contract amendments. Del Rio's available supply will likewise need to increase over time (see Del Rio strategies) to meet Laughlin AFB's need. Under the existing contract, additional cost to purchase future increases are $53,580 in 2020, increasing to $212,470 in 2070. There is no capital cost for this strategy.

# 5A-20 WATER MANAGEMENT STRATEGIES FOR VAL VERDE COUNTY MINING

The mining industry in Val Verde County is projected to have a maximum of 210 acre-feet of mining water supply shortage over the planning horizon. Both surface water and groundwater supplies provide water for mining purposes within the County. The Edwards-Trinity (Plateau) Aquifer is the sole groundwater source used for mining purposes. The following water management strategies are recommended to enhance the reliability of the future water supply availability for the mining water supply shortages within Val Verde County:

- (J-89) Additional Wells in the Edwards-Trinity (Plateau) Aquifer (Rio Grande River Basin)

## J-89 Additional Wells – Rio Grande Basin

The Edwards-Trinity (Plateau) Aquifer has been identified as a potential source of water to meet the mining water supply shortage within Val Verde County. The Aquifer consists of lower Cretaceous age, saturated limestones and dolomites of the Edwards and Trinity Groups that occur in the Edwards Plateau. Water from this source can be variable, with water quality ranging from fresh to slightly saline in the outcrop areas, and brine water in subsurface portions. Reported well yields commonly range from less than 50 gpm where saturated thickness is thin; to more than 1,000 gpm where large capacity wells are completed in jointed and cavernous limestone. This strategy assumes that three new wells will be drilled to produce 50 gpm of water from approximately 900 feet below the surface.

**Quantity, Reliability, and Cost** – The four new wells are assumed to supply an additional 242 acre-feet per year. The reliability of this supply is medium to high, based on competing demands and water quality issues. Total cost of this project will be approximately $1,100,000.

# APPENDIX 5B
# STRATEGY EVALUATION
# QUANTIFICATION MATRIX

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# STRATEGY EVALUATION QUANTIFICATION MATRIX

The practicality of an implemented water management strategy may be measured in terms of quantity, quality and reliability of water produced and the varying degree of impact (positive or negative) on pre-existing local conditions. The Plateau Region Water Planning Group has adopted a standard procedure for ranking potential water management strategies. Quantitative and qualitative measurements are tabulated in Chapter 5 Tables 5-2 and 5-4. This procedure classifies the strategies using the TWDB's following standard categories developed for regional water planning:

**Table 5-2:**

Quantity

Quality

Reliability

Impact of Water, Agricultural, and Natural Resources

**Table 5-4:**

Environmental Impact

Environmental water needs

Wildlife habitat

Cultural resources

Environmental water quality

Bays and estuaries

**<u>Quantity, Quality and Reliability</u>**

Quantity, quality and reliability are quantitatively assessed and assigned a ranking from 1 to 3 as listed in the Matrix Table below, which shows the correlation between the category and the ranking.

**Table 5B-1. Quantity, Quality and Reliability Category Ranking Matrix**

| Rank | Quantity | Quality | Reliability |
|---|---|---|---|
| 1 | Meets 100% of shortage | Meets safe drinking water standards | Sustainable |
| 2 | Meets 50-99% of shortage | Must be treated or mixed to meet safe drinking water standards | Interruptible |
| 3 | Meets < 50% of shortage | Usable for intended non-drinking use only | Un-sustainable |

**Quantity** adequacy is measured as a percent of the volume of water needed to meet the specified water user group's (WUG's) shortage as calculated in Table 4-1 of Chapter 4 that is produced by the water management strategy. Percent volumes are only analyzed for WUGs with projected supply shortages.

**Quality** adequacy is measured in terms of meeting TCEQ Safe Drinking Water Standards. However, not all strategies are intended for use requiring SDWSs.

**Reliability** is evaluated based on the expected or potential for the water to be available during drought. Strategies that use water from a source that would not exceed permits or MAGs even during droughts are rated as sustainable. Strategies that use water from a source that is available during normal meteorological conditions, but may not be 100% available during drought are rated as interruptible. Strategies in which 100% of the supply cannot be maintained even during normal meteorological conditions are rated as un-sustainable.

**Impact on Water, Agricultural and Natural Resources**

Impacts are quantitatively assessed and assigned a ranking from 1 to 5 as listed in the Matrix Table below, which shows the correlation between the category and the ranking.

**Table 5B-2. Strategy Impact Category Ranking Matrix**

| Rank | Water Resources | Agricultural Resources | Natural Resources |
|---|---|---|---|
| 1 | Positive | Positive | Positive |
| 2 | None | None | None |
| 3 | Low | Low | Low |
| 4 | Medium | Medium | Medium |
| 5 | High | High | High |

**Water Resources** impacts refer to the potential for the implemented strategy to compete for water sources shared with adjacent properties. The matrix ranking depicts the potential range of water-level drawdown induced across property boundaries during the life of the strategy project.

1 Positive - No aquifer drawdown; increased surface water flow

2 None – No new aquifer drawdown; no change to surface water flow

3 Low – <10 feet of aquifer drawdown; < 10% reduction in average surface flows

4 Medium – 10 to 50 feet of aquifer drawdown; 10 to 30% reduction in average surface flows

5 High - > 50 feet of aquifer drawdown; > 30% reduction in surface flows

**Agricultural Resources** impacts refer to the agricultural economic impact resulting from the loss or gain of water supplies currently in use by the agricultural user as the result of the implementation of a strategy. See Section 1.2.8 in Chapter 1 for a detailed discussion on the Agricultural Resources of the Plateau Region.

1 Positive – provides water to agricultural users

2 None – does not impact agricultural supplies

3 Low – reduces agricultural activity by less than 10%

4 Medium – reduces agricultural activity by more than 10%

5 High – water rights use changes from agricultural to some other use thus elimination agricultural activity

**Natural Resources** impacts are those that impact the terrestrial and aquatic habitat of native plant and animal wildlife, as well as the scenic beauty of the Region that is critical to the tourism industry. See Section 1.2.9 in Chapter 1 for a detailed discussion on the Natural Resources of the Plateau Region.

1 Positive – provides water to natural resources

2 None – does not impact natural resources

3 Low – reduces natural resources water supply by less than 10%

4 Medium – reduces natural resources water supply by more than 10%

5 High – reduces natural resources water supply by more than 50%

**Environmental Impacts**

Environmental impacts are quantitatively assessed and assigned a ranking from 1 to 5 as listed in the Matrix Table below, which shows the correlation between the category and the ranking. The Environmental Matrix takes into consideration the following categories;

Environmental Water Needs

Wildlife Habitat

Cultural Resources

Environmental Water Quality

Bays and Estuaries

**Table 5B-3. Environmental Impact Category Ranking Matrix**

| Rank | Environmental Water Needs | Wildlife Habitat | Cultural Resources | Environmental Water Quality | Bays and Estuaries |
|---|---|---|---|---|---|
| 1 | Positive | Positive | Positive | Positive | Not applicable |
| 2 | No new | No new | No new | No new | |
| 3 | Minimal negative | Minimal negative | Minimal negative | Minimal negative | |
| 4 | Moderate negative | Moderate negative | Moderate negative | Moderate negative | |
| 5 | Significant negative | Significant negative | Significant negative | Significant negative | |

**Environmental Water Needs** impacts refer to how the strategy will impact the area's overall environmental water needs. Water is vital to the environmental health of a region, and so it is important to consider how strategies will impact the amount of water that will be available to the environment.

1 Positive – additional water will be introduced for environmental use

2 No new – no additional water will be introduced for environmental use

3 Minimal negative – environmental water needs will be reduced by <10%

4 Moderate negative – environmental water needs will be reduced by 10 to 30%

5 Significant negative - environmental water needs will be reduced by >30%

**Wildlife Habitat** impacts refer to how the strategy will impact the wildlife habitat of the local area. The more area that is impacted due to the implementation of the strategy, the more the area's habitat will be disrupted.

1 Positive – additional habitat area for wildlife use will be created

2 No new – no additional habitat area for wildlife use will be created or destroyed

3 Minimal negative – wildlife habit will be reduced by < 100 acres

4 Moderate negative – wildlife habit will be reduced by 100 to 1,000 acres

5 Significant negative - wildlife habit will be reduced by > 1,000 acres

**Cultural Resources** impacts refer to how the strategy will impact cultural resources located within the area. Cultural resources are defined as the collective evidence of the past activities and accomplishments of people. Locations, buildings and features with scientific, cultural or historic value are considered to be cultural resources.

1 Positive – cultural resources will be identified and protected

2 No new – no impact will occur to local cultural resources

3 Minimal negative – disturbance to cultural resources will be < 10%

4 Moderate negative – disturbance to cultural resources will be 10 to 20%

5 Significant negative - disturbance to cultural resources will be > 20%

**Environmental Water Quality** impacts refer to the impact that the implementation of the strategy will have on the local area's natural water quality. Negative impacts could include the introduction of poorer quality water, the reduction of the natural flow of water of native quality source water, or the introduction of detrimental chemical elements into the natural water ways.

1 Positive – water quality of area streams will be enhanced for existing environmental use

2 No new – water quality characteristics of existing environmental habitat will not be changed

3 Minimal negative – water quality characteristics of existing environmental habitat will be negatively altered by < 10%

4 Moderate negative – water quality characteristics of existing environmental habitat will be negatively altered by < 10 to 30%

5 Significant negative - water quality characteristics of existing environmental habitat will be negatively altered by > 30%

**Bays and Estuaries** – The Plateau Region is located too far away from any bays and estuaries of the Texas coastline to have a quantifiable impact. Therefore, this category was assumed to be non-applicable for every strategy.

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# CHAPTER 6

# REGIONAL WATER PLAN IMPACTS AND CONSISTENCY WITH PROTECTION OF WATER, AGRICULTURAL AND NATURAL RESOURCES

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# 6 REGIONAL WATER PLAN IMPACTS AND CONSISTENCY WITH PROTECTION OF WATER, AGRICULTURAL AND NATURAL RESOURCES

Chapter 6 describes how this *2021 Plan* is consistent with the long-term protection of water resources, agricultural resources, and natural resources that are important to the Plateau Region. All planning analyses applied and recommendations made in the development of this *Plan* honor all existing water rights, contracts, and option agreements; and have no impact on navigation on any of the Region's surface water streams and rivers. Third-party social and economic impacts resulting from voluntary redistributions of water, including impacts of moving water from rural and agricultural areas were considered; however, no strategies were recommended that resulted in moving water from such areas.

The socioeconomic impact of not meeting water supply needs within the Region is discussed in an analysis report prepared by the Texas Water Development Board and presented in Appendix 6A at the end of this chapter. Based on projected water demands and existing water supplies, the Region identified water needs (potential shortages) that could occur under a repeat of the drought of record for five water use categories (irrigation, livestock, manufacturing, mining and municipal). The TWDB then estimated the annual socioeconomic impacts of those needs—if they are not met—for each water use category and as an aggregate for the region.

The report describes that the Plateau Region generated more than $4.5 billion in gross domestic product (2018 dollars) and supported roughly 68,000 jobs in 2016. It is estimated that not meeting the identified water needs in the Plateau Region would result in an annually combined lost income impact of approximately $233 million in 2020, increasing to $257 million in 2070. In 2020, the Region would lose approximately 2,300 jobs, and by 2070 job losses would increase to approximately 3,000 if anticipated needs are not mitigated.

## 6.1 PROTECTION OF WATER RESOURCES

Water resources in the Plateau Region as described in Chapter 3 include groundwater in numerous aquifers and surface water occurring in five rivers and their tributaries. The numerous springs, which represent an inter-relational transition point between groundwater and surface water, are also recognized in Chapter 1, Section 1.4.3 and Chapter 3, Section 3.3 for their major importance.

The first step in achieving long-term water resources protection was in the process of estimating each source's availability. Surface water estimates are developed through a water availability model process (WAM) and are based on the quantity of surface water available to meet existing water rights during a drought-of-record.

Groundwater availability estimates are based on the Modeled Available Groundwater (MAG) volumes that may be produced on an average annual basis to achieve a Desired Future Condition (DFC) as adopted by Groundwater Management Areas (GMAs). Establishing conservative levels of water source availability, thus results in less potential of over exploiting the supply.

The next step in establishing the long-term protection of water resources occurs in the water management strategies developed in Chapter 5 to meet potential water supply shortages. Each strategy was evaluated for potential threats to water resources in terms of source depletion (reliability), quality degradation, and impact to environmental habitat.

Key parameters of water quality are discussed in Chapter 1 Section 1.4.5. The potential for surface water contamination resulting from urban runoff in rapidly growing population centers is of concern in the Plateau Region. Groundwater contamination most often results from old, poorly constructed or new improperly constructed water wells. In both surface water and groundwater concerns, this *Plan* attempts to (1) provide the reader with information pertaining to best practices to prevent water contamination, (2) recognize local organizational (river authorities, ground water districts, etc.) practices and programs intended to prevent water contamination, and (3) present recommended water management strategies that do not result in potential contamination issues. It is the specific intent of the PWPG that Utilities and WUGs use all necessary precautions and follow all mandated guidelines in the construction of recommended water management strategies. In the analysis of potential water quality impact, no recommended strategies were determined to result in an anticipated water quality degradation.

Water conservation strategies are also recommended for each entity with a supply deficit. Conservation reduces the impact on water supplies by reducing the actual water demand for the supply. Table 5-2 and 5-4 in Chapter 5 provides an overview of these impact evaluations.

Chapters 5 and 7 contain information and recommendations pertaining to water conservation and drought management practices. When enacted, the conservation practices will diminish water demand, the drought management practices will extend supplies over the stress period, and the land management practices will potentially increase aquifer recharge.

## 6.2 PROTECTION OF AGRICULTURAL RESOURCES

Agriculture in the Plateau Region, as described in Chapter 1, Sections 1.2.7 and 1.3.3, and Chapter 3, Section 3.1.10 includes the raising of crops and livestock, as well as a multitude of businesses that support this industry. Many of the communities in the Region depend on various forms of the agricultural industry for a significant portion of their economy. It is thus important to the economic health and way of life in these communities to protect water resources that have historically been used in the support of agricultural activities.

TWDB's socio-economic analysis (Appendix 6A) reports that a projected water shortages in the irrigated agriculture water use category for one or more decades within the water planning horizon (Chapter 4, Table 4-1) only occurs in Bandera County. Per the TWDB's socio-economic analysis, a negative tax impact was surmised, primarily due to past subsidies from the federal government.

Portions of three of the six counties in the Region (Bandera, Kerr and Kinney) are projected to experience water shortages in the livestock water use category for one or more decades within the water planning horizon (Chapter 4, Table 4-1). Income loss is estimated to be approximately $11 million, which includes approximately 573 job losses per decade (Table 6-1).

The *2021 Plateau Region Water Plan* provides irrigation strategy recommendations for minor projected shortages in parts of Bandera County in Chapter 5. Also, non-agricultural strategies provided in Chapter 5 include an analysis of potential impact to agricultural interests.

An interim project was performed in 2010 to evaluate the water use by livestock and game animals in the Plateau Region. This report titled "Water Use by Livestock and Game Animals in the Plateau Regional Water Planning Area" is printed in the *2011 Plateau Region Water Plan*.

**Table 6-1. Impacts of Water Shortages on Irrigation and Livestock**

| WUG | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| Irrigation | $0 | $0 | $0 | $0 | $0 | $0 |
| Job Losses | 0 | 0 | 0 | 0 | 0 | 0 |
| Livestock | $11M | $11M | $11M | $11M | $11M | $11M |
| Job Losses | 573 | 573 | 573 | 573 | 573 | 573 |

* Year 2018 dollars rounded. Entries denoted by a zero ($0) indicate income losses less than $500,000.

## 6.3 PROTECTION OF NATURAL RESOURCES

The Plateau Region Water Planning Group has adopted a stance toward the protection of natural resources. Natural resources are defined in Chapter 1, Sections 1.2.6 and 1.2.7 as including terrestrial and aquatic habitats that support a diverse environmental community as well as provide recreational and economic opportunities. Environmental and recreational water needs are discussed in Chapter 2, Section 2.3.

The protection of natural resources is closely linked with the protection of water resources as discussed in Section 6.1 above. Where possible, the methodology used to assess groundwater source availability is based on not significantly lowering water levels to a point where spring flows might be impacted. Thus, the intention to protect surface flows is directly related to those natural resources that are dependent on surface water sources or spring flows for their existence.

Environmental impacts were evaluated in the consideration of strategies to meet water-supply deficits. Table 5-4 in Chapter 5 provides a comparative analysis of all selected strategies. Of prime consideration was whether a strategy potentially could diminish the quantity of water currently existing in the natural environment and if a strategy could impact water quality to a level that would be detrimental to animals and plants that naturally inhabit the area under consideration.

Although the Planning Group chooses to respect the privacy of private lands by not recommending "Ecologically Unique River and Stream Segments" in this *Water Plan*, the Group recognizes and applauds the conservation work that is undertaken on a daily basis by the majority of all landowners in the Region.

## 6.4 PROTECTION OF PUBLIC HEALTH AND SAFETY

Sufficient water management strategy supplies are recommended in this *2021 Plan* to meet the identified projected needs of all municipal water user groups (WUGs) in the Region except for:

- Bandera River Ranch 1 and Lake Medina Shores in Bandera County
- County Other in Val Verde County
- Livestock in Kerr and Kinney Counties

The public health and safety of meeting municipal water supply needs is of significant concern of the PRWPG in preparing this *2021 Plan*. The unmet needs listed above received attention in terms of considering additional conservation and infrastructure strategies. Insufficient water available to meet the needs of the two entities in Bandera County is the result of GMA limitations placed on groundwater availability. Additional groundwater well strategies can be generated to account for the above needed supplies; however, Bandera River Ranch and Lake Medina Shores must negotiate permit allowances with the Bandera County River Authority and Groundwater Conservation District.

The County Other category in Val Verde County is experiencing a high growth rate with a population expected to double over the 50-year planning horizon. Water use in these rural communities is generally less than the State average and therefore drought management will likely have only a minor impact. Water loss audit and main line repair strategies are presented in this plan to create demand reductions. An unmet need is not projected for this category until the 2070 decade by which time sufficient transitions in water-supplier opportunities will have occurred. The Del Rio Utilities Commission will likely expand its area of service to incorporate a portion of these communities.

Livestock use shortages in Kerr and Kinney Counties are likewise the result of GMA limitations on groundwater availability. Livestock supply use are considered “Exempt” from permitting but should consult with the local Groundwater Conservation Districts for advice on aquifer supply availability. During drought of record conditions, livestock is typically reduced to a manageable level which would likely eliminate the unmet needs condition. Public health and safety are not at risk as a result of unmet Livestock supply needs.

Conservation was considered and recommended as a strategy to help reduce the unmet municipal needs and protect the human health and safety of the residents of Bandera River Ranch 1 and Lake Medina Shores in Bandera County and County-Other in Val Verde County. Additional conservation is anticipated to be enacted by each entity as described in their Conservation Plans. Drought management was also considered for both entities but was not considered feasible for meeting long-term growth in demands. The Bandera County River Authority and Groundwater Conservation District maintains an active drought management program in which these two entities are monitored and provided the opportunity to learn and experience activities designed to conserve water. Drought management in Valverde County will likely be enacted by the Del Rio Utilities Commission with outreach to County-Other entities.

The PRWPG does not anticipate amending the *2021 Plan* to address these unmet municipal needs but is prepared to do so if conditions cause an entity to request such a change. More likely, it is expected that the entity may choose to wait to incorporate any new information (such as modification of the MAGs) in the *2026 Plateau Region Water Plan*.

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# APPENDIX 6A
# SOCIOECONOMIC IMPACT OF UNMET WATER NEEDS

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# Socioeconomic Impacts of Projected Water Shortages for the Plateau (Region J) Regional Water Planning Area

**Prepared in Support of the 2021 Region J Regional Water Plan**

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Water Use, Projections, & Planning Division
Texas Water Development Board

November 2021

# Table of Contents

# Executive Summary

Evaluating the social and economic impacts of not meeting identified water needs is a required analysis in the regional water planning process. The Texas Water Development Board (TWDB) estimates these impacts for regional water planning groups (RWPGs) and summarizes the impacts in the state water plan. The analysis presented is for the Plateau Regional Water Planning Group (Region J).

Based on projected water demands and existing water supplies, Region J identified water needs (potential shortages) that could occur within its region under a repeat of the drought of record for six water use categories (irrigation, livestock, manufacturing, mining, municipal and steam-electric power). The TWDB then estimated the annual socioeconomic impacts of those needs—if they are not met—for each water use category and as an aggregate for the region.

This analysis was performed using an economic impact modeling software package, IMPLAN (Impact for Planning Analysis), as well as other economic analysis techniques, and represents a snapshot of socioeconomic impacts that may occur during a single year repeat of the drought of record with the further caveat that no mitigation strategies are implemented. Decade specific impact estimates assume that growth occurs, and future shocks are imposed on an economy at 10-year intervals. The estimates presented are not cumulative (i.e., summing up expected impacts from today up to the decade noted), but are simply snapshots of the estimated annual socioeconomic impacts should a drought of record occur in each particular decade based on anticipated water supplies and demands for that same decade.

For regional economic impacts, income losses and job losses are estimated within each planning decade (2020 through 2070). The income losses represent an approximation of gross domestic product (GDP) that would be foregone if water needs are not met.

The analysis also provides estimates of financial transfer impacts, which include tax losses (state, local, and utility tax collections); water trucking costs; and utility revenue losses. In addition, social impacts are estimated, encompassing lost consumer surplus (a welfare economics measure of consumer wellbeing); as well as population and school enrollment losses.

IMPLAN data reported that the Region J generated more than $4.5 billion in gross domestic product (GDP) (2018 dollars) and supported roughly 68,000 jobs in 2016. The Region J estimated total population was approximately 131,000 in 2016.

It is estimated that not meeting the identified water needs in Region J would result in an annually combined lost income impact of approximately $233 million in 2020, increasing to $257 million in 2070 (Table ES-1). In 2020, the region would lose approximately 2,300 jobs, and by 2070 job losses would increase to approximately 3,000 if anticipated needs are not mitigated.

All impact estimates are in year 2018 dollars and were calculated using a variety of data sources and tools including the use of a region-specific IMPLAN model, data from TWDB annual water use estimates, the U.S. Census Bureau, Texas Agricultural Statistics Service, and the Texas Municipal League.

**Table ES-1 Region J socioeconomic impact summary**

| Regional Economic Impacts | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Income losses ($ millions)*** | $233 | $298 | $316 | $289 | $268 | $257 |
| **Job losses** | 2,272 | 2,597 | 2,780 | 2,850 | 2,935 | 3,064 |
| **Financial Transfer Impacts** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| **Tax losses on production and imports ($ millions)*** | $26 | $33 | $35 | $32 | $29 | $28 |
| **Water trucking costs ($ millions)*** | $1 | $1 | $1 | $1 | $1 | $1 |
| **Utility revenue losses ($ millions)*** | $14 | $15 | $17 | $18 | $20 | $22 |
| **Utility tax revenue losses ($ millions)*** | $0 | $0 | $0 | $0 | $0 | $0 |
| **Social Impacts** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| **Consumer surplus losses ($ millions)*** | $5 | $7 | $8 | $10 | $12 | $15 |
| **Population losses** | 417 | 477 | 510 | 523 | 539 | 563 |
| **School enrollment losses** | 80 | 91 | 98 | 100 | 103 | 108 |

* Year 2018 dollars, rounded**.** Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

# 1 Introduction

Water shortages during a repeat of the drought of record would likely curtail or eliminate certain economic activity in businesses and industries that rely heavily on water. Insufficient water supplies could not only have an immediate and real impact on the regional economy in the short term, but they could also adversely and chronically affect economic development in Texas. From a social perspective, water supply reliability is critical as well. Shortages could disrupt activity in homes, schools and government, and could adversely affect public health and safety. For these reasons, it is important to evaluate and understand how water supply shortages during drought could impact communities throughout the state.

As part of the regional water planning process, RWPGs must evaluate the social and economic impacts of not meeting water needs (31 Texas Administrative Code §357.33 (c)). Due to the complexity of the analysis and limited resources of the planning groups, the TWDB has historically performed this analysis for the RWPGs upon their request. Staff of the TWDB's Water Use, Projections, & Planning Division designed and conducted this analysis in support of Region J, and those efforts for this region as well as the other 15 regions allow consistency and a degree of comparability in the approach.

This document summarizes the results of the analysis and discusses the methodology used to generate the results. Section 1 provides a snapshot of the region's economy and summarizes the identified water needs in each water use category, which were calculated based on the RWPG's water supply and demand established during the regional water planning process. Section 2 defines each of ten impact assessment measures used in this analysis. Section 3 describes the methodology for the impact assessment and the approaches and assumptions specific to each water use category (i.e., irrigation, livestock, manufacturing, mining, municipal, and steam-electric power). Section 4 presents the impact estimates for each water use category with results summarized for the region as a whole. Appendix A presents a further breakdown of the socioeconomic impacts by county.

## 1.1 Regional Economic Summary

The Region J Regional Water Planning Area generated more than $4.5 billion in gross domestic product (2018 dollars) and supported roughly 68,000 jobs in 2016, according to the IMPLAN dataset utilized in this socioeconomic analysis. This activity accounted for 0.3 percent of the state's total gross domestic product of 1.73 trillion dollars for the year based on IMPLAN. Table 1-1 lists all economic sectors ranked by the total value-added to the economy in Region J. The real estate and retail trade sectors generated close to 20 percent of the region's total value-added and were also significant sources of tax revenue. The top employers in the region were in the public administration, retail trade, and health care sectors. Region J's estimated total population was roughly 131,000 in 2016, approximately 0.5 percent of the state's total.

This represents a snapshot of the regional economy as a whole, and it is important to note that not all economic sectors were included in the TWDB socioeconomic impact analysis. Data considerations prompted use of only the more water-intensive sectors within the economy because damage estimates could only be calculated for those economic sectors which had both reliable income and water use estimates.

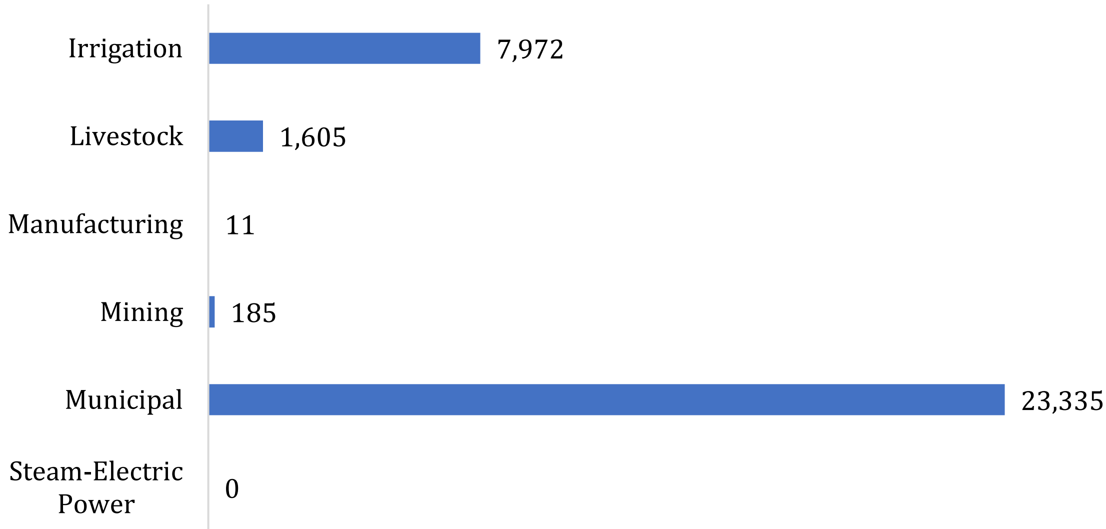
**Table 1-1 Region J regional economy by economic sector***

| Economic sector | Value-added ($ millions) | Tax ($ millions) | Jobs |
|---|---|---|---|
| **Public Administration** | $1,098.8 | $(7.7) | 10,835 |
| **Real Estate and Rental and Leasing** | $511.9 | $91.5 | 3,031 |
| **Retail Trade** | $383.5 | $100.4 | 7,154 |
| **Manufacturing** | $372.0 | $14.1 | 3,610 |
| **Health Care and Social Assistance** | $364.4 | $5.9 | 7,151 |
| **Construction** | $270.8 | $5.6 | 5,093 |
| **Accommodation and Food Services** | $230.2 | $33.8 | 5,358 |
| **Professional, Scientific, and Technical Services** | $189.9 | $6.4 | 3,150 |
| **Other Services (except Public Administration)** | $184.0 | $19.9 | 4,987 |
| **Wholesale Trade** | $171.9 | $65.4 | 2,211 |
| **Administrative and Support and Waste Management and Remediation Services** | $137.6 | $3.4 | 2,744 |
| **Transportation and Warehousing** | $135.8 | $4.2 | 1,756 |
| **Finance and Insurance** | $128.8 | $8.2 | 2,828 |
| **Information** | $91.9 | $32.3 | 662 |
| **Mining, Quarrying, and Oil and Gas Extraction** | $89.9 | $49.8 | 1,334 |
| **Agriculture, Forestry, Fishing and Hunting** | $59.4 | $2.5 | 3,769 |
| **Utilities** | $54.7 | $14.7 | 218 |
| **Arts, Entertainment, and Recreation** | $35.1 | $6.5 | 1,075 |
| **Educational Services** | $28.4 | $1.9 | 1,025 |
| **Management of Companies and Enterprises** | $6.7 | $0.7 | 251 |
| **Grand Total** | $4,545.8 | $459.6 | 68,241 |

*Source: 2016 IMPLAN for 536 sectors aggregated by 2-digit NAICS (North American Industry Classification System)

Figure 1-1 illustrates Region J's breakdown of the 2016 water use estimates by TWDB water use category. The categories with the highest use in Region J in 2016 were municipal (70 percent) and irrigation (24 percent).

**Figure 1-1 Region J 2016 water use estimates by water use category (in acre-feet)**




Source: TWDB Annual Water Use Estimates (all values in acre-feet)

## 1.2 Identified Regional Water Needs (Potential Shortages)

As part of the regional water planning process, the TWDB adopted water demand projections for water user groups (WUG) in Region J with input from the planning group. WUG-level demand projections were established for utilities that provide more than 100 acre-feet of annual water supply, combined rural areas (designated as county-other), and county-wide water demand projections for five non-municipal categories (irrigation, livestock, manufacturing, mining and steam-electric power). The RWPG then compared demands to the existing water supplies of each WUG to determine potential shortages, or needs, by decade.

Table 1-2 summarizes the region's identified water needs in the event of a repeat of the drought of record. Demand management, such as conservation, or the development of new infrastructure to increase supplies, are water management strategies that may be recommended by the planning group to address those needs. This analysis assumes that no strategies are implemented, and that the identified needs correspond to future water shortages. Note that projected water needs generally increase over time, primarily due to anticipated population growth, economic growth, or declining supplies. To provide a general sense of proportion, total projected needs as an overall percentage of total demand by water use category are also presented in aggregate in Table 1-2. Projected needs for individual water user groups within the aggregate can vary greatly and may reach 100% for a given WUG and water use category. A detailed summary of water needs by WUG and county appears in Chapter 4 of the 2021 Region J Regional Water Plan.

**Table 1-2 Regional water needs summary by water use category***

| Water Use Category | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|
| **Irrigation** | water needs (acre-feet per year) | 75 | 75 | 75 | 75 | 75 | 75 |
| | % of the category's total water demand | 1% | 1% | 1% | 1% | 1% | 1% |
| **Livestock** | water needs (acre-feet per year) | 357 | 357 | 357 | 357 | 357 | 357 |
| | % of the category's total water demand | 16% | 16% | 16% | 16% | 16% | 16% |
| **Manufacturing** | water needs (acre-feet per year) | - | - | - | - | - | - |
| | % of the category's total water demand | 0% | 0% | 0% | 0% | 0% | 0% |
| **Mining** | water needs (acre-feet per year) | 221 | 281 | 294 | 259 | 229 | 210 |
| | % of the category's total water demand | 62% | 67% | 66% | 63% | 58% | 55% |
| **Municipal**** | water needs (acre-feet per year) | 5,956 | 6,685 | 7,336 | 8,143 | 9,198 | 10,223 |
| | % of the category's total water demand | 23% | 24% | 26% | 28% | 30% | 32% |
| **Steam-electric power** | water needs (acre-feet per year) | - | - | - | - | - | - |
| | % of the category's total water demand | 0% | 0% | 0% | 0% | 0% | 0% |
| **Total water needs (acre-feet per year)** | | **6,609** | **7,398** | **8,062** | **8,834** | **9,859** | **10,865** |

*Entries denoted by a dash (-) indicate no identified water need for a given water use category.
** Municipal category consists of residential and non-residential (commercial and institutional) subcategories.

# 2 Impact Assessment Measures

A required component of the regional and state water plans is to estimate the potential economic and social impacts of potential water shortages during a repeat of the drought of record. Consistent with previous water plans, ten impact measures were estimated and are described in Table 2-1.

**Table 2-1 Socioeconomic impact analysis measures**

| **Regional economic impacts** | **Description** |
|---|---|
| **Income losses - value-added** | The value of output less the value of intermediate consumption; it is a measure of the contribution to gross domestic product (GDP) made by an individual producer, industry, sector, or group of sectors within a year. Value-added measures used in this report have been adjusted to include the direct, indirect, and induced monetary impacts on the region. |
| **Income losses - electrical power purchase costs** | Proxy for income loss in the form of additional costs of power as a result of impacts of water shortages. |
| **Job losses** | Number of part-time and full-time jobs lost due to the shortage. These values have been adjusted to include the direct, indirect, and induced employment impacts on the region. |
| **Financial transfer impacts** | **Description** |
| **Tax losses on production and imports** | Sales and excise taxes not collected due to the shortage, in addition to customs duties, property taxes, motor vehicle licenses, severance taxes, other taxes, and special assessments less subsidies. These values have been adjusted to include the direct, indirect and induced tax impacts on the region. |
| **Water trucking costs** | Estimated cost of shipping potable water. |
| **Utility revenue losses** | Foregone utility income due to not selling as much water. |
| **Utility tax revenue losses** | Foregone miscellaneous gross receipts tax collections. |
| **Social impacts** | **Description** |
| **Consumer surplus losses** | A welfare measure of the lost value to consumers accompanying restricted water use. |
| **Population losses** | Population losses accompanying job losses. |
| **School enrollment losses** | School enrollment losses (K-12) accompanying job losses. |

## 2.1 Regional Economic Impacts

The two key measures used to assess regional economic impacts are income losses and job losses. The income losses presented consist of the sum of value-added losses and the additional purchase costs of electrical power.

### *Income Losses - Value-added Losses*

Value-added is the value of total output less the value of the intermediate inputs also used in the production of the final product. Value-added is similar to GDP, a familiar measure of the productivity of an economy. The loss of value-added due to water shortages is estimated by input-output analysis using the IMPLAN software package, and includes the direct, indirect, and induced monetary impacts on the region. The indirect and induced effects are measures of reduced income as well as reduced employee spending for those input sectors which provide resources to the water shortage impacted production sectors.

### *Income Losses - Electric Power Purchase Costs*

The electrical power grid and market within the state is a complex interconnected system. The industry response to water shortages, and the resulting impact on the region, are not easily modeled using traditional input/output impact analysis and the IMPLAN model. Adverse impacts on the region will occur and are represented in this analysis by estimated additional costs associated with power purchases from other generating plants within the region or state. Consequently, the analysis employs additional power purchase costs as a proxy for the value-added impacts for the steam-electric power water use category, and these are included as a portion of the overall income impact for completeness.

For the purpose of this analysis, it is assumed that power companies with insufficient water will be forced to purchase power on the electrical market at a projected higher rate of 5.60 cents per kilowatt hour. This rate is based upon the average day-ahead market purchase price of electricity in Texas that occurred during the recent drought period in 2011. This price is assumed to be comparable to those prices which would prevail in the event of another drought of record.

### *Job Losses*

The number of jobs lost due to the economic impact is estimated using IMPLAN output associated with each TWDB water use category. Because of the difficulty in predicting outcomes and a lack of relevant data, job loss estimates are not calculated for the steam-electric power category.

## 2.2 Financial Transfer Impacts

Several impact measures evaluated in this analysis are presented to provide additional detail concerning potential impacts on a portion of the economy or government. These financial transfer impact measures include lost tax collections (on production and imports), trucking costs for imported water, declines in utility revenues, and declines in utility tax revenue collected by the state. These measures are not solely adverse, with some having both positive and negative impacts. For example, cities and residents would suffer if forced to pay large costs for trucking in potable water. Trucking firms, conversely, would benefit from the transaction. Additional detail for each of these measures follows.

### *Tax Losses on Production and Imports*

Reduced production of goods and services accompanying water shortages adversely impacts the collection of taxes by state and local government. The regional IMPLAN model is used to estimate reduced tax collections associated with the reduced output in the economy. Impact estimates for this measure include the direct, indirect, and induced impacts for the affected sectors.

### *Water Trucking Costs*

In instances where water shortages for a municipal water user group are estimated by RWPGs to exceed 80 percent of water demands, it is assumed that water would need to be trucked in to support basic consumption and sanitation needs. For water shortages of 80 percent or greater, a fixed, maximum of $35,000[1] per acre-foot of water applied as an economic cost. This water trucking cost was utilized for both the residential and non-residential portions of municipal water needs.

### *Utility Revenue Losses*

Lost utility income is calculated as the price of water service multiplied by the quantity of water not sold during a drought shortage. Such estimates are obtained from utility-specific pricing data provided by the Texas Municipal League, where available, for both water and wastewater. These water rates are applied to the potential water shortage to estimate forgone utility revenue as water providers sold less water during the drought due to restricted supplies.

### *Utility Tax Losses*

Foregone utility tax losses include estimates of forgone miscellaneous gross receipts taxes. Reduced water sales reduce the amount of utility tax that would be collected by the State of Texas for water and wastewater service sales.

[1] Based on staff survey of water hauling firms and historical data concerning transport costs for potable water in the recent drought in California for this estimate. There are many factors and variables that would determine actual water trucking costs including distance to, cost of water, and length of that drought.

## 2.3 Social Impacts

### *Consumer Surplus Losses for Municipal Water Users*

Consumer surplus loss is a measure of impact to the wellbeing of municipal water users when their water use is restricted. Consumer surplus is the difference between how much a consumer is willing and able to pay for a commodity (i.e., water) and how much they actually have to pay. The difference is a benefit to the consumer's wellbeing since they do not have to pay as much for the commodity as they would be willing to pay. Consumer surplus may also be viewed as an estimate of how much consumers would be willing to pay to keep the original quantity of water which they used prior to the drought. Lost consumer surplus estimates within this analysis only apply to the residential portion of municipal demand, with estimates being made for reduced outdoor and indoor residential use. Lost consumer surplus estimates varied widely by location and degree of water shortage.

### *Population and School Enrollment Losses*

Population loss due to water shortages, as well as the associated decline in school enrollment, are based upon the job loss estimates discussed in Section 2.1. A simplified ratio of job and net population losses are calculated for the state as a whole based on a recent study of how job layoffs impact the labor market population.[2] For every 100 jobs lost, 18 people were assumed to move out of the area. School enrollment losses are estimated as a proportion of the population lost based upon public school enrollment data from the Texas Education Agency concerning the age K-12 population within the state (approximately 19%).

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[2] Foote, Andrew, Grosz, Michel, Stevens, Ann. "Locate Your Nearest Exit: Mass Layoffs and Local Labor Market Response." University of California, Davis. April 2015, http://paa2015.princeton.edu/papers/150194. The study utilized Bureau of Labor Statistics data regarding layoffs between 1996 and 2013, as well as Internal Revenue Service data regarding migration, to model the change in the population as the result of a job layoff event. The study found that layoffs impact both out-migration and in-migration into a region, and that a majority of those who did move following a layoff moved to another labor market rather than an adjacent county.

# 3 Socioeconomic Impact Assessment Methodology

This portion of the report provides a summary of the methodology used to estimate the potential economic impacts of future water shortages. The general approach employed in the analysis was to obtain estimates for income and job losses on the smallest geographic level that the available data would support, tie those values to their accompanying historic water use estimate, and thereby determine a maximum impact per acre-foot of shortage for each of the socioeconomic measures. The calculations of economic impacts are based on the overall composition of the economy divided into many underlying economic sectors. Sectors in this analysis refer to one or more of the 536 specific production sectors of the economy designated within IMPLAN, the economic impact modeling software used for this assessment. Economic impacts within this report are estimated for approximately 330 of these sectors, with the focus on the more water-intensive production sectors. The economic impacts for a single water use category consist of an aggregation of impacts to multiple, related IMPLAN economic sectors.

## 3.1 Analysis Context

The context of this socioeconomic impact analysis involves situations where there are physical shortages of groundwater or surface water due to a recurrence of drought of record conditions. Anticipated shortages for specific water users may be nonexistent in earlier decades of the planning horizon, yet population growth or greater industrial, agricultural or other sector demands in later decades may result in greater overall demand, exceeding the existing supplies. Estimated socioeconomic impacts measure what would happen if water user groups experience water shortages for a period of one year. Actual socioeconomic impacts would likely become larger as drought of record conditions persist for periods greater than a single year.

## 3.2 IMPLAN Model and Data

Input-Output analysis using the IMPLAN software package was the primary means of estimating the value-added, jobs, and tax related impact measures. This analysis employed regional level models to determine key economic impacts. IMPLAN is an economic impact model, originally developed by the U.S. Forestry Service in the 1970's to model economic activity at varying geographic levels. The model is currently maintained by the Minnesota IMPLAN Group (MIG Inc.) which collects and sells county and state specific data and software. The year 2016 version of IMPLAN, employing data for all 254 Texas counties, was used to provide estimates of value-added, jobs, and taxes on production for the economic sectors associated with the water user groups examined in the study. IMPLAN uses 536 sector-specific Industry Codes, and those that rely on water as a primary input were assigned to their appropriate planning water user categories (irrigation, livestock, manufacturing, mining, and municipal). Estimates of value-added for a water use category were obtained by summing value-added estimates across the relevant IMPLAN sectors associated with that water use category. These calculations were also performed for job losses as well as tax losses on production and imports.

The adjusted value-added estimates used as an income measure in this analysis, as well as the job and tax estimates from IMPLAN, include three components:

- ***Direct effects*** representing the initial change in the industry analyzed;
- ***Indirect effects*** that are changes in inter-industry transactions as supplying industries respond to reduced demands from the directly affected industries; and,
- ***Induced effects*** that reflect changes in local spending that result from reduced household income among employees in the directly and indirectly affected industry sectors.

Input-output models such as IMPLAN only capture backward linkages and do not include forward linkages in the economy.

## 3.3 Elasticity of Economic Impacts

The economic impact of a water need is based on the size of the water need relative to the total water demand for each water user group. Smaller water shortages, for example, less than 5 percent, are generally anticipated to result in no initial negative economic impact because water users are assumed to have a certain amount of flexibility in dealing with small shortages. As a water shortage intensifies, however, such flexibility lessens and results in actual and increasing economic losses, eventually reaching a representative maximum impact estimate per unit volume of water. To account for these characteristics, an elasticity adjustment function is used to estimate impacts for the income, tax and job loss measures. Figure 3-1 illustrates this general relationship for the adjustment functions. Negative impacts are assumed to begin accruing when the shortage reaches the lower bound 'b1' (5 percent in Figure 3-1), with impacts then increasing linearly up to the 100 percent impact level (per unit volume) once the upper bound reaches the 'b2' level shortage (40 percent in Figure 3-1).

To illustrate this, if the total annual value-added for manufacturing in the region was $2 million and the reported annual volume of water used in that industry is 10,000 acre-feet, the estimated economic measure of the water shortage would be $200 per acre-foot. The economic impact of the shortage would then be estimated using this value-added amount as the maximum impact estimate ($200 per acre-foot) applied to the anticipated shortage volume and then adjusted by the elasticity function. Using the sample elasticity function shown in Figure 3-1, an approximately 22 percent shortage in the livestock category would indicate an economic impact estimate of 50% of the original $200 per acre-foot impact value (i.e., $100 per acre-foot).

Such adjustments are not required in estimating consumer surplus, utility revenue losses, or utility tax losses. Estimates of lost consumer surplus rely on utility-specific demand curves with the lost consumer surplus estimate calculated based on the relative percentage of the utility's water shortage. Estimated changes in population and school enrollment are indirectly related to the elasticity of job losses.

Assumed values for the lower and upper bounds 'b1' and 'b2' vary by water use category and are presented in Table 3-1.

**Figure 3-1 Example economic impact elasticity function (as applied to a single water user's**

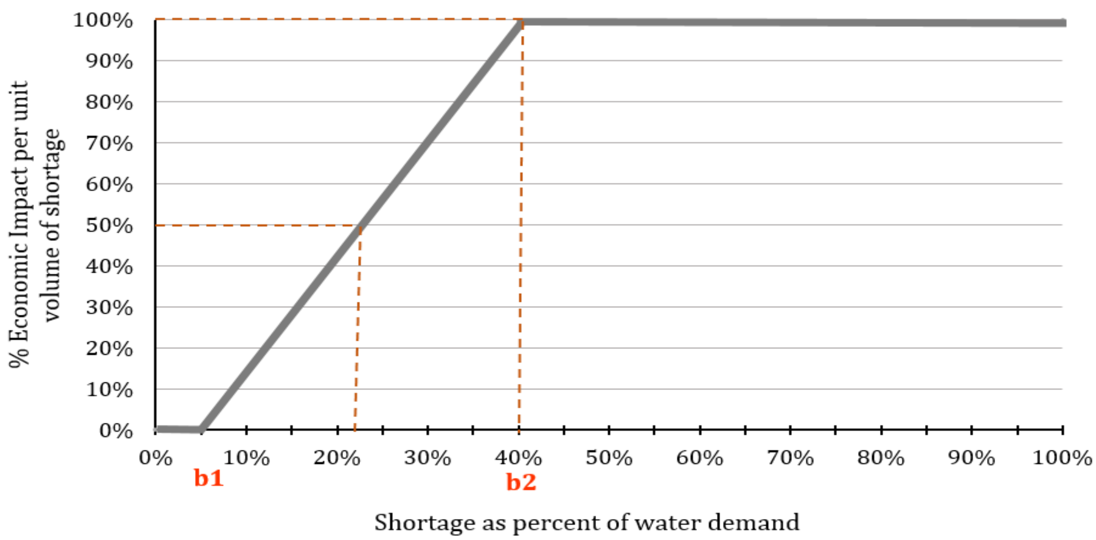


**Table 3-1 Economic impact elasticity function lower and upper bounds**

| Water use category | Lower bound (b1) | Upper bound (b2) |
|---|---|---|
| **Irrigation** | **5%** | **40%** |
| **Livestock** | **5%** | **10%** |
| **Manufacturing** | **5%** | **40%** |
| **Mining** | **5%** | **40%** |
| **Municipal (non-residential water intensive subcategory)** | **5%** | **40%** |
| **Steam-electric power** | **N/A** | **N/A** |

## 3.4 Analysis Assumptions and Limitations

The modeling of complex systems requires making many assumptions and acknowledging the model's uncertainty and limitations. This is particularly true when attempting to estimate a wide range of socioeconomic impacts over a large geographic area and into future decades. Some of the key assumptions and limitations of this methodology include:

1. The foundation for estimating the socioeconomic impacts of water shortages resulting from a drought are the water needs (potential shortages) that were identified by RWPGs as part of the

regional water planning process. These needs have some uncertainty associated with them but serve as a reasonable basis for evaluating the potential impacts of a drought of record event.

2. All estimated socioeconomic impacts are snapshots for years in which water needs were identified (i.e., 2020, 2030, 2040, 2050, 2060, and 2070). The estimates are independent and distinct "what if" scenarios for each particular year, and water shortages are assumed to be temporary events resulting from a single year recurrence of drought of record conditions. The evaluation assumed that no recommended water management strategies are implemented. In other words, growth occurs and future shocks are imposed on an economy at 10-year intervals, and the resulting impacts are estimated. Note that the estimates presented are not cumulative (i.e., summing up expected impacts from today up to the decade noted), but are simply snapshots of the estimated annual socioeconomic impacts should a drought of record occur in each particular decade based on anticipated water supplies and demands for that same decade.

3. Input-output models such as IMPLAN rely on a static profile of the structure of the economy as it appears today. This presumes that the relative contributions of all sectors of the economy would remain the same, regardless of changes in technology, availability of limited resources, and other structural changes to the economy that may occur in the future. Changes in water use efficiency will undoubtedly take place in the future as supplies become more stressed. Use of the static IMPLAN structure was a significant assumption and simplification considering the 50-year time period examined in this analysis. To presume an alternative future economic makeup, however, would entail positing many other major assumptions that would very likely generate as much or more error.

4. This is not a form of cost-benefit analysis. That approach to evaluating the economic feasibility of a specific policy or project employs discounting future benefits and costs to their present value dollars using some assumed discount rate. The methodology employed in this effort to estimate the economic impacts of future water shortages did not use any discounting methods to weigh future costs differently through time.

5. All monetary values originally based upon year 2016 IMPLAN and other sources are reported in constant year 2018 dollars to be consistent with the water management strategy requirements in the State Water Plan.

6. IMPLAN based loss estimates (income-value-added, jobs, and taxes on production and imports) are calculated only for those IMPLAN sectors for which the TWDB's Water Use Survey (WUS) data was available and deemed reliable. Every effort is made in the annual WUS effort to capture all relevant firms who are significant water users. Lack of response to the WUS, or omission of relevant firms, impacts the loss estimates.

7. Impacts are annual estimates. The socioeconomic analysis does not reflect the full extent of impacts that might occur as a result of persistent water shortages occurring over an extended duration. The drought of record in most regions of Texas lasted several years.

8. Value-added estimates are the primary estimate of the economic impacts within this report. One may be tempted to add consumer surplus impacts to obtain an estimate of total adverse economic impacts to the region, but the consumer surplus measure represents the change to the wellbeing of households (and other water users), not an actual change in the flow of dollars through the economy. The two measures (value-added and consumer surplus) are both valid impacts but ideally should not be summed.

9. The value-added, jobs, and taxes on production and import impacts include the direct, indirect and induced effects to capture backward linkages in the economy described in Section 2.1. Population and school enrollment losses also indirectly include such effects as they are based on the associated losses in employment. The remaining measures (consumer surplus, utility revenue, utility taxes, additional electrical power purchase costs, and potable water trucking costs), however, do not include any induced or indirect effects.

10. The majority of impacts estimated in this analysis may be more conservative (i.e., smaller) than those that might actually occur under drought of record conditions due to not including impacts in the forward linkages in the economy. Input-output models such as IMPLAN only capture backward linkages on suppliers (including households that supply labor to directly affected industries). While this is a common limitation in this type of economic modeling effort, it is important to note that forward linkages on the industries that use the outputs of the directly affected industries can also be very important. A good example is impacts on livestock operators. Livestock producers tend to suffer substantially during droughts, not because there is not enough water for their stock, but because reductions in available pasture and higher prices for purchased hay have significant economic effects on their operations. Food processors could be in a similar situation if they cannot get the grains or other inputs that they need. These effects are not captured in IMPLAN, resulting in conservative impact estimates.

11. The model does not reflect dynamic economic responses to water shortages as they might occur, nor does the model reflect economic impacts associated with a recovery from a drought of record including:
    a. The likely significant economic rebound to some industries immediately following a drought, such as landscaping;
    b. The cost and time to rebuild liquidated livestock herds (a major capital investment in that industry);
    c. Direct impacts on recreational sectors (i.e., stranded docks and reduced tourism); or,
    d. Impacts of negative publicity on Texas' ability to attract population and business in the event that it was not able to provide adequate water supplies for the existing economy.

12. Estimates for job losses and the associated population and school enrollment changes may exceed what would actually occur. In practice, firms may be hesitant to lay off employees, even in difficult economic times. Estimates of population and school enrollment changes are based on regional evaluations and therefore do not necessarily reflect what might occur on a statewide basis.

13. **The results must be interpreted carefully. It is the general and relative magnitudes of impacts as well as the changes of these impacts over time that should be the focus rather than the absolute numbers.** Analyses of this type are much better at predicting relative percent differences brought about by a shock to a complex system (i.e., a water shortage) than the precise size of an impact. To illustrate, assuming that the estimated economic impacts of a drought of record on the manufacturing and mining water user categories are $2 and $1 million, respectively, one should be more confident that the economic impacts on manufacturing are twice as large as those on mining and that these impacts will likely be in the millions of dollars. But one should have less confidence that the actual total economic impact experienced would be $3 million.

14. The methodology does not capture "spillover" effects between regions – or the secondary impacts that occur outside of the region where the water shortage is projected to occur.

15. The methodology that the TWDB has developed for estimating the economic impacts of unmet water needs, and the assumptions and models used in the analysis, are specifically designed to estimate potential economic effects at the regional and county levels. Although it may be tempting to add the regional impacts together in an effort to produce a statewide result, the TWDB cautions against that approach for a number of reasons. The IMPLAN modeling (and corresponding economic multipliers) are all derived from regional models – a statewide model of Texas would produce somewhat different multipliers. As noted in point 14 within this section, the regional modeling used by TWDB does not capture spillover losses that could result in other regions from unmet needs in the region analyzed, or potential spillover gains if decreased production in one region leads to increases in production elsewhere. The assumed drought of record may also not occur in every region of Texas at the same time, or to the same degree.

# 4 Analysis Results

This section presents estimates of potential economic impacts that could reasonably be expected in the event of water shortages associated with a drought of record and if no recommended water management strategies were implemented. Projected economic impacts for the six water use categories (irrigation, livestock, manufacturing, mining, municipal, and steam-electric power) are reported by decade.

## 4.1 Impacts for Irrigation Water Shortages

One of the six counties in the region are projected to experience water shortages in the irrigated agriculture water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 4-1. Note that tax collection impacts were not estimated for this water use category. IMPLAN data indicates a negative tax impact (i.e., increased tax collections) for the associated production sectors, primarily due to past subsidies from the federal government. However, it was not considered realistic to report increasing tax revenues during a drought of record.

**Table 4-1 Impacts of water shortages on irrigation in Region J**

| Impact measure | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Income losses ($ millions)*** | $0 | $0 | $0 | $0 | $0 | $0 |
| **Job losses** | 0 | 0 | 0 | 0 | 0 | 0 |

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

## 4.2 Impacts for Livestock Water Shortages

Three of the six counties in the region are projected to experience water shortages in the livestock water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 4-2.

**Table 4-2 Impacts of water shortages on livestock in Region J**

| Impact measure | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Income losses ($ millions)*** | $11 | $11 | $11 | $11 | $11 | $11 |
| **Jobs losses** | 573 | 573 | 573 | 573 | 573 | 573 |
| **Tax losses on production and imports ($ millions)*** | $1 | $1 | $1 | $1 | $1 | $1 |

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

## 4.3 Impacts of Manufacturing Water Shortages

None of the six counties in the region are projected to experience water shortages in the manufacturing water use category. Estimated impacts to this water use category appear in Table 4-3.

**Table 4-3 Impacts of water shortages on manufacturing in Region J**

| Impacts measure | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Income losses ($ millions)*** | $- | $- | $- | $- | $- | $- |
| **Job losses** | - | - | - | - | - | - |
| **Tax losses on production and Imports ($ millions)*** | $- | $- | $- | $- | $- | $- |

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

## 4.4 Impacts of Mining Water Shortages

Mining water shortages in the region are projected to occur in three of the six counties in the region one or more decades within the planning horizon. Estimated impacts to this water use type appear in Table 4-4.

**Table 4-4 Impacts of water shortages on mining in Region J**

| Impacts measure | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Income losses ($ millions)*** | $162 | $220 | $230 | $195 | $164 | $144 |
| **Job losses** | 495 | 666 | 696 | 592 | 502 | 441 |
| **Tax losses on production and Imports ($ millions)*** | $19 | $26 | $27 | $23 | $19 | $17 |

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

## 4.5 Impacts for Municipal Water Shortages

Five of the six counties in the region are projected to experience water shortages in the municipal water use category for one or more decades within the planning horizon.

Impact estimates were made for two sub-categories within municipal water use: residential, and non-residential. Non-residential municipal water use includes commercial and institutional users, which are further divided into non-water-intensive and water-intensive subsectors including car wash, laundry, hospitality, health care, recreation, and education. Lost consumer surplus estimates were made only for needs in the residential portion of municipal water use. Available IMPLAN and TWDB Water Use Survey data for the non-residential, water-intensive portion of municipal demand allowed these sectors to be included in income, jobs, and tax loss impact estimate.

Trucking cost estimates, calculated for shortages exceeding 80 percent, assumed a fixed, maximum cost of $35,000 per acre-foot to transport water for municipal use. The estimated impacts to this water use category appear in Table 4-5.

**Table 4-5 Impacts of water shortages on municipal water users in Region J**

| Impacts measure | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Income losses[1] ($ millions)*** | $59 | $67 | $75 | $83 | $92 | $101 |
| **Job losses[1]** | 1,204 | 1,358 | 1,511 | 1,686 | 1,860 | 2,050 |
| **Tax losses on production and imports[1] ($ millions)*** | $6 | $7 | $8 | $9 | $10 | $11 |
| **Trucking costs ($ millions)*** | $1 | $1 | $1 | $1 | $1 | $1 |
| **Utility revenue losses ($ millions)*** | $14 | $15 | $17 | $18 | $20 | $22 |
| **Utility tax revenue losses ($ millions)*** | $0 | $0 | $0 | $0 | $0 | $0 |

[1] Estimates apply to the water-intensive portion of non-residential municipal water use.
* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

## 4.6 Impacts of Steam-Electric Water Shortages

None of the six counties in the region are projected to experience water shortages in the steam-electric water use category. Estimated impacts to this water use category appear in Table 4-6.

Note that estimated economic impacts to steam-electric water users:

- Are reflected as an income loss proxy in the form of estimated additional purchasing costs for power from the electrical grid to replace power that could not be generated due to a shortage;
- Do not include estimates of impacts on jobs. Because of the unique conditions of power generators during drought conditions and lack of relevant data, it was assumed that the industry would retain, perhaps relocating or repurposing, their existing staff in order to manage their ongoing operations through a severe drought.
- Do not presume a decline in tax collections. Associated tax collections, in fact, would likely increase under drought conditions since, historically, the demand for electricity increases during times of drought, thereby increasing taxes collected on the additional sales of power.

**Table 4-6 Impacts of water shortages on steam-electric power in Region J**

| Impacts measure | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Income Losses ($ millions)*** | $- | $- | $- | $- | $- | $- |

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

## 4.7 Regional Social Impacts

Projected changes in population, based upon several factors (household size, population, and job loss estimates), as well as the accompanying change in school enrollment, were also estimated and are summarized in Table 4-7.

**Table 4-7 Region-wide social impacts of water shortages in Region J**

| Impacts measure | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Consumer surplus losses ($ millions)*** | $5 | $7 | $8 | $10 | $12 | $15 |
| **Population losses** | 417 | 477 | 510 | 523 | 539 | 563 |
| **School enrollment losses** | 80 | 91 | 98 | 100 | 103 | 108 |

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

# Appendix A - County Level Summary of Estimated Economic Impacts for Region J

County level summary of estimated economic impacts of not meeting identified water needs by water use category and decade (in 2018 dollars, rounded). Values are presented only for counties with projected economic impacts for at least one decade.
**(* Entries denoted by a dash (-) indicate no estimated economic impact)**

| | | Income losses (Million $)* | | | | | | Job losses | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| County | Water Use Category | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| **BANDERA** | IRRIGATION | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | 0 | 0 | 0 | 0 | 0 | 0 |
| **BANDERA** | MUNICIPAL | $0.71 | $0.90 | $1.00 | $1.05 | $1.08 | $1.09 | 14 | 18 | 20 | 21 | 22 | 22 |
| **BANDERA Total** | | **$0.71** | **$0.91** | **$1.01** | **$1.05** | **$1.08** | **$1.10** | **15** | **18** | **21** | **21** | **22** | **22** |
| **EDWARDS** | MINING | $14.69 | $14.69 | $14.69 | $14.69 | $14.69 | $14.69 | 55 | 55 | 55 | 55 | 55 | 55 |
| **EDWARDS** | MUNICIPAL | $0.31 | $0.30 | $0.29 | $0.29 | $0.29 | $0.29 | 6 | 6 | 6 | 6 | 6 | 6 |
| **EDWARDS Total** | | **$15.00** | **$14.99** | **$14.98** | **$14.98** | **$14.98** | **$14.98** | **62** | **61** | **61** | **61** | **61** | **61** |
| **KERR** | LIVESTOCK | $10.90 | $10.90 | $10.90 | $10.90 | $10.90 | $10.90 | 527 | 527 | 527 | 527 | 527 | 527 |
| **KERR** | MINING | $0.36 | $0.41 | $0.52 | $0.59 | $0.60 | $0.71 | 1 | 2 | 2 | 2 | 2 | 3 |
| **KERR** | MUNICIPAL | $4.45 | $5.32 | $5.56 | $6.29 | $7.17 | $7.98 | 90 | 108 | 113 | 127 | 145 | 162 |
| **KERR Total** | | **$15.71** | **$16.63** | **$16.97** | **$17.78** | **$18.68** | **$19.59** | **618** | **636** | **641** | **656** | **674** | **691** |
| **KINNEY** | LIVESTOCK | $0.54 | $0.54 | $0.54 | $0.54 | $0.54 | $0.54 | 46 | 46 | 46 | 46 | 46 | 46 |
| **KINNEY Total** | | **$0.54** | **$0.54** | **$0.54** | **$0.54** | **$0.54** | **$0.54** | **46** | **46** | **46** | **46** | **46** | **46** |
| **REAL** | MUNICIPAL | $2.35 | $2.28 | $2.23 | $2.22 | $2.22 | $2.22 | 48 | 46 | 45 | 45 | 45 | 45 |
| **REAL Total** | | **$2.35** | **$2.28** | **$2.23** | **$2.22** | **$2.22** | **$2.22** | **48** | **46** | **45** | **45** | **45** | **45** |
| **VAL VERDE** | MINING | $147.22 | $204.75 | $214.50 | $179.40 | $149.17 | $128.70 | 438 | 609 | 638 | 534 | 444 | 383 |
| **VAL VERDE** | MUNICIPAL | $51.61 | $58.21 | $65.51 | $73.36 | $81.04 | $89.62 | 1,046 | 1,179 | 1,327 | 1,486 | 1,642 | 1,816 |
| **VAL VERDE Total** | | **$198.84** | **$262.96** | **$280.01** | **$252.75** | **$230.22** | **$218.32** | **1,484** | **1,789** | **1,966** | **2,020** | **2,086** | **2,199** |
| **REGION J Total** | | **$233.14** | **$298.31** | **$315.75** | **$289.32** | **$267.72** | **$256.74** | **2,272** | **2,597** | **2,780** | **2,850** | **2,935** | **3,064** |

# CHAPTER 7

# DROUGHT RESPONSE INFORMATION, ACTIVITIES, AND RECOMMENDATIONS

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# 7 REGIONAL DROUGHT RESPONSE

Drought is a frequent and inevitable factor in the climate of Texas. Therefore, it is vital to plan for the effect that droughts will have on the use, allocation and conservation of water in the State. Through the regional water planning process, requirements for drought management planning are found in Title 31 of the Texas Administrative Code (TAC), Part 10, Chapter 357, Subchapter D. Texas Statute reference §357.42 includes requirements regarding drought response information, activities, and recommendations. This chapter examines these specific requirements and identifies significant drought impacts within the Region.

## 7.1 DROUGHT OF RECORD IN THE PLATEAU REGION

The severity of the recent drought significantly impacted the lives of water users, providers and water managers who were hard-pressed to find solutions to critical supply and demand issues. The severity of the impacts varied, but the overriding sense of urgency to create workable strategies and solutions was acknowledged and acted upon Statewide. Therefore, it is critical in this planning cycle to continue to address the impact that drought is currently has had and will have on the future use, allocation and conservation of water in the State.

There are different types of drought that have been defined in various ways; however, these definitions fall into four primary categories: meteorological, agricultural, hydrological and socioeconomic drought. In the most general sense, drought is a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group or environmental purpose. The State Drought Preparedness Plan provides more specific and detailed definitions and is located at the following link:

https://www.dps.texas.gov/dem/CouncilsCommittees/droughtCouncil/droughtPrepPlan.pdf.

Meteorological drought is quantified by how dry it is (for example, a rain deficit) compared to normal conditions as well as the duration of the dry period. This is typically a region-specific metric, since factors affecting meteorological drought can vary so much in different regions.

Agricultural drought looks at the effects of meteorological drought in terms of agricultural impacts. For example, evapotranspiration, soil moisture and plant stress are measures of agricultural drought, which account for vulnerability of crops through the various growth stages.

Hydrological drought is measured in terms of effects on surface and subsurface waters, such as reservoir stage and capacity, stream flow or groundwater levels in wells. Hydrological drought is usually defined on a river-basin or watershed scale. Hydrological droughts typically lag behind meteorological and agricultural droughts because it takes more time for the evidence of basin-wide impacts to manifest.

Socioeconomic drought occurs when the demand for an economic product (such as hydroelectric power) exceeds supply due to a weather-related deficit. Typically, demand for a good increases with population growth and per capita consumptions. Supply increases due to efficiency technology and the construction of new water projects. If both are increasing, the rate of change between supply and demand is the key. However, when demand exceeds supply, vulnerability is magnified by water shortages during drought.

Several climatological drought indicators have been formulated in order to quantify drought. The Palmer Drought Severity Index (PDSI) was developed in 1965 and is currently used by many federal and state agencies. The PDSI is a soil moisture index that works best in relatively large regions with uniform topography that don't experience extreme climate shifts. PDSI values can lag oncoming drought by several months. The TWDB uses the PDSI to monitor State drought conditions, which has values ranging between -6.0 (driest) to 6.0 (wettest). "Extreme drought" conditions have a PDSI between -6.0 and -4.0, and "severe drought" conditions have a PDSI between -3.99 and -3.0.

An accumulated area graph of the weekly PDSI categories for the Edwards Plateau region of Texas is included as Figure 7-1. Since 2000, the Plateau region experienced recurring extreme drought conditions in 2006-2007 and 2008-2009.

The Plateau region experienced the longest sustained periods of extreme drought between November, 2010 and May, 2012, and between September, 2012 and May, 2015.

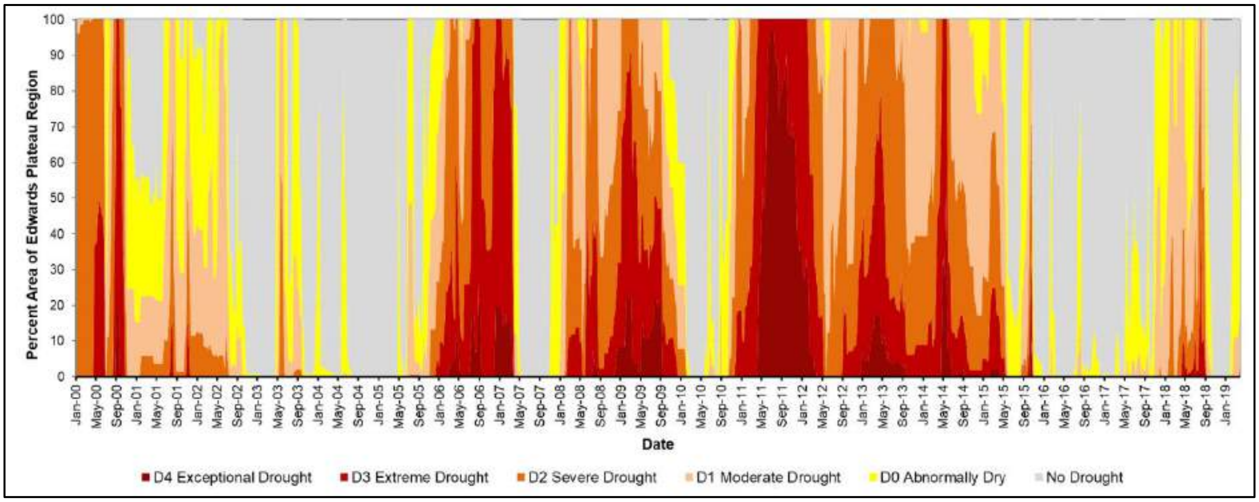


**Figure 7-1. Drought in the Edwards Plateau Region of Texas, 2000-2018**
Source: U.S. Drought Monitor

The climate of the Plateau Region is intermediate to the more humid climates of regions to the east and drier climates of regions to the west. The combination of high temperatures, high potential evapotranspiration and intermediate rainfall totals combine to produce a semi-arid climate with drought conditions during all or parts of some years (Bomar, 1995).

### 7.1.1 Precipitation Indicator

Although residents are generally accustomed to the highly variable climatic conditions typical of the Plateau Region, the relatively low rainfall and the accompanying high levels of evaporation underscore the necessity of developing plans that respond to potential disruptions in the supply of groundwater and surface water caused by drought conditions.

Comparing the 1950s DOR and the current drought can be done using historic precipitation, stream flow records, spring discharge and water level measurements in wells for locations that have accumulated data measurements since the 1940s.

Precipitation data for quadrangles 807 (west Plateau Region - portions of Edwards, Kinney and Val Verde Counties) and 808 (east Plateau Region - portions of Bandera, Kerr, Real, and Medina Counties) from 1940 through 2018 are shown on Figure 7-2. Average annual rainfall for these quadrangles is 24.6 and 26.8 inches, respectively. These data indicate that the DOR in the 1950s was associated with seven years of below average rainfall (5-inch deficit per year). The current drought indicates a trend toward below average annual rainfall between 2008 and 2015. Years with below average rainfall have a deficit of about 10 inches for the year.

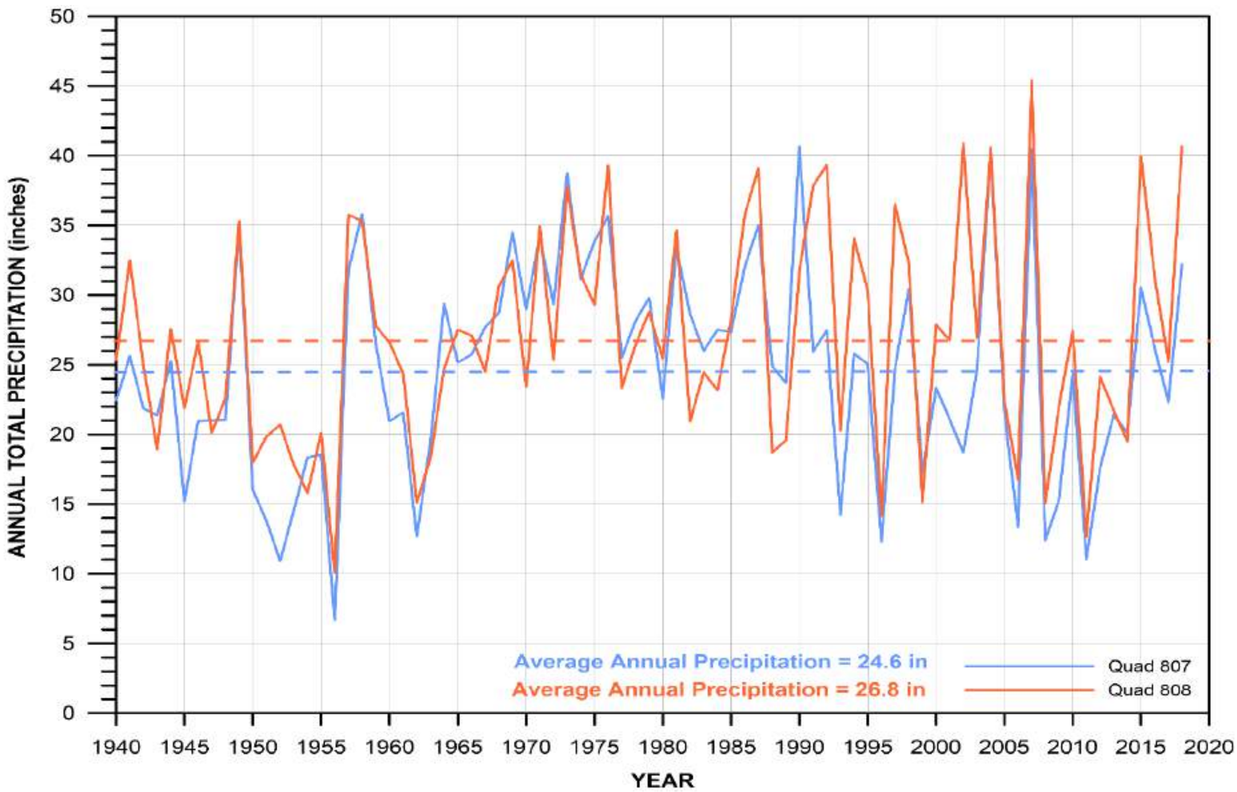


**Figure 7-2. Annual Precipitation, 1940-2013**
Source: TWDB

### 7.1.2 Stream Flow Indicator

The U.S. Geological Survey (USGS) has six stream gages located in or proximal to the Plateau Region that have flow data measurements extending back to 1943 (Figure 7-3). Graphs of the annual mean daily discharge (by calendar year) are presented with the average annual mean daily discharge, in cubic feet per second (cfs).

Some general comparisons can be made between the gaging stations during the DOR. It appears that the DOR affected stream flow in the Nueces River basin by 1950, whereas in the Frio and Guadalupe River basins, stream flow was not impacted until after 1950. Since the western counties in the region average about 2 inches of rainfall less than the eastern counties, this impact lag is somewhat intuitive but worth noting nonetheless. The stream flow data in the Frio, Sabinal and Guadalupe River basins illustrate this more readily than the gages located in the Nueces River basin. Additionally, the gaging data highlights the gradual decrease in stream flow that can be seen during the DOR in the 1950s compared to the sudden decrease of flow that is evident in the more recent flow data. These graphs show that recent stream flow in all river basins decreased suddenly compared to the DOR in the 1950s, and that the decreased flow occurred nearly simultaneously in all basins. Generally, it appears that the current drought is having a more intense and rapid impact on stream flow; however, it is uncertain what portion of the decrease in stream flow can be attributed to a decrease in base flow due to increased groundwater pumping. Also, except for perhaps the West Nueces River gaging station near Brackettville (the most arid station location), there does not appear to be a historical decrease in flow since year 2000 as has been observed in the Upper Colorado River basin (Figure 7-4).

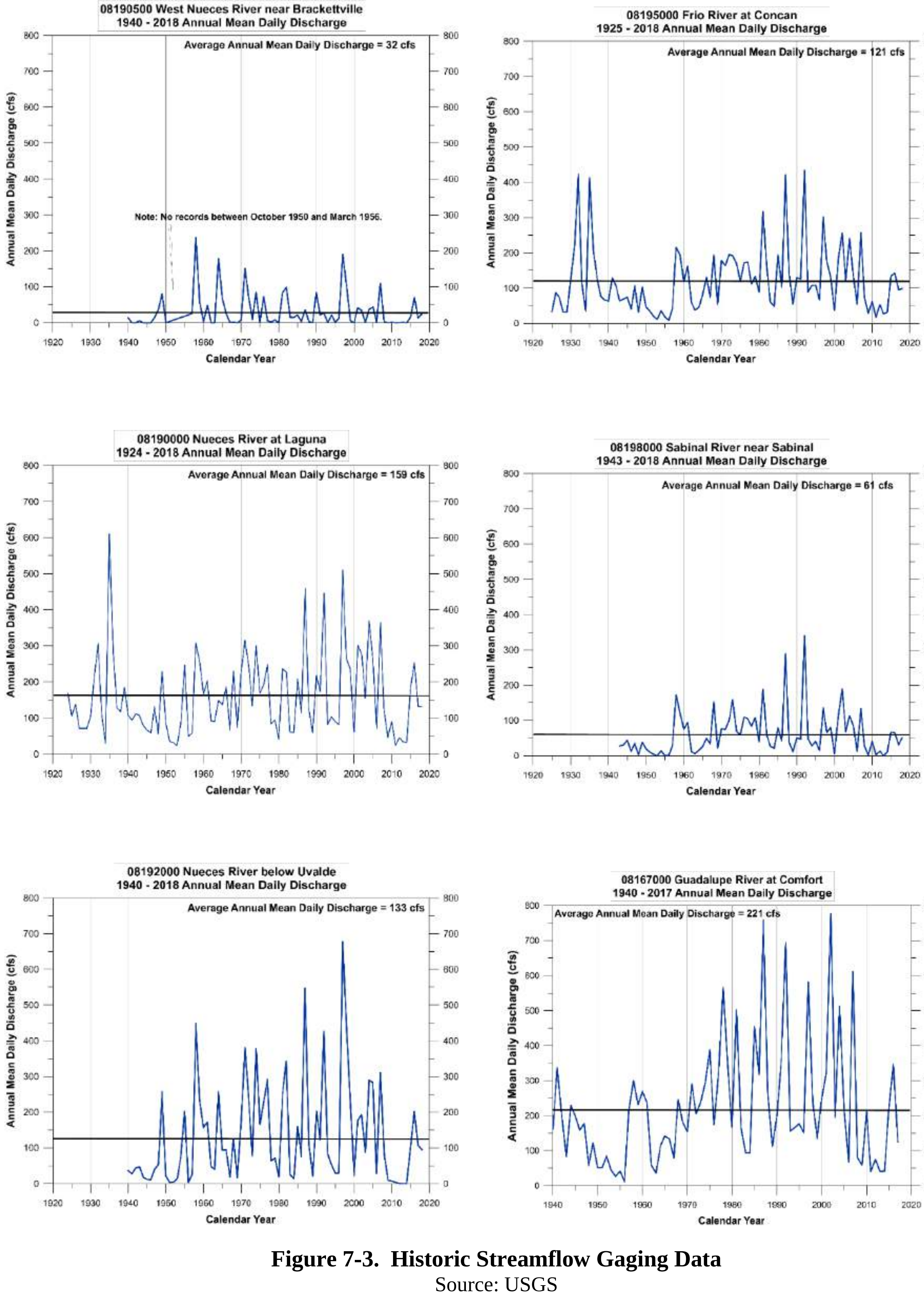


**Figure 7-3. Historic Streamflow Gaging Data**
Source: USGS

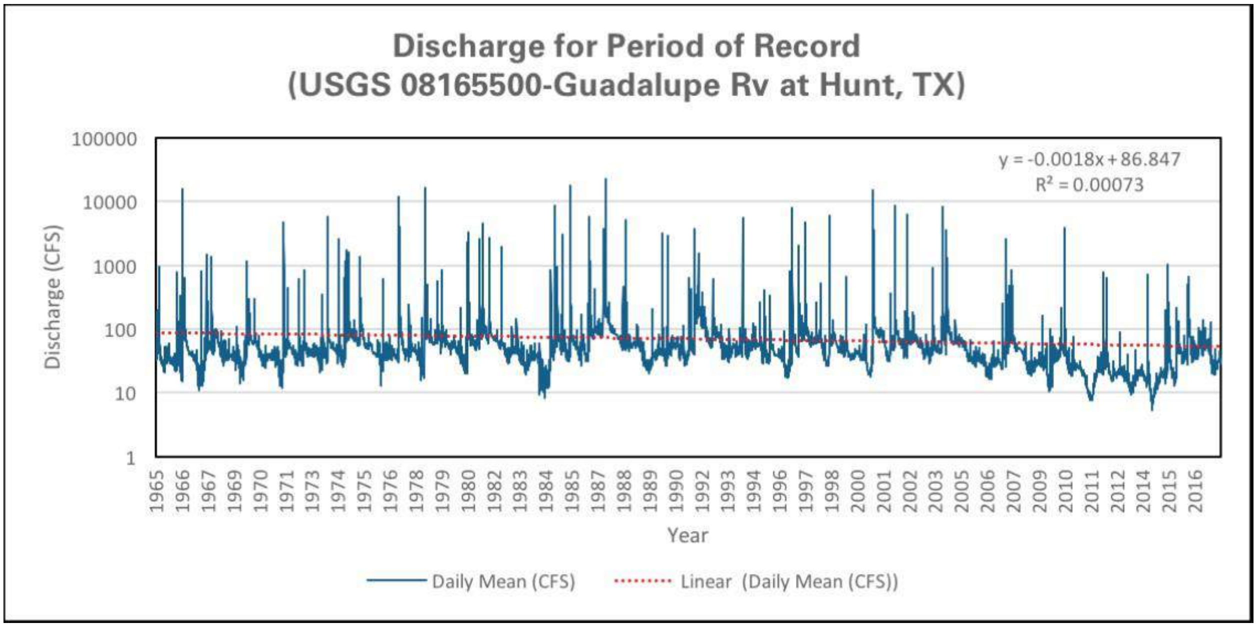


**Figure 7-4. Guadalupe River at Hunt Discharge (2000-2017).**
Source: Meadows Center, 2019.

### 7.1.3 Spring Discharge Indicator

Historic spring flow at USGS station 0846300 – Las Moras Springs at Brackettville - is available for years 1895 through 2014. These data are shown on Figure 7-5. The available data are instantaneous discharge measurements which do not necessarily occur on a regularly scheduled interval. Spring discharge has dropped below five cfs numerous times since 1952 (1953, 1956, 1963, 1964, 1966, 1967, 1969, 1971, 1976, 1978, 1980, 1989, 1995, 1996, 2000, 2006, 2011, 2012 and 2014). The periods with flow less than 5 cfs typically lasted for up to 3 months. The only exception is a ten-month period between July 2012 and May 2013. A few zero measurements have also occurred (1964, 1967, 1971 and 1996). Most of these occurrences appear to have lasted less than six weeks.

San Felipe Springs discharge data were not used because the construction of Lake Amistad in 1968 permanently affected the spring discharge measurements and therefore comparison between the current drought and the DOR would be difficult. Flow at the springs has been greater than five cfs since October, 2014.

It is uncertain how much of the low flow at Las Moras can be attributed to the anthropological impacts on drought indicators, such as increased groundwater pumping due to drought conditions and increased demands since the 1950s.

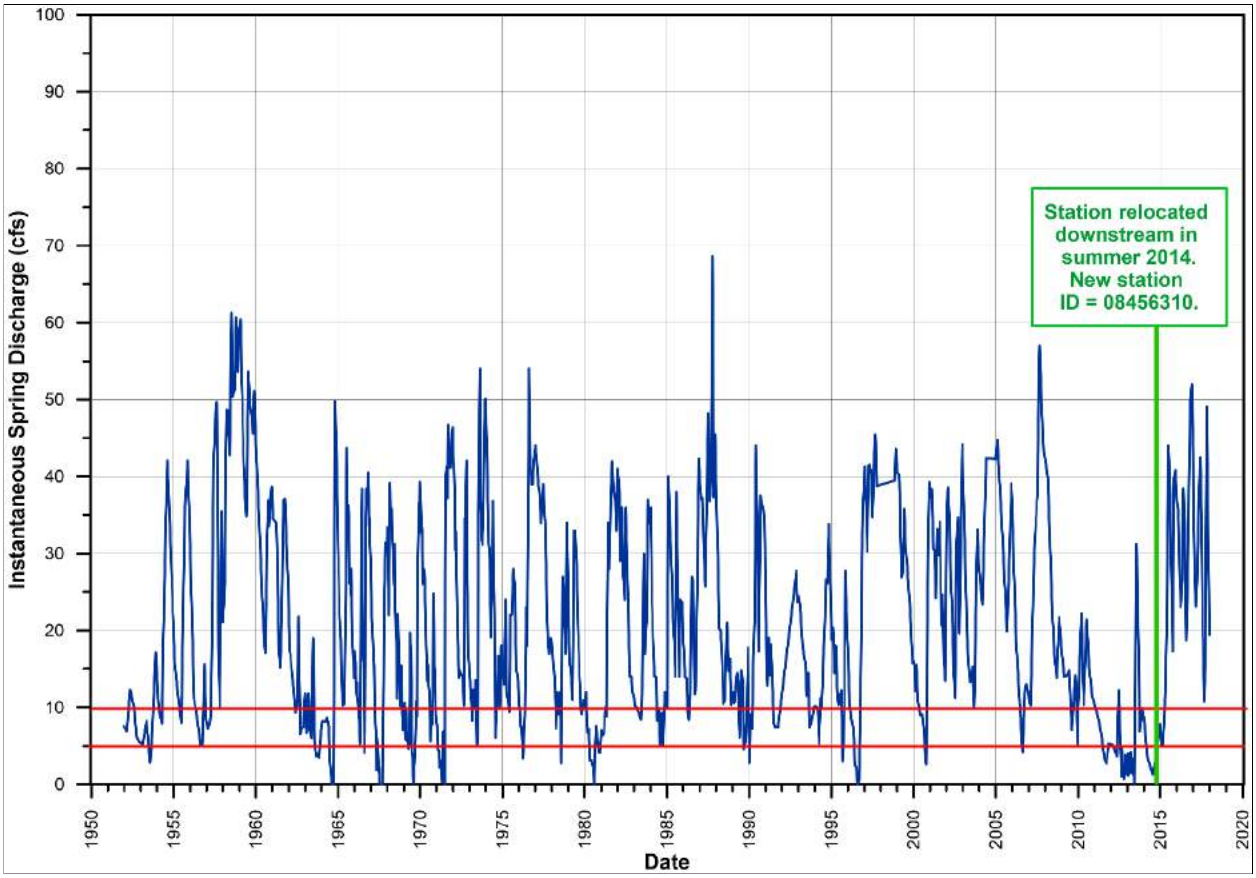


**Figure 7-5. Historic Discharge Measurements at Las Moras Springs**
Source: U.S. Geological Survey

### 7.1.4 Groundwater Level Indicator

Figure 7-6 and Figure 7-7 compare daily water level data from existing real-time monitoring wells with daily precipitation data from nearby NWS Cooperative Weather Stations to illustrate aquifer response to precipitation events. Figure 7-6 represents a well in the Edwards-Trinity (Plateau) Aquifer in Val Verde County. The data suggests that response time in the aquifer is quite rapid and occurs within a few days. Note that the water levels in the aquifer remain relatively constant, which suggests that there is not much competition for groundwater near this location. The recent severe drought does not appear to have affected water levels significantly at this location.

Figure 7-7 shows a well completed in the Trinity Aquifer in Real County near Leakey, Texas. The data suggests that response time in the aquifer is quite rapid and occurs within a few days. Total water level decline in the well is over 80 feet in a span of thirteen years. This is likely due to both drought conditions and population growth which both contribute to increased pumping.

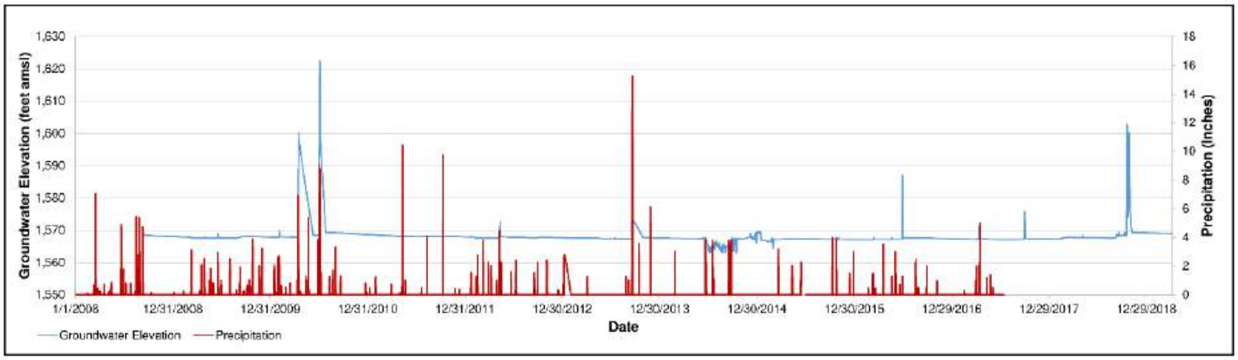


**Figure 7-6. Daily Groundwater Elevation and Daily Precipitation, Edwards-Trinity (Plateau), Val Verde County**

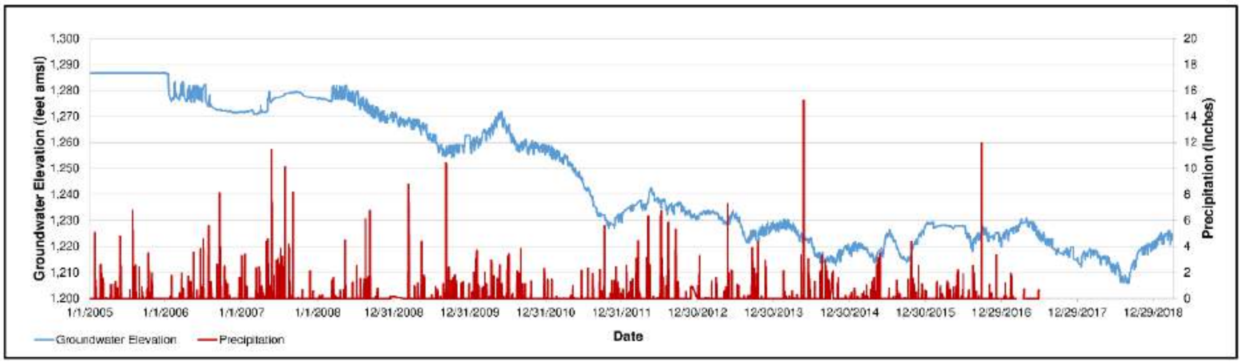


**Figure 7-7. Daily Groundwater Elevation and Daily Precipitation, Trinity Aquifer, Real County**

### 7.1.5 Plateau Region Drought of Record

For this planning cycle, the drought of the 1950s is declared the Drought of Record.

The catalyst for the recent drought can be attributed primarily to rainfall deficit (meteorological drought). The hydrological drought that has occurred because of rainfall deficit is evident in the decrease in stream flow and spring discharge data that has been presented. However, the greatest unknown factor that these data collectively point to is the impact that can be attributed to anthropological factors.

The hydrological drought (impact on surface waters and groundwater) is a result of both meteorological and socioeconomic drought. To reiterate, socioeconomic drought occurs when demand exceeds supply due to a weather-related deficit. Typically, demand for a product increases with population growth and per capita consumptions. Supply increases due to efficiency technology and the construction of new water projects. If both are increasing, the rate of change between supply and demand is the key. However, when demand exceeds supply, vulnerability is magnified by water shortages during drought.

In future planning cycles, it would be interesting to attempt to quantify how much anthropological factors exacerbate drought severity. Suggested areas of investigation include: base flow studies, sub-watershed scale water balance calculations, rainfall deficit quantification, and historical pumping.

# 7.2 CURRENT DROUGHT PREPARATIONS AND RESPONSE

As mandated by 31 TAC 357.42(a)&(b), this section of the RWP summarizes and assesses all preparations and drought contingency plans that have been adopted by municipalities and GCDs within the Plateau Region. The summary includes what specific triggers are used to determine the onset of each defined drought stage and the associated response actions that have been developed by local entities to decrease water demand during the particular drought stage.

Because of the range of conditions that affected the more than 4,000 water utilities throughout the State in 1997, the Texas Legislature directed the TCEQ to adopt rules establishing common drought plan requirements for water suppliers. As a result, TCEQ requires all wholesale public water providers, retail public water suppliers serving 3,300 connections or more, and irrigation districts to submit drought contingency plans (DCPs). In addition, many Groundwater Conservation Districts also have DCPs that provide education and voluntary action recommendations.

Wholesale water providers and retail public water suppliers serving less than 3,300 connections are now required to prepare and administer DCPs no later than May 1, 2014. Plans are required to be made available for inspection upon request. Guidelines as to what should be included in each drought contingency plan can be found on TCEQ's website. at the following link: http://www.tceq.texas.gov/permitting/water_rights/contingency.html/#contents

DCPs are intended to establish criteria to identify when water supplies may be threatened and the actions that should be taken to ensure these potential threats are minimized. A common feature of drought contingency plans is a structure that allows increasingly stringent drought response measures to be implemented in successive stages as water supply decreases and water demand increases. This measured or gradual approach allows for timely and appropriate action as a water shortage develops. The onset and termination of each implementation stage should be defined by specific "triggering" criteria. Triggering criteria are intended to ensure that: 1) timely action is taken in response to a developing situation, and 2) the response is appropriate to the level of severity of the situation. Each water-supply entity is responsible for establishing its own DCP that includes appropriate triggering criteria and responses.

Figure 7-1 illustrates that drought conditions during this current planning period (2016-2020) were less severe than during the previous planning period (2011-2015). As a result, water utilities and conservation districts implemented less stringent measures during this recent period. Most entities declared no more than a low drought condition with voluntary restrictions throughout the warmer/dryer part of the year, and escalating to moderate drought declarations during the dryer than normal summer months of 2018. The Bandera County River Authority and Groundwater District did resort to a severe declaration from December 2019 through January 2020, but is currently back to a moderate condition.

## 7.2.1 Drought Response Triggers

Drought response triggers should be specific to each water supplier and should be based on an assessment of the water user's vulnerability. In some cases, it may be more appropriate to establish triggers based on a supply source volumetric indicator such as a lake surface elevation or an aquifer static water level. Similarly, triggers might be based on supply levels remaining in an elevated or ground storage tank within the water distribution system; this is not a recommended approach, as the warning of supply depletion would be only three to four days. Triggers based on demand levels can also be effective, if the demands are very closely and frequently monitored. Whichever method is employed, trigger criteria should be defined on well-established relationships between the benchmark and historical experience. If historical observations have not been made, then common sense must prevail until such time that more specific data can be presented.

### 7.2.2 Surface Water Triggers

Surface water sources are among the first reliable indicators of the onset of hydrologic drought. Diminished spring discharge and stream flow, for example, can be monitored daily by city, county, and state agencies. Of interest, however, are the levels to which spring discharge and stream flow are reduced before the onset of drought is declared and appropriate response measures are initiated in the region. Cities that rely exclusively on spring flow for municipal water are particularly vulnerable to drought-induced reductions in discharge, especially if alternative sources of supply have not been developed to make up potential shortfalls created by lower discharge. As an operating definition of hydrologic drought, it is recommended that reductions of spring discharge between 25 percent and 33 percent be considered effective hydrologic drought triggers in the Plateau Region.

### 7.2.3 Groundwater Triggers

Groundwater triggers that indicate the onset of drought are not as easily identified as factors related to surface-water systems. This is attributable to (1) the rapid response of stream discharge and reservoir storage to short-term changes in climatic conditions within a region and within adjoining areas where surface drainage originates, and (2) the typically slower response of groundwater systems to recharge processes. Although climatic conditions over a period of one or two years might have a significant impact on the availability of surface water, aquifers of the same area might not show comparable levels of response for much longer periods of time, depending on the location and size of recharge areas in a basin, the distribution of precipitation over recharge areas, the amount of recharge, and the extent to which aquifers are developed and exploited by major users of groundwater. It is recognized, however, that karstic formations such as the Edwards-Trinity (Plateau) may produce rapid recharge rates in aquifers.

Except for the Trinity Aquifer of Bandera and Kerr Counties, all other aquifers in the rural counties are unlikely to experience significant water-level declines, based on comparisons between projected water demand, aquifer recharge and storage. In these areas, water levels are expected to remain constant or relatively constant over the 50-year planning period (see Figure 7-6). Observation wells in major recharge areas and in areas adjacent to municipal well fields in the rural counties might provide a sufficient number of points to monitor water levels, provided that water-level measurements are made on a regular basis for long periods of time. Water levels below specified elevations for a pre-determined period might be interpreted to be reasonable groundwater indicators of drought conditions in any basin.

Basins that do not receive sufficient recharge to offset natural discharge and pumpage may be depleted of groundwater (e.g., mined). This is especially the case with the Trinity Aquifer of Bandera and Kerr Counties. The rate and extent of groundwater mining in any area are related to the timeframe and the extent to which withdrawals exceed recharge. In such basins, water levels may fall over long periods of time, eventually reaching a point at which the cost of lifting water to the surface becomes an economical concern. Thus, water levels in such areas may not be a satisfactory drought trigger. Instead, communities might consider the rate at which water levels decline in response to increased demand as a sufficient indicator of drought. Entities that utilize groundwater triggers include: Bandera, Rocksprings, Ingram, Loma Vista Water Supply, Brackettville and Fort Clark Springs MUD.

### 7.2.4 System Capacity Triggers

Because of the above described problems with using water levels as drought-condition indicators, several municipal water-supply entities in the Plateau Region that rely on groundwater generally establish drought-condition triggers based on levels of demand that exceed a percentage of the systems production capacity. Rocksprings, Ingram (Aqua Texas), Loma Vista Water System, Camp Wood, City of Del Rio and City of Kerrville utilize drought triggers that consider demand and system capacity components.

### 7.2.5 Municipal and Wholesale Water Provider Drought Contingency Plans

The TCEQ requires all retail public water suppliers serving 3,300 connections or more and wholesale public water providers to submit a drought contingency plan to prepare and respond to water shortages. The amended *Title 30, Texas Administrative Code, Chapter 288* became effective on December 6, 2012 addressing TCEQ's guidelines and plan requirements. The forms for wholesale public water providers, retail public water suppliers and irrigation districts are available at:

https://www.tceq.texas.gov/permitting/water_rights/wr_technical-resources/contingency.htmlDrought contingency plans for municipal uses by public water suppliers must document coordination with the regional water planning groups to ensure consistency with the regional water plans. The following entities have prepared drought contingency plans:

- City of Bandera
- City of Kerrville
- City of Rocksprings
- City of Camp Wood
- Wiedenfeld Water Works
- City of Ingram (Aqua Texas)
- Loma Vista Water System (Aqua Texas)
- City of Brackettville
- Fort Clark Springs Municipal Water District
- City of Del Rio (Wholesale Water Provider)
- City of Leakey

A list of entities, their supply source, specific triggers and actions, for each drought stage is provided in Table 7-1. A DCP was not provided to the Regional Planning Group by Laughlin AFB.

**Table 7-1. Municipal Mandated Drought Triggers and Actions**

| Water Supply Entity | Water Supply Source | Drought Trigger | Drought Stage and Response | | | | |
|---|---|---|---|---|---|---|---|
| | | | Mild | Moderate | Severe | Critical | Emergency |
| City of Bandera | Trinity | Multi-stage drop in water levels in the Dallas Street Municipal Well. | Voluntary conservation May 1 - Sept 30. | Depth to water between 516 and 531 feet. | Depth to water between 532 and 546 feet. | Depth to water between 547 and 566 feet. | Depth to water below 567 feet, or system failure. |
| | | | Voluntary usage reduction. | Reduce demand by 20%. | Reduce demand by 35%. | Reduce demand by 50%. | Reduce demand by 90%. |
| City of Rocksprings | Edwards-Trinity (Plateau) | Based on a comparison of the daily water demand to the static water level of the Sharp Well (55-63-803). | Depth to water reaches 429 feet for 3 consecutive days. | Depth to water reaches 445 feet for 3 consecutive days. | Depth to water reaches 461 feet for 3 consecutive days. | N/A | Depth to water reaches 477 feet for 3 consecutive days. |
| | | | Reduce demand by 10%. | Reduce demand by 20%. | Reduce demand by 30%. | N/A | Notify state emergency response officials. |
| City of Kerrville | Upper Guadalupe River and Trinity Aquifer | Based on a comparison of demand and system's safe operating capacity, which is the maximum amount of water the city can safely deliver to the distribution system. Safe capacity is calculated using the following sources: 1) the WTP, 2) ASR, 3) City wells and 4) other potable sources. | Seven-day average demand exceeds 65% of the system's safe operating capacity. | Seven-day average demand exceeds 75% of the system's safe operating capacity. | Seven-day average demand exceeds 85% of the system's safe operating capacity. | Seven-day average demand exceeds 95% of the system's safe operating capacity. | Seven-day average demand exceeds 100% of the system's safe operating capacity. |
| | | | Implement landscape watering schedule; no operation of fountains/ponds. | Landscape watering with hand held hose only; non-essential water use prohibited. | No application for new, additional, or expanded water service connections. | Landscape watering with potable water prohibited. | Allocation of available water; notify state emergency response officials. |
| City of Ingram (Aqua Texas) | Trinity | Demand-based triggers include the following components: 1) percent of water treatment capacity, 2) total daily demand as percent of pumping capacity, 3) storage capacity (tank level) and 4) well pump run time. | Voluntary conservation late Spring and Summer. | 75%, tank level within 4 feet of low-level lockout, 16 hours. | 85%, tank level within 3 feet of low-level lockout, 20 hours. | 95%, tank level reaches low-level lockout, 22 hours. | |
| | | | Reduce demand by 5%. | Reduce demand by 10%. | Reduce demand by 20%. | Reduce demand by 40%. | N/A |

**Table 7-1. (Continued) Municipal Mandated Drought Triggers and Actions**

| Water Supply Entity | Water Supply Source | Drought Trigger | Drought Stage and Response | | | | |
|---|---|---|---|---|---|---|---|
| | | | Mild | Moderate | Severe | Critical | Emergency |
| City of Ingram (Aqua Texas) | Purchased supply | Supply-based triggers are utilized for systems Aqua provides water from either a district, authority or wholesale supplier. | Upon notification by district, authority, or wholesale supplier, Aqua may implement equivalent stage and restrictions. | | | | |
| City of Brackettville | Edwards-Trinity (Plateau) | Multi-stage drop in water levels in city well. | Depth to water reaches 50 feet or less while pumping (based on 10-day moving average). | Depth to water reaches 65 feet or less while pumping (based on 10-day moving average). | Depth to water reaches 85 feet or less while pumping (based on 10-day moving average). | Depth to water reaches 110 feet or less while pumping (based on 10-day moving average). | |
| | | | Reduce demand by 10%. | Reduce demand by 15%. | Reduce demand by 25%. | N/A | Notify state emergency response officials. |
| Fort Clark Springs Municipal Water District | Edwards-Trinity (Plateau) | Multi-stage drop in water levels in municipal well. | Depth to water reaches 25 feet or less while pumping (based on 10-day moving average). | Depth to water reaches 35 feet or less while pumping (based on 10-day moving average). | Depth to water reaches 50 feet or less while pumping (based on 10-day moving average). | Depth to water reaches 75 feet or less while pumping (based on 10-day moving average). | |
| | | | Voluntary - reduce demand by 10%. | Reduce demand by 15%. | Reduce demand by 25%. | N/A | Notify state emergency response officials. |
| City of Camp Wood | Spring flow from Edwards-Trinity (Plateau) | Base on system capacity limits. | Low distribution pressure for more than 6 hours. | Demand exceeds 70% of safe operating capacity (based on seven-day average). | Demand exceeds 80% of safe operating capacity (based on seven-day average). | Demand exceeds 90% of safe operating capacity (based on seven-day average). | Major system failures or supply contamination. |
| | | | Voluntary - reduce demand by 6%. | Reduce demand by 6%. | Reduce demand by 11%. | Reduce demand by 20%. | Reduce demand by 30%. |
| City of Leakey | Frio River Alluvium | | NO DCP | | | | |

**Table 7-1. (Continued) Municipal Mandated Drought Triggers and Actions**

| Water Supply Entity | Water Supply Source | Drought Trigger | Drought Stage and Response | | | | |
|---|---|---|---|---|---|---|---|
| | | | Mild | Moderate | Severe | Critical | Emergency |
| City of Del Rio | San Felipe Springs Edwards-Trinity (Plateau) | Water levels in Bedell Street Storage Reservoirs are less than a designated depth; San Felipe Spring flow drops below a specific flow rate. | Water levels are less than 100 % full; San Felipe Spring flow is less than 40 mgd. | Water levels are less than 30 feet; San Felipe Spring flow is less than 25 mgd. | Water levels are less than 25 feet; San Felipe Spring flow is less than 20 mgd. | Water levels are less than 20 feet; San Felipe Spring flow is less than 15 mgd. | Water levels are less than 15 feet; San Felipe Spring flow is less than 10 mgd. |
| | | | Reduce demand to 95% of the 30-day average prior to initiation. | Reduce demand to 90% of the 30-day average prior to initiation. | Reduce demand to 80% of the 30-day average prior to initiation. | Reduce demand to 70% of the 30-day average prior to initiation. | Notify state emergency response officials. |
| Wiedenfeld Water Works | Trinity (HGCD MW-7, HGCD MW-11, HGCD MW-ISD, Cedar Springs well, 169 Greenwood well, CCGCD Langford, and EAA J17 well). | Cumulative point system based upon water levels and daily pumping time (in minutes) in 7 different wells. Two if the wells monitor both upper and lower Trinity water levels. | | 3 points | 6 points | 8 points | |
| | | | N/A | Reduce non-essential & outdoor use by 50% of summer water use. | Elimination of non-essential & outdoor use. | Allocation of available water. | N/A |
| Loma Vista Water Supply (Aqua Texas) | Trinity | Demand-based triggers include the following components: 1) percent of water treatment capacity, 2) total daily demand as percent of pumping capacity, 3) storage capacity (tank level) and 4) well pump run time. | Voluntary conservation late Spring and Summer. | 75%, tank level within 4 feet of low-level lock out, 16 hours. | 85%, tank level within 3 feet of low-level lock out, 20 hours. | 95%, tank level reaches low-level lock out, 22 hours. | |
| | | | Reduce demand by 5%. | Reduce demand by 10%. | Reduce demand by 20%. | Reduce demand by 40%. | N/A |
| | Purchased supply | Supply-based triggers are utilized for systems Aqua provides water from either a district, authority or wholesale supplier. | Upon notification by district, authority, or wholesale supplier, Aqua may implement equivalent stage and restrictions. | | | | |

### 7.2.6 Groundwater Conservation District Drought Contingency Plans

A discussion of the creation and the goals of the four Groundwater Conservation Districts (GCDs) formed in the Plateau Region are discussed in more detail in Chapter 5, Section 5.3.7. This section will focus on summarizing drought management by the Districts.

Four districts are currently in operation within the planning region:

Bandera County River Authority and Groundwater District (http://bcragd.org)

Headwaters Groundwater Conservation District (Kerr County) (http://hgcd.org)

Kinney County Groundwater Conservation District (http://kinneycogcd-state-tx.us)

Real-Edwards Conservation and Reclamation District (http://recrd.org)

Groundwater Conservation Districts are required to define management goals that specifically address drought conditions within their groundwater management plans. These are delineated via management objectives and performance standards. Drought Contingency Plans have also been adopted by three of the four GCDs in the Plateau region. Following are the District's drought management objectives.

#### 7.2.6.1 Bandera County River Authority and Groundwater District

**Management Objective 1** – Record the Palmer Drought Severity Index once at the first of the month and when drought conditions exist, implement to Drought Management Plan as adopted in April 2009.

**Management Objective 2** – Evaluate groundwater availability each year by monitoring water levels of the aquifer from at least six monitor wells with continuous recorders within Bandera County.

The District has implemented a drought management plan to aid in groundwater conservation and is designed to reduce pumpage of the aquifer during the different drought stages. The triggers and actions incorporated into the drought plan are summarized below. These five drought stages are mandated restrictions for permitted wells and recommended restrictions for exempt wells.

**Bandera County River Authority and Groundwater District**
**Drought Triggers and Actions**

| Stage & Description | 1 – Mild | 2 – Moderate | 3 – Severe | 4 – Extreme | 5 - Exceptional |
|---|---|---|---|---|---|
| Trigger | Stages are triggered by the U.S. Drought Monitor, but can be adjusted at the discretion of the District when aquifer levels, rainfall and river flow conditions warrant. | | | | |
| Conservation Goal (percent reduction in pumpage) | 10% | 20% | 30% | 40% | 50% |

### 7.2.6.2 Headwaters Groundwater Conservation District

**Management Objective** – Monitor drought conditions by reviewing aquifer data monthly and declaring drought stages based on the District's defined drought triggers.

The District has implemented a drought management plan to aid in groundwater conservation and is designed to reduce pumpage of the aquifer during the different drought stages. The triggers and actions incorporated into the drought plan are summarized below.

**Headwaters Groundwater Conservation District Drought Triggers and Actions**

| Stage & Description | 1 – Mild | 2 – Moderate | 3 – Severe | 4 – Extreme |
|---|---|---|---|---|
| Trigger | 1410 feet amsl | 1400 feet amsl | 1390 feet amsl | 1380 feet amsl |
| Conservation Goal (percent reduction in pumpage) | 10% | 20% | 30% | 40% |

The HGCD Drought Index Levels which are the average water level in 4 selected monitor wells (Stonehenge, HGCD MW #11 Middle Trinity, County Agriculture Barn, and HGCD MW # 7 Middle Trinity). The District will also monitor and consider the Palmer Drought Severity Index (PDSI) and the Guadalupe River Flow Rate at Kerrville in initiating drought stages and notices of impending drought or extremely dry conditions. Drought stages may be initiated at the discretion of the District depending on the ability of the City of Kerrville to draw surface water from the Guadalupe River.

These four drought stages invoke mandated restrictions for permitted wells and recommended restrictions for exempt wells.

### 7.2.6.3 Kinney County Groundwater Conservation District

Management Objective – Once a month, the District will download the latest drought information from the National Weather Service – Climate Prediction Center website. A report on the drought data obtained from the National Weather Service will be included in the regular monthly meeting agenda and retained in the meeting minutes kept at the District office.

### 7.2.6.4 Real-Edwards Conservation and Reclamation District

Management Objective – Curtailment of Groundwater Withdrawal. To accomplish this objective, the annual amount of groundwater permitted by the District for withdrawal from the portion of the aquifers located within the District may be curtailed during periods of extreme drought in the recharge zones of the aquifers or because of other conditions that cause significant declines in groundwater surface elevations. Such curtailment may be triggered by the District's Board of Directors based on the groundwater elevation measured in the District's monitoring well(s) and/or stream flow measurements along with other indices such as rainfall and soil moisture. District staff currently monitors three locations along the Frio River and its tributaries and two locations on the Nueces River. A weir box will be placed on Old Faithful Spring and measurements will be routinely taken at that location. The triggers and actions incorporated into the drought plan are summarized below.

**Real-Edwards Conservation and Reclamation District Drought Triggers and Actions**

| Stage & Description | 1 – Mild | 2 – Moderate | 3 – Severe | 4 – Extreme |
|---|---|---|---|---|
| Trigger | PDSI -1 or less | PDSI -2 or less | PDSI -3 or less | PDSI -4 or less |
| Conservation Goal (percent reduction in pumpage) | Voluntary | 10% | 20% | 30% |

The Palmer Drought Severity Index, which is an index based on regional meteorological and hydrological data such as rainfall, temperature and soil moisture content will be used as the primary triggering criteria for the initiation and termination of the drought plan.

The four drought stages are mandated restrictions for permitted wells during stages 2, 3, and 4 and recommended restrictions for exempt wells.

## 7.3 EXISTING AND POTENTIAL EMERGENCY INTERCONNECTS

According to Texas Statute §357.42(d),(e) regional water planning groups are to collect information on existing major water infrastructure facilities that may be used in the event of an emergency shortage of water. Pertinent information includes identifying the potential user(s) of the interconnect, the potential supplier(s), the estimated potential volume of supply that could be provided, and a general description of the facility. Texas Water Code §16.053(c) requires information regarding facility locations to remain confidential. This section provides general information regarding existing and potential emergency interconnects among water user groups within the Plateau Region.

The RWPG is required to gather information pertinent to major water infrastructure facilities that are currently or could potentially be utilized during emergency water shortages. Major water infrastructure facilities within the Plateau Region were identified through a survey process to better evaluate existing and potentially feasible emergency interconnects. There are no existing emergency interconnects. There are only two potential interconnects that have been identified within the Plateau Region in the current planning cycle, as shown below.

**Potential Emergency Interconnects to Major Water Facilities**

| Entity Providing Supply | Entity Receiving Supply |
|---|---|
| City of Kerrville | Cherokee Mobile Home Park |
| City of Del Rio | Laughlin AFB and the Landings at Laughlin |

## 7.4 EMERGENCY RESPONSES TO LOCAL DROUGHT CONDITIONS OR LOSS OF MUNICIPAL SUPPLY

Texas Statute §357.42(g) requires regional water planning groups to evaluate potential temporary emergency water supplies for all County-Other WUGs and municipalities with 2010 populations less than 7,500 that rely on a sole source of water. The purpose of this evaluation is to identify potential alternative water sources that may be considered for temporary emergency use in the event that the existing water supply sources become temporarily unavailable due to extreme hydrologic conditions such as emergency water right curtailment, unanticipated loss of reservoir conservation storage, or other localized drought impacts.

This section provides potential solutions that should act as a guide for municipal water users that are most vulnerable in the event of a loss of supply. Entities evaluated for emergency responses to local drought conditions or loss of municipal supply were assumed to have 180 days or less of remaining supply. This review was limited and did not require technical analyses or evaluations following in accordance with 31 TAC §357.34.

In the Plateau Region, there are seven municipal and County-Other WUGs that have a 2010 Census population of less than 7,500 and rely upon a sole source of water. Six of the sole source WUGs rely on groundwater, and one WUG relies on surface water (City of Camp Wood).

Potential emergency water supply sources that might be used by small sole-source municipal WUGs or County-Other WUGs include the following:

- New local groundwater well
- Emergency interconnect
- Use of other named local supply
- Trucked-in water delivery
- Brackish groundwater limited treatment
- Brackish groundwater desalination
- Release from upstream reservoir
- Curtailment of upstream and/or downstream water rights

Based upon personal communication with the WUGs within the Plateau Region, the addition of a new local groundwater well was identified for all entities as a potential emergency water supply source. The Bandera County FWSD #1 (Bandera county-other) would also consider the curtailment of proximal water rights, and the City of Bandera would also consider trucked-in water delivery as a feasible option under emergency conditions. The entities along with feasible potential emergency water supply options have been included in Table 7-2.

## Table 7-2. Emergency Responses to Local Drought Conditions

| Entity | | | | | | Implementation Requirements | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Water User Group Name** | **County** | **2019 Population Served by Water System (per TCEQ)** | **2019 Service Connections (per TCEQ)** | **2020 Population** | **2020 Demand (AF/year)** | **Drill additional groundwater wells** | **Brackish groundwater limited treatment** | **Brackish groundwater desalination** | **Emergency interconnect** | **Other named local supply** | **Trucked - in water** | **Type of infrastructure required** | **Entity providing supply** | **Other local entities required to participate** | **Emergency agreements already in place** |
| City of Bandera | Bandera | 3,19 | 1,060 | 1,875 | 342 | ▪ | | | ▪ | | ▪ | Well | City | | |
| City of Rocksprings | Edwards | 1,85 | 619 | 1,259 | 198 | ▪ | | | ▪ | | ▪ | Well | City | | |
| Ingram Water Supply | Kerr | 5,23 | 1,746 | 1,837 | 165 | ▪ | | | | | ▪ | Well | | | |
| City of Brackettville | Kinney | 2,42 | 835 | | | ▪ | | | | | ▪ | Well | | | |
| Fort Clark Springs MUD | Kinney | 1,20 | 989 | 1,259 | 618 | ▪ | | | | | ▪ | Well | | | |
| City of Camp Wood | Real | 1,35 | 450 | 747 | 143 | ▪ | | | ▪ | | ▪ | Well | City | | |
| Laughlin Air Force Base | Val | 4,01 | 495 | 1,767 | 1,018 | ▪ | | | ▪ | | ▪ | Well | City of Del Rio | | |
| **County Other** | | | | | | | | | | | | | | | |
| Bandera County FWSD 1 | Bandera | 1,04 | 348 | 679 | 141 | ▪ | | | ▪ | | ▪ | Well | District | | |
| Bandera River Ranch 1 | Bandera | 822 | 274 | 929 | 97 | ▪ | | | ▪ | | ▪ | Well | WSC | | |
| Barksdale WSC | Edwards | 249 | 83 | 264 | 29 | ▪ | | | | | ▪ | Well | | | |
| Center Point North Water System | Kerr | 237 | 79 | 255 | 22 | ▪ | | | | | ▪ | Well | | | |
| Center Point Taylor System | Kerr | 492 | 164 | 530 | 45 | ▪ | | | ▪ | | ▪ | Well | District | | |
| Center Point Wiedenfeld Works | Kerr | 168 | 56 | 161 | 14 | ▪ | | | ▪ | | ▪ | Piping | Aqua Texas | | |
| Cedar Springs MHP | Kerr | 144 | 48 | | | ▪ | | | ▪ | | ▪ | Piping | Ingram Oaks Park | | |
| Heritage Park Water System | Kerr | 87 | 29 | | | ▪ | | | ▪ | | ▪ | Piping | Aqua Texas | | |
| Hills & Dales Wiedenfeld Water Works | Kerr | 222 | 74 | 202 | 17 | ▪ | | | ▪ | | ▪ | Piping | Aqua Texas | | |
| Kerrville South Water | Kerr | | | 2,851 | 341 | ▪ | | | | | ▪ | Well | Aqua Texas | | |
| Oak Ridge Estates Water System | Kerr | 132 | 44 | | | ▪ | | | | | ▪ | Well | | | |
| Southern Hills Wiedenfeld Water | Kerr | 891 | 297 | | | ▪ | | | ▪ | | ▪ | Piping | Aqua Texas | | |
| Verde Park Estates Wiedenfeld Water | Kerr | 210 | 70 | 178 | 15 | ▪ | | | ▪ | | ▪ | Piping | Elmwood MHP | | |
| Vista Hills | Kerr | 42 | 14 | | | ▪ | | | | | ▪ | Well | | | |
| Westwood Water System | Kerr | 390 | 130 | 269 | 23 | ▪ | | | | | ▪ | Well | | | |
| Windwood Oaks Water System | Kerr | 57 | 19 | | | ▪ | | | ▪ | | ▪ | Piping | The Woods Sub. | | |
| Woodhaven Mobile Home Park | Kerr | 96 | 32 | | | ▪ | | | ▪ | | ▪ | Piping | Aqua Texas | | |
| Flying L Ranch PUD | Bandera | 903 | 301 | | | ▪ | | | | | ▪ | Well | | | |
| City of Leakey | Real | 1,74 | 582 | 1,415 | 193 | ▪ | | | ▪ | | ▪ | System | City | | |
| Medina WSC | Bandera | 810 | 270 | 895 | 93 | ▪ | | | | | ▪ | Well | | | |

To qualify for emergency funds that are earmarked for emergency groundwater supply wells, entities must have a drought plan in place and be currently listed as an entity that is limiting water use to avoid shortages. This list is updated weekly by the TCEQ's Drinking Water Technical Review and Oversight Team and can be found at: https://www.tceq.texas.gov/drinkingwater/trot/droughtw.html.

There is some assistance available through the Texas Department of Agriculture and the Texas Water Development Board. There are requirements, deadlines, and a specific application process. Contact the TWDB by e-mail, <Financial_Assistance@twdb.texas.gov>, or call 512-463-7853. Contact the Texas Department of Agriculture, Community Development Block Grants, or call 512-936-7891. Funding is limited.

Other TCEQ Guidance resources:

Emergency and Temporary Use of Wells for Public Water Supplies (RG-485)

https://www.tceq.texas.gov/assets/public/comm_exec/pubs/rg/rg-485.pdf

Questions from the TCEQ's Workshops on Drought Emergency Planning: Answers to Help Drinking-Water Systems Prepare for Emergencies http://www.rgrwa.org/images/pdfs/workshop-questions071312.pdf

Video: Workshop on Drought Emergency Planning for Public Water Systems in Texas

http://www.youtube.com/watch?v=BdlF9CEcGPI&feature=plcp&context=C34378a7UDOEgsToPDskJNYWXf5I3pKq8tW9pkVqQU

# 7.5 REGION-SPECIFIC DROUGHT RESPONSE RECOMMENDATIONS AND MODEL DROUGHT CONTINGENCY PLANS

As mandated by TAC 357.42(c)&(i), the RWPGs shall develop drought response recommendations regarding the management of existing groundwater and surface water sources in the RWPA designated in accordance with §357.32. The RWPGs shall make drought preparation and response recommendations regarding the development of, content contained within, and implementation of local drought contingency plans. The RWPGs shall develop region-specific model drought contingency plans that shall be presented in the RWP which shall be consistent with 30 TAC Chapter 288 requirements.

Regional drought planning expands the conceptualization and application of drought planning by specific entities to encompass the entire Plateau Region. The approach utilized in developing a region-specific drought plan will consider the following: 1) all regional groundwater and surface water sources, 2) current drought plans that are being utilized by user entities within the region, and 3) current monitoring stations within the region that have evolved since the previous planning cycle.

The goals of this approach are: 1) to gain a comprehensive view of what particular resources are being monitored by entities within the region, 2) determine which resources are not being monitored, 3) determine which users do not fall under the umbrella of existing DCPs, 3) identify potential monitoring stations with publicly accessible real-time data that currently exist, and 4) determine how these data can be utilized for the water user groups that do are not subject to existing DCPs, and ultimately 5) development of a regional model drought contingency plan.

As discussed in Section 7.2, several GCDs, towns/cities and various public supply systems have written drought management / contingency plans and have provided them for inclusion in the *Regional Plan.*

## 7.5.1 Regional Groundwater Resources and Monitoring

The six groundwater resources identified within the Plateau Region and their contribution to total regional groundwater supply are:

- Edwards-Trinity (Plateau) (61%)
- Trinity (29%)
- Edwards (BFZ) (less than 7%)
- Austin Chalk (less than 3%)
- Frio River Alluvium (less than 1%)
- Nueces River Alluvium (less than 1%)

The aquifer contribution to the regional supply calculation is based upon historical pumping averages for years 2012 through 2016.

Current drought contingency plans were detailed in Section 7.3.5 and Table 7-1. State well numbers of the monitoring wells used by municipal entities that utilize groundwater triggers are shown in Table 7-3. A map of these locations is included as Figure 7-8.

**Table 7-3. Current Municipal Trigger Monitoring Wells**

| Water Supply Entity | County | Water Supply Source | Well ID |
|---|---|---|---|
| City of Rocksprings | Edwards | Edwards-Trinity (Plateau) | 55-63-803 Sharp Well |
| City of Bandera | Bandera | Trinity | 69-24-102 Dallas Street Well |
| Fort Clark Springs MUD | Kinney | Edwards-Trinity (Plateau) | 70-45-504 Well #1 |
| City of Brackettville | Kinney | Edwards-Trinity (Plateau) | 70-45-601 Well #1 |

Previous *Plateau Regional Water Plans* identified wells that could potentially be used for drought monitoring.

Table **7-4** provides a selection of groundwater trigger wells included in the *2011 and 2016 Plans*, with an updated status and history of measurements.

**Table 7-4. RWP Groundwater Trigger Monitoring Wells**

| Aquifer | County | Well ID | Monitoring Agency | Period of Record and Measurement Count | Current Status |
|---|---|---|---|---|---|
| Trinity | Bandera | 69-16-902 (Purple Sage Well) | Unknown | 1 measurement | Inactive - Replaced by BCRAGCD network |
| Edwards-Trinity | Edwards | 55-63-803 (City of Rocksprings) | TWDB | 1953 - 2019 (39 measurements) | Active |
| Trinity | Kerr | 56-63-916 | HGCD (Donna Drive well) | 1977 - 2019 (340 measurements) | Currently active in HGCD network |
| Edwards-Trinity | Kerr | 56-53-304 | Not being monitored | 1966 – 1997 (16 measurements) | Inactive - Replaced by HGCD network |
| Edwards-Trinity | Kinney | Ring Well | Unknown | Unknown | Unknown |
| Edwards (BFZ) | Kinney | 70-38-902 | TWDB | 1973 – 2013 (113 measurements) | Active |
| Austin Chalk | Kinney | 70-45-404 | TWDB | 1937 – 2008 (91 measurements) | Unknown |
| Frio River Alluvium | Real | 69-18-302 (City of Leakey) | Unknown | 2 measurements on WIID | Unknown |
| Edwards-Trinity | Val Verde | Old Y Well | City of Del Rio | 2013 - 2014 | Inactive |
| Edwards-Trinity | Val Verde | Agarita Well | City of Del Rio | Unknown | Inactive |
| Edwards-Trinity | Val Verde | Tiera del Largo Well | City of Del Rio | Unknown | Inactive |

The TWDB has a component of their website called Water Data for Texas (similar to the U.S. Geological Survey's NWIS server) that is a collective of real-time monitoring data from both groundwater wells and reservoir stage-capacity gages. Table 7-5 is a summary of the 24 groundwater wells located within Region J. These locations are included on Figure 7-8.

**Table 7-5. Currently Active (Real-Time) Monitoring Wells**
Source: Water Data for Texas

| County | State Well Number | Aquifer | Aquifer Type | Entity/Cooperator | Data Transmission | Start Date Period of Record |
|---|---|---|---|---|---|---|
| Bandera | 6912206 | Edwards-Trinity (Plateau) | Unconfined | U.S. Geological Survey | Satellite | 11/6/2012 |
| Bandera | 6924225 | Trinity | Confined | Texas Water Development Board | Satellite | 8/11/2008 |
| Kerr | 5643901 | Trinity | Confined | Headwaters GCD | Satellite | 5/6/2009 |
| Kerr | 5652704 | Trinity | Confined | Headwaters GCD | Satellite | 12/9/2010 |
| Kerr | 5654106 | Trinity | Confined | Headwaters GCD | Satellite | 11/29/2010 |
| Kerr | 5654405 | Trinity | Confined | Texas Water Development Board | Satellite | 8/10/2004 |
| Kerr | 5655805 | Trinity | Confined | Headwaters GCD | Satellite | 3/15/2007 |
| Kerr | 5659201 | Trinity | Confined | Headwaters GCD | Satellite | 5/6/2009 |
| Kerr | 5661101 | Trinity | Confined | Headwaters GCD | Satellite | 3/13/2007 |
| Kerr | 5663922 | Trinity | Confined | Texas Water Development Board | Satellite | 12/5/2002 |
| Kerr | 5663923 | Trinity | Confined | Headwaters GCD | Satellite | 7/5/2010 |
| Kerr | 5663924 | Trinity | Confined | Headwaters GCD | Satellite | 7/12/2010 |
| Kerr | 5664301 | Trinity | Confined | Headwaters GCD | Satellite | 3/20/2013 |
| Kerr | 5664302 | Edwards-Trinity (Plateau) | Unconfined | Headwaters GCD | Satellite | 3/20/2013 |
| Kerr | 5757805 | Trinity | Confined | Headwaters GCD | Satellite | 7/16/2008 |
| Kerr | 6801703 | Trinity | Confined | Headwaters GCD | Satellite | 10/5/2009 |
| Kerr | 6801704 | Trinity | Confined | Headwaters GCD | Satellite | 5/14/2009 |
| Kerr | 6904503 | Trinity | Confined | Headwaters GCD | Satellite | 10/6/2009 |
| Kerr | 6907107 | Trinity | Confined | Headwaters GCD | Satellite | 5/8/2008 |
| Kerr | 6908304 | Trinity | Confined | Headwaters GCD | Satellite | 3/2/2008 |
| Kerr | 6908305 | Trinity | Confined | Headwaters GCD | Satellite | 3/2/2008 |
| Real | 6919401 | Trinity | Confined | Texas Water Development Board | Satellite | 2/15/1993 |
| Val Verde | 5463401 | Edwards-Trinity (Plateau) | Unconfined | Texas Water Development Board | Satellite | 9/9/2008 |
| Val Verde | 7001707 | Edwards-Trinity (Plateau) | Unconfined | Texas Water Development Board | Data Card | 8/6/2007 |

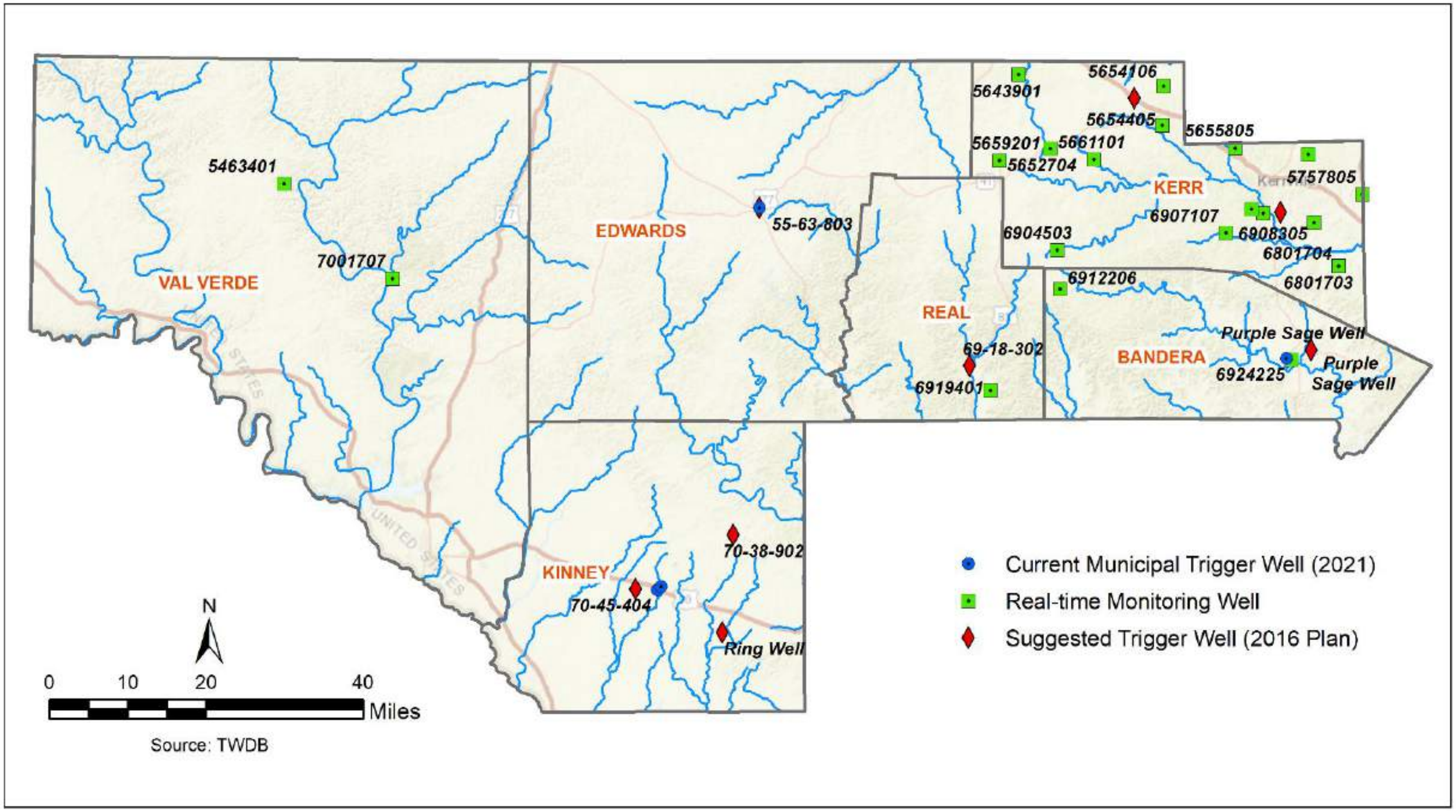


**Figure 7-8. Regional Monitoring and Trigger Wells**

### 7.5.2 Regional Surface Water Resources and Monitoring

The five surface water basins identified within the Plateau Region and their contribution to total regional surface water supply are:

- Rio Grande Basin (84%)
- Nueces River Basin (9%)
- Guadalupe River Basin (6%)
- Colorado River Basin (<1%)
- San Antonio River Basin (<1%)

The basin contribution to the regional supply calculation is based upon the WAM Run 3 (Full Authorization) availability numbers. Surface water features that are actively being monitored by an entity within the Plateau Region are detailed in Table 7-6.

**Table 7-6. Surface Water Sources Currently Monitored by Regional Entities**
Source: Plateau Region Drought Contingency Plans

| Entity | County | Water Supply Source | Station ID | Measuring Agency | Period of Record | Current Measurement Frequency |
|---|---|---|---|---|---|---|
| City of Del Rio | Val Verde | San Felipe Springs | 08-4530.00 (gage on creek) | IBWC | 1931-2019 | 15 minutes |
| Headwaters GCD | Kerr | Guadalupe River | 08166200 Guadalupe River at Kerrville | USGS | 1986 -2019 | Daily |
| Real-Edwards CRD | Real | Frio River | Fulgham's crossing, Leakey Springs crossing, Mill Creek crossing, Frio River Place crossing | RECRD | ? – 2019 | Monthly |
| Real-Edwards CRD | Real | Frio River - West Prong | Rancho Real crossing, Kent Creek crossing | RECRD | ? – 2019 | Monthly |
| Real-Edwards CRD | Edwards | Nueces River | McDonald's Crossing, Nueces River Dam | RECRD | ? – 2019 | Monthly |
| Real-Edwards CRD | Edwards | South Llano River | Telegraph crossing, Hwy 377 at Evergreen School crossing | RECRD | ? – 2019 | Monthly |

The only station that is utilized as an active trigger is San Felipe Springs. The other stations are included in this table to present a complete list of surface water locations that are currently being monitored within the Region. Note that the Guadalupe River is an optional trigger for HGCD. The Frio and Nueces crossings that are measured by the RECRD are posted on their website monthly.

A list of all currently active stream flow, spring flow and reservoir stage gaging stations are listed in Table 7-7. The USGS stations have real-time data that is publicly accessible online. These locations are shown on Figure 7-9.

**Table 7-7. Currently Active Surface Water Gaging Locations**
Source: Water Data for Texas

| County | Station ID | Station Name | Agency |
|---|---|---|---|
| **Rio Grande Basin** | | | |
| Val Verde | 8449100 | Dolan Creek abv Devils River near Comstock, TX | USGS |
| Val Verde | 8447410 | Pecos River near Langtry, TX | USGS |
| Val Verde | 08-3772.00 | Rio Grande at Foster Ranch near Langtry, TX | IBWC |
| Val Verde | 08-4508.00 | International Amistad Reservoir Storage | IBWC |
| Val Verde | 08-4530.00 | San Felipe Creek | IBWC |
| Kinney | 8456300 and 8456310 | Las Moras Springs at Brackettville, TX (main channel) | USGS |
| **Nueces River Basin** | | | |
| Kinney | 8190500 | W Nueces River near Brackettville, TX | USGS |
| Edwards | 818999010 | Nueces River near Barksdale, TX | USGS |
| Real | 8194840 | Frio River at Leakey, TX | USGS |
| Bandera | 8197936 | Sabinal River below Mill Creek near Vanderpool, TX | USGS |
| | | | |
| | | | |
| **Guadalupe River Basin** | | | |
| Kerr | 8165300 | North Fork Guadalupe River near Hunt, TX | USGS |
| Kerr | 8165500 | Guadalupe River at Hunt, TX | USGS |
| Kerr | 8166000 | Johnson Creek near Ingram, TX | USGS |
| Kerr | 8166140 | Guadalupe River above Bear Creek at Kerrville, TX | USGS |
| Kerr | 8166200 | Guadalupe River at Kerrville, TX | USGS |
| Kerr | 8166250 | Guadalupe River near Center Point, TX | USGS |
| **San Antonio River Basin** | | | |
| Bandera | 817887350 | Medina River at Patterson Road at Medina, TX | USGS |
| Bandera | 8178880 | Medina River at Bandera, TX | USGS |
| Bandera | 8178980 | Medina River above English Creek Spring near Pipe Creek, TX | USGS |
| Medina | 8179500 | Medina Lake near San Antonio, TX | USGS |

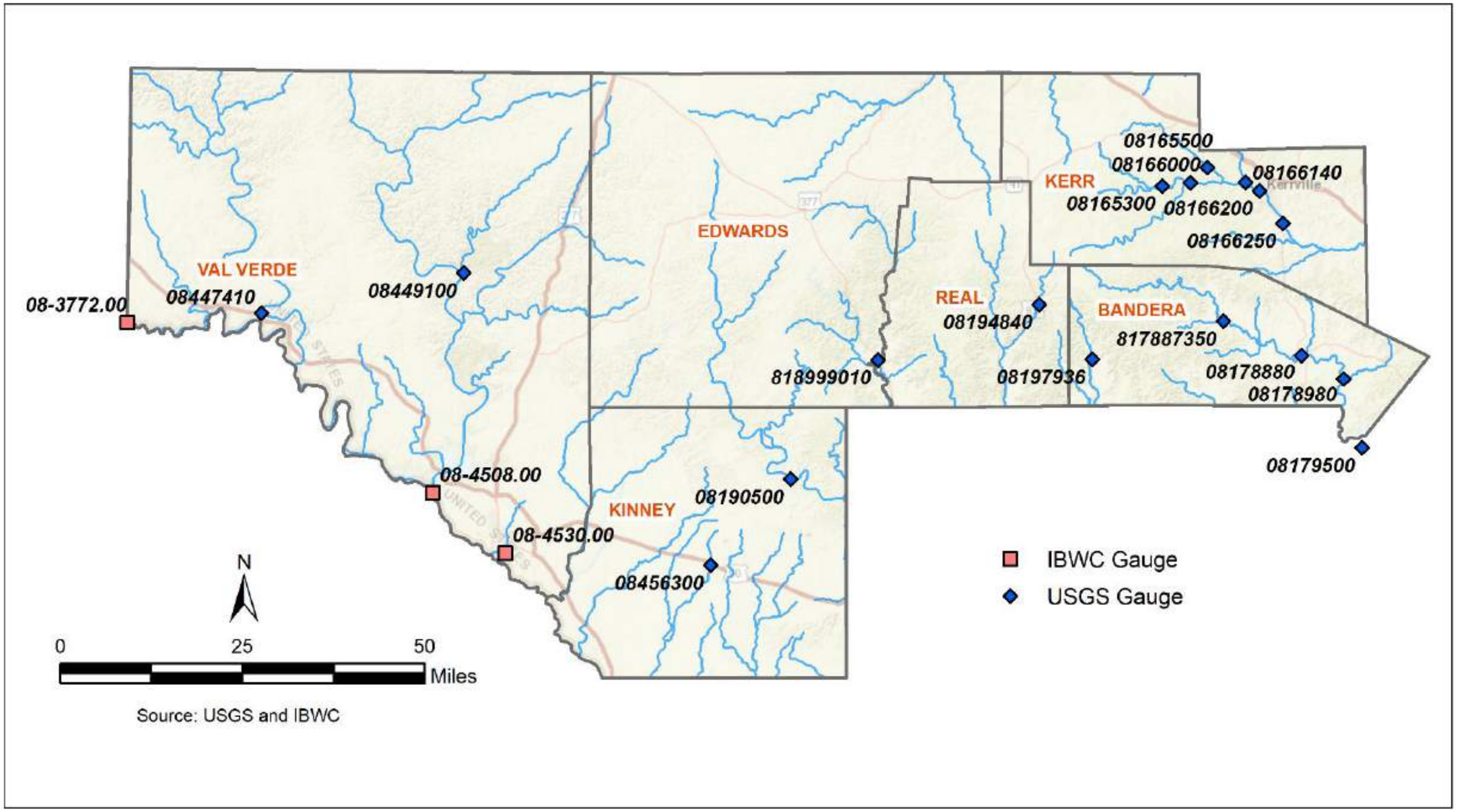


**Figure 7-9. Currently Active Surface Water Gaging Locations**

### 7.5.3 Regional Model Drought Contingency Plan

The Regional Model DCP summary table (Table 7-8) provides an overview of all existing regional water sources, WUGs, monitoring wells, gaging stations as well as recommended drought triggers and actions. The intent of including the monitoring wells and stations is to provide a comprehensive region-wide assessment of what current tools are available to WUGs and districts to monitor resources within the Plateau region.

The Regional Model DCP will undoubtedly change over time in order to address particular needs and issues of the Region's users. Therefore, this initial version of the model plan will primarily focus on identifying all sources, users and monitoring tools in order to find the particular components within the Region that are not currently incorporated into any existing drought plan but could potentially utilize existing data resources. Another focus of this first model plan will consider consistency of existing plans within the Region. Entities that have adopted drought plans will only be assessed to this end, therefore fine tuning existing triggers of existing municipal drought plans is not a goal of the model plan beyond an effort toward achieving consistent responses/actions to drought across the Region. Triggers have been recommended that are listed in Table 7-1 that are consistent with existing Municipal and GCD plans. An effort has been made to make the percent reduction of demand/use a little more aggressive and more equitable across the board. Additionally, 'voluntary conservation' has been removed as a stage 1 action. Conservation is a BMP that ideally will ultimately be practiced on a daily basis, and not merely as a reaction to drought conditions, therefore it has been removed as an action in the Regional Model DCP.

Smaller PWS entities (county-other), manufacturing, power, and irrigation water wells that exceed GCD exempt well production thresholds are subject to drought actions imposed by the conservation districts. Exempt well users are requested to voluntarily follow the actions specified by the Districts for non-exempt users. Generally, the water user groups within the Region that are not included in these plans (or included on a voluntary basis) are: 1) all exempt water wells in counties with established GCDs, and 2) all users in Val Verde County except those who are provided water by the City of Del Rio.

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**Table 7-8. Recommended Regional Drought Plan Triggers and Actions**

| Source Name | Source Type (SW or GW) | Source User Entity | Current WUG Monitoring | Real-time Source Monitoring | Factors to be Considered | Recommendations | Specific Triggers | | | | | | | | Specific Actions (Percent Reduction Demand/ Use) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Source Manager *a | | | | Users *b | | | | Source Manager *c | | | | Users *d | | | |
| | | | | | | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| | | | | | | | Mild | Mod | Severe | Critical | Mild | Mod | Severe | Critical | Mild | Mod | Severe | Critical | Mild | Mod | Severe | Critical |
| Edwards - Trinity (Plateau) | GW | City of Rocksprings | 55-63-803 (Sharp well) | --- | Plan in place | Add stage 4. | *a | *a | *a | *a | | | | | 10 | 20 | 30 | 40 | 10 | 20 | 30 | 40 |
| | | City of Brackettville | 70-45-601 (Well #1) | --- | Plan in place | Add stage 4. | *a | *a | *a | *a | | | | | 10 | 15 | 25 | 35 | 10 | 15 | 25 | 35 |
| | | Fort Clark Springs MUD | 70-45-504 (Well #1) | --- | Plan in place | Remove voluntary conservation as a stage | *a | *a | *a | *a | | | | | 10 | 15 | 25 | 35 | 10 | 15 | 25 | 35 |
| | | City of Del Rio | No groundwater triggers | --- | Plan in place | Make stage 1 a 10% demand reduction. | *a | *a | *a | *a | | | | | 10 | 20 | 30 | 40 | 10 | 20 | 30 | 40 |
| | | Laughlin AFB | | | | | | | | | *b | *b | *b | *b | | | | | | | | |
| | | County Other | N/A | 69-12-206 (Bandera)<br>56-64-302 (Kerr)<br>54-63-401 (Val Verde)<br>70-01-707 (Val Verde) | District plans in place | Make stage 1 a 10% demand reduction (REGRD only). | | | | | *b | *b | *b | *b | 10 | 20 | 30 | 40 | 10 | 20 | 30 | 40 |
| | | Irrigation | | | | | | | | | *b | *b | *b | *b | | | | | | | | |
| | | MAN, MIN | | | | | | | | | *b | *b | *b | *b | | | | | | | | |
| Trinity | GW | City of Bandera | Groundwater triggers | TWDB 69-24-225 | Plan in place | Remove voluntary conservation as a stage. | *a | *a | *a | *a | | | | | 10 | 20 | 35 | 50 | 10 | 20 | 35 | 50 |
| | | City of Kerrville | Comparison of demand and safe operation capacity | --- | Plan in place | No change. | *a | *a | *a | *a | | | | | *c | *c | *c | *c | | | | |
| | | City of Ingram | Demand-based triggers | --- | Plan in place | Remove voluntary conservation as a stage. Make stage 1 a 10% demand reduction. | *a | *a | *a | *a | | | | | 10 | 20 | 30 | 40 | 10 | 20 | 30 | 40 |
| | | County Other | N/A | 56-54-405 (Kerr)<br>56-63-922 (Kerr)<br>69-19-401 (Real)<br>16 HGCD wells (Kerr) | District plans in place | No change. | | | | | *b | *b | *b | *b | 10 | 20 | 30 | 40 | 10 | 20 | 30 | 40 |
| | | Irrigation | | | | | | | | | | | | | | | | | | | | |
| | | MAN, MIN | | | | | | | | | | | | | | | | | | | | |
| Edwards (BFZ) | GW | County Other | N/A | 70-38-902 (Kinney) | No drought plan | No change. | | | | | *b | *b | *b | *b | | | | | *d | *d | *d | *d |
| | | Irrigation | | | | | | | | | | | | | | | | | | | | |
| | | MAN, MIN | | | | | | | | | | | | | | | | | | | | |
| Austin Chalk | GW | County Other | N/A | --- | No drought plan | No change. | | | | | *b | *b | *b | *b | | | | | *d | *d | *d | *d |
| | | Irrigation | | | | | | | | | | | | | | | | | | | | |
| | | MAN, MIN | | | | | | | | | | | | | | | | | | | | |
| Frio River Alluvium | GW | City of Leakey | N/A | --- | District plan in place | Remove voluntary conservation as a stage. | | | | | *b | *b | *b | *b | 10 | 20 | 30 | 40 | 10 | 20 | 30 | 40 |
| | | Irrigation | N/A | | | | | | | | | | | | | | | | | | | |
| | | County Other | | | | | | | | | | | | | | | | | | | | |
| Nueces River Alluvium | GW | Community of Barksdale | Unknown | --- | District plan in place | Remove voluntary conservation as a stage. | | | | | *b | *b | *b | *b | 10 | 20 | 30 | 40 | 10 | 20 | 30 | 40 |
| | | Irrigation | N/A | | | | | | | | | | | | | | | | | | | |
| | | County Other | | | | | | | | | | | | | | | | | | | | |

*a Source Manager Triggers – See Table 7-1 for specific triggers in Municipal and GCD drought management plans.
*b User Triggers – Follow local Municipal or GCD drought management plans as shown in Table 7-1.
*c Source Manager Action – See Table 7-1 for specific triggers in Municipal and GCD drought management plans.
*d User Action – Follow local Municipal or GCD drought management plans as shown in Table 7-1.

**Table 7-8. (Continued) Recommended Regional Drought Plan Triggers and Actions**

| Source Name | Source Type (SW or GW) | Source User Entity | Current WUG Monitoring | Real-time Source Monitoring | Factors to be Considered | Recommendations | Specific Triggers | | | | | | | | Specific Actions (Percent Reduction Demand/ Use) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Source Manager *a | | | | Users *b | | | | Source Manager | | | | Users | | | |
| | | | | | | | Mild | Mod | Severe | Critical | Mild | Mod | Severe | Critical | Mild | Mod | Severe | Critical | Mild | Mod | Severe | Critical |
| **Rio Grande Basin** | | | | | | | | | | | | | | | | | | | | | | |
| Las Moras Springs | | City of Brackettville | N/A | USGS station 08456300 and 08456310 | Plan in place | Add stage 4. | *a | *a | *a | *a | | | | | 10 | 15 | 25 | 35 | 10 | 15 | 25 | 35 |
| San Felipe Springs | | City of Del Rio | stages triggered by spring discharge and storage reservoirs | IBWC station 08-4530.00 | Plan in place | Increase stage 1 to a 10% demand reduction. | *a | *a | *a | *a | | | | | 10 | 20 | 30 | 40 | 10 | 20 | 30 | 40 |
| San Felipe Creek | SW | | N/A | IBWC station 08-4530.00 | No drought plan | | | | | | *b | *b | *b | *b | | | | | *d | *d | *d | *d |
| Rio Grande | | County Other | | IBWC station 08-3772.00 | | | | | | | | | | | | | | | | | | |
| Pecos River | | Irrigation | | USGS station 08447410 | | | | | | | | | | | | | | | | | | |
| Devils River | | MAN, MIN | | USGS station 08449100 | | | | | | | | | | | | | | | | | | |
| Amistad Reservoir | | | | IBWC station 08-4508.00 | | | | | | | | | | | | | | | | | | |
| Cienegas Creek | | | | --- | | | | | | | | | | | | | | | | | | |
| **Nueces River Basin** | | | | | | | | | | | | | | | | | | | | | | |
| Old Faithful Springs | | City of Camp Wood | RECRD weir box; based on system capacity limits | RECRD weir box | Plan in place | Remove voluntary conservation as a stage. Make stage 1 a 10% mandated demand reduction. | *a | *a | *a | *a | | | | | 10 | 20 | 30 | 40 | 10 | 20 | 30 | 40 |
| West Nueces River | SW | | RECRD monitors two gages RECRD monitors six gages | USGS station 08190500 | No drought plan | | | | | | *b | *b | *b | *b | | | | | *d | *d | *d | *d |
| Nueces River Basin | | County Other | | USGS station 0818999010 | | | | | | | | | | | | | | | | | | |
| Frio River | | Irrigation | | USGS station 08194840 | | | | | | | | | | | | | | | | | | |
| Sabinal River | | MAN, MIN | | USGS station 08197936 | | | | | | | | | | | | | | | | | | |
| Hondo Creek | | | | N/A | | | | | | | | | | | | | | | | | | |
| **Colorado River Basin** | | | | | | | | | | | | | | | | | | | | | | |
| Llano River | SW | County Other<br>Irrigation<br>MAN, MIN | RECRD monitors two gages | Telegraph crossing, Hwy 377 at Evergreen School crossing | District plans in place (HGCD and REGRD) | Make stage 1 a 10% demand reduction (REGRD only). | | | | | *b | *b | *b | *b | 10 | 20 | 30 | 40 | 10 | 20 | 30 | 40 |
| **San Antonio River Basin** | | | | | | | | | | | | | | | | | | | | | | |
| Medina River | SW | County Other | N/A | USGS stations 0817887350, 08178880, and 08178980 | | | | | | | *b | *b | *b | *b | | | | | *d | *d | *d | *d |
| Medina Lake | | Irrigation, MAN, Min | N/A | USGS station 08179500 | | | | | | | | | | | | | | | | | | |
| **Guadalupe River Basin** | | | | | | | | | | | | | | | | | | | *d | *d | *d | *d |
| Guadalupe River | SW | City of Kerrville | Comparison of demand and safe operation capacity | --- | Plan in place | No change. | *a | *a | *a | *a | | | | | *c | *c | *c | *c | | | | |
| | | County Other | N/A | USGS stations 08165300, 08165500, 08166000, 08166140, 08166200, and 08166250 | District plan in place | No change. | | | | | *b | *b | *b | *b | 10 | 20 | 30 | 40 | 10 | 20 | 30 | 40 |
| | | Irrigation, MAN, Min | N/A | | | | | | | | *b | *b | *b | *b | | | | | *d | *d | *d | *d |

### 7.5.4 Model Drought Contingency Plans

In 2019, the Drought Preparedness Council recommended that a model DCP be in place for any water user group that exceeds ten percent of the Region's water demands. For the Plateau Region, these user groups include irrigation and municipal. Based on this recommendation, model DCPs for municipal and irrigation, along with wholesale, are available under the heading of MODEL DROUGHT CONTINGENCY PLANS on the Plateau Region Water Plan website: http://www.ugra.org/plateau-water-planning-group.

#### Public Water Supplier

Drought contingency plans have previously been adopted by the majority of the public suppliers and municipalities in the Plateau Region, although some suppliers did not provide any adopted plans. Current triggers and response actions for participating entities are summarized in Table 7-1.

#### Irrigation

Irrigation wells located within a municipality are subject to the triggers and response actions designated by the city's drought plan. Non-exempt irrigation wells located outside of a municipality but within a GCD are subject to the triggers and response actions of the GCD. Exempt irrigation wells located within a GCD are requested to comply voluntarily with response actions that have been mandated for non-exempt well owners. No response actions have been designated for irrigators located in Val Verde County except for those located within the City of Del Rio's jurisdictional boundary.

#### Wholesale Water Provider

The only wholesale water provider in the Plateau Region is the City of Del Rio. Generally, triggers are invoked when water levels in the Bedell Street Storage Reservoirs are less than a designated depth and San Felipe Spring flow drops below a specific flow rate. Currently adopted triggers and actions are summarized below in Table 7-9.

**Table 7-9. City of Del Rio Drought Triggers and Response Actions**

| Stage & Description | 1 – Mild | 2 – Moderate | 3 – Severe | 4 – Extreme | 5 – Emergency |
|---|---|---|---|---|---|
| Trigger | Water levels are less than 100% full; San Felipe Spring flow is less than 40 mgd. | Water levels are less than 30 feet; San Felipe Spring flow is less than 25 mgd. | Water levels are less than 25 feet; San Felipe Spring flow is less than 20 mgd. | Water levels are less than 20 feet; San Felipe Spring flow is less than 15 mgd. | Water levels are less than 15 feet; San Felipe Spring flow is less than 10 mgd. |
| Conservation Goal (percent reduction in pumpage) | Reduce demand to 95% of the 30-day average prior to initiation | Reduce demand to 90% of the 30-day average prior to initiation | Reduce demand to 80% of the 30-day average prior to initiation | Reduce demand to 70% of the 30-day average prior to initiation | Notify state |

## 7.6 DROUGHT WATER MANAGEMENT STRATEGIES

The PWPG has designated drought management strategies (J-14 and J-18) for the Bandera County Other category to administered by the Bandera County River Authority and Groundwater District. Drought management stages by the District are triggered by the U.S. Drought Monitor and adjusted at the discretion of the District when aquifer levels, rainfall and river flow conditions warrant. Drought management is considered a temporary measure aimed at conserving available water supplies during times of drought or emergencies. Drought management is most adequately addressed in the region through the implementation of local drought contingency plans. The PWPG is supportive of the development and use of these plans during periods of drought or emergency water needs.

# 7.7 OTHER DROUGHT-RELATED CONSIDERATIONS AND RECOMMENDATIONS

### 7.7.1 Texas Drought Preparedness Council and Drought Preparedness Plan

In accordance with TWDB rules, all relevant recommendations from the Drought Preparedness Council were considered in the writing of this Chapter. The Texas Drought Preparedness Council is composed of representatives from multiple State agencies and plays an important role in monitoring drought conditions, advising the governor and other groups on significant drought conditions, and facilitating coordination among local, State, and federal agencies in drought-response planning. The Council meets regularly to discuss drought indicators and conditions across the State and releases Situation Reports summarizing their findings. Additionally, the Council has developed the State Drought Preparedness Plan, which sets forth a framework for approaching drought in an integrated manner to minimize impacts to people and resources. Region J supports the ongoing efforts of the Texas Drought Preparedness Council and recommends that water providers and other interested parties regularly review the Situation Reports as part of their drought monitoring procedures. The Council provided two new recommendations in 2019 to all RWPGs which are addressed in this chapter.

- Follow the outline template for Chapter 7 provided to the regions by TWDB staff in April of 2019, making an effort to fully address the assessment of current drought preparations and planned responses, as well as planned responses to local drought conditions or loss of municipal supply.
- Develop region-specific model drought contingency plans for all water use categories in the region that account for more than 10 percent of water demands in any decade over the 50-year planning horizon.

To meet these recommendations, the PWPG has developed this Chapter to correspond with the sections of the outline template, and has provided model DCPs for both municipal and irrigation users.

### 7.7.2 Other Drought Recommendations

The PWPG recognizes that while drought preparedness, including DCPs, are an important tool, in some instances drought cannot be prepared for, it must be responded to. The PWPG maintains that DCPs developed by the local, individual water providers are the best available tool for drought management. The PWPG fully supports the use and implementation of individual DCPs during times of drought. The PWPG has reviewed provided DCPs and specific drought response strategies proposed in this *Plan* and find no unnecessary or counterproductive variations to exist.

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# CHAPTER 8
# POLICY AND UNIQUE SITES RECOMMENDATIONS

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# 8 POLICY AND UNIQUE SITES RECOMMENDATIONS

The regional water planning process offers an opportunity to make recommendations pertaining to the development and management of the groundwater and surface water resources of the State of Texas. This chapter contains specific suggestions and decisions made by the Plateau Water Planning Group (PWPG). Regional water planning remains a learning and improving process for the State of Texas. Because of the complex nature of this undertaking, many ideas and approaches to the problems of water-resource management are either refined or changed significantly as all participants in the planning process learn more about the Region's water resources and about what is required to produce a plan that will benefit all areas of the Region. The PWPG supports the continuation of the regional planning process and recommends certain modifications intended to strengthen its effectiveness.

The following recommendations by the PWPG are derived from careful consideration of many issues covered during the course of the planning exercise including needed legislative actions, state funding and assistance, water supply management planning, and needed studies and data. Issues concerning ecologically unique river and stream segments and sites for the construction of reservoirs are covered. The recommendations in the following sections are designed to present new and/or modified approaches to key technical, administrative, institutional, and policy matters that will help to streamline the planning process, and to offer guidance to future planners with regard to specific issues of concern within the Region.

# 8.1 CONSERVATION RECOMMENDATIONS

### 1. Watershed Management Practices

Selective vegetative (brush) management, as a tool to improve watershed yields and water quality, is a strategy of great interest in the Plateau Region, as well as in surrounding planning regions. A balanced approach to brush control contributes to the land's ability to absorb, retain, filter, and slow rainfall runoff. However, a narrow goal only to encourage the enhancement of runoff should be avoided.

The State should draft legislation based upon the best available science and input from all stakeholders to provide a cost-share funding program to landowners in the targeted watersheds for selective brush management and required other practices. It is generally recognized that brush infestations are the symptom of deeper ecological disturbances such as fire control, drought, grazing mismanagement, wildlife overpopulations and other causes. As such, the cost-share program should involve a long-range contract between the State and the landowner for at least ten (10) years of post-treatment management with required brush re-invasion treatments. To accurately assess the benefits, treated watersheds will require thorough monitoring of groundwater, springs and surface waters by appropriate state and federal agencies. Information and assistance are available from the USDA Natural Resources Conservation Service (NRCS) and the Texas State Soil and Water Conservation Board.

Currently, Texas Parks & Wildlife Department (TPWD) has a program specifically developed for landowners involving brush management in areas possibly containing endangered species. As has been proven on the Kerr Wildlife Management Area (TPWD) with long-term studies, selective brush management coupled with good rangeland management can benefit endangered species and ranchers as well. It is highly likely that watershed values will fit into the same package to provide a win-win situation for all.

### 2. Riparian Stewardship

The interaction between soil, water and vegetation in the floodplains and along streambeds constitutes riparian function, which buffers and slows floodwaters, filters sediment, improves natural infiltration and recharge of alluvial aquifers, and enhances water quality. The PWPG encourages riparian landowners to learn and implement land stewardship practices that support healthy riparian function. The PWPG continues to encourage funding for projects aimed at the eradication and long-term suppression of salt cedar, Arundo donax, and other nuisance phreatophytes in the Regional watersheds.

### 3. Conservation Management of State-Owned Lands

All state-owned land should be managed in ways that enhance water conservation. State agencies need to take the lead in water conservation, and it should start on state-owned properties. Unless State agencies set good conservation examples for the public, any public program encouraging such conservation will likely be perceived as "do as I say, not as I do", something that never plays well. Considering that approximately 95 percent of Texas land is privately owned, the State needs to be convincing when making recommendations to the public if it hopes to be successful.

**4. Rainwater Harvesting as an Alternative Source of Water**

Rainwater harvesting programs should be supported by the State. Rainwater harvesting is one way to meet rural or urban domestic water demands, as well as use for limited irrigation, such as vineyards, orchards or small farms under drip irrigation. Livestock and wildlife can also be provided supplemental water by rainwater harvesting. This should be widely encouraged by funded education programs and cost-share funding to individual homeowners, farmers, businesses, public entities and ranchers.

**5. Conservation and Drought Planning**

Because portions of the Plateau Region are particularly susceptible to water-supply shortages during periods of drought conditions, these areas are especially encouraged to develop conservation oriented management plans. Likewise, water-user entities within these areas should become actively involved in the regional water planning activities associated with this Plan.

# 8.2 WATER MANAGEMENT RECOMMENDATIONS

### 1. Headwaters GCD Access to Groundwater under State-Owned Land

The Texas Legislature recognizes that a landowner owns the groundwater below the surface of the landowner's land as real property (*Water Code Chapter 36.002 Ownership of Groundwater*). Water Code Chapter 36.104 states that a groundwater district may purchase, sell, transport and distribute surface water or groundwater. For the long-term benefit of meeting the future water demands of the citizens in Kerr County, Texas, the PWPG recommends that the State of Texas enter into a long-term lease agreement or contract that will allow the Headwaters Groundwater Conservation District to retain/acquire the groundwater rights located under all State-owned property within the boundaries of Kerr County. This will provide for:

- better long-term management of local groundwater sources,
- additional drilling sites for test/monitor wells,
- more county-wide data collection and monitoring of aquifer conditions, and
- increased availability of scientific data for local water management planning.

The District's enabling legislation (*Special District Local Laws Code Chapter 8842 Section 102.B*) states that the District may contract with a state agency or another governmental body to carry out any function of the District. The access right to groundwater underlying State-owned land would be included in the District's Management Plan.

### 2. GCD Management of Brackish Groundwater

Brackish-quality groundwater is recognized State-wide as an underutilized water supply source, and programs are in place in the State's water agencies to encourage the development of this source to meet future water supply shortages. Science recognizes that most of these brackish aquifers represent a down-dip component of an aquifer's freshwater zone, and that the withdrawal of water from the brackish portion may impact the updip fresh-water portion of the same aquifer. The Legislature has declared that groundwater conservation districts are the State's recognized authority to locally manage groundwater sources. The PWPG affirms that local groundwater conservation districts have the authority and should retain the authority to manage the brackish portion of aquifers.

### 3. Recharge Structures

Recharge structures are a relatively low-cost method of enhancing aquifer recharge if sited to provide adequate streambed water percolation based upon the best available science. Recharge structures such as small dams, gabions, or terraces can provide multiple benefits under ideal conditions as has been proven along the Edwards Aquifer Recharge Zone. This interest in recharge structures should be encouraged, funding provided, and perhaps some streamlining of any required permitting procedures as possible and as advised. Programs and funding should be available to identify appropriate locations for recharge structures and technical assistance provided for construction and maintenance.

# 8.3 WATER PLANNING RECOMMENDATIONS

### 1. Transient Population Impact on Water Demand

Municipal water use reports capture the total amount of water produced and distributed by the city. In concept, this volume includes water consumed by both permanent and transient populations within the community. However, the counties of the Plateau Region have a high transient influx of vacationers and hunters that frequent the more remote areas and are not likely included in the water demand estimates. Likewise, there are a high percentage of second-home owners in the rural counties that is also not accounted. Officials in the most rural counties in the Region estimate that as much as 70 percent of landowners are not permanent residents. This transient water demand likely has a significant impact on water demand estimates used by the planning group. The PWPG encourages the TWDB to consider this water-use category and develop a method for estimating its impact.

### 2. Better Methodologies for Estimating Population and Water Demand

The revision of population and demand estimates should be discussed by regional water planning groups and put before the public for several months, and then be presented to the planning groups for consideration and adoption. This will allow more time for water users within the region to hear about the planning effort and to have input to the revisions of population, water demand, and water supply.

Modification of demand numbers should be allowed further into the planning process. Demand errors may not be discovered until the supply-demand analysis is performed. Some entities or water-use categories may have been overlooked early in the process and their demands need to be added later for the supply-demand analyses to match.

### 3. County-Other Demand Distribution

In the regional water planning process, water supply demand is determined on a county and river basin basis and is then evenly distributed over the designated area. In some cases, this results in a misrepresentation of the actual rural density within segments of the county-river basin area. The primary disadvantage of this is that a high-density rural area may have a legitimate need of water supply management even though the county-river basin statistical numbers do not indicate a supply shortage. A recommended water management strategy in an area such as this does not register as high of a priority as it realistically should. The PWPG therefore recommends that the TWDB develop a planning process that will justifiably recognize the high-priority needs of relatively higher-density County-Other areas.

### 4. Irrigation Surveys

Irrigation application is the largest use of water in the State, yet its quantification is probably the least accurate. Irrigation use is only being accurately determined in areas where groundwater conservation districts are requiring the installation of irrigation well flow meters and where irrigation districts record surface water diversions. Elsewhere, planning group members directly involved in the agricultural industry have viewed irrigation surveys with skepticism in many counties. Nursery farms, greenhouse operations, wildlife and exotic animal food plots, and non-municipal golf courses are just a few of the irrigation activities that are often overlooked in the surveys. The TWDB is encouraged to develop a more confident means of estimating actual irrigation use.

### 5. Peak-Use Management

Drought management plans need to be developed based on peak use demand instead of annual production capabilities. The current Plan is based on drought-of-record conditions on an annual basis. While this is a good starting point in the planning process, it would be beneficial to also plan based on peak demand during a year. For example, current planning does not address water needs during the peak use period of summer months. During the summer, in many areas of the State, severe water problems may exist that are not apparent based on an annual water management plan. This results in a plan that may indicate that water supply needs are satisfied for a region, when in reality such needs may not be satisfied throughout the year. This presents a significant problem in the current planning process.

### 6. MAG Availability Alternative

Modeled Available Groundwater (MAG) is the quantitative limit set by Groundwater Management Areas for groundwater use in a given area and is the cap for groundwater source use in regional water planning. The PWPG recommends that MAGs be used as the water planning cap <u>unless</u> the Planning Group obtains written permission from a Groundwater Conservation District (GCD) to allow a water management strategy to be recommended that uses more groundwater then the MAG cap. This approach assumes that the strategy is consistent with the GCD Management Plan, but allows for minor supply shortages to be covered without excessive administrative actions and allows the GCD to apply local knowledge to account for variations in permitting approaches and usage patterns. The approach could also be used in areas with no GCDs.

### 7. Regional Planning Coordination

The two regional planning processes developed by the Legislature (Regional Water Planning and Groundwater Management Areas) have in some cases resulted in conflicting methodologies of reaching long-term planning goals. The PWPG encourages better communication between the stakeholders at earlier stages of both processes in the future. The PWPG also encourages the Legislature to examine ways in which both planning processes can better interact for the good of all citizens and economies in the impacted regions.

### 8. Training for New Regional Water Planning Group Members

The TWDB is encouraged to continue providing training opportunities for new planning group members. Planning group members provide better input to the planning process when they fully understand the requirements, schedules, and the multitude of internal components of the regional plan.

### 9. Require Participation of State Agencies Involved with the Planning Process

Representatives of State agencies involved in the regional planning process could effectively derail a regional plan at the end of the planning period - without attending as much as one meeting. The PWPG recommends that nonvoting members of State agencies be required to attend and provide input at every planning group meeting. If an agency’s nonvoting representative does not contribute or fails to attend meetings, then that agency should not be permitted to object to or alter contents of a planning group’s adopted plan. It should be noted that TWDB, TPWD, and TSSWCB staff were very active (and much appreciated) in the Plateau Region planning process.

## 8.4 WATER RESEARCH NEEDS

The State should fund or conduct specific studies that will shed more information on specific water-resource issues. The questions unanswered by current sources of information are critical to future PWPG decisions. The following are recommendations pertaining to specific studies and data acquisition that the PWPG believes would provide significant insight into specific planning issues in the Region.

### 1. Edwards-Trinity (Plateau) Aquifer

All six counties in the Plateau Region are partially or fully underlain by the Edwards- Trinity (Plateau) Aquifer. Even though a groundwater availability model (GAM) has been constructed for this aquifer, there remain many hydrological questions about the aquifer. Specific counties are embroiled in controversy pertaining to groundwater supply availability. At issue is the disagreement about the total amount of water in the county that is available on an annual basis to meet all of the counties projected water demands now and into the future, and the amount of groundwater in excess of that amount that might be available for other purposes other than in-county use. All concerned agree that sound science is needed to assess this quantification.

Specific concern has been voiced by citizens in Val Verde County where the groundwater source availability of the Edwards-Trinity (Plateau) Aquifer changed from 25,000 acre-feet per year in the 2016 Plateau Region Water Plan to 50,000 acre-feet per year in this current Plan. TWDB modelers are particularly critical of the ability of any existing groundwater model to accurately assess Val Verde County groundwater availability as aquifer properties are poorly defined in most of Val Verde County because there are few data on aquifer responses to pumping stresses. In particular, a better understanding is needed of the different geohydrologic environments that exist between the southern San Felipe Springs – Amistad Reservoir area verses the upstream Pecos and Devil's River area.

A basic, unbiased, scientific study that encompasses the hydrologic characterization of the Edwards-Trinity (Plateau) Aquifer and adjacent associated aquifers (Edwards-BFZ and Austin Chalk) and the inter-formational flow between them, their contribution to surface water flows, and the historical withdrawals from the aquifers is needed in order for the local groundwater management entities and the PWPG to make sound management decisions and recommendations.

### 2. Unpermitted Withdrawals of Riparian Water

A significant amount of unpermitted riparian water is withdrawn from rivers and their tributaries in the Region. Unpermitted pumping is particularly escalated during drought periods when increased withdrawals occur for irrigation of lawns. This water use is unaccounted for in the Water Availability Models that are developed for these waterways. State water agencies should devise a survey method to establish a reasonable estimate of these diversions.

### 3. Emphasis on Basic TWDB Water Evaluation Studies

In the past, the TWDB has provided significant knowledge concerning the groundwater resources in the State in the form of basic data and reports. The Board's current emphasis on groundwater modeling with its intended use as a water management planning tool is recognized as an important advancement in providing planning tools. However, the Board should not abandon its important basic data gathering and evaluation responsibility. The Board should emphasize more realistic and useful groundwater studies that include the extensive field data collection necessary for such studies.

**4. Radionuclides in Trinity Aquifer Groundwater**

Recent groundwater sampling by groundwater conservation districts have identified elevated levels of radionuclides in the Trinity Aquifer. Further studies are needed to - identify the specific source of the radionuclides, map their areal distribution and concentration, determine their health concerns, and monitor their changing concentrations over time.

**5. Groundwater/Surface Water Relationship**

The PWPG defines groundwater availability as a maximum level of aquifer withdrawal that results in an acceptable level of long-term aquifer impact such that the base flow in rivers and streams is not significantly affected beyond a level that would be anticipated due to naturally occurring conditions. This water supply policy definition can best be achieved when the relationship between groundwater and surface water is fully understood. The PWPG encourages the State (TWDB) to embrace this concept and focus water availability studies on this topic.

**6. Impact of Transient Water Demand in Rural Counties**

The concern pertaining to transient population water demand in rural counties was expressed in Section 8.1.8. A study is needed to quantify this impact that is not based solely on the resident population but rather considers the total count of individuals within the respective area.

**7. Underestimated Water Demand of Exotic Animals**

The PWPG investigated the water use generated by the expanding exotic animal industry within the Region (see Appendix 2B of the *2011 Plan*) and expects to build on this information to generate more accurate water demand estimates in future regional plans. The PWPG encourages the TWDB and other agencies to continue funding for this endeavor in the Plateau Region and throughout the State.

**8. Upper Guadalupe River Basin Groundwater/Springflow Analysis**

Surface water base flow in the three branches of the upper Guadalupe River in western Kerr County is derived almost exclusively from groundwater discharge through springs. Both the PWPG and members of Groundwater Management Area 9 recognize the need to manage groundwater use in this area where critical surface water/groundwater interaction occurs. However, developing management decisions is impaired by the lack of current understanding of how groundwater level elevations relate to spring flow rates. Only one monitoring well is in place that provides continuous water level readings, and no attempt has thus far been made to relate this recent data to spring flows. A study is needed to evaluate this critical interaction so that future management decisions can be based on a more substantial level of scientific knowledge.

## 8.5 CONSIDERATION OF ECOLOGICALLY UNIQUE RIVER AND STREAM SEGMENTS

Under regional planning guidelines (§357.43), each planning region may recommend specific river or stream segments to be considered by the legislature for designation as ecologically unique. The legislative designation of a river or stream segment would only mean that the State could not finance the construction of a reservoir that would impact the segment. The intent is to provide a means of protecting the segments from activities that may threaten their environmental integrity.

Texas Parks and Wildlife Department (TPWD) provided a list of stream segments that were identified as meeting ecologically unique criteria. This list and map can be viewed in Appendix 8B of the *2011 Plan*. For each segment, TPWD lists qualities of each segment that support the stream's candidacy. These qualities may include but are not limited to biological function, hydrological function, location with respect to conservation areas, water quality, the presence of state- or federally-listed threatened or endangered species, and the critical habitat for such species.

The Plateau Region contains some of the most ecologically pristine areas in the State. The preservation of this natural environment is an important component of the Region's economy, which is closely tied to these natural resources. The PWPG recognizes the uniqueness of this Region and has followed a policy throughout this planning period of always considering the impact that their decisions have on the area's ecological resources. The PWPG also recognize the extent of Region L designated ecologically unique stream segments that extend upstream to the southern boundary of the Plateau Region.

The PWPG has established the following procedure for public requests for Planning Group consideration of an ecologically unique stream segments:

- PWPG must receive a clearly designated letter and map requesting the EUSS. Letter must be from an individual or entity that resides or principal office is within the geographic boundary of the Plateau Water Planning Region.
- All property owners within the recommended designated area must be provided written notice by certified mail of the proposed designation.
- At least two thirds of the property owners that respond within the recommended area must concur with the proposed EUSS recommended designation.
- The County Commissioners' Court must vote in favor of the recommended designation and submit to the PWPG.

However, because the subsequent ramifications of designation are not fully understood, the PWPG, in keeping its respect toward all individual landowners along these segments and their private property rights, has chosen to refrain from recommending specific segments for designation as "ecologically unique" at this time. The PWPG strongly maintains that all river and stream segments in the Plateau Region are vitally important and their flows constitute a major consideration in adoption of this *2021 Plan*.

The Upper Guadalupe River Authority (UGRA) Board of Directors has presented the following letter in expression of their concern for possible ramifications of RWPGs recommending Ecologically Unique River and Stream Segments:

> *Based on 31 TAC §357.43 a regional water planning group (RWPG) may recommend a river or stream segment as being of unique ecological value based on the criteria set forth in 31 TAC §358.2(6). Consideration of the designation of stream segments of unique ecological value (unique stream segments) is a component of regional water planning throughout the State. For some, however, including the Plateau Region (J), there is a significant concern about the use of unique stream segments because of a lack of clarity about how the designation might be used in the future. In particular, there are concerns about the provision being used for purposes other than the intent of the legislature, usurping local control, and resulting in the restriction of individual and private property rights for landowners.*
>
> *31 TAC §358.2(6) states the following: River and stream segments of unique ecological value--Those river or stream segments that may be identified by the Texas Water Development Board in coordination with the Texas Parks and Wildlife Department and the Commission or identified in an approved regional water plan based on the following criteria: (A) Biological function--stream segments which display significant overall habitat value including both quantity and quality considering the degree of biodiversity, age, and uniqueness observed and including terrestrial, wetland, aquatic, or estuarine habitats; (B) Hydrologic function--stream segments which are fringed by habitats that perform valuable hydrologic functions relating to water quality, flood attenuation, flow stabilization, or groundwater recharge and discharge; (C) Riparian conservation areas--stream segments which are fringed by significant areas in public ownership including state and federal refuges, wildlife management areas, preserves, parks, mitigation areas, or other areas held by governmental organizations for conservation purposes, or stream segments which are fringed by other areas managed for conservation purposes under a governmentally approved conservation plan; (D) High water quality/exceptional aquatic life/high aesthetic value--stream segments and spring resources that are significant due to unique or critical habitats and exceptional aquatic life uses dependent on or associated with high water quality; or (E) Threatened or endangered species/unique communities--sites along stream where water development projects would have significant detrimental effects on state or federally listed threatened and endangered species; and sites along streams significant due to the presence of unique, exemplary, or unusually extensive natural communities.*
>
> *Designation of a river or stream segment as ecologically unique is defined by Chapter 16 of the Texas Water Code §16.051(f) to mean "…that a state agency or political subdivision of the state may not finance the actual construction of a reservoir in a specific river or stream designated by the legislature…". When the first regional water plans were prepared in 2001, the RWPGs requested clarification of the intent of unique stream segment designations. The legislature addressed that issue in the 77th Legislative Session which is reflected in Chapter 16 of the Texas Water Code §16.051(f) cited earlier. This implies that it would be irrelevant to consider recommending a segment for designation if it does not have potential to be a reservoir site. In other words, no regulatory purpose has been identified that would be served by a unique stream segment designation other than precluding reservoir construction with state funding.*
>
> *Despite the clarification by the 77th Legislature, many regional water planning groups (including Region J) have struggled with requests for the designation of a stream segment(s) in their respective planning areas based on criteria other than that which was identified by the 77th Legislature. There is considerable concern from some planning group members that using this provision for other than its original intent, which is to prevent a state agency or political subdivision of the state from financing the actual construction of a reservoir in a specific river or stream designated by the*

*legislature under this provision, will lead to additional unwarranted restrictions on the use of the segment which can negatively impact individual landowners and infringe on private property rights.*

*Because the subsequent ramifications of unique stream designations are not fully understood, the use of the designation for anything other than the original intent could lead to the impingement of individual and private property rights, and costly litigation. The intent of the Texas Legislature regarding the purpose of the unique stream segment designation is clearly stated in Section 16.051(f) of the Texas Water Code. The current process incorporates considerations made by rule which exceed the legislature's intent and §16.051(f) of the Texas Water Code thereby usurping local control and due process by duly elected local officials.*

<u>Recommendation</u>:

*The Plateau Water Planning Group recommends the modification of 31 TAC §358.2 by striking subsection 6 (a through e) "Ecologically Unique Stream Segments" and the modification of sections that reference 31 TAC §358.2(6) with the rationale that this section's instruction for unique stream designation supersedes the directive in Texas Water Code 16.051(f). Striking 31 TAC §358.2(6) will additionally preserve and protect local control as well as individual and personal property rights.*

## 8.6 CONSIDERATION OF UNIQUE SITES FOR RESERVOIR CONSTRUCTION

Regional water planning guidelines (§357.43) instruct that planning groups may recommend sites of unique value for construction of reservoirs by including descriptions of the sites, reasons for the unique designation, and expected beneficiaries of the water supply to be developed at the site. The following criteria shall be used to determine if a site is unique for reservoir construction:

1. Site-specific reservoir development is recommended as a specific water management strategy or in an alternative long-term scenario in an adopted plan.
2. The location, hydrologic, geologic, topographic, water availability, water quality, environmental, cultural, and current development characteristics, or other pertinent factors make the site uniquely suited for:
    - reservoir development to provide water supply for the current planning period; or
    - where it might reasonably be needed to meet needs beyond the 50-year planning period.

Following consideration of the above criteria the PWPG makes no recommendation of unique sites for reservoir construction.

# CHAPTER 9

# WATER INFRASTRUCTURE FINANCING ANALYSIS

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# 9 WATER INFRASTRUCTURE FINANCING ANALYSIS

The Infrastructure Financing Report survey presented in this chapter identifies the state financing options proposed by entities in this *Plan* to meet future infrastructure needs. Chapter 5 provides recommended water management strategies for numerous communities in Far West Texas that either have a projected water supply deficit and recommended strategies to meet that need, or have an identified need for a water supply infrastructure project, which may require state financial assistance. These entities were surveyed to determine their proposed method(s) for financing the estimated capital costs involved in implementing the water supply strategies recommended in the *2021 Plateau Region Water Plan*.

Unlike infrastructure financing surveys conducted for previous regional water plans, questions during this planning cycle focused on projected needs for financial assistance from programs administered by the TWDB. The TWDB will aggregate the projected requests for funding from these programs from the 16 water planning regions to provide a picture of estimated long-term infrastructure funding needs to the State Legislature.

## 9.1 TWDB FUNDING PROGRAMS

The TWDB offers financial assistance for the planning, design and construction of projects identified in Regional Water Plans or the State Water Plan. Programs available include the State Water Implementation Fund for Texas (SWIFT), Water Infrastructure Fund (WIF), the State Participation Fund (SP), and the Economically Distressed Areas Program (EDAP). To be eligible to apply for funding from the SWIFT source, the applicant must be a political subdivision of the state, or in some cases a water supply corporation and the proposed project must be a recommended water management strategy in the most recent approved Regional Water Plan or State Water Plan.

### 9.1.1 State Water Implementation Fund for Texas (SWIFT)

The Texas Legislature created the SWIFT to provide affordable, ongoing state financial assistance for projects in the state water plan. Passed by the Legislature and approved by Texas voters through a constitutional amendment, the SWIFT helps communities develop and optimize water supplies at cost-effective rates. The program provides low-interest loans, extended repayment terms, deferral of loan repayments, and incremental repurchase terms for projects with state ownership aspects. Recognizing the benefit of conservation and the needs of rural Texas, the legislation directed that not less than 10% of the SWIFT funding should support projects for rural communities and agricultural water conservation; and not less than 20% of the funds should support water conservation and reuse projects.

### 9.1.2 Water Infrastructure Fund (WIF)

The Water Infrastructure Fund (WIF) provides subsidized interest rate loans for planning, design and construction. The WIF-Deferred fund offers the option of deferring all interest and principal payments for up to 10 years for planning, design and permitting costs, while the WIF-Construction fund offers subsidized interest for all construction costs including planning, acquisition, design, and construction.

### 9.1.3 State Participation Fund (SP)

The State Participation Fund (SP) is geared towards large projects which are regional in scope and meant to capitalize on economies of scale in design and construction, but where the local project sponsors are unable to assume the debt for an optimally sized facility. The TWDB assumes a temporary ownership interest in the project, and the local sponsor repays the cost of the funding through purchase payments on a deferred schedule. The goal of the program is to build a project that will be the right size for future needs, even if that results in the short term in building excess capacity, rather than constructing one or more smaller projects now.

### 9.1.4 Rural and Economically Distressed Areas (EDAP)

Both grants and zero percent interest loans for planning, design and construction costs are offered through these programs, which are available to eligible small, low-income communities. Rural and economically distressed areas that meet population, income and other criteria are eligible to apply for these funds. EDAP funding eligibility also requires adoption of the Texas Model Subdivision Rules by the applicant planning entities.

## 9.2 INFRASTRUCTURE FINANCE SURVEY

The survey instrument is prefaced with an explanation of its purpose in identifying the need for financial assistance programs offered by the State of Texas and administered by the TWDB. The available funding programs (SWIFT, WIF, SP and EDAP) are summarized, and the survey participant is asked to: 1) identify the amounts they might request from each funding source for each identified project or strategy; and 2) the earliest date the funds would be needed, by fund type. Water user groups with multiple strategies to meet future water needs are only surveyed for strategies with a capital cost.

All communities listed in Chapter 5 water management strategies were presented with surveys provided by the TWDB. The survey along with supporting documentation that summarized the water management strategies included in the *Regional Plan* for that entity were delivered to the mayor or the city/utility manager and follow-up contacts were made with each entity to encourage response to the survey. Table 9-1 presents the surveys responses.

## Table 9-1. Infrastructure Finance Report Survey

| | | | |
|---|---|---|---|
| CITY OF BANDERA - ADDITIONAL MIDDLE TRINITY WELLS WITHIN CITY WATER INFRASTRUCTURE | PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING | | Completed |
| CITY OF BANDERA - ADDITIONAL MIDDLE TRINITY WELLS WITHIN CITY WATER INFRASTRUCTURE | CONSTRUCTION FUNDING | $244,500 | Completed |
| CITY OF BANDERA - ADDITIONAL MIDDLE TRINITY WELLS WITHIN CITY WATER INFRASTRUCTURE | PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY | $0 | |
| CITY OF BANDERA - PROMOTE, DESIGN AND INSTALL RAINWATER HARVESTING SYSTEMS | PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING | | Not considered |
| CITY OF BANDERA - PROMOTE, DESIGN AND INSTALL RAINWATER HARVESTING SYSTEMS | CONSTRUCTION FUNDING | | Not considered |
| CITY OF BANDERA - PROMOTE, DESIGN AND INSTALL RAINWATER HARVESTING SYSTEMS | PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY | | Not considered |
| CITY OF BANDERA - REUSE TREATED WASTEWATER EFFLUENT FOR IRRIGATION | PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING | | Not considered |
| CITY OF BANDERA - REUSE TREATED WASTEWATER EFFLUENT FOR IRRIGATION | CONSTRUCTION FUNDING | | Not considered |
| CITY OF BANDERA - REUSE TREATED WASTEWATER EFFLUENT FOR IRRIGATION | PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY | | Not considered |
| CITY OF BANDERA - SURFACE WATER ACQUISITION, TREATMENT AND ASR | PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING | | Not considered |
| CITY OF BANDERA - SURFACE WATER ACQUISITION, TREATMENT AND ASR | CONSTRUCTION FUNDING | | Not considered |
| CITY OF BANDERA - SURFACE WATER ACQUISITION, TREATMENT AND ASR | PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY | | Not considered |
| CITY OF KERRVILLE - EXPLORE AND DEVELOP NEW ELLENBURGER AQUIFER WELL SUPPLY | PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING | $3,998,750 | 2021 |
| CITY OF KERRVILLE - EXPLORE AND DEVELOP NEW ELLENBURGER AQUIFER WELL SUPPLY | CONSTRUCTION FUNDING | $11,996,250 | 2021 |
| CITY OF KERRVILLE - EXPLORE AND DEVELOP NEW ELLENBURGER AQUIFER WELL SUPPLY | PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY | $0 | |
| CITY OF KERRVILLE - INCREASE WASTEWATER REUSE | PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING | $0 | NA |
| CITY OF KERRVILLE - INCREASE WASTEWATER REUSE | CONSTRUCTION FUNDING | $0 | NA |
| CITY OF KERRVILLE - INCREASE WASTEWATER REUSE | PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY | $0 | |
| CITY OF KERRVILLE - INCREASED WATER TREATMENT AND ASR CAPACITY | PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING | $3,059,100 | 2030 |
| CITY OF KERRVILLE - INCREASED WATER TREATMENT AND ASR CAPACITY | CONSTRUCTION FUNDING | $7,137,900 | 2031 |
| CITY OF KERRVILLE - INCREASED WATER TREATMENT AND ASR CAPACITY | PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY | $0 | |
| CITY OF KERRVILLE - WATER LOSS AUDIT AND MAIN-LINE REPAIR | PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING | $789,750 | 2022 |
| CITY OF KERRVILLE - WATER LOSS AUDIT AND MAIN-LINE REPAIR | CONSTRUCTION FUNDING | $9,477,000 | 2023 |
| CITY OF KERRVILLE - WATER LOSS AUDIT AND MAIN-LINE REPAIR | PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY | $0 | |

# CHAPTER 10
# PUBLIC PARTICIPATION
# AND PLAN ADOPTION

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# 10 PUBLIC PARTICIPATION AND PLAN ADOPTION

Chapter 10 contains an overview of the Plateau Water Planning Group (PWPG) representation, administrative planning process, specific activities that insured that the public was informed and involved in the planning process, and the implementation of the *Plan*. Chapter 10 appendices contain comments and responses on the Initially Prepared Plan by the Public (Appendix 10A), TWDB (Appendix 10B), and TPWD (Appendix 10C).

# 10.1 PLATEAU WATER PLANNING GROUP

The TWDB appointed an initial coordinating body or PWPG for the original Region J based on names submitted by the public for consideration. The PWPG then voted to change its name to Plateau and expanded its membership based on their knowledge of additional persons who could appropriately represent water user groups (Table 10-1). Non-voting members representing interested state agencies and adjacent planning regions are listed in Table 10-2. State planning provisions mandate that one or more representatives of the following water user groups be seated on each planning group: agriculture, counties, electric generating utilities, environment, industries, municipalities, river authorities, public, small business, water districts, and water utilities. An electric generating utility does not exist within the Plateau Region and is therefore not represented. In addition to the other 10 categories, the PWPG chose to appoint a member to represent the tourism industry because of its prevalence in the Region. Also, to insure adequate geographic representation, the PWPG made sure that at least one member was selected from each of the six counties. Membership was also extended to represent the three Groundwater Management Areas within the Region. Staff persons from both the Texas Parks and Wildlife Department and the Texas Department of Agriculture were also appointed as non- voting members. The PWPG members voluntarily devote considerable amounts of their time to the planning process.

**Table 10-1. Plateau Water Planning Group Voting Members (Effective March 3, 2020)**

| Name | Water-use Category | County |
|---|---|---|
| Jonathan Letz, *Chair* | Small Businesses | Kerr |
| Genell Hobbs, *Vice Chair* | GMA 10 | Kinney |
| Gene Williams, *Secretary* | Water Districts | Kerr |
| Ray Buck, *Political Entity* | River Authorities | Kerr |
| Jerry Simpton | Other | Val Verde |
| William Feathergail Wilson | Other | Bandera |
| Joseph McDaniel | Industries | Kerr |
| Homer T. Stevens, Jr. | Tourism | Bandera |
| Charlie Wiedenfeld | Water Utilities | Kerr |
| David Maulk | Water Districts | Bandera |
| Roland Trees | Water Districts | Real |
| Rene Villareal | Water Districts | Kinney |
| Wes Robinson | Agriculture | Kinney |
| Tully Shahan | Environment | Kinney |
| Lee Sweeten | Counties | Edwards |
| Scott Loveland | Municipalities | Kerr |
| Otila Gonzalez | Municipalities | Val Verde |
| Dell Dickinson | Public | Val Verde |
| Max Martin | Public | Edw/VV/Kin |
| Charlie Flatten | Public | Kerr/Ban/Real |
| Genell Hobbs | GMA7 | Kinney |
| David Jeffery | GMA9 | Bandera |

**Table 10-2. Plateau Water Planning Group Non-Voting Members (Effective March 3, 2020)**

| Name | Organization |
|---|---|
| William Alfaro | Texas Water Development Board |
| Robin Barthen | Texas Department of agriculture |
| Chad Norris | Texas Parks and Wildlife Department |
| Rusty Ray | Texas State Soil & Water Conservation Board |
| Kenn Norris | Region E Liaison |
| Paul Tybor | Region K Liaison |
| Con Mims | Region L Liaison |
| Thomas Rodriquez | Region M Liaison |
| Carl Schwing | Region J Liaison to Region M |

**Interregional Planning Council**

The TWDB is required by Texas Water Code Section 16.052 to appoint an Interregional Planning Council made up of one member from each regional water planning group (RWPG). The purpose of the Council is to:

- Improve coordination among the RWPGs, and between the RWPGs and the TWDB in meeting goals of the state water planning process;
- Facilitate dialogue regarding regional water management strategies; and
- Share operational best practices of the regional water planning process.

The PWPG has appointed Ray Buck to this position.

## 10.2 ADMINISTRATIVE PROCESS AND PROJECT MANAGEMENT

The PWPG functions through procedures set forth in their adopted bylaws and follow planning guidelines establish by Legislative rule and TWDB contractual guidelines. With planning funds administered through TWDB, the PWPG then hires technical consultants to perform the work of preparing the regional plan for planning group review and adoption. Work required completing the Plan follows well-defined guidelines intended to meet the mandated legislation and to establish a degree of format uniformity between plans submitted by all 16 planning regions. The PWPG operates its administrative function through the Upper Guadalupe River Authority (UGRA), which oversees contractual and budgetary obligations. All meetings of the PWPG are open to the public and meet Open Meetings Act requirements.

## 10.3 PLANNING GROUP MEETINGS AND PUBLIC HEARINGS

All activities associated with the Regional Water Planning Process were performed in accordance with the State Open Meetings Act. All meetings of the PWPG, including committee meetings, are open to the public where visitors are afforded the opportunity and encouraged to voice their opinions, concerns, or suggestions. Meetings are primarily held in Leakey Texas so that all citizens within the Region have an equal opportunity to attend. Meeting notices are posted with the County Commissioners' Courts of each county.

All material to be presented at public meetings and all draft and final *Plan* documents were made available for public inspection on the Planning Group's website hosted by the UGRA in accordance with the Texas Public Information Act.

A public hearing was held virtually on April 23, 2020 to receive comments on the *2021 Initially Prepared Plan*. Notice of the Public Hearings was sent to 334 down-river water rights holders as well as to each county commissioner's court and designated libraries. Hard copies of the *Initially Prepared Plan* were placed in the courthouse and a designated library in each of the Regions' six counties listed below, and an electronic copy of the draft *Plan* was made available on the Upper Guadalupe River Authority web site http://www.ugra.org/waterdevelopment.html. The public was given a full month prior to the hearing to review the document.

- Bandera County Library
- Butt-Holdsworth Memorial Library (Kerr County)
- Claud H. Gilmer Memorial Library (Edwards County)
- Kinney County Public Library
- Real County Public Library
- Val Verde County Library

Prior to receiving official comments during the public hearing, a question and answer session was held so that the public attendees would have an opportunity to gain a better understanding of how the draft *Plan* was formulated. X people representing the public attended the hearing, along with several planning group members. At the conclusion of the hearing, the public was notified that there would be a 60-day period in which the PWPG would continue to receive written comments. The TWDB and TPWD also reviewed the *Initially Prepared Plan* and provided comments. Responses to agency and public comments are provided in Appendix 10A, Appendix 10B and Appendix 10C. On October 22, 2020, the PWPG met in a public forum and approved the final *2021 Plateau Region Water Plan* for submittal to the TWDB.

## 10.4 COORDINATION WITH OTHER REGIONS

Coordination with other regions was accomplished through liaisons shared with adjacent regions (Regions E, F, K, L and M) and through active participation in Chairs Conferences scheduled by the TWDB.

## 10.5 PLAN IMPLEMENTATION

Following final adoption of the *2021 Plateau Region Water Plan*, copies of the *Plan* were provided to each municipality and county commissioners' court in the Region. An electronic copy of the *Plan* is also available on the UGRA and TWDB web sites.

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# APPENDIX 10A
# RESPONSE TO PUBLIC COMMENTS

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# PUBLIC COMMENTS

The Plateau Water Planning Group (PWPG) hosted a virtual (in response to COVID 19) Public Hearing on the Plateau Water Initially Prepared Plan (IPP) on April 23, 2020. The Planning Group received one comment from Mr. Skip Newson, a resident of Val Verde County and an owner of property abutting the Devil's River.

Skip Newsom
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June 20, 2020

Mr. Jonathon Letz
Chairman
Plateau Water Planning Group (Region J)
700 Main Street, Ste. 101
Kerrville, TX 78028

Re: Initially Prepared Plan for the Plateau Region 2021 Regional Water Plan

Dear Chairman Letz,

Enclosed for filing and consideration by you and your Voting Members please find my written Comments to the Initially Prepared Plan for the Plateau Region 2021 Regional Water Plan prepared on behalf of Region J by Carollo Engineers. Should you, your staff, representatives, or any of Region J's Members have any questions regarding these Comments or require additional information, please feel free to contact me directly. Please also put me on your notification list for any and all notifications or announcements respecting the proposed Water Plan.

Respectfully yours,

Skip Newsom

To: Plateau Water Planning Group (Region J)
From: Skip Newsom
Date: June 20, 2020
Re: Comments to Plateau Region Initially Prepared Water Plan (March 2020)

## Introduction to Plan Comments

As a resident of Val Verde County and an owner of property abutting the Devils River, I offer these comments to (a) compliment the draft Plan's explanatory detail relating to necessary conservation measures and costs to meet present and future water needs, (b) address what I see as significant shortcomings in Region J's proposed 2021 Plan relating to Val Verde County, the Devils River and its underlying aquifer, and (c) offer my own perspective as to how such issues may be resolved in keeping with the Plateau Group's overall mission. More specifically:

1. The draft Plan employs a self-described "conservative methodology" to quantify sustainable groundwater supplies protective of the County's natural resources; however, it actually imposes an assumed, but wholly unsubstantiated, "zero" flow on drought period Devils River spring flows and declares groundwater availability values and a hydrogeological spring flow "trigger" derived from a "one size fits all" modeling extrapolation which, if adopted, invites habitat demise and excessive Devils River area pumping without County or stakeholder consent.

2. The draft Plan claims the intention of protecting surface water and spring flows directly related to the preservation of natural resources which are dependent on such surface water sources or spring flows for their existence. Yet, such Plan neither conducts nor relies upon any riverine or other environmental assessment to identify, quantify or correlate how such habitat, species and spring flow resources would be protected by the adoption of the proposed Plan.

3. The draft Plan's groundwater availability assessment doubles County-wide groundwater availability from Region J's previous 2016 Water Plan without explanation and adopts a County-wide hydrogeological "trigger" based strictly upon estimated pumping impacts from three southeast County wells upon southeast County spring flows measured at San Felipe Springs. Such approach reveals nothing about upgradient groundwater availability or potential pumping impacts upon any of the springs which actually contribute to the base flow of either the Devils or Pecos Rivers. The failure to provide any correlation between southeast County groundwater and spring flow conditions and Devils River or Pecos River area groundwater conditions and spring flows corrupts the County-wide water availability conclusions set forth in the draft Plan and precludes their applicability to any portion of Val Verde County other than, at best, the southeast. The Plan should be revised to reflect the Texas Water Development Board's own conclusion that no properly developed quantitative groundwater availability model currently exists for Val Verde County and no such model is available due to current data deficiencies.

4. The draft Plan recommends the creation of a groundwater conservation district for Val Verde County without delineating any reasons, consequences or costs associated with such an effort, and without any discussion of the availability or adequacy of water data details to support such creation, much less the promulgation of a groundwater management plan and the issuance or denial of pumping permits by such district once created. Unless the Plan is modified to accountably provide a detailed and reasoned explanation underlying such recommendation, accompanied by a realistic assessment of foreseeable costs associated with such undertaking, the Plan should explicitly state that it takes no position relative to such creation.

I am neither a groundwater hydrologist nor a habitat biologist, but I am passionate about protecting the unique and pristine character of the Devils River, having fished and paddled it over the course of the past five decades. I am also a member of the Devils River Conservancy and am the Chairman of the Devils River Association Water Committee, although these comments are strictly my own. In addition to being a dearly interested landowner, I have been a Texas water law specialist throughout my legal career, focusing on all facets and tangents of Texas water law across the State on behalf of landowners, water suppliers and customers, corporations, water districts and municipalities since my years in the Texas Attorney General's Office in the 1970's, where I represented the Texas Water Development Board, Texas Parks & Wildlife Department, and the predecessor agencies to the current Texas Commission on Environmental Quality. I am pleased to have this opportunity to contribute to Region J's Planning efforts and hope that these comments may prove helpful in fulfilling the Plateau Group's mission to safeguard the Devils River and its source artesian springs for future generations.

For clarity of the information and observations presented herein, a locational map of most all Val Verde County springs is appended at the end of these comments.[1]

## I
## PROTECTION OF NATURAL RESOURCES

The Devils River has long been considered to be "the most unspoiled, pristine and ecologically intact river in Texas."[2] There are a number of threatened and endangered species that inhabit springs or spring-fed streams in Val Verde County. The Devils River supports five listed species, with a sixth being currently evaluated for list inclusion by the

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[1] Spring location map is derived from the Texas Water Development Board publication "Overview of Groundwater Conditions in Val Verde County, Texas", Dec. 2018, Figure 4-12 at p. 46

[2] Birdwatchersdigest.com, "Devils River State Natural Area"; Texas Parks & Wildlife Magazine, "Falling Water," Emily Moskai, June 2017; Wikepedia.com, "Devils River"

U.S. National Park Service and the U.S. Fish and Wildlife Service.[3] The draft Plan, however, devotes little actual attention to the Devils River or its protection and, in fact, expressly declines to recommend any declaration of "ecologically unique river or stream segments" which could lend an additional level of protection for such species and habitats beyond the remarkable stewardship historically exercised by most Devils River watershed landowners in their continued efforts to preserve precious riverine habitats and species.[4]

Despite such omission, the draft Plan appears to provide an encouraging commitment to the protection of spring flows and riverine habitats found in the Devils River:

> The long-term protection of the Plateau Region's water resources, agricultural resources, and natural resources is an important component of this *2021* update of the *Plateau Region Water Plan*. Long-term water resources protection occurs in the conservative methodology of estimating water supply availability…The methodology adopted to assess groundwater source availability is based on not significantly impacting spring flows that contribute to base flows in area rivers. Thus, the intention to protect surface flows is directly related to those natural resources that are dependent on surface water sources (or spring flows) for their existence…Of prime consideration was whether a strategy potentially could diminish the quantity of water currently existing in the natural environment and if a strategy could impact water quality to a level that would be detrimental to

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[3] Texas Water Development Board, "Overview of Groundwater Conditions in Val Verde County, Texas, Dec. 2018, at p. 8, Table 2-1

[4] Plateau Region Initially Prepared Water Plan, March 2020, Corollo Engineers, Supra at pp. ES-12 and 6-4

animals and plants that naturally inhabit the area under consideration.[5]

Unfortunately, and while no doubt well intended, scrutiny of the proposed Plan's textual detail and other related documents on file at the Texas Water Development Board reveals the Plan's commitment to be more platitude than certitude.

Indeed, rather than utilizing its self-described "conservative methodology" to quantify sustainable groundwater supplies protective of the County's natural resources, the draft Plan doubles projected groundwater availability from Region J's previous 2016 Water Plan without explanation, imposes an assumed, but unsubstantiated, "zero" flow on drought period Devils River spring flows and employs groundwater availability values derived from a faulty "one size fits all" modeling extrapolation inviting potentially excessive pumping without County or stakeholder consent.

**Val Verde County Groundwater Availability Modeling**

In the past decade alone, there have been no less than four notable groundwater modeling efforts, each employing distinctly different methodologies and developing vastly different water availability assessments for Val Verde County.[6]

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[5] Id.

[6] See: (1) Anaya and Jones, 2009, "Groundwater Availability Model for the Edwards-Trinity (Plateau) and Pecos Valley Aquifers of Texas", Texas Water Development Board Report 373, April 2009; (2) Wet Rock Groundwater Services, L.L.C, 2010a, "Water Resources Evaluation of the Edwards-Trinity (Plateau) Aquifer, Weston Ranch - Val Verde County, Texas", report of findings for Western Water Division, Grass Valley Water L.P.; Wet Rock Groundwater Services, L.L.C, 2010b, "Groundwater Modeling of the Grass Valley Water Project: Weston Ranch - Val Verde County, Texas", report of findings for Western Water

Reviewing these models generally, the Texas Water Development Board staff has explained the limitations currently inherent in any Val Verde County groundwater availability model as follows:

> Numerical groundwater models are computer tools used to represent and understand aquifer flow systems. When properly calibrated, models may also be used to simulate groundwater conditions for a given set of assumptions. The level of complexity and usefulness of groundwater flow models are generally constrained by the availability of data and the range of conditions reflected in the available data. The relative scarcity of historical measurements for much of Val Verde County constitutes a challenge for modeling the Edwards-Trinity (Plateau) Aquifer groundwater flow system.[7]

Indeed, the Water Development Board staff has been particularly critical of the ability of any existing groundwater model to accurately assess Val Verde County groundwater availability:

> Aquifer properties are poorly defined in most of Val Verde County because there are few data on aquifer responses to pumping stresses. These data are needed to estimate critical parameters such as aquifer hydraulic conductivity and storage. Preferably, aquifer tests could be designed and

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Division, Grass Valley Water L.P.; (3) Eco-Kai Environmental Inc. and Hutchison, W. R., 2014, "Hydrogeological study for Val Verde County and City of Del Rio, Texas", report prepared for Val Verde County and City of Del Rio; and (4) Toll, N., Fratesi, S.B., Green, R.T., Bertetti, F.P., and Nunu, R., 2017, "Water resource management of the Devils River watershed", final report, Southwest Research Institute

[7] Texas Water Development Board (TWBD) "Overview of Groundwater Conditions in Val Verde County, Texas", Dec. 2018, p. 66

conducted on wells constructed for this purpose and located where data are most needed.[8]

Quantitative evaluation of the effects of potential future pumping on recharge, streamflow, and groundwater-surface water interaction requires an appropriately scaled, calibrated, and validated numerical model of coupled groundwater and surface water processes. Such a model is not currently available and key inputs needed to develop one are not well constrained.[9]

Water level measurements are the fundamental record required to assess groundwater resources. The current network of observation wells does not provide adequate spatial or temporal detail over the extent of Val Verde County.[10]

Models need to incorporate higher temporal and spatial resolution than the regional Edwards-Trinity (Plateau) Aquifer GAM to assess compliance with desired future conditions, but data to support more detailed models are generally lacking.[11]

Several lines of evidence suggest that a large part of the Val Verde water budget actually originates outside the model domain; if so, these models are not properly calibrated and estimates of aquifer/properties and the groundwater volumes available for use are likely in error.[12]

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[8]Id, at p. 76

[9] Id at p. 56

[10] Id. at p. 75

[11] Id at p. 66

[12] Id at pp. 66

Despite such severe model and data limitations inherent in the Plateau Region's GAM (Groundwater Availability Model) and underlying Eco-Kai and W. R. Hutchison, 2014 model for Del Rio and Val Verde County noted by the Water Development Board, together with the Board's express concerns as to likely calibration errors presented by such modeling efforts, the draft Plan's groundwater availability projection relies exclusively upon GMA7's 2018 Desired Future Condition (DFC) and Modeled Available Groundwater (MAG) determinations. Those determinations double the previously declared groundwater availability for Val Verde County from 25k AF to 50k AF, without any explanation, articulated rationale or model changes from that previously employed in GMA7's 2015 DFC Resolution and Region J's adopted 2016 Plan.[13] Such "doubled" modeled groundwater availability, although wholly unexplained in the proposed Plan or GMA7's 2018 Resolution adopting DFCs or even W.R. Hutchison's 2018 "GMA7 Explanatory Report, is entirely based upon the same W.R. Hutchison's Eco Kai 2014 model relied upon for the previous GMA7 Val Verde County DFC and Plateau Group 2016 Water Plan for Val Verde County which generated a DFC or groundwater availability of 25k AF, not 50k AF.[14] Notably, however, Mr. Hutchison's own 2018 GMA7 Explanatory Report, in a number of instances, continues to reference a Val Verde County groundwater availability of 25k AF, not 50k AF.[15] Such unexplained doubling and inconsistent presentation

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[13] See, Plateau Region Initially Prepared Water Plan, Supra, at p. 11-6, Table 11-3); Compare: Eco Kai Environmental and WR Hutchison, "Val Verde County/City of Del Rio Hydrogeological Study", May, 2014) with WR Hutchison, "GMA7 Explanatory Report, Edwards-Trinity (Plateau), Pecos Valley and Trinity Aquifers", March 2018

[14] Compare: Eco Kai Environmental and WR Hutchison, "Val Verde County/City of Del Rio Hydrogeological Study", May, 2014) with WR Hutchison, "GMA7 Explanatory Report, Edwards-Trinity (Plateau), Pecos Valley and Trinity Aquifers", March 2018).

[15] See, e.g., "GMA7 Explanatory Report", Table 1, p. 17

presents an unanswered question as to the cause and source of such change, suggesting a predetermined quantitative assessment of County-wide groundwater availability. When the same modeling results are used to support a 100% increase in modeled water availability, with absolutely no supporting explanation, something is clearly amiss, but both the draft Plan and GMA7's declared groundwater availability determinations ignore such dichotomy.

Notwithstanding the notable lack of professional consensus in approach or results presented by the various Val Verde County groundwater models reviewed by the Water Development Board, their poorly defined Aquifer properties, lack of available data necessary to accurately estimate critical aquifer parameters, and the great likelihood of calibration error in their assessments of groundwater available for use, GMA7's DFC determination is wholly irrelevant to Val Verde County. Unlike the case for every other county within GMA7, no statutorily required public hearing was conducted in Val Verde County to support any water availability assessment or DFC adopted by GMA7 for the County.[16] Likewise by statute, Groundwater Management Authorities, such as GMA7, are exclusively composed of groundwater conservation districts which set their own DFCs based upon modeled water availability within their jurisdiction.[17] Val Verde County has no such groundwater conservation district and therefore had no representation, voice or vote in any GMA7 groundwater management decisions or availability assessments declared on behalf of the County.

The draft Plan's groundwater water availability assessment for Val Verde County, based upon GMA7's adopted DFC, is an erroneous over-reach and not binding upon the County as GMA7 does not regulate Val Verde County and such adoption lacks the consent of the County and its landowning stakeholders who, as emphatically stated by our Texas Supreme Court, are the actual owners of the affected groundwater in

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16 Texas Water Code §38.108 (d-2)

17 Texas Water Code §36.108(c)

place, not the State of Texas or its legislative creations.[18] Since a determined volume of groundwater in place and actually available for capture and use beneath a surface estate can dramatically affect the value of such property, it cannot be artificially or arbitrarily increased or reduced by regulatory decree without notice to the landowners affected thereby and a fair opportunity for hearing thereon. To so decree without such notice invites litigation for a regulatory taking without due process or compensation.

The proposed Plan's implicit embrace of W.R. Hutchison's Eco Kai 2014 groundwater availability model and GMA7's Desired Future Condition is especially egregious when applied to the entire County, and the Devils River in particular, because it is based solely upon estimated pumping impacts from only three southeast County well fields upon San Felipe Springs, located in southeast Val Verde County below Amistad Reservoir. Indeed, such limited scope may have been by design since such modeling effort appears to have been directed under a City and County Partnership primarily to determine the impact of well fields proposed by the San Antonio Water System upon San Felipe Springs for a then proposed out of county export project.[19] The model was not intended to quantify groundwater conditions needed to sustain contributing spring flows to either the Devils or the Pecos River systems as those systems are not affected by San Felipe Spring flows or pumping from the southeast county wells simulated in the model. The process employed by the Hutchison/Eco Kai 2014 model is best explained by the Water Development Board staff as follows:

> The model associated with a hydrogeological study for Val Verde County and the City of Del Rio (Eco Kai Environmental, Inc. and Hutchison, 2014), was used …

[18] *Edwards Aquifer Authority vs. Day, 369 S.W.3d 814(Tex. 2012)*
[19] Hutchison/Eco Kai Environmental 2014 Hydrogeological Study, Supra at p. 46; See also, San Antonio Express News, Nolan Hicks, Jan. 12, 2014, "Opposition Grows to Val Verde Water Plan

> to simulate multiple pumping scenarios indicating the effects of a proposed well field. The model indicated the effects of varied pumping rates and well field locations. These model runs were used by Groundwater Management Area 7 as the basis for the desired future conditions for Val Verde County. * * *
> There is no associated drawdown as a desired future condition. The desired future condition is based solely on simulated spring flow conditions at San Felipe Spring of 73 to 75 million gallons per day. Pumping scenarios—50,000 acre-feet per year—in three well field locations, and monthly hydrologic conditions for the historic period 1969 to 2012 meet the desired future conditions set by Groundwater Management Area 7, Eco Kai and Hutchison, 2014; Hutchison 2018b.[20]

Notably, this is the same model run and Plateau Region Edwards-Trinity Aquifer GAM which the Water Development Board has stated needed to incorporate higher temporal and spatial resolution to assess compliance with desired future conditions and may have substantive calibration errors due to out of County sourced groundwater flows.[21]

Not only is the limited four year period of hydrological conditions utilized by the model and proposed by the Plan to simulate DFC compliance and future conditions for up to fifty years an inordinately restricted time period upon which to premise long term availability estimates, such approach tells us absolutely nothing about upgradient

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[20] Texas Water Development Board, I. Jones, "GAM RUN 16-026, MAG Version 2: Modeled Available Groundwater for the Aquifers in GMA7, Sept. 2018, at pp. 4 and 9; Hutchison/Eco Kai Environmental 2014 Hydrogeological Study, Supra at Table 12, p. 45

[21] Texas Water Development Board "Overview of Groundwater Conditions in Val Verde County, Texas", Dec. 2018, Supra at pp. 66

groundwater availability or potential pumping impacts upon any of the springs which actually contribute to the base flow of the Devils River. San Felipe Springs and the southeast portion of the County generally receive abundant groundwater flows from Edwards and Kinney Counties to the northeast and significant down pressure surface water infiltration and groundwater displacement from Amistad Reservoir's surface water storage.[22] Neither the karst conduits transmitting Edwards and Kinney County groundwater flows into southeast Val Verde County nor Amistad Reservoir's forced surface water intrusions into the underlying aquifer influence Devils River springs above Pafford Crossing. Notably, the Water Development Board has documented Amistad Reservoir's "dominating" influence on San Felipe Springs as having sizably increased southeast County groundwater elevations and San Felipe Springs flows since the Reservoir began impounding water,[23] and the Hutchison/Eco Kai 2014 model itself estimated groundwater flows to the area emanating from Edwards and Kinney County in volumes in excess of 200k AF per year.[24]

While the San Felipe Springs flow hydrologic trigger of 73-75 mgd, established by GMA7 from the Hutchison/Eco Kai 2014 groundwater availability model, may serve to protect San Felipe spring flows used by the City of Del Rio as its primary municipal water supply, such DFC spring flow trigger has no relevance to and offers no protection for Devils River or Pecos River spring flows. Indeed, the Water Development Board has expressly stated that the DFC for Val Verde County does not reflect groundwater conditions in the Devils River or Pecos River drainage basins:

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[22] Texas Water Development Board "Overview of Groundwater Conditions in Val Verde County, Texas", Dec. 2018, Supra at pp. 52, 73-74, and Figures 4-18, 5-3 and 5-4

[23] Id at p. 52; See also, W.R. Hutchison/Eco Kai 2014 Hydrogeological Study, Supra at p.50

[24] Hutchison/Eco Kai Environmental 2014 Hydrogeological Study, Supra at Table 12, p. 45

> Because the currently adopted desired future condition focuses on San Felipe Springs, it may not adequately address all potential groundwater management concerns in Val Verde County. As noted previously in this report, San Felipe Springs discharge is strongly influenced by water levels in Amistad Reservoir, such that spring flow is a poor indicator of overall groundwater conditions in the county. In addition, the drainage basin contributing to flow from San Felipe Springs may represent only a small part of Val Verde County. Groundwater management decisions based solely on San Felipe Springs discharge will not reflect groundwater conditions in the Devils River or Pecos River drainage basins.[25]

The draft Plan's recommended groundwater assessment and management for Val Verde County relies entirely upon the Hutchison/Eco Kai 2014 model for both availability and DFC hydrogeological trigger. That model, however, does "not reflect groundwater conditions in the Devils River or Pecos River drainage basins," and "is a poor indicator of overall groundwater conditions in the county." [26] The Plan should instead reflect the Water Development Board's resolute conclusion that no properly developed quantitative groundwater availability model currently exists for Val Verde County and no such model is available due to existing data deficiencies.

**<u>Devils River Spring Flows</u>**

The draft Plan additionally declares that its "intention to protect surface flows is directly related to those natural resources that are dependent on

[25] Texas Water Development Board "Overview of Groundwater Conditions in Val Verde County, Texas", Dec. 2018, Supra at p. 98
[26] Id.

surface water sources or spring flows for their existence,"[27] despite having neither conducted nor relied upon any riverine or other environmental assessment to actually determine or correlate such resources and the essential spring flows upon which they are dependent. Unlike the proposed Plan, the Texas Water Development Board has specifically addressed the frail relationship between Devils River listed species, their habitat and spring flows:

> Streamflow requirements for these species are linked to spring discharges and therefore are tied to groundwater conditions. Aquatic habitats for these species depend upon groundwater inflows to maintain sufficient, good quality river flows, particularly during droughts and summer low-flows when surface runoff is minimal and water quality begins to deteriorate. Water quality can be compromised during low flow events if water temperatures rise and dissolved oxygen decreases, further impacting these rare aquatic organisms. *** The threat of worsening drought in concert with the potential for groundwater development could exacerbate the loss of species habitat, thereby increasing the rate of species decline and leading to critical groundwater problems in the future.[28]

The proposed Plan unaccountably makes no effort to mention, much less address, such potential habitat loss, species decline or critical future groundwater problems or how the Plan's stated "intention" to protect the spring flows upon which the Region's riverine habitat resources depend is to be carried out. As such, the Plan's declared "intention" is, unfortunately, wholly unsupported and self-serving and should be retracted or revised to provide appropriate documentation to support such assertion.

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[27] Plateau Region Initially Prepared Water Plan, Supra, at p. 6-4

[28] Texas Water Development Board "Overview of Groundwater Conditions in Val Verde County, Texas", Dec. 2018, Supra at p. 11

More significantly, the proposed Plan's declared intent to protect habitat spring flows is expressly belied by its own invented characterization of Devils River flows as "generally low and undependable" as well as its unsubstantiated assumption that "zero" flows dominate during a drought-of-record:

> In absence of data for the 1950s-drought period, and considering the generally low and undependable flows within the Devils River, a realistic estimate of the drought-of-record amount of supply from the Devils River within the Plateau Region is zero.[29]

Such unfounded assertions equate to an "intermittent" stream status declaration for the Devils River and could be foreseeably used to garner regulatory support for aquifer drawdowns during periods of drought or low precipitation, thereby resulting in a self-fulfilling prophesy of truly zero spring flows. Indeed, such assertions manifest the Water Development Board's worst critical habitat fears for an unsustainable habitat condition. Yet, such assertions are not only wholly without foundation, they are expressly contrary to the drought-of-record history of the River as reported by long time Devils River area ranchers having personal knowledge and recollection of such drought-of-record conditions.[30] Quizzically, however, such area landowners were never consulted in the preparation of the proposed Plan. The draft Plan's assertions are likewise not supported by the Texas Water Development Board's own studies of the River's "continuous perennial" nature

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[29] Plateau Region Initially Prepared Plan, Supra, at p. 3-23.
[30] The author personally consulted with a number of such long time area ranchers, each of whom confirmed such draft Plan assertions to be factually erroneous.

downstream of where the River's spring-fed base flow begins at Pecan Springs.[31]

Wholly unsustainable habitat conditions in the Devils River during future periods of drought or low precipitation could potentially result from a regulatory adoption of the draft Plan's unsubstantiated "generally low and undependable" characterization and "zero" drought flow assumption for the River. Such result would be greatly catastrophic to one of the State's natural resource gems. The draft Plan's unsupported and greatly disputed contentions of "low" "undependable" and drought derived "zero" Devils River spring flows are unacceptable and factually incorrect and should be rejected and retracted in their entirety.

## II
## GROUNDWATER CONSERVATION DISTRICT CREATION

The creation of a groundwater conservation/management district for Val Verde County has been the topic of considerable debate since the passage of Texas Water Code Chapter 36's enabling legislation.[32] A groundwater conservation district creation for Val Verde County has been repeatedly presented and rejected at the Texas Legislature over the last several legislative sessions. What such a district would cost and how it would protect either private property rights or potentially at risk water resources has beguiled stakeholders ever since such questions first arose. The lack of consensus among geohydrology professionals as to Val Verde County's aquifer recharge, conductivity and storage properties, complicated by an inadequate level of recorded water data details has

[31] Texas Water Development Board "Overview of Groundwater Conditions in Val Verde County, Texas", Dec. 2018, Supra at pp. 43-51, and see Figures 6-2 and 6-7 at pp. 79 and 86

been and continues to be a serious obstacle to any appropriate groundwater management effort.[33] The costs and legal consequence uncertainties posed by such a proposed creation additionally confound the proposition.

While the Region's proposed 2021Plan advocates for such creation, [34] it is notably silent about any reasoned basis for such recommendation. Indeed, no aspect of such proposed district's governance, costs, funding, permit standards, underlying policies or resulting legal or environmental consequences is addressed by the draft Plan's recommendation. In order to embrace the Plan's proposed recommendation that a groundwater conservation district for the entire County be created, however, we must first understand why such recommendation may be perceived necessary. Such understanding should be accompanied by a realistic assessment of the likely consequences associated with such creation. It is beyond the scope of these brief comments to argue definitively in favor of or in opposition to the ultimate creation of a conservation/management district for Val Verde County. It must nonetheless be noted that, at least at this time, the creation of a groundwater conservation district is premature as neither the modeling nor aquifer defining characteristics upon which such modeling would depend are currently available, and, at present, there is no viable threat of groundwater depletion from out-of-county exportation. Indeed, the required time and expense necessary to accurately conduct a properly validated assessment of groundwater availability for Val Verde County under Texas Water Development Board standards would be significant. Even so, none of the foundational features of a district creation decision, such as cost, governance structure or policies, or legal and environmental consequences of district management and permitting decisions are presented in the proposed

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[30] Creation of water district remains a controversial topic, Del Rio News Herald, Ruben Cantu, Mar. 8, 2020

[33] Texas Water Development Board, "Overview of Groundwater Conditions in Val Verde County," Texas, Supra

[34] Plateau Region Initially Prepared Water Plan, March, 2020, p. 8-4

Plan. Such features must be accountably addressed in order to provide context to any responsible recommendation that a groundwater conservation district be created.

I do not believe that anyone legitimately fears that either our property rights or water resources in Val Verde County are threatened by future water uses within the County. However, the same cannot be said for potential water exportation projects serving municipal type uses beyond our County's boundaries. If properly presented by a reasonably prepared permit application, a groundwater conservation district has little discretion but to grant a groundwater development and use permit for export for out-of-county uses. Texas Water Code §36.122 (g) provides:

> The district may not deny a permit based on the fact that the applicant seeks to transfer groundwater outside of the district.[35]

Additionally, to avoid a takings claim and contentious, expensive, litigation, the permit granted for such export must provide for a time period sufficient to allow recovery of all transmission and facility development costs. If construction has already commenced on the transmission conduit, the minimum time period for the permit is thirty years.[36]

Numerous proposals have been considered to export Val Verde County groundwater for municipal type purposes.[37] None of such proposals are

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[35] Texas Water Code §36.122 (g)

[36] Id., at §36.122 (h and i)

[37] See, cf., Eco Kai Environmental and W.R. Hutchison, Final Draft Report, Val Verde County/City of Del Rio Hydrogeological Study, May 2014, p. 46; Joe Hyde, San Angelo Live, Sept. 22, 2013, "A Water Pipe to San Angelo will make Del Rio Howl"; San Antonio Express News,

currently active, however, and nearly all the major potential buyers -- the cities of San Antonio, San Angelo, Abilene and Midland -- have now secured large, long term water supply contractual commitments to meet their foreseeable needs.[38] Nonetheless, it should be recognized that in order to make any such trans-regional Val Verde County water transmission project financially feasible, the volume of water to be delivered would need to be substantial, as would the financing necessary to such a project. Such funding and financing of a trans-region scale water project requires a level of certainty and security which, in part, only the creation of a regulatory and tax empowered governmental entity, such as a groundwater conservation district, can offer. Without the certainty afforded by a groundwater conservation district permit stipulating availability, volume and duration, it is questionable whether any such trans-region transmission project could secure adequate funding as both equity investment and bond markets are historically and inherently risk averse, requiring a reasonable degree of success assurance to advance.

In short, the creation of a conservation district may, in fact, be an indispensable *sin qua non* to the financial viability of any potential regional groundwater export project. If true, such recognition creates the ironic paradox that, in order to protect our groundwater resources from depletion due to large scale out-of-county export, we must create a groundwater conservation district permitting authority to assure availability for such project, and then authorize and oversee such export,

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Nolan Hicks, Jan. 12, 2014, "Opposition Grows to Val Verde Water Plan

[38] San Antonio Express-News, "Like it or not, Vista Ridge pipeline now delivering water to San Antonio", Scott Huddleston, May 11, 2020; Hill Country Alliance, "SAWS Vista Ridge Pipeline Project"; Go San Angelo, "San Angelo negotiates 50-year contract to buy 1.5 billion more gallons of water per year", John Tufts, San Angelo Standard Times, May 12, 2020

when such export would not even have been financially feasible in absence of such conservation district's creation.

It should be also recognized that a groundwater conservation district is statutorily obligated to issue permits for reasonable uses of water determined to be available in nearly all instances:

> A district, to the extent possible, shall issue permits up to the point that the total volume of exempt and permitted groundwater production will achieve an applicable desired future condition under Section 36.108.) [39]

As previously noted, currently available Val Verde County groundwater models and water data details are inadequate to determine the point at which total groundwater production will achieve any declared DFC. In light of such inadequacies, a district attempting to balance the exercise of private property rights with public resource conservation goals currently would face the extreme likelihood of liability for "regulatory taking" claims and compensation for property rights taken in whole or in part as the result of licensing or other regulatory processes.[40] Indeed, in the *Bragg* case, such a "takings" judgment was issued against the Edwards Aquifer Authority for over $4.5 million.[41] Unfortunately, in these litigious times, groundwater conservation districts, can be easy targets for takings claims, particularly when, as will most often be the case, the interests of property owners wishing to maximize their business

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[39] Texas Water Code §36.1132(a)

[40] *Edwards Aquifer Authority vs. Day,* 369 S.W.3d 814(Tex. 2012); *Edwards Aquifer Authority v. Bragg,* 421 S.W.3d 118, 126–131 (Tex. App.—San Antonio 2013, pet. Denied; See also, *Stratta vs. Brazos Valley Groundwater Conservation District,* No. 18-50994, U.S Court of Appeals, 5th Cir., May 29, 2020

[41] *Stratta vs. Brazos Valley Groundwater Conservation District,* Supra at p. 14)

opportunities collide with the public goal of resource conservation.[42] On the other hand, it is also entirely possible that a district, mindful of its potential liability to pay takings judgment awards with taxpayer funds, would shy away from litigation and simply capitulate to the drawdown demands of well-represented applicants.

In order for a Val Verde County groundwater conservation district to comply with Water Code §36.1131(a) and accurately and reliably ascertain "the point that the total volume of exempt and permitted groundwater production will achieve an applicable desired future condition", such district will have to perform a "quantitative evaluation of the effects of potential future pumping on recharge, streamflow, and groundwater-surface water interaction (requiring) an appropriately scaled, calibrated, and validated numerical model of coupled groundwater and surface water processes" as plainly set out the Water Development Board's Overview of Groundwater Conditions in Val Verde County.[43] Significantly, the same Texas Water Development Board that instructs us as what such a reliable quantitative groundwater evaluation must consist of also advises us that "such a model is not currently available and key inputs needed to develop one are not well constrained."[44]

The bottom line here is simply that, at least with respect to that portion of the Edwards aquifer underlying the Devils River watershed and the focus of these comments, (1) there is no consensus among hydrogeological professionals as to critical aquifer properties or spring flow parameters, (2) a properly scaled, calibrated and validated numerical model of such parameters does not exist, and (3) such model is not presently available since currently existing data is inadequate to

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42 See, e.g. *Statta vs Brazos Valley Groundwater Conservation District,* Supra)

43 Texas Water Development Board "Overview of Groundwater Conditions in Val Verde County, Texas", Dec. 2018, Supra at p. 56

44 Id.

such purpose. The creation of a groundwater conservation district in such a vacuum of aquifer defining quantitative data and lack of reliable, validated modeling assessments would be sheer folly where permit approvals or denials can be legitimately challenged based upon the quality of evidence presented or lack thereof.[45] The lack of available data to support a district's regulatory decisions will not qualify as a rational or evidentiary defense of such decisions, but that lack of evidence could readily support claims that such decisions are arbitrary or capricious.

It goes without saying that litigation can be quite costly to landowner parties, as well as to the district and its taxpayers, but win or lose it will be a long-term field day for lawyers and their consulting witnesses. A judicial takings award constitutes a judgment for debt. As statutorily provided in Texas Water Code 36.066(b):

> Any court in the state rendering judgment for debt against a district may order the board to levy, assess, and collect taxes or assessments to pay the judgment.[46]

Indeed, that is exactly what the Court in *Bragg* ordered against the largest and best funded conservation district in the State – the Edwards Aquifer Authority.[47]

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[45] See, e.g., the long standing central Texas disputes over the Carrizo-Wilcox Simsboro formation over groundwater availability, whose aquifer properties are much more clearly defined than the Edwards-Trinity Aquifer in Val Verde County: Austin American Statesman, "LCRA declines to reveal science behind Bastrop County groundwater case," Christopher De Los Santos, Dec. 28, 2018); Reporting Texas, "Bastrop Water Conflict Turns on Competing Assessments of Aquifer Volume," Christopher De Los Santos, Dec. 17, 2018; Corridor News, "Judge Rules for Local Landowners in Groundwater Export Dispute," Jan. 5, 2018).

[46] Texas Water Code §36.066(b)

The recommendations of the Plateau Group should not invite litigation. However, the proposed recommendation that a groundwater conservation district be created in the near or foreseeable future, in the absence of coherent and well supported quantitative assessments of groundwater availability, will likely do just that.

While aquifer tests could be designed and conducted on wells constructed to provide the much needed numerical inputs required for an accurate quantitative assessment of groundwater availability, such a district endeavor would take considerable time and extensive funds which the proposed Plan neither identifies nor allocates as part of its Water Management Strategies and Conservation Recommendations. If the Plan is to seriously recommend the creation of a groundwater conservation district for Val Verde County, it should tabulate all foreseeable costs and include them in the Plan's Recommended Strategies. It should be recognized, however, that even once such additional data collection and availability assessments are conducted, there may be no assurance that such efforts will be sufficient to generate the substantive quantitative groundwater assessment described by the Water Development Board and invariably necessary to minimize the threat of litigation over the district's management and permitting processes.[48]

Under the totality of circumstances here presented, since neither a quantitative availability assessment of groundwater underlying the Pecos and Devils River Watersheds nor a Desired Future Condition for such areas has been, and presently cannot be, accurately or reliably determined, and no imminent threat of Val Verde County aquifer

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[47] *Edwards Aquifer Authority v. Bragg,* Supra

[48] Texas Water Development Board "Overview of Groundwater Conditions in Val Verde County, Texas", Dec. 2018, Supra at p 56

drawdowns from out-of-county groundwater export projects is currently presented, the facts simply do not support the creation of a groundwater conservation district for Val Verde County at this time. The proposed Plan should be modified to expressly state that the Plateau Group makes no recommendation as to the creation of a groundwater conservation district for Val Verde County.

## AFTERTHOUGHTS

I stated at the outset that I am passionate about protecting the Devils River, its springs and its habitat. I am also a realist, so while I am hopeful that these comments will prompt further examination and reformation of the currently proposed Plan as relevant to Val Verde County and the Devils River, as a practical matter, that may be unduly optimistic. Although Val Verde County, as reported by the draft Plan's demographics, maintains the largest population in the Region, represents the majority of the Region's municipal water use, is reported to have the highest volume of retrievable groundwater in the Region and has the greatest socio-economic risk associated with potential fresh water shortages, the County has been relegated to only 3 voting directors (15%) on the 20 member Region J Board. Likewise, because Groundwater Management Areas are comprised of and governed solely by groundwater conservation districts, Val Verde County has no seat at the table for water availability and DFC determinations of Groundwater Management Area 7 simply because it has, to date, not elected to undertake the costs or uncertainties commensurate with the creation of a groundwater conservation district within its boundaries. Hence, given that Val Verde County has very limited voice or influence in the decisions of the Plateau Group or GMA7, I can only hopefully ask that your adoption of a 2021 Water Plan for Region J be driven by the power of persuasion and documentary support presented in these comments, not the power of politics in the Plateau Group's representative make-up or that of GMA7. I urge that your acceptance of the proposed Plan, as it relates to the Devils River and its underlying aquifer, be conditioned upon reformation of the proposed Plan consistent with the comments and proposals here presented.

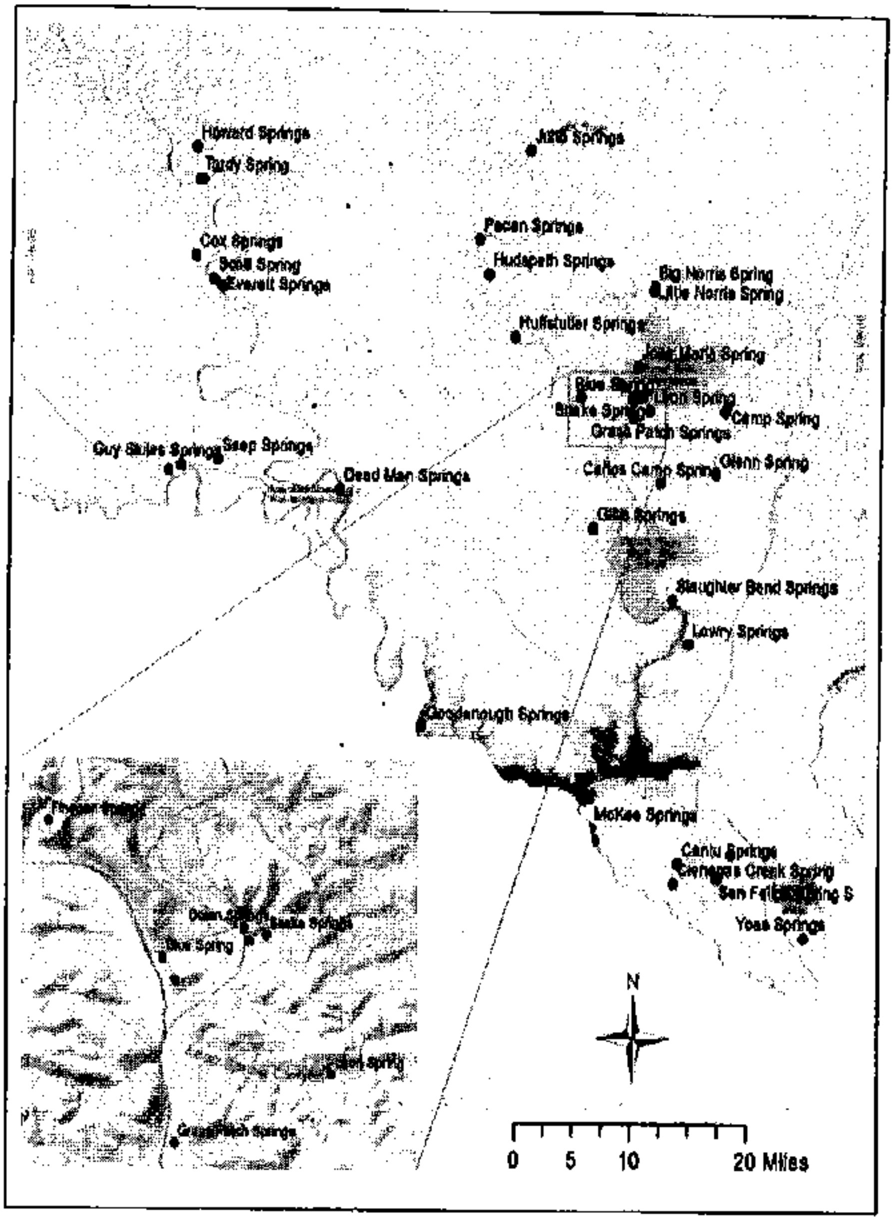


*Figure 4-12. Locations of springs in Val Verde County (adapted from Ashworth and Stein, 2005).*

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# RESPONSES TO PUBLIC COMMENTS

The Plateau Water Planning Group appreciates the well-written comment / position paper presented by Mr. Skip Newsom and, in response, the PWPG has eliminated their recommendation pertaining to the creation of a Val Verde Groundwater Conservation District (Chapter 8). The Group has also added the following language to the recommendation pertaining to water research needs for the Edwards-Trinity (Plateau) Aquifer:

> *Specific concern has been voiced by citizens in Val Verde County where the groundwater source availability of the Edwards-Trinity (Plateau) Aquifer changed from 25,000 acre-feet per year in the 2016 Plateau Region Water Plan to 50,000 acre-feet per year in this current Plan. TWDB modelers are particularly critical of the ability of any existing groundwater model to accurately assess Val Verde County groundwater availability as aquifer properties are poorly defined in most of Val Verde County because there are few data on aquifer responses to pumping stresses. In particular, a better understanding is needed of the different geohydrologic environments that exist between the southern San Felipe Springs – Amistad Reservoir area verses the upstream Pecos and Devil's River area.*

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# APPENDIX 10B
# RESPONSE TO TWDB COMMENTS

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# TWDB comments on the Initially Prepared 2021 Plateau (Region J) Regional Water Plan.

**Level 1: Comments, questions, and data revisions that must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements.**

1. Chapter 5 and the State Water Planning Database (DB22). The plan includes the following recommended water management strategies (WMS) by WMS type, providing supply in 2020 (not including demand management): 24 *groundwater wells & other*, one *other direct reuse*, three *aquifer storage and recovery*, and three *other surface water*. **Strategy supply with an online decade of 2020 must be constructed and delivering water by January 5, 2023**.
   a) Please confirm that all strategies shown as providing supply in 2020 are expected to be providing water supply by January 5, 2023. *[31 § TAC 357.10(21); Contract Exhibit C, Section 5.2]*
   b) Please provide the specific basis on which the planning group anticipates that it is feasible that the three *aquifer storage and recovery*, and three *other surface water* WMSs will all actually be online and providing water supply by January 5, 2023. For example, provide information on actions taken by sponsors and anticipated future project milestones that demonstrate sufficient progress toward implementation. *[31 § TAC 357.10(21); Contract Exhibit C, Section 5.2]*
   c) In the event that the resulting adjustment of the timing of WMSs in the plan results in an increase in near-term unmet water needs, please update the related portions of the plan and DB22 accordingly, and also indicate whether 'demand management' will be the WMS used in the event of drought to address such water supply shortfalls or if the plan will show these as simply 'unmet'. If municipal shortages are left 'unmet' and without a 'demand management' strategy to meet the shortage, please also ensure that adequate justification is included in accordance with 31 TAC § 357.50(j). *[TWC § 16.051(a); 31 § TAC 357.50(j); [31 TAC § 357.34(i)(2); Contract Exhibit C, Section 5.2]*
   d) **Please be advised that, in accordance with Senate Bill 1511, 85th Texas Legislature, the planning group will be expected to rely on its next planning cycle budget to amend its 2021 Regional Water Plan during development of the 2026 Regional Water Plan, if recommended WMSs or projects become infeasible, for example, do to timing of projects coming online.** Infeasible WMSs include those WMSs where proposed sponsors have not taken an affirmative vote or other action to make expenditures necessary to construct or file applications for permits required in connection with implementation of the WMS on a schedule in order for the WMS to be completed by the time the WMS is needed to address drought in the plan. *[Texas Water Code § 16.053(h)(10); 31 TAC § 357.12(b)]*

2. ES Appendix. The plan includes some DB22 reports that appear blank due to the region not having relevant data for these reports. Please provide a cover page to the DB22 report appendix indicating the reason for these report contents being blank.

3. Chapter 1. Please include a discussion of the current preparation for drought within the planning area in Chapter 1 of the final, adopted regional water plan. *[31 TAC § 357.30(10)]*

4. Chapter 3, page 3-7 and ES Appendix. The total existing water supplies presented in Table 3-2 appear to be inconsistent with existing supplies reported in DB22. For example, Table 3-2 shows a total of 62,846 acre-ft/year from 2020 to 2060 and 62,845 for 2070. DB22 reports the total existing supply as 61,578 acre-ft/year from 2020 to 2070. Please reconcile this information as necessary in the final, adopted regional water plan. *[31 TAC § 357.32(e)]*

5. Chapter 3, page 3-8, Table 3-3. Please revise the Table 3-3 header and column header from 'Wholesale Water Provider' to 'Major Water Provider' in the final, adopted regional water plan. *[31 TAC § 357.32(g)]*

6. Section 3.1.1, Table 3-4, page 3-11. Please update Table 3-4 to include Guadalupe Basin, Real County for the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers. *[Contract Exhibit C, Section 3.5.2]*

7. Section 3.4, page 3-30. It is not clear what methodology was used to calculate direct reuse supplies discussed in Section 3.4. Please provide a more detailed explanation of the methodology used to calculate reuse supplies, including as relates to existing treatment capacity, in the final, adopted regional water plan. *[Contract Exhibit C, Section 3.4]*

8. Chapter 3. Please include a summary of the Water Availability Models (WAM) used, including any modification to the models approved by the TWDB's Executive Administrative in the final, adopted regional water plan. The summary of WAM models used should include information on WAM version/date, WRAP version used for simulation, and the date of the simulation. *[Contract Exhibit C, Section 3.2.1]*

9. Chapter 4, page 4-4, Table 4-2. Please revise the Table 4-2 header and column header from 'Wholesale Water Provider' to 'Major Water Provider' in the final, adopted regional water plan. *[31 TAC § 357.33(b)]*

10. Page 4-5. The plan includes blank spaces for Table 4.3 (Second -Tier Identified Water Needs) and Table 4.4 (WUG Unmet Needs). Please either include this information or refer the reader to the applicable DB22 reports in the final, adopted regional water plan. Additionally, unmet needs should be presented in Chapter 6. *[31 TAC § 357.33(e); 31 TAC § 357.40(c)]*

11. Chapter 4. The plan does not appear to include a secondary needs analysis for major water providers (MWP). If the region does not include a separate table for Del Rio, please indicate where the reader can find the secondary needs for Del Rio (the

region's MWP), in the DB22 reports in the final, adopted regional water plan. *[31 TAC § 357.33(e)]*

12. Section 5.2.5, page 5-10. Del Rio is identified as having significant water needs; however, the plan does not appear to provide a specific assessment of aquifer storage and recovery (ASR) for the identified needs for Del Rio. Please present information on the assessment of ASR for Del Rio in the final, adopted regional water plan. *[TWC § 16.053(e)(10); 31 TAC § 357.34(h)]*

13. Table 5-2 and Appendix 5A. Vegetative Management is presented in the plan as a recommended WMS with a zero supply yield in all decades in Table 5-2 and is included as the strategy evaluations J-13, J-29; J-44, J-70, J-71, J-78, J-87. Please remove Vegetative Management from the list of recommended WMSs, and present information on Vegetative Management in a separate section in the final, adopted regional water plan. *[31 TAC § 357.34(d)]*

14. Page 5A-3. The strategy evaluation for J-1 appears to describe a reuse WMS used for irrigation at a resort. These projects are not appropriate for inclusion in the regional water plans per Contract Exhibit C, Section 5.5.3. Reuse WMSs may not include distribution lines directly to residences or commercial businesses. Please ensure projects not required to increase the volume of water supply are omitted from the final, adopted regional water plan. *[Contract Exhibit C, Section 5.5.3]*

15. Pages 5A-4, 5A-16, and 5A-42. The evaluation for strategy J-28 states that in a severe drought, alluvial aquifers are the first to go dry and the evaluation for strategy J-75 states that reliability of supply is low to medium based on water quantity issues. Additionally, the evaluation for J-2 indicates a seasonal supply based on rainfall. Please remove these strategies from the final, adopted regional water plan since the IPP indicates that the strategy supplies presented in for strategy J-2, J-28, and J-75 will not be available as firm supplies under drought of record conditions. In the event that the resulting adjustment of the timing of WMSs in the plan results in an increase in near-term unmet water needs, please update the related portions of the plan and DB22 accordingly. *[31 TAC § 357.34(b)]*

16. Page 5A-26, Strategy J45, project 1. The plan does not appear to present separately the reservoir associated land costs. Please include separated reservoir-associated land costs or indicate land costs are not applicable to this strategy in the final, adopted regional water plan. *[Contract Exhibit C, Section 5.5]*

17. Page 5A-26, Strategy J-45, project 2. The plan indicates that the Kerr County Commissioners Court would negotiate diversion rights up to 6,000 acre-feet/year of water. Please clarify whether the region coordinated with Region L on the yield for this WMS, as the 2021 Region L IPP indicated a potential commitment of 2,000 acre-feet/year from Canyon Reservoir. After confirmation or coordination with Region L/GBRA, please adjust the anticipated yield, if necessary, in the final, adopted regional water plan to reflect the expected supply volume. In the event that the resulting adjustment of the timing of WMSs in the plan results in an increase in

near-term unmet water needs, please update the related portions of the plan and DB22 accordingly. *[31 TAC § 357.35(f)]*

18. Page 5A-46. It is not clear from the evaluation for J-83 what reuse project components are included for this WMS. Please ensure that reuse WMSs do not include distribution lines directly to residences or commercial businesses and ensure projects not required to increase the volume of water supply are omitted from the final, adopted regional water plan. *[Contract Exhibit C, Section 5.5.3]*

19. Chapter 5B. The plan includes *brush control* and *rainwater harvesting* recommendations in the *conservation* recommendation subchapter. For planning purposes, these strategy types may not be considered demand reduction and must be presented separately from conservation, in addition, they are reported separately in DB22. Please remove the Vegetative Management and Rainwater Harvesting recommendations from the conservation subchapter in the final, adopted regional water plan. *[31 TAC § 357.34(h); Contract Exhibit C, Section 5.10]*

20. Chapter 5 and DB22. From the information presented in the plan, it is not clear that all required capital cost components were evaluated for each strategy. For example, capital costs should consider the following as applicable: construction costs, engineering and feasibility studies, legal assistance, financing, bond counsel and contingencies, permitting and mitigation, land purchase not associated with mitigation, easement costs, and purchases of water rights. Please clarify the cost elements considered in strategy evaluations in the final, adopted regional water plan. *[Contract Exhibit C, Section 5.5]*

21. Units costs reported in DB22 appear notably high for the City of Brackettville - Increase Supply to Spofford with New Water Line and Storage and the Val Verde County Other - Val Verde County WCID - Water Loss Audit and Main-Line Repair WMSs. For example, unit costs are reported as $153,214 per acre-foot in 2020 and 2030 for the City of Brackettville - Increase Supply to Spofford with New Water Line and Storage WMS, and unit costs are reported as $41,026 in 2020 and 2030 for the Val Verde County Other - Val Verde County WCID - Water Loss Audit and Main-Line Repair WMS. Please confirm that the calculated unit costs are correct in DB22 and that costs were considered in WMS recommendations in the final, adopted regional water plan. *[31 TAC § 357.34(e)(2)]*

22. Appendix 5A. The plan in several instances, for example, evaluations J-30, J-32, J-34, J-64, J-88, presents mining conservation strategies with zero costs and yet notes an assumption that there are strategy costs that are assumed to be paid back within a year. Please report the initial one-time costs for these strategies against which cost savings are based in the final, adopted regional water plan. *[31 TAC § 357.34(e)(3)(A); Contract Exhibit C, Section 5.5]*

23. Appendix 5A. The plan does not clearly state if or how TCEQ adopted environmental flow standards were taken into account in calculation of yield for the following WMSs: Acquire Surface Water Supply (J-5) and Eastern Kerr County Regional Water

Supply Project (J-45, Project 1). The evaluation for J-5 states that 7Q2 was used, however the Chapter 298 environmental flow standards for the San Antonio Basin should be used. If the diversion associated with J-45, Project 1 isn't already permitted, Chapter 298 environmental flow standards should be used. Please clarify the application of environmental flow standards for these WMSs and reevaluate the WMSs using the required environmental standards if they were not applied in the final, adopted regional water plan. *[31 TAC § 357.34(e)(3)(B); 31 TAC § 358.3(22); 31 TAC § 358.3(23)]*

24. Chapter 5. The plan does not include the WMS project costing tool's output report for projects or analogously present the capital cost for each project component. Please submit the costing tool's standardized cost output report or present capital cost estimates for each project component for each WMS evaluated in the final, adopted regional water plan. *[31 TAC § 357.34(f); 31 TAC § 358.3(21); Contract Exhibit C, Section 5.5.1; Contract Exhibit C, Section 5.7]*

25. Chapter 5. The plan presents the documented process for identifying potentially feasible WMSs but does not appear to include the process of selecting recommended WMSs and projects. Please include documentation of the process of selecting recommended WMSs and projects in the final, adopted regional water plan. *[Contract Scope of Work, Task 5A subtask 5]*

26. Chapter 5. Please include documentation of why seawater desalination was not selected as a recommended WMS in the final, adopted regional water plan. *[TWC § 16.053(e)(5)(j); Contract Exhibit C, Section 5.2; 31 TAC § 357.34(g)]]*

27. Chapter 5. It is not clear if third-party social and economic impacts resulting from voluntary redistributions of water, including impacts of moving water from rural and agricultural areas, were considered in the evaluation of potentially feasible WMSs. Please clarify how these impacts were considered (or clarify if there are no impacts) in the final, adopted regional water plan. *[31 TAC § 357.34(e)(7)]*

28. Chapter 6. The plan does not appear to include a description of third-party social and economic impacts resulting from voluntary redistributions of water, including analysis of third-party impacts of moving water from rural and agricultural areas. Please include this information (or clarify if there are no impacts) in the final, adopted regional water plan. *[31 TAC § 357.40(b)(4)]*

29. Chapter 6. Please include a description of major impacts of recommended WMSs on key parameters of water quality in Chapter 6 of the final, adopted regional water plan. *[31 TAC § 357.40(b)(5)]*

30. Chapter 6. The plan states that there are no identified unmet water needs in Chapter 5 (page 5-11), however data reported in DB22 shows unmet water needs for the following WUGs: Laughlin Air Force Base, County-other sub-WUGs: Bandera River Ranch 1, Lake Medina Shores, Center Point, Center Point Taylor System, Val Verde County-Other, and Livestock Kerr County, and Livestock Kinney County. Please reconcile this information and provide documentation that all potentially feasible

WMSs were considered to meet identified needs. Additionally, please include a summary of unmet water needs in Chapter 6 and provide an adequate justification of unmet needs for municipal WUGs as specified in rule and contract guidance, in the final, adopted regional water plan. *[31 TAC § 357.40(c); 31 TAC § 357.50(j); Contract Exhibit C, Section 6.3]*

31. Section 7.4, page 7-19. Please confirm whether the entities evaluated for emergency responses to local drought conditions or loss of municipal supply were assumed to have 180 days or less of remaining supply. *[Contract Exhibit C, Section 7.4]*

32. Section 7.5.3. Table 7-8 appears to include recommended drought triggers and actions; however, the table is blank for all columns associated with triggers. Please include specific drought response triggers in Table 7-8 in the final, adopted regional water plan. *[31 TAC § 357.42(c)(1)]*

33. Section 7.5.4, page 7-32. The plan does not appear to include copies of the model drought contingency plans as referenced in Attachment 7-1. Please include the model plans (two plans minimum) in the final, adopted regional water plan. *[31 TAC § 357.42(j)]*

34. Chapter 7. Model drought contingency plans were not provided for review. Please ensure that model drought contingency plans submitted with the final, adopted regional water plan at a minimum have triggers and responses to 'severe' and 'critical/emergency' drought conditions. *[Contract Exhibit C, Section 7.6]*

35. Page 7-33. Section 7.6 states that "The PWPG does not consider drought management as a feasible strategy to meet long-term growth in demands or current needs." However, Drought Management is presented as a recommended WMS for Bandera County-Other in Table 5-2 and as reported in DB22. Please reconcile this information as appropriate, including references the associated triggers to initiate each of the recommended drought management strategies, if any, throughout the final, adopted regional water plan. *[31 TAC § 357.42(f)(2)]*

36. Chapter 7. The plan does not appear to include a discussion of whether drought contingency measures have been recently implemented (for example, since the adoption of the last regional water plan) in response to drought conditions. Please include this information in the final, adopted regional water plan. *[Contract Scope of Work, Task 7, subtask 3]*

37. Chapter 10. The plan notes that all meetings were held in accordance with the Texas Open Meetings Act but does not discuss compliance with the Texas Public Information Act. Please address how the planning group complied with the Texas Public Information Act in the final, adopted regional water plan. *[31 TAC §357.21; 31 TAC §357.50(f)]*

38. Chapter 11, Table 11-1. The plan did not include implementation survey data collected to date. Please ensure that the template and data used for the implementation survey in the final, adopted regional water plan are based on the

survey template and data that the TWDB provided in June 2019. *[31 TAC § 357.45(a)]*

39. Chapter 11, Table 11-9. Please remove the Vegetative Management zero yield WMSs from Table 11-9. Additionally, please provide a brief summary of how the 2016 Plan differs from the 2021 Plan with regards to recommended and alternative WMS *projects* in the final, adopted regional water plan. *[31 TAC § 357.45(b)(4)]*

**Level 2: Comments and suggestions for consideration that may improve the readability and overall understanding of the regional water plan.**

1. Page ES-9 references tables ES-2 through ES-6, however these tables do not appear to be in the plan. Please consider updates these table references.
2. Page ES-12. Please correct spelling of "Agricultural" in bold heading text.
3. Chapter 3. Please consider adding table numbers to the tables on pages 3-12 and 3-16.
4. Section 3.1, page 3-9. The study Occurrence of Significant River Alluvium Aquifers in the Plateau Region, 2010 does not appear to be linked on the Plateau RWPG's webpage, as indicated on page 3-9. Please provide an active link to the webpage with the final plan.
5. Section 3.1.1, Table 3-4, page 3-11. For the groundwater availability methodology listed as "GMA9 Non-Relevant, TWDB modeled". Please consider clarifying which model runs were used and if this includes pumping from the associated modeled available groundwater run that was compatible with the DFC, which was provided to planning groups for consideration.
6. Page 3-11, Table 3-4. Please consider adding a source for the Austin Chalk Aquifer methodology presented.
7. Page 3-11, Table 3-4. Please consider revising the terminology of "hydraulic conductivity" to 'Annual availability" in reference to the Ellenburger/San Saba Aquifer.
8. Section 5.3.4, page 5-29. Please correct the first sentence that states, "Many of the recommended water management strategies listed in Error! Reference source not found.2 are…".
9. Section 5.3.5. Please consider including that all entities with 3,300 or more connections and/or a financial obligation with TWDB greater than $500,000 are also required to submit WCPs.

10. Section 5.3.3, page 216. The reference to Report 362 is outdated. A current list of BMPs is available at https://www.twdb.texas.gov/conservation/BMPs/index.asp.

11. Page 5A-44. The plan states that the Oakmont Saddle Mountain WSC has applied to the TWDB for SWIFT funding for an additional well. To date, the TWDB has not received a SWIFT application from Oakmont Saddle Mountain WSC. Please reconcile this statement in the final plan.

12. Page 7-22. The plan states that this is the first cycle regional drought planning was required. Please consider updating this statement, as regional model drought contingency plans were required in the previous planning cycle.

13. The GIS files submitted for WMS projects do not adhere to the contractually required naming convention. Please rename the GIS files following the naming convention outlined in Exhibit D, Section 2.4.5 in the final GIS files submitted. *[Contract Exhibit D, Section 2.4.5]*

14. The GIS files submitted for WMS projects do not include all of the required attribute fields listed in Table 1 of Exhibit D, Section 2.4.5. Please include the following attribute fields in all submitted WMS project GIS data: Project ID, Sponsor, Name, Location Description, Project Components, and Datum, with the final GIS files submitted. *[Contract Exhibit D, Section 2.4.5]*

**RESPONSE TO TWDB COMMENTS**

**<u>LEVEL 1:</u>**

1a. The following ten strategies listed in the IPP have been changed to a starting decade of 2030 (See response 1b below).

- City of Bandera – Reuse treated wastewater effluent for irrigation ---
- City of Bandera – Promote, design and install rainwater harvesting systems ---
- City of Bandera – Additional Lower Trinity well ---
- City of Bandera – Surface water acquisition, treatment and ASR
- City of Kerrville – Increase water treatment and ASR capacity
- EKCRWSP Project 1 – Construction of an Ellenburger Aquifer water supply well
- EKCRWSP Project 2 – Construction of off-channel surface water storage
- EKCRWSP Project 3 – Construction of an ASR facility
- EKCRWSP Project 4 – Construction of a wellfield and desalination plant
- City of Brackettville – Increased supply to Spofford with new water line and increased storage facility
- Fort Clark Springs MUD – Increased storage facility
- City of Leakey – Develop interconnection between city wells
- City of Del Rio – Water treatment plant expansion
- City of Del Rio – Develop a wastewater reuse program

1b. The remaining strategies listed as starting in the 2020 decade could feasibly be implemented by January 5, 2023.

- All conservation strategies can be implemented immediately at the discretion and need of the WUG.
- All water loss audit and main-line repairs can be implemented in a very short time at the discretion of the WUG.
- Groundwater well projects can feasibly be implemented within approximately one year at the discretion of the WUG.

1c. There are no increases in unmet needs resulting from changing the starting decade of implementation of the above strategies to 2030.

1d. The Plateau Region Water Planning Group acknowledges that they will be expected to rely on its next planning cycle budget for any required Plan amendments.

2. DB22 report appendix page now contains listing of TWDB provided tables and notations on tables with no relevant data.

3. Current preparation for drought in the region is discussed in Chapter 1, Section 1.2.5, final paragraph.

4. Tables 3-1, 3-2 and 3-3 in the Plan now match Ex Sum TWDB tables.

5. Table 3.2 headers are corrected to show "<u>Major</u> Water Provider".

6. Guadalupe Basin is added in Table 3-4.

7. Reuse source supply methodology is provided in Chapter 3 Section 3.4.

8. River Basin WAM summary information is provided in Chapter 3 Section 3.2.

9. Table 4.2 headers are corrected to show "Major Water Provider".

10. Tables 4-3 and 4-4 are eliminated and reference is made to the appropriate tables in the Executive Summary Database-22 Appendix.

11. The second-tier needs analysis for WUGs and MWPs is referenced to the appropriate TWDB DB22 table in the Executive Summary Appendix in the third paragraph of Ch 4 Sec 4. Text is revised to specifically explain that Del Rio Utilities Commission, the Region's only Major water Provider, is listed in this table.

12. An ASR discussion is added to Chapter 5 Section 5.2.5.

13. Vegetative Management strategies have been eliminated from Chapter 5 Tables 5-2, 5-3, 5-4 and Appendix 5A; and is discussed as a recommended conservation practice in Chapter 5 Section 5-2-8.

14. Discussion pertaining to Flying L Resort is eliminated from Strategy J-1.

15. PWPG considers strategies J-2, J-28 and J-75 capable of producing firm yields during drought conditions and desires to retain all three strategies. Strategy discussions are altered to eliminate confusion and the "Reliability" factor index definition at the end of Table 5-2 is changed to read "2 = Provides firm supply, but may be partially impacted during drought conditions". Strategy J-75 was incorrectly titled and is corrected to read "Drill Additional Well in the Lower Trinity Aquifer".

16. Land purchase and survey cost is shown in Chapter 5 Appendix 5A Strategy J-45 Project 2a.

17. This strategy has been eliminated.

18. Strategy J-83 discussion is revised to describe the infrastructure component of the project as a 10-mile long major transmission pipeline. Reference to the TWDB funded project has been deleted.

19. Brush Control and Rainwater Harvesting are not intended as "recommendations", but are presented in the conservation subchapter as "State Water Conservation Programs and Guides". This material is presented solely for reader education and not intended as a water management strategy discussion. Rainwater Harvesting is removed from the list of conservation strategies in Ch 5 Sec 5.3.4.

20. A description of capital cost elements are included in Ch 5 Sec 5.2.1.

21. Unit costs in Strategy J-66 (Brackettville-Spoford) and J-84 (Val Verde County Other) have been verified and are in agreement with DB22.

22. Strategies J-30, J-32, J-34, J-64 and J-88 have been eliminated and a discussion pertaining to mining conservation has been added in Chapter 5 Section 5.2.2.

23. Strategies J-5 and J-45 Project 2a have been revised to include environmental flow standards.

24. The costing tool's output report is provided for all required projects and capital costs are presented for all project strategies in Chapter 5 Tables 5-2 and 5-3.

25. An explanation of the process of selecting recommended strategies is added in the first paragraph of Chapter 5 Section 5.2.4.
26. The reasoning for not including seawater desalination is included in the second paragraph of Chapter 5 Section 5.2.4.
27. Third-party social and economic impacts of moving water from rural and agricultural areas is addressed in the third paragraph of Chapter 5 Section 5.2.4.
28. Third-party social and economic impacts of moving water from rural and agricultural areas is addressed in the first paragraph of Chapter 6 Section 6.
29. Chapter 1 Section 1.4.5 describes water quality issues relevant to the Plateau Region. Major impacts of recommended water management strategies on key parameters of water quality are discussed in the fifth paragraph of Chapter 6 Section 6.1.
30. Chapter 6 Section 6.4 is added to discuss unmet water needs that match the final DB22 report. Center Point and Center Point Taylor were corrected in the database to not show as having unmet needs. A new strategy was generated for Laughlin AFB to take care of their needs.
31. Entities evaluated for emergency response with 180 days or less of remaining supply is stated in the second paragraph of Chapter 7 Section 7.4.
32. Chapter 7 Table 7-8 is revised to include drought triggers and actions. No new triggers and actions were generated, so table shows that recommendations are to follow existing triggers and actions noted in Table 7-1.
33. Model drought contingency plans are discussed in Chapter 7 Section 7.5.4 and provided by link to the Plateau Region Water Plan website.
34. Model drought contingency plans are discussed in Chapter 7 Section 7.5.4 and provided by link to the Plateau Region Water Plan website.
35. Chapter 7 Section 7.6 is modified to recognize drought management strategies J-14 and J-18 for Bandera County-Other.
36. A discussion pertaining to recent implementation of drought contingency measures is added as the fifth paragraph of Chapter 7 Section 7.2.
37. The Texas Public Information Act is added to the first paragraph of Chapter 10 Section 10.3.
38. Chapter 11 Table 11-1 implementation survey report has been added.
39. Chapter 11 Table 11-6 has been replaced and does not contain Vegetative Management strategies. Chapter 11 Tables 11-7 and 11-8 have been added and a narrative has been added in Sec 11.2.6 that compare recommended and alternate WMS *projects*.

**LEVEL 2:**

1. Text on page ES-9 is revised to not show table numbers. A listing of all TWDB tables are now provided on the ES Appendix cover page.
2. The spelling of Agriculture is corrected on page ES-12 of the Executive Summary.
3. The table on Chapter 3 Page 3-12 has been redesigned as a bulleted list. The table on page 3-16 is made into Table 3-5, which results in renumbering the previous Table 3-5 on page 3-26 to Table 3-6.
4. Alluvial Aquifers Report (2010) has been sent to UGRA for posting on PWPG website.
5. Corrections made in Chapter 3 Table 3-4.
6. Corrections made in Chapter 3 Table 3-4.
7. Corrections made in Chapter 3 Table 3-4.
8. "Error! Reference source not found.2" is corrected in Chapter 5 Section 5.3.4.
9. Additional entities required to submit WCPs are added to Chapter 5 section 5.3.5.
10. Conservation BMPs reference is replaced with new website in Chapter 5 Section 5.3.3.
11. Statement pertaining to Oakmont Saddle Mountain funding has been removed from Chapter 5 Strategy J-79.
12. Reference to first planning period has been deleted in Chapter 7 Section 7.5.
13. An attempt has been made to properly rename GIS files according to the naming convention outlines in the Guidelines.
14. An attempt has been made to include all required attribute fields in the GIS data.

# APPENDIX 10C
# RESPONSE TO TPWD COMMENTS

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June 22, 2020

Mr. Jonathan Letz, Chairman
Plateau Water Planning Group (Region J)
700 Main Street, Suite 101
Kerrville, Texas 78028

Dear Mr. Letz:

Thank you for seeking review and comment from the Texas Parks and Wildlife Department ("TPWD") on the 2021 Initially Prepared Regional Water Plan (IPP) for the Plateau Region J Water Planning Area. Water impacts every aspect of TPWD's mission to manage and conserve the natural and cultural resources of Texas. Although TPWD has limited regulatory authority over the use of state waters, we are the agency charged with primary responsibility for protecting the state's fish and wildlife resources. To that end, TPWD offers these comments intended to help avoid or minimize impacts to state fish and wildlife resources.

TPWD understands that regional water planning groups are guided by 31 TAC §357 when preparing regional water plans. These water planning rules spell out requirements related to natural resource and environmental protection. Accordingly, TPWD staff reviewed the IPP with a focus on the following questions:

- Does the IPP include a quantitative reporting of environmental factors including the effects on environmental water needs and habitat?
- Does the IPP include a description of natural resources and threats to natural resources due to water quantity or quality problems?
- Does the IPP discuss how these threats will be addressed?
- Does the IPP describe how it is consistent with long-term protection of natural resources?
- Does the IPP include water conservation as a water management strategy?
- Does the IPP include Drought Contingency Plans?
- Does the IPP recommend any stream segments be nominated as ecologically unique?
- Does the IPP address concerns raised by TPWD in connection with the 2016 Water Plan?

TPWD appreciates the Plateau Water Planning Group's (PWPG) response to the Department's comments regarding the 2016 plan and acknowledgement of staff support during the current and previous planning cycles. It is clear the PWPG recognizes the importance of protecting the natural and ecological resources of the Region as they are important economic drivers for the area.

The 2021 IPP is a refinement of the 2016 Regional Water Plan. Projected population has not changed significantly with the population of the 6 county Plateau Water Planning Area estimated to grow by 52 percent from 141,176 in 2020 to about 185,000 by 2070. Approximately 45 percent of the total population of the area is located in the two largest cities, Del Rio and Kerrville. The forecasted total demand for water needed in the Region will increase from the year 2020 by 44,937 acre-feet (13 percent) by the year 2070. Municipal and irrigation combined represent 93 percent of all water used in the Region.

Recommended Water Management Strategies (WMS) for meeting future water needs include water conservation, reuse, additional groundwater development, expansion of an existing aquifer storage and recovery (ASR) project and construction of a new ASR project, a new off-channel reservoir, rainwater harvesting and vegetative management. TPWD commends the Plateau Region J Water Planning Group for its emphasis on water conservation and reuse. In addition each WMS was evaluated to determine whether a strategy potentially could diminish the quantity of water currently existing in the natural environment and if a strategy could impact water quality to a level that would be detrimental to animals and plants that naturally inhabit the area under consideration.

The Plateau Region J IPP includes thorough descriptions of natural resources and acknowledges the importance of protecting those resources. Section 1.2.6 describes the Native Vegetation and Ecology but does not include a list of threatened and endangered species found in the Region. There have been recent updates (March 30, 2020) to the list of federal and state listed species and Species of Greatest Conservation need, including species in Region J counties. We recommend that you include a table with the latest information that is available at, https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/nongame/listed-species/.

Environmental and recreational water needs are discussed in Sections 1.35 and 2.3 and elsewhere in the document. Even though environmental and recreational water uses are not quantified, they are recognized as being an important consideration. It would be appropriate to mention the Senate Bill 3 environmental flows process in this discussion.

Table 5-4 provides an analysis of environmental impacts related to each WMS. TPWD appreciates the inclusion of Appendix 5B in response to our comments in 2015. Appendix 5B provides both quantitative and qualitative descriptions of impact ranges as well as a quantification of threatened and endangered species found in the county where the WMS is located. Each Recommended and Alternate WMS is given an Environmental Impact Factor score based on impacts to environmental water needs, wildlife habitat, cultural resources, environmental water quality and bays and estuaries. Environmental Impact Factors range from 1-5 where a score of 1 represents a positive impact and a score of 5 represents a significantly negative impact. For the most part each WMS scored 1 (positive impact) or 2 (no new impact impact). Two strategies received scores of 3 based on the potential to cause minimal habitat impacts. One strategy, the City of Bandera's Aquifer Storage and Recovery Project received a score of 4 (moderate negative) due to potential instream flow impacts. There appears to be a typo in the title for Table 5B-3. Environmental Impact Category *Ranting* Matrix.

As in previous plans, the IPP includes a good discussion of major springs and seeps that occur in the region and recognizes the important ecological water supply function that all springs perform. The PWPG defines groundwater availability as a maximum level of aquifer withdrawal that results in an acceptable level of long-term aquifer impact such that the base flow in rivers and streams is not significantly affected beyond a level that would be anticipated due to naturally occurring conditions. TPWD applauds this approach to defining groundwater availability and supports the PWPG recommendation for more groundwater/surface water interaction studies such as streamflow gain/loss studies and is interested in assisting regional entities in developing and implementing such studies.

TPWD appreciates the PWPG's efforts this planning cycle regarding nomination of ecologically unique stream segments. During this planning cycle the PWPG created a new process with six required steps for nominating stream segments. Even though the planning group ultimately decided not to nominate any segments at this time, the PWPG strongly maintains that all river and stream segments in the Plateau Region are vitally important and their flows constitute a major consideration in adoption of this 2021 Plan. If the PWPG chooses to recommend any of these stream segments in the future TPWD stands ready to provide any additional supporting information necessary to designate these segments as unique. It would be helpful for future discussions to include a description of the nomination process in the final regional water plan.

Thank you for your consideration of these comments. TPWD appreciates recognition in the IPP of our participation in the planning process. We look forward to continuing to work with the planning group to develop water supply strategies that not only meet the future water supply needs of the region but also preserve the ecological health of the region's aquatic resources. Please contact me at (512) 389-8715 or Cindy.Loeffler@TPWD.Texas.gov if you have any questions or comments.

Sincerely,

*Cindy Loeffler*

Cindy Loeffler, Chief
Water Resources Branch

CL:lc

# RESPONSES TO TPWD COMMENTS

The Plateau Water Planning Group (PWPG) thanks the TPWD staff for their technical review and comments on the 2020 Plateau IPP and wish to express their appreciation for the agencies active role in the Plateau Regional Water Planning process. The PWPG would also like to thank the TPWD staff for recognizing the concerted effort that the Planning Group has made to include environmental needs in the develop of this regional water plan as shown in the following key phrases contained in the agency's comments:

- *It is clear the PWPG recognizes the importance of protecting the natural and ecological resources of the Region as they are important economic drivers for the area.*
- *TPWD commends the Plateau Region J Water Planning Group for its emphasis on water conservation and reuse.*
- *The Plateau Region J IPP includes thorough descriptions of natural resources and acknowledges the importance of protecting those resources.*
- *As in previous plans, the IPP includes a good discussion of major springs and seeps that occur in the region and recognizes the important ecological water supply function that all springs perform.*
- *TPWD applauds this approach to defining groundwater availability and supports the PWPG recommendation for more groundwater/surface water interaction studies such as streamflow gain/loss studies and is interested in assisting regional entities in developing and implementing such studies.*
- *TPWD appreciates the PWPG's efforts this planning cycle regarding nomination of ecologically stream segments.*

Following are responses to TPWD comments on the 2020 Plateau IPP:

1. TPWD - Suggestion to include a table listing federal and state listed species and species of greatest conservation need.
   *PWPG – The list is quite extensive, so a discussion is provided in Chapter 1 Section 1.2.7 that discusses the list, and the link taking the reader to the TPWD website is updated.*

2. TPWD – Suggestion to mention the Senate Bill 3 environmental flows process.
   *PWPG – A discussion pertaining to the environmental flows process is added in the last paragraph of Chapter 2 Section 2.3.*

3. TPWD – Suggestion to correct a typo in the title of Table 5B-3.
   *PWPG – Typo has been corrected.*

4. TPWD – Suggestion to include a description of the ecologically unique stream segment nomination process.
   *PWPG – The nomination process has been added to the discussion in Chapter 8 Section 8.5.*

# CHAPTER 11

# IMPLEMENTATION AND COMPARISON TO THE PREVIOUS REGIONAL WATER PLAN

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# 11 IMPLEMENTATION AND COMPARISON TO THE PREVIOUS REGIONAL WATER PLAN

Chapter 11 provides a survey of the level of implementation and identified impediments to the development of previously (*2016 Plan*) recommended Water Management Strategies that have affected progress in meeting projected water-supply needs. To best appreciate the continued improvements to the Plateau Region water planning process, this Chapter offers a comparison of key components in the *2016 Plateau Region Water Plan* to those in this current *2021 Plateau Region Water Plan*. This Chapter also assesses the progress of the Plateau planning area in encouraging cooperation between water user groups for achieving economies of scale and otherwise incentivizing strategies that benefit the entire Region.

# 11.1 IMPLEMENTATION OF PREVIOUS REGIONAL WATER PLAN

Information needed to report on the level of implementation and identified impediments to the development of previously (*2016 Plan*) recommended Water Management Strategies that have affected progress in meeting projected water-supply needs was collected through an emailed survey and follow-up messages were delivered one month after first delivery and in a subsequent message to the PRWPG to encourage further responses. Additional methods that were considered for identifying projects that may potentially have been implemented include:

- Tracking changes since the last Plan;
- Using TWDB funding records; and
- Using conservation implementation reports submitted to the TWDB.

A summary of the survey results are provided in Table 11-1 and the entire populated spreadsheet is returned to the TWDB.

**Table 11-1. 2021 Plateau Region Strategy Implementation Survey**

| WMS or WMS Project Name | Implementation Survey Record Type | Has Sponsor taken affirmative vote or actions?* (TWC 16.053(h)(10)) | If yes, in what year did this occur? | If yes, by what date is the action on schedule for implementation? | At what level of implementation is the project currently?* | If not implemented, why?* (When "If other, please describe" is selected, please add the descriptive text to that field) | What impediments presented to implementation?* (When "If other, please describe" is selected, please add the descriptive text to that field) | Current water supply project yield (ac-ft/yr) | Funds expended to date ($) | Project Cost ($) | Year the project is online?* | Is this a phased project?* | (Phased) Ultimate volume (ac-ft/yr) | (Phased) Ultimate project cost ($) | Year project reaches maximum capacity?* | What is the project funding source(s)?* | Funding Mechanism if Other? | Included in 2021 plan?* | Does the project or WMS involve reallocation of flood control?* | Does the project or WMS provide any measurable flood risk reduction?* | Optional Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CITY OF KERRVILLE - INCREASE WASTEWATER REUSE | RECOMMENDED WMS PROJECT | Yes | 2018 | Completed | Currently operating | | Political support/governance | 3,069 | $23 million | $23 million | 2019 | No | | | 2019 | Other | Kerrville Public Utility Board | Yes | No | No | |
| CITY OF KERRVILLE - INCREASED WATER TREATMENT AND ASR CAPACITY | RECOMMENDED WMS PROJECT | Yes | 2016 | 2017 | Under construction | | Access to funding | 1,120 | $1,750,000 | Undetermined | 2023 | Yes | Undetermined | Undetermined | 2025 | Market | | Yes | No | No | Wells are currently being drilled which will eventually be converted from production to ASR. Planning for treatment expansion has not started. |
| CITY OF KERRVILLE - WATER LOSS AUDIT AND MAIN-LINE REPAIR | RECOMMENDED WMS PROJECT | Yes | Ongoing annually | See comments at end | Under construction | | Access to funding | 4% reduction in loss | $350,000 | $750,000 | 2023 | Yes | 7% total reduction in losses | $750,000 | 2025 | Other | Operational funds (utility rates) | Yes | No | No | Annually 750-1,000 feet replaced, 15-20 meters replaced, 3-yr phase in of an AMI meter read system being developed. |
| CITY OF KERRVILLE - PURCHASE WATER FROM UGRA | RECOMMENDED WMS SUPPLY WITHOUT WMS PROJECT | No | | | Not implemented | Too soon | Not applicable | NA | NA | NA | 2023 | No | | | 2030 | Other | None identified | No | No | No | |

## 11.2 COMPARISON TO PREVIOUS PLAN

The following section includes a summary that shows how the *2021 Water Plan* differs from the *2016 Water Plan*. Comparisons include:

- Water demand projections;
- Drought of record and the hydrologic and modeling assumptions on which plans are based;
- Water availability at the source;
- Existing water supplies of WUGs;
- WUG and WWP needs;
- Recommended and alternative water management strategies; and
- Any other aspects of the plans that the PWPG chooses to compare.

### 11.2.1 Water Demand Projections

Table 11-2 provides a comparison between *2016* and *2021 Plan* water demand projections. The more populated counties show slight increases in demand, while rural counties show a slight decrease. The largest percentage change between the two *Plans* is in Kinney County where a significant decrease in irrigation demand in the *2021 Plan* results in a county total demand decrease of 38 percent.

**Table 11-2. Water Demand Projections Comparison by County (Acre-Feet per Year)**

| County | Plan | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|
| Bandera | 2016 | 3,413 | 3,717 | 3,872 | 3,928 | 3,972 | 3,998 |
| | 2021 | 4,007 | 4,330 | 4,493 | 4,553 | 4,601 | 4,629 |
| Edwards | 2016 | 1,230 | 1,211 | 1,193 | 1,184 | 1,173 | 1,166 |
| | 2021 | 1,092 | 1,082 | 1,073 | 1,071 | 1,071 | 1,071 |
| Kerr | 2016 | 9,063 | 9,154 | 9,171 | 9,242 | 9,343 | 9,433 |
| | 2021 | 9,659 | 9,780 | 9,827 | 9,926 | 10,054 | 10,166 |
| Kinney | 2016 | 8,406 | 8,397 | 8,384 | 8,380 | 8,378 | 8,378 |
| | 2021 | 5,227 | 5,218 | 5,204 | 5,201 | 5,199 | 5,199 |
| Real | 2016 | 913 | 890 | 870 | 855 | 843 | 835 |
| | 2021 | 881 | 866 | 853 | 848 | 847 | 847 |
| Val Verde | 2016 | 16,777 | 17,664 | 18,519 | 19,398 | 20,262 | 21,127 |
| | 2021 | 16,471 | 17,452 | 18,394 | 19,361 | 20,306 | 21,243 |
| Total | 2016 | 39,802 | 41,033 | 42,009 | 42,987 | 43,971 | 44,937 |
| | 2021 | 37,337 | 38,728 | 39,844 | 40,960 | 42,078 | 43,155 |

### 11.2.2 Drought of Record and Hydrologic and Modeling Assumptions

The drought of record consideration for water supply analysis for both the *2016* and *2021 Plans* is the drought of the 1950s. The *2016 Plan* recognized that the current drought conditions, as particularly witnessed in the summer of 2011, was having a significant impact on local water supply sources. Surface water availability for both the *2016* and *2021 Plans* is based on Run 3 of the TCEQ Water Availability Models (WAMs) for the five river basins within the Plateau Region.

Groundwater availability in the *2016 and 2021 Plans* is based on the Modeled Available Groundwater (MAG) volumes 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). Aquifers recognized in both *Plans* that are not included in the GMA-MAG process are termed “non-relevant" and "other aquifer". Groundwater availability for these sources is calculated by modeling or standard geohydrologic methods.

### 11.2.3 Source Water Availability

Total water supply from the source increased from 169,608 acre-feet per year in the *2016 Plan* to 194,942 acre-feet per year in the *2021 Plan*, with groundwater increasing by 17.5 percent and surface water increasing by 5.4 percent. A Source Data Comparison table is provided in the Executive summary of this *Plan*.

### 11.2.4 Existing Water Supplies of WUGs

A WUG Data Comparison Table is provided in the Executive Summary of this *Plan* which compares *2016 Plan* and *2021 Plan* water supplies available to cities and general water use categories based on the current infrastructure ability of each to obtain water supplies. These abilities primarily include existing infrastructure, water-rights limitations, and groundwater conservation district permit limitations.

### 11.2.5 WUG and WWP Needs

Water supply needs occur when an entity's (WUG's) projected water demand exceeds its supply availability. Table 11-3 and 11-4 compare entities in the *2016 Plan* and *2021 Plan* that are projected to experience a water supply need at some decade in the next 50 years. The dramatic difference between WUG needs in the two *Plans* is primarily the result of the decreased supply source availability shown in the *2021 Plan*.

**Table 11-3. 2016 WUG and WWP Needs (Acre-Feet per Year)**

| County | WUG/WWP | Source Basin | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|---|
| Bandera | Irrigation | San Antonio | 129 | 129 | 129 | 129 | 129 | 129 |
| | Livestock | Guadalupe | 12 | 12 | 12 | 12 | 12 | 12 |
| | Livestock | San Antonio | 1 | 1 | 1 | 1 | 1 | 1 |
| Edwards | Rocksprings | Nueces | 98 | 96 | 94 | 94 | 94 | 94 |
| | Livestock | Nueces | 16 | 16 | 16 | 16 | 16 | 16 |
| | Mining | Rio Grande | 22 | 22 | 22 | 22 | 22 | 22 |
| Kerr | Kerrville | Guadalupe | 3,194 | 3,263 | 3,281 | 3,334 | 3,396 | 3,450 |
| | Loma Vista WS | Guadalupe | 30 | 37 | 38 | 44 | 51 | 57 |
| | County Other | Colorado | 5 | 5 | 5 | 5 | 6 | 7 |
| | County Other | Nueces | 1 | 1 | 1 | 1 | 1 | 1 |
| | Livestock | Colorado | 106 | 106 | 106 | 106 | 106 | 106 |
| | Livestock | Nueces | 6 | 6 | 6 | 6 | 6 | 6 |
| | Livestock | San Antonio | 18 | 18 | 18 | 18 | 18 | 18 |
| | Irrigation | San Antonio | 14 | 14 | 13 | 13 | 12 | 12 |
| | Mining | Colorado | 12 | 13 | 17 | 17 | 19 | 21 |
| Kinney | Livestock | Rio Grande | 22 | 22 | 22 | 22 | 22 | 22 |
| Real | Camp Wood | Nueces | 134 | 131 | 128 | 127 | 126 | 126 |
| | Livestock | Nueces | 33 | 33 | 33 | 33 | 33 | 33 |
| Val Verde | Mining | Rio Grande | 4 | 63 | 73 | 37 | 6 | |

**Table 11-4. 2021 WUG and MWP Needs (Acre-Feet per Year)**

| County | WUG/MWP | Source Basin | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|---|
| Bandera | Livestock | Guadalupe | 2 | 2 | 2 | 2 | 2 | 2 |
| | Livestock | Nueces | 3 | 3 | 3 | 3 | 3 | 3 |
| | Bandera County FWSD 1 | San Antonio | 66 | 83 | 92 | 96 | 99 | 100 |
| | County-Other \| Bandera River Ranch 1 | San Antonio | 28 | 39 | 44 | 46 | 48 | 49 |
| | County-Other \| Lake Medina Shores | San Antonio | 196 | 225 | 239 | 244 | 248 | 251 |
| | County-Other Medina WSC | San Antonio | 35 | 46 | 51 | 53 | 54 | 55 |
| | Irrigation | San Antonio | 75 | 75 | 75 | 75 | 75 | 75 |
| Edwards | Mining | Colorado | 12 | 12 | 12 | 12 | 12 | 12 |
| | Rocksprings | Nueces | 98 | 96 | 94 | 94 | 94 | 94 |
| | Mining | Nueces | 16 | 16 | 16 | 16 | 16 | 16 |
| | Mining | Rio Grande | 31 | 31 | 31 | 31 | 31 | 31 |
| Kerr | Mining | Colorado | 11 | 12 | 15 | 16 | 17 | 19 |
| | Livestock | Colorado | 119 | 119 | 119 | 119 | 119 | 119 |
| | County-Other \| Center Point | Guadalupe | 3 | 3 | 3 | 3 | 3 | 4 |
| | County-Other \| Center Point Taylor System | Guadalupe | 2 | 2 | 3 | 3 | 4 | 5 |
| | Livestock | Guadalupe | 173 | 173 | 173 | 173 | 173 | 173 |
| | County-Other | Nueces | 1 | 1 | 1 | 1 | 1 | 1 |
| | Livestock | Nueces | 6 | 6 | 6 | 6 | 6 | 6 |
| | Livestock | San Antonio | 27 | 27 | 27 | 27 | 27 | 27 |
| Kinney | Livestock | Nueces | 27 | 27 | 27 | 27 | 27 | 27 |
| Real | Camp Wood | Nueces | 143 | 139 | 136 | 135 | 135 | 135 |
| Val Verde | Del Rio Utilities Commission | Rio Grande | 4,423 | 4,918 | 5,419 | 5,995 | 6,598 | 7,191 |
| | Laughlin Air Force Base | Rio Grande | 87 | 183 | 284 | 346 | 345 | 345 |
| | County-Other | Rio Grande | | | | | 12 | 377 |
| | Mining | Rio Grande | 151 | 210 | 220 | 184 | 153 | 132 |

### 11.2.6 Recommended Water Management Strategies and Projects

A total of 67 water management strategies (Table 11-5) for 27 water user groups (WUGs) were recommended in the *2016 Plan*, with a total capital cost of $146,202,577. As a result of more WUGs projecting a water supply need (Table 11-3) in the *2021 Plan*, a total of 67 strategies (Table 11-5) for 35 WUGs were recommended with a total capital cost of $230,456,000. Tables 11-7 and 11-8 provide a similar comparison between strategy projects in the *2016 and 2021 Plans*. The *2016 Plan* contains 57 projects for 25 WUGs, while the *2021 Plan* contains 52 projects for 29 WUGs. The principal change in the two *Plans* centers around how the *2021 Plan* designates the Eastern Kerr County Regional Water Supply Project as a single strategy with multiple project components.

**Table 11-5. 2016 Summary of Recommended Water Management Strategies**

| County | Water User Group | Strategy Source Basin | Water Management Strategy | 2016 Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | |
| Bandera | City of Bandera | San Antonio | Reuse treated wastewater effluent for irrigation use | J-1 | 310 | 310 | 310 | 310 | 310 | 310 | $450,000 |
| | | | Promote, design & install rainwater harvesting systems | J-2 | 1 | 1 | 1 | 1 | 1 | 1 | $56,000 |
| | | | Additional Lower Trinity well and lay necessary pipeline | J-4 | 323 | 323 | 323 | 323 | 323 | 323 | $2,284,000 |
| | | | Additional Middle Trinity wells within City water infrastructure | J-5 | 161 | 161 | 161 | 161 | 161 | 161 | $779,000 |
| | *Bandera County Other | | Water loss audit and main-line repair for Bandera County FWSD #1 | J-6 | 1 | 1 | 1 | 1 | 1 | 1 | $163,000 |
| | | | Water loss audit and main-line repair for Bandera River Ranch #1 | J-7 | 1 | 1 | 1 | 1 | 1 | 1 | $463,000 |
| | | | Water loss audit and main-line repair for Medina Water Supply Corporation | J-8 | 1 | 1 | 1 | 1 | 1 | 1 | $447,000 |
| | | | **Vegetative Management | J-9 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| | | | Drought Management (BCRAGD) | J-68 | 467 | 519 | 546 | 556 | 563 | 568 | $0 |
| | | | Additional well for Pebble Beach Subdivision | J-10 | 161 | 161 | 161 | 161 | 161 | 161 | $3,717,000 |
| | | | Additional wells to provide emergency supply to VFD | J-11 | 189 | 189 | 189 | 189 | 189 | 189 | $2,824,000 |
| | | | Additional wells to help Medina Lake area | J-12 | 27 | 27 | 27 | 27 | 27 | 27 | $1,377,000 |
| | | Nueces | Drought Management (BCRAGD) | J-69 | 29 | 32 | 34 | 34 | 35 | 35 | $0 |
| | * Bandera County Irrigation | Nueces | Additional groundwater wells | J-13 | 130 | 130 | 130 | 130 | 130 | 130 | $244,000 |
| | * Bandera County Livestock | San Antonio | Additional groundwater well | J-14 | 20 | 20 | 20 | 20 | 20 | 20 | $103,000 |
| Edwards | * City of Rocksprings | Colorado | Water loss audit and main-line repair | J-15 | 1 | 1 | 1 | 1 | 1 | 1 | $129,000 |
| | | Nueces | Additional groundwater well | J-16 | 121 | 121 | 121 | 121 | 121 | 121 | $650,000 |
| | Edwards County Other | Nueces | Water loss audit and main-line repair for Barksdale WSC | J-17 | 1 | 1 | 1 | 1 | 1 | 1 | $203,000 |
| | | | Additional well in the Nueces River Alluvium Aquifer | J-18 | 54 | 54 | 54 | 54 | 54 | 54 | $114,000 |
| | | | **Vegetative Management | J-19 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |

**Table 11-5. (Continued) 2016 Summary of Recommended Water Management Strategies**

| County | Water User Group | Strategy Source Basin | Water Management Strategy | 2016 Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | |
| Edwards | * Edwards County Livestock | Nueces | Additional groundwater wells | J-20 | 20 | 20 | 20 | 20 | 20 | 20 | $105,000 |
| Edwards | * Edwards County Mining | Rio Grande | Additional groundwater wells | J-21 | 30 | 30 | 30 | 30 | 30 | 30 | $109,000 |
| Kerr | * City of Kerrville | Guadalupe | Increase wastewater reuse | J-22 | 5,041 | 5,041 | 5,041 | 5,041 | 5,041 | 5,041 | $23,000,000 |
| Kerr | * City of Kerrville | Guadalupe | Water loss audit and main-line repair | J-23 | 147 | 147 | 147 | 147 | 147 | 147 | $9,339,000 |
| Kerr | * City of Kerrville | Guadalupe | Purchase water from UGRA | J-24 | | 0 | 0 | 0 | 0 | 0 | $4,103,791 |
| Kerr | * City of Kerrville | Guadalupe | Increased water treatment and ASR capacity | J-25 | 3,360 | 3,360 | 3,360 | 3,360 | 3,360 | 3360 | $11,543,000 |
| Kerr | * Loma Vista WSC | Guadalupe | Conservation: Public information | J-26 | 4 | 4 | 4 | 4 | 4 | 4 | $0 |
| Kerr | * Loma Vista WSC | Guadalupe | Additional groundwater well | J-27 | 57 | 57 | 57 | 57 | 57 | 57 | $728,000 |
| Kerr | * Kerr County Other | Guadalupe | Water loss audit and main-line repair for Center Point WWW | J-28 | 1 | 1 | 1 | 1 | 1 | 1 | $33,000 |
| Kerr | * Kerr County Other | Guadalupe | Water loss audit and main-line repair for Hills and Dales WWW | J-29 | 1 | 1 | 1 | 1 | 1 | 1 | $138,000 |
| Kerr | * Kerr County Other | Guadalupe | Water loss audit and main-line repair for Rustic Hills Water | J-30 | 1 | 1 | 1 | 1 | 1 | 1 | $99,000 |
| Kerr | * Kerr County Other | Guadalupe | Water loss audit and main-line repair for Verde Park Estates WWW | J-31 | 1 | 1 | 1 | 1 | 1 | 1 | $102,000 |
| Kerr | * Kerr County Other | Guadalupe | Conservation: Public information | J-32 | 9 | 9 | 9 | 10 | 9 | 8 | $0 |
| Kerr | * Kerr County Other | Colorado | Conservation: Public information - Water shortage met with J-32 | J-32A | 5 | 5 | 5 | 5 | 6 | 7 | $0 |
| Kerr | * Kerr County Other | Nueces | Conservation: Public information - Water shortage met with J-32 | J-32B | 1 | 1 | 1 | 1 | 1 | 1 | $0 |
| Kerr | * Kerr County Other | Guadalupe | **Vegetative management - UGRA | J-33 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| Kerr | * Kerr County Other | Guadalupe | UGRA Acquisition of Surface Water Rights [2](EKCRWSP) | J-34 | 1,029 | 1,029 | 1,029 | 1,029 | 1,029 | 1029 | $1,087,367 |
| Kerr | * Kerr County Other | Guadalupe | KCCC Acquisition of Surface Water Rights [2](EKCRWSP) | J-35 | 6,000 | 6,000 | 6,000 | 6,000 | 6,000 | 6,000 | $6,342,000 |
| Kerr | * Kerr County Other | Guadalupe | Construction of an Off-Channel Surface Water Storage [2](EKCRWSP) | J-36 | 1,121 | 1,121 | 1,121 | 1,121 | 1,121 | 1,121 | $7,534,303 |

**Table 11-5. (Continued) 2016 Summary of Recommended Water Management Strategies**

| County | Water User Group | Strategy Source Basin | Water Management Strategy | 2016 Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | |
| Kerr | *Kerr County-Other | Guadalupe | Construction of surface water treatment facilities and transmission lines ²(EKCRWSP) | J-37 | 149 | 149 | 149 | 149 | 149 | 149 | $25,581,000 |
| | | | Construction of ASR facility ²(EKCRWSP) | J-38 | 1,124 | 1,124 | 1,124 | 1,124 | 1,124 | 1,124 | $1,258,000 |
| | | | Construction of Well field for dense, rural areas ²(EKCRWSP) | J-39 | 860 | 860 | 860 | 860 | 860 | 860 | $4,357,000 |
| | | | Construction of Desalination plant ²(EKCRWSP) | J-40 | 860 | 860 | 860 | 860 | 860 | 860 | $14,539,000 |
| | | | Construction of an Ellenburger Aquifer water supply well ²(EKCRWSP) | J-41 | 108 | 108 | 108 | 108 | 108 | 108 | $567,000 |
| | *Kerr County Irrigation | San Antonio | Additional groundwater well | J-42 | 20 | 20 | 20 | 20 | 20 | 20 | $78,000 |
| | * Kerr County Livestock | Colorado | Additional groundwater wells | J-43 | 108 | 108 | 108 | 108 | 108 | 108 | $667,000 |
| | * Kerr County Livestock | Guadalupe | Additional groundwater wells | J-44 | 20 | 20 | 20 | 20 | 20 | 20 | $190,000 |
| | * Kerr County Livestock | San Antonio | Additional groundwater well | J-45 | 20 | 20 | 20 | 20 | 20 | 20 | $65,000 |
| | * Kerr County Mining | Guadalupe | Additional groundwater well | J-46 | 30 | 30 | 30 | 30 | 30 | 30 | $132,000 |
| Kinney | City of Brackettville | Rio Grande | Water loss audit and main-line repair | J-47 | 58 | 58 | 58 | 58 | 58 | 58 | $1,116 |
| | | | Increase supply to Spoford with new water line | J-48 | 3 | 3 | 3 | 3 | 3 | 3 | $751,000 |
| | | | Increase storage facility | J-49 | 3 | 3 | 3 | 3 | 3 | 3 | $288,000 |
| | Fort Clark Springs MUD | | Increase storage facility | J-50 | 620 | 620 | 620 | 620 | 620 | 620 | $1,033,000 |
| | Kinney County Other | | **Vegetative Management | J-51 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| | * Kinney County Livestock | | Additional groundwater wells | J-52 | 22 | 22 | 22 | 22 | 22 | 22 | $55,000 |

**Table 11-5. (Continued) 2016 Summary of Recommended Water Management Strategies**

| County | Water User Group | Strategy Source Basin | Water Management Strategy | 2016 Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | |
| Real | * City of Camp Wood | Nueces | Conservation: Public information | J-53 | 1 | 1 | 1 | 1 | 1 | 1 | $0 |
| | | | Additional groundwater wells | J-54 | 172 | 172 | 172 | 172 | 172 | 172 | $1,887,000 |
| | City of Leakey (Real County Other) | | Water loss audit and main-line repair | J-55 | 1 | 1 | 1 | 1 | 1 | 1 | $52,000 |
| | | | Additional groundwater well | J-56 | 91 | 91 | 91 | 91 | 91 | 91 | $156,000 |
| | | | Develop interconnections between wells within the City | J-57 | 81 | 81 | 81 | 81 | 81 | 81 | $200,000 |
| | Real County Other | | Water loss audit and main-line repair for Real WSC | J-58 | 2 | 2 | 2 | 2 | 2 | 2 | $199,000 |
| | | | **Vegetative Management | J-59 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| | | | Additional well for Oakmont Saddle WSC | J-60 | 54 | 54 | 54 | 54 | 54 | 54 | $420,000 |
| | * Real County Livestock | | Additional groundwater wells | J-61 | 40 | 40 | 40 | 40 | 40 | 40 | $74,000 |
| Val Verde | City of Del Rio | Rio Grande | Water loss audit and main-line repair | J-62 | 119 | 119 | 119 | 119 | 119 | 119 | $8,673,000 |
| | | | Drill & equip new well, connect to distribution system | J-63 | 850 | 850 | 850 | 850 | 850 | 850 | $2,937,000 |
| | | | Water treatment plant expansion | J-64 | | 943 | 943 | 943 | 943 | 943 | $1,841,000 |
| | | | Develop a wastewater reuse program | J-65 | 3,092 | 3,092 | 3,092 | 3,092 | 3,092 | 3,092 | $1,700,000 |
| | Val Verde County Other | | **Vegetative Management | J-66 | 0 | 0 | 0 | 0 | 0 | 0 | $0 |
| | * Val Verde County Mining | | Additional groundwater well | J-67 | 80 | 80 | 80 | 80 | 80 | 80 | $235,000 |

*WUGs with projected water supply needs (deficits).

**Table 11-6. 2021 Summary of Recommended and Alternate Water Management Strategies**

| County | Water User Group | Strategy | Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | |
| Bandera | City of Bandera | Reuse treated wastewater effluent for irrigation of public spaces | J-1 | 0 | 310 | 310 | 310 | 310 | 310 | $1,496,000 |
| | | Promote, design & install rainwater harvesting systems on public buildings | J-2 | 0 | 1 | 1 | 1 | 1 | 1 | $56,000 |
| | | Additional Lower Trinity well and lay necessary pipeline **ALTERNATE** | J-3 | 0 | 403 | 403 | 403 | 403 | 403 | $3,298,000 |
| | | Additional Middle Trinity wells within City water infrastructure area | J-4 | 161 | 161 | 161 | 161 | 161 | 161 | $625,000 |
| | | Surface water acquisition, treatment and ASR | J-5 | 0 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | $34,188,000 |
| | *Bandera County FWSD #1 | Public conservation education | J-6 | 2 | 2 | 2 | 2 | 2 | 2 | $0 |
| | | Additional groundwater well | J-7 | 100 | 100 | 100 | 100 | 100 | 100 | $990,000 |
| | *Bandera County Other - Bandera River Ranch #1 | Water loss audit and main-line repair for | J-8 | 4 | 4 | 4 | 4 | 4 | 4 | $902,000 |
| | *Bandera County Other - Lake Medina Shores | Public conservation education | J-9 | 3 | 3 | 3 | 3 | 3 | 3 | $0 |
| | | Additional groundwater wells **ALTERNATE** | J-10 | 251 | 251 | 251 | 251 | 251 | 251 | $1,477,000 |
| | *Bandera County Other - Medina WSC | Public conservation education | J-11 | 1 | 1 | 1 | 1 | 1 | 1 | $0 |
| | | Additional groundwater well | J-12 | 55 | 55 | 55 | 55 | 55 | 55 | $1,417,000 |
| | Bandera County Other | Drought management (BCRAGD) | J-14 | 441 | 491 | 516 | 525 | 533 | 537 | $0 |
| | Bandera County Other - Volunteer Fire Dept. | Additional groundwater wells to provide emergency supply **ALTERNATE** | J-16 | 189 | 189 | 189 | 189 | 189 | 189 | $4,280,000 |
| | Bandera County Other - Enchanted River Estates | Water loss audit and main-line repair | J-17 | 1 | 1 | 1 | 1 | 1 | 1 | $117,000 |
| | Bandera County Other | Drought management (BCRAGD) | J-18 | 23 | 26 | 27 | 28 | 28 | 28 | $0 |
| | *Bandera County Irrigation | Irrigation scheduling | J-20 | 36 | 36 | 36 | 36 | 36 | 36 | $0 |
| | | Additional groundwater wells | J-21 | 75 | 75 | 75 | 75 | 75 | 75 | $291,000 |

**Table 11-6. (continued) 2021 Summary of Recommended and Alternate Water Management Strategies**

| County | Water User Group | Strategy | Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | |
| Bandera | *Bandera County Livestock | Livestock conservation | J-22 | 1 | 1 | 1 | 1 | 1 | 1 | $0 |
| | | Additional groundwater well | J-23 | 2 | 2 | 2 | 2 | 2 | 2 | $135,000 |
| | | Livestock conservation | J-24 | 1 | 1 | 1 | 1 | 1 | 1 | $0 |
| | | Additional groundwater well | J-25 | 3 | 3 | 3 | 3 | 3 | 3 | $126,000 |
| Edwards | City of Rocksprings | Public conservation education | J-26 | 1 | 1 | 1 | 1 | 1 | 1 | $0 |
| | | Additional groundwater well | J-27 | 121 | 121 | 121 | 121 | 121 | 121 | $681,000 |
| | Edwards County Other (Barksdale WSC) | Additional well in the Nueces River Alluvium Aquifer and RO wellhead treatment | J-28 | 54 | 54 | 54 | 54 | 54 | 54 | $178,000 |
| | *Edwards County Mining | Additional groundwater well | J-31 | 16 | 16 | 16 | 16 | 16 | 16 | $125,000 |
| | | Additional groundwater well | J-33 | 12 | 12 | 12 | 12 | 12 | 12 | $73,000 |
| | | Additional groundwater wells | J-35 | 31 | 31 | 31 | 31 | 31 | 31 | $132,000 |
| Kerr | *City of Kerrville | Increase wastewater reuse | J-36 | 2,500 | 2,500 | 2,500 | 2,500 | 2,500 | 2,500 | $12,570,000 |
| | | Water loss audit and main-line repair | J-37 | 134 | 134 | 134 | 134 | 134 | 134 | $12,636,000 |
| | | Explore and develop new Ellenburger Aquifer well supply | J-39 | 1,156 | 1,156 | 1,156 | 1,156 | 1,156 | 1,156 | $14,493,000 |
| | | Increased water treatment and ASR capacity | J-41 | 0 | 3,360 | 3,360 | 3,360 | 3,360 | 3,360 | $15,393,000 |
| | Kerr County Other -Eastern Kerr County Regional Water Supply Project | Project 1. Construction of an Ellenburger Aquifer water supply well | J-45 | 0 | 108 | 108 | 108 | 108 | 108 | $652,000 |
| | | Project 2. Construction of off-channel surface water storage | | 0 | 1,121 | 1,121 | 1,121 | 1,121 | 1,121 | $25,231,000 |
| | | Project 2. Construction of surface water treatment facilities and transmission lines | | | | | | | | $22,829,000 |
| | | Project 3. Construction of ASR facility | | 0 | 1,124 | 1,124 | 1,124 | 1,124 | 1,124 | $1,461,000 |

**Table 11-6. (continued) 2021 Summary of Recommended and Alternate Water Management Strategies**

| County | Water User Group | Strategy | Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | |
| Kerr | Kerr County Other -Eastern Kerr County Regional Water Supply Project | Project 4. Construction of Trinity Aquifer wellfield for dense, rural areas | J-45 | 0 | 860 | 860 | 860 | 860 | 860 | $8,367,000 |
| | | Project 4. Construction of desalination plant | | | | | | | | $21,162,000 |
| | Kerr County Other - *Center Point | Public conservation education | J-54 | 1 | 1 | 1 | 1 | 1 | 1 | $0 |
| | | Purchase water from EKCRWSP | J-46 | 11 | 11 | 11 | 11 | 11 | 11 | $0 |
| | Kerr County Other - *Center Point Taylor System | Public conservation education | J-55 | 1 | 1 | 1 | 1 | 1 | 1 | $0 |
| | | Purchase water from EKCRWSP | J-47 | 43 | 43 | 43 | 43 | 43 | 43 | $0 |
| | Kerr County Other - Verde Park Estates | Water loss audit and main-line repair | J-42 | 1 | 1 | 1 | 1 | 1 | 1 | $155,000 |
| | *Kerr County Other | Public conservation education | J-43 | 1 | 1 | 1 | 1 | 1 | 1 | $0 |
| | *Kerr County Livestock | Livestock conservation | J-56 | 24 | 24 | 24 | 24 | 24 | 24 | $0 |
| | | Additional groundwater wells **ALTERNATE** | J-57 | 119 | 119 | 119 | 119 | 119 | 119 | $985,000 |
| | | Livestock conservation | J-58 | 35 | 35 | 35 | 35 | 35 | 35 | $0 |
| | | Additional groundwater wells **ALTERNATE** | J-59 | 173 | 173 | 173 | 173 | 173 | 173 | $370,000 |
| | | Livestock conservation | J-60 | 5 | 5 | 5 | 5 | 5 | 5 | $0 |
| | | Additional groundwater well **ALTERNATE** | J-61 | 27 | 27 | 27 | 27 | 27 | 27 | $79,000 |
| | | Livestock conservation | J-62 | 1 | 1 | 1 | 1 | 1 | 1 | $0 |
| | | Additional groundwater well **ALTERNATE** | J-63 | 6 | 6 | 6 | 6 | 6 | 6 | $66,000 |
| | *Kerr County Mining | Additional groundwater wells | J-65 | 19 | 19 | 19 | 19 | 19 | 19 | $197,000 |
| Kinney | City of Brackettville | Increase supply to Spofford with new water line | J-66 | 0 | 3 | 3 | 3 | 3 | 3 | $4,271,000 |
| | | Increase storage facility | J-67 | 0 | 3 | 3 | 3 | 3 | 3 | $1,272,000 |
| | Fort Clark Springs MUD | Water loss audit and main-line repair | J-68 | 79 | 79 | 79 | 79 | 79 | 79 | $1,531,000 |

**Table 11-6. (continued) 2021 Summary of Recommended and Alternate Water Management Strategies**

| County | Water User Group | Strategy | Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | |
| Kinney | Fort Clark Springs MUD | Increase storage facility | J-69 | 0 | 620 | 620 | 620 | 620 | 620 | $1,501,000 |
| Real | *City of Camp Wood | Public conservation education | J-72 | 1 | 1 | 1 | 1 | 1 | 1 | $0 |
| | | Additional groundwater wells | J-73 | 143 | 143 | 143 | 143 | 143 | 143 | $1,709,000 |
| | City of Leakey | Additional groundwater well | J-75 | 91 | 91 | 91 | 91 | 91 | 91 | $189,000 |
| | | Develop interconnections between wells within the City | J-76 | 0 | 81 | 81 | 81 | 81 | 81 | $202,000 |
| | Real County Other - Real WSC | Water loss audit and main-line repair | J-77 | 2 | 2 | 2 | 2 | 2 | 2 | $482,000 |
| | Real County Other - Oakmont Saddle Mountain WSC | Additional groundwater well | J-79 | 54 | 54 | 54 | 54 | 54 | 54 | $417,000 |
| Val Verde | *City of Del Rio | Water loss audit and main-line repair | J-80 | 12 | 12 | 12 | 12 | 12 | 12 | $5,672,000 |
| | | Additional groundwater well | J-81 | 7,191 | 7,191 | 7,191 | 7,191 | 7,191 | 7,191 | $12,695,000 |
| | | Water treatment plant expansion | J-82 | 0 | 943 | 943 | 943 | 943 | 943 | $8,646,000 |
| | | Develop a wastewater reuse program | J-83 | 0 | 3,092 | 3,092 | 3,092 | 3,092 | 3,092 | $2,846,000 |
| | Laughlin Air Force Base | Purchase water from City of Del Rio | J-87 | 87 | 183 | 284 | 346 | 345 | 345 | $0 |
| | Val Verde County Other - Val Verde County WCID Comstock | Water loss audit and main-line repair | J-84 | 1 | 1 | 1 | 1 | 1 | 1 | $406,000 |
| | Val Verde County Other - San Pedro Canyon Upper Subdivision | Water loss audit and main-line repair | J-85 | 7 | 7 | 7 | 7 | 7 | 7 | $142,000 |
| | Val Verde County Other - Tierra Del Lago | Water loss audit and main-line repair | J-86 | 4 | 4 | 4 | 4 | 4 | 4 | $146,000 |
| | *Val Verde County Mining | Additional groundwater wells | J-89 | 242 | 242 | 242 | 242 | 242 | 242 | $1,096,000 |

**Table 11-7. 2016 Summary of Recommended Water Management Projects**

| County | Water User Group | Strategy Source Basin | Water Management Strategy | 2016 Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | |
| Bandera | City of Bandera | San Antonio | Reuse treated wastewater effluent for irrigation use | J-1 | 310 | 310 | 310 | 310 | 310 | 310 | $450,000 |
| | | | Promote, design & install rainwater harvesting systems | J-2 | 1 | 1 | 1 | 1 | 1 | 1 | $56,000 |
| | | | Additional Lower Trinity well and lay necessary pipeline | J-4 | 323 | 323 | 323 | 323 | 323 | 323 | $2,284,000 |
| | | | Additional Middle Trinity wells within City water infrastructure | J-5 | 161 | 161 | 161 | 161 | 161 | 161 | $779,000 |
| | *Bandera County Other | | Water loss audit and main-line repair for Bandera County FWSD #1 | J-6 | 1 | 1 | 1 | 1 | 1 | 1 | $163,000 |
| | | | Water loss audit and main-line repair for Bandera River Ranch #1 | J-7 | 1 | 1 | 1 | 1 | 1 | 1 | $463,000 |
| | | | Water loss audit and main-line repair for Medina Water Supply Corporation | J-8 | 1 | 1 | 1 | 1 | 1 | 1 | $447,000 |
| | | | Additional well for Pebble Beach Subdivision | J-10 | 161 | 161 | 161 | 161 | 161 | 161 | $3,717,000 |
| | | | Additional wells to provide emergency supply to VFD | J-11 | 189 | 189 | 189 | 189 | 189 | 189 | $2,824,000 |
| | | | Additional wells to help Medina Lake area | J-12 | 27 | 27 | 27 | 27 | 27 | 27 | $1,377,000 |
| | * Bandera County Irrigation | Nueces | Additional groundwater wells | J-13 | 130 | 130 | 130 | 130 | 130 | 130 | $244,000 |
| | * Bandera County Livestock | San Antonio | Additional groundwater well | J-14 | 20 | 20 | 20 | 20 | 20 | 20 | $103,000 |
| Edwards | * City of Rocksprings | Colorado | Water loss audit and main-line repair | J-15 | 1 | 1 | 1 | 1 | 1 | 1 | $129,000 |
| | | Nueces | Additional groundwater well | J-16 | 121 | 121 | 121 | 121 | 121 | 121 | $650,000 |
| | Edwards County Other | Nueces | Water loss audit and main-line repair for Barksdale WSC | J-17 | 1 | 1 | 1 | 1 | 1 | 1 | $203,000 |
| | | | Additional well in the Nueces River Alluvium Aquifer | J-18 | 54 | 54 | 54 | 54 | 54 | 54 | $114,000 |

**Table 11-7. (continued) 2016 Summary of Recommended Water Management Projects**

| County | Water User Group | Strategy Source Basin | Water Management Strategy | 2016 Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | |
| Edwards | * Edwards County Livestock | Nueces | Additional groundwater wells | J-20 | 20 | 20 | 20 | 20 | 20 | 20 | $105,000 |
| Edwards | * Edwards County Mining | Rio Grande | Additional groundwater wells | J-21 | 30 | 30 | 30 | 30 | 30 | 30 | $109,000 |
| Kerr | * City of Kerrville | Guadalupe | Increase wastewater reuse | J-22 | 5,041 | 5,041 | 5,041 | 5,041 | 5,041 | 5,041 | $23,000,000 |
| Kerr | * City of Kerrville | Guadalupe | Water loss audit and main-line repair | J-23 | 147 | 147 | 147 | 147 | 147 | 147 | $9,339,000 |
| Kerr | * City of Kerrville | Guadalupe | Purchase water from UGRA | J-24 | | 0 | 0 | 0 | 0 | 0 | $4,103,791 |
| Kerr | * City of Kerrville | Guadalupe | Increased water treatment and ASR capacity | J-25 | 3,360 | 3,360 | 3,360 | 3,360 | 3,360 | 3360 | $11,543,000 |
| Kerr | * City of Kerrville | Guadalupe | Additional groundwater well | J-27 | 57 | 57 | 57 | 57 | 57 | 57 | $728,000 |
| Kerr | * Kerr County Other | Guadalupe | Water loss audit and main-line repair for Center Point WWW | J-28 | 1 | 1 | 1 | 1 | 1 | 1 | $33,000 |
| Kerr | * Kerr County Other | Guadalupe | Water loss audit and main-line repair for Hills and Dales WWW | J-29 | 1 | 1 | 1 | 1 | 1 | 1 | $138,000 |
| Kerr | * Kerr County Other | Guadalupe | Water loss audit and main-line repair for Rustic Hills Water | J-30 | 1 | 1 | 1 | 1 | 1 | 1 | $99,000 |
| Kerr | * Kerr County Other | Guadalupe | Water loss audit and main-line repair for Verde Park Estates WWW | J-31 | 1 | 1 | 1 | 1 | 1 | 1 | $102,000 |
| Kerr | * Kerr County Other | Guadalupe | UGRA Acquisition of Surface Water Rights [2](EKCRWSP) | J-34 | 1,029 | 1,029 | 1,029 | 1,029 | 1,029 | 1029 | $1,087,367 |
| Kerr | * Kerr County Other | Guadalupe | KCCC Acquisition of Surface Water Rights [2](EKCRWSP) | J-35 | 6,000 | 6,000 | 6,000 | 6,000 | 6,000 | 6,000 | $6,342,000 |
| Kerr | * Kerr County Other | Guadalupe | Construction of an Off-Channel Surface Water Storage [2](EKCRWSP) | J-36 | 1,121 | 1,121 | 1,121 | 1,121 | 1,121 | 1,121 | $7,534,303 |

**Table 11-7. (continued) 2016 Summary of Recommended Water Management Projects**

| County | Water User Group | Strategy Source Basin | Water Management Strategy | 2016 Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | |
| Kerr | *Kerr County-Other | Guadalupe | Construction of surface water treatment facilities and transmission lines [2](EKCRWSP) | J-37 | 149 | 149 | 149 | 149 | 149 | 149 | $25,581,000 |
| | | | Construction of ASR facility [2](EKCRWSP) | J-38 | 1,124 | 1,124 | 1,124 | 1,124 | 1,124 | 1,124 | $1,258,000 |
| | | | Construction of Well field for dense, rural areas [2](EKCRWSP) | J-39 | 860 | 860 | 860 | 860 | 860 | 860 | $4,357,000 |
| | | | Construction of Desalination plant [2](EKCRWSP) | J-40 | 860 | 860 | 860 | 860 | 860 | 860 | $14,539,000 |
| | | | Construction of an Ellenburger Aquifer water supply well [2](EKCRWSP) | J-41 | 108 | 108 | 108 | 108 | 108 | 108 | $567,000 |
| | *Kerr County Irrigation | San Antonio | Additional groundwater well | J-42 | 20 | 20 | 20 | 20 | 20 | 20 | $78,000 |
| | * Kerr County Livestock | Colorado | Additional groundwater wells | J-43 | 108 | 108 | 108 | 108 | 108 | 108 | $667,000 |
| | * Kerr County Livestock | Guadalupe | Additional groundwater wells | J-44 | 20 | 20 | 20 | 20 | 20 | 20 | $190,000 |
| | * Kerr County Livestock | San Antonio | Additional groundwater well | J-45 | 20 | 20 | 20 | 20 | 20 | 20 | $65,000 |
| | * Kerr County Mining | Guadalupe | Additional groundwater well | J-46 | 30 | 30 | 30 | 30 | 30 | 30 | $132,000 |
| Kinney | City of Brackettville | Rio Grande | Water loss audit and main-line repair | J-47 | 58 | 58 | 58 | 58 | 58 | 58 | $1,116 |
| | | | Increase supply to Spoford with new water line | J-48 | 3 | 3 | 3 | 3 | 3 | 3 | $751,000 |
| | | | Increase storage facility | J-49 | 3 | 3 | 3 | 3 | 3 | 3 | $288,000 |
| | Fort Clark Springs MUD | | Increase storage facility | J-50 | 620 | 620 | 620 | 620 | 620 | 620 | $1,033,000 |
| | * Kinney County Livestock | | Additional groundwater wells | J-52 | 22 | 22 | 22 | 22 | 22 | 22 | $55,000 |

**Table 11-7. (continued) 2016 Summary of Recommended Water Management Projects**

| County | Water User Group | Strategy Source Basin | Water Management Strategy | 2016 Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | |
| Real | * City of Camp Wood | Nueces | Additional groundwater wells | J-54 | 172 | 172 | 172 | 172 | 172 | 172 | $1,887,000 |
| Real | City of Leakey (Real County Other) | Nueces | Water loss audit and main-line repair | J-55 | 1 | 1 | 1 | 1 | 1 | 1 | $52,000 |
| Real | City of Leakey (Real County Other) | Nueces | Additional groundwater well | J-56 | 91 | 91 | 91 | 91 | 91 | 91 | $156,000 |
| Real | City of Leakey (Real County Other) | Nueces | Develop interconnections between wells within the City | J-57 | 81 | 81 | 81 | 81 | 81 | 81 | $200,000 |
| Real | Real County Other | Nueces | Water loss audit and main-line repair for Real WSC | J-58 | 2 | 2 | 2 | 2 | 2 | 2 | $199,000 |
| Real | Real County Other | Nueces | Additional well for Oakmont Saddle WSC | J-60 | 54 | 54 | 54 | 54 | 54 | 54 | $420,000 |
| Real | * Real County Livestock | Nueces | Additional groundwater wells | J-61 | 40 | 40 | 40 | 40 | 40 | 40 | $74,000 |
| Val Verde | City of Del Rio | Rio Grande | Water loss audit and main-line repair | J-62 | 119 | 119 | 119 | 119 | 119 | 119 | $8,673,000 |
| Val Verde | City of Del Rio | Rio Grande | Drill & equip new well, connect to distribution system | J-63 | 850 | 850 | 850 | 850 | 850 | 850 | $2,937,000 |
| Val Verde | City of Del Rio | Rio Grande | Water treatment plant expansion | J-64 | | 943 | 943 | 943 | 943 | 943 | $1,841,000 |
| Val Verde | City of Del Rio | Rio Grande | Develop a wastewater reuse program | J-65 | 3,092 | 3,092 | 3,092 | 3,092 | 3,092 | 3,092 | $1,700,000 |
| Val Verde | * Val Verde County Mining | Rio Grande | Additional groundwater well | J-67 | 80 | 80 | 80 | 80 | 80 | 80 | $235,000 |

**Table 11-8. 2021 Summary of Recommended and Alternate Water Management Projects**

| County | Water User Group | Strategy | Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | |
| Bandera | City of Bandera | Reuse treated wastewater effluent for irrigation of public spaces | J-1 | 0 | 310 | 310 | 310 | 310 | 310 | $1,496,000 |
| | | Promote, design & install rainwater harvesting systems on public buildings | J-2 | 0 | 1 | 1 | 1 | 1 | 1 | $56,000 |
| | | Additional Lower Trinity well and lay necessary pipeline **ALTERNATE** | J-3 | 0 | 403 | 403 | 403 | 403 | 403 | $3,298,000 |
| | | Additional Middle Trinity wells within City water infrastructure area | J-4 | 161 | 161 | 161 | 161 | 161 | 161 | $625,000 |
| | | Surface water acquisition, treatment and ASR | J-5 | 0 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | $34,188,000 |
| | *Bandera County FWSD #1 | Additional groundwater well | J-7 | 100 | 100 | 100 | 100 | 100 | 100 | $990,000 |
| | *Bandera County Other - Bandera River Ranch #1 | Water loss audit and main-line repair for | J-8 | 4 | 4 | 4 | 4 | 4 | 4 | $902,000 |
| | *Bandera County Other - Lake Medina Shores | Additional groundwater wells **ALTERNATE** | J-10 | 251 | 251 | 251 | 251 | 251 | 251 | $1,477,000 |
| | *Bandera County Other - Medina WSC | Additional groundwater well | J-12 | 55 | 55 | 55 | 55 | 55 | 55 | $1,417,000 |
| | Bandera County Other - Volunteer Fire Dept. | Additional groundwater wells to provide emergency supply **ALTERNATE** | J-16 | 189 | 189 | 189 | 189 | 189 | 189 | $4,280,000 |
| | Bandera County Other - Enchanted River Estates | Water loss audit and main-line repair | J-17 | 1 | 1 | 1 | 1 | 1 | 1 | $117,000 |
| | *Bandera County Irrigation | Additional groundwater wells | J-21 | 75 | 75 | 75 | 75 | 75 | 75 | $291,000 |
| | *Bandera County Livestock | Additional groundwater well | J-23 | 2 | 2 | 2 | 2 | 2 | 2 | $135,000 |
| | | Additional groundwater well | J-25 | 3 | 3 | 3 | 3 | 3 | 3 | $126,000 |
| Edwards | City of Rocksprings | Additional groundwater well | J-27 | 121 | 121 | 121 | 121 | 121 | 121 | $681,000 |
| | Edwards County Other (Barksdale WSC) | Additional well in the Nueces River Alluvium Aquifer and RO wellhead treatment | J-28 | 54 | 54 | 54 | 54 | 54 | 54 | $178,000 |
| | *Edwards County Mining | Additional groundwater well | J-31 | 16 | 16 | 16 | 16 | 16 | 16 | $125,000 |
| | | Additional groundwater well | J-33 | 12 | 12 | 12 | 12 | 12 | 12 | $73,000 |

**Table 11-8. (continued) 2021 Summary of Recommended and Alternate Water Management Projects**

| County | Water User Group | Strategy | Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | |
| Edwards | *Edwards County Mining | Additional groundwater wells | J-35 | 31 | 31 | 31 | 31 | 31 | 31 | $132,000 |
| Kerr | *City of Kerrville | Increase wastewater reuse | J-36 | 2,500 | 2,500 | 2,500 | 2,500 | 2,500 | 2,500 | $12,570,000 |
| | | Water loss audit and main-line repair | J-37 | 134 | 134 | 134 | 134 | 134 | 134 | $12,636,000 |
| | | Explore and develop new Ellenburger Aquifer well supply | J-39 | 1,156 | 1,156 | 1,156 | 1,156 | 1,156 | 1,156 | $14,493,000 |
| | | Increased water treatment and ASR capacity | J-41 | 0 | 3,360 | 3,360 | 3,360 | 3,360 | 3,360 | $15,393,000 |
| | Kerr County Other - Eastern Kerr County Regional Water Supply Project | Project 1. Construction of an Ellenburger Aquifer water supply well | J-45 | 0 | 108 | 108 | 108 | 108 | 108 | $652,000 |
| | | Project 2. Construction of off-channel surface water storage | | 0 | 1,121 | 1,121 | 1,121 | 1,121 | 1,121 | $25,231,000 |
| | | Project 2. Construction of surface water treatment facilities and transmission lines | | | | | | | | $22,829,000 |
| | | Project 3. Construction of ASR facility | | 0 | 1,124 | 1,124 | 1,124 | 1,124 | 1,124 | $1,461,000 |
| | | Project 4. Construction of Trinity Aquifer wellfield for dense, rural areas | | 0 | 860 | 860 | 860 | 860 | 860 | $8,367,000 |
| | | Project 4. Construction of desalination plant | | | | | | | | $21,162,000 |
| | Kerr County Other - Verde Park Estates | Water loss audit and main-line repair | J-42 | 1 | 1 | 1 | 1 | 1 | 1 | $155,000 |
| | *Kerr County Livestock | Additional groundwater wells **ALTERNATE** | J-57 | 119 | 119 | 119 | 119 | 119 | 119 | $985,000 |
| | | Additional groundwater wells **ALTERNATE** | J-59 | 173 | 173 | 173 | 173 | 173 | 173 | $370,000 |
| | | Additional groundwater well **ALTERNATE** | J-61 | 27 | 27 | 27 | 27 | 27 | 27 | $79,000 |
| | | Additional groundwater well **ALTERNATE** | J-63 | 6 | 6 | 6 | 6 | 6 | 6 | $66,000 |
| | *Kerr County Mining | Additional groundwater wells | J-65 | 19 | 19 | 19 | 19 | 19 | 19 | $197,000 |
| Kinney | City of Brackettville | Increase supply to Spofford with new water line | J-66 | 0 | 3 | 3 | 3 | 3 | 3 | $4,271,000 |
| | | Increase storage facility | J-67 | 0 | 3 | 3 | 3 | 3 | 3 | $1,272,000 |

**Table 11-8. (continued) 2021 Summary of Recommended and Alternate Water Management Projects**

| County | Water User Group | Strategy | Strategy ID | Strategy Supply (Acre-Feet Per Year) | | | | | | Total Capital Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | |
| Kinney | Fort Clark Springs MUD | Water loss audit and main-line repair | J-68 | 79 | 79 | 79 | 79 | 79 | 79 | $1,531,000 |
| | | Increase storage facility | J-69 | 0 | 620 | 620 | 620 | 620 | 620 | $1,501,000 |
| Real | *City of Camp Wood | Additional groundwater wells | J-73 | 143 | 143 | 143 | 143 | 143 | 143 | $1,709,000 |
| | City of Leakey | Additional groundwater well | J-75 | 91 | 91 | 91 | 91 | 91 | 91 | $189,000 |
| | | Develop interconnections between wells within the City | J-76 | 0 | 81 | 81 | 81 | 81 | 81 | $202,000 |
| | Real County Other - Real WSC | Water loss audit and main-line repair | J-77 | 2 | 2 | 2 | 2 | 2 | 2 | $482,000 |
| | Real County Other - Oakmont Saddle Mountain WSC | Additional groundwater well | J-79 | 54 | 54 | 54 | 54 | 54 | 54 | $417,000 |
| Val Verde | *City of Del Rio | Water loss audit and main-line repair | J-80 | 12 | 12 | 12 | 12 | 12 | 12 | $5,672,000 |
| | | Additional groundwater well | J-81 | 7,191 | 7,191 | 7,191 | 7,191 | 7,191 | 7,191 | $12,695,000 |
| | | Water treatment plant expansion | J-82 | 0 | 943 | 943 | 943 | 943 | 943 | $8,646,000 |
| | | Develop a wastewater reuse program | J-83 | 0 | 3,092 | 3,092 | 3,092 | 3,092 | 3,092 | $2,846,000 |
| | Val Verde County Other - Val Verde County WCID Comstock | Water loss audit and main-line repair | J-84 | 1 | 1 | 1 | 1 | 1 | 1 | $406,000 |
| | Val Verde County Other - San Pedro Canyon Upper Subdivision | Water loss audit and main-line repair | J-85 | 7 | 7 | 7 | 7 | 7 | 7 | $142,000 |
| | Val Verde County Other - Tierra Del Lago | Water loss audit and main-line repair | J-86 | 4 | 4 | 4 | 4 | 4 | 4 | $146,000 |
| | *Val Verde County Mining | Additional groundwater wells | J-89 | 242 | 242 | 242 | 242 | 242 | 242 | $1,096,000 |

# 11.3 PROGRESS OF REGIONALIZATION

Five of the six counties that comprise the Plateau Region are highly rural with each county containing only one or two communities of significant size. Generally, these rural communities are totally self-supportive without need or justification for regional / shared water supply projects.

The *2021 Plateau Region Water Plan* projects only a limited amount of water-supply shortage for the rural Guadalupe River Basin portion of Kerr County at large; however, it is recognized that a greater percentage of the rural population is concentrated in the eastern portion of the county (see Chapter 2, Figure 2-3). Population growth in eastern Kerr County continues to increase, creating genuine concerns pertaining to the water availability needed to meet these growing demands.

To meet this anticipated need, the Kerr County Commissioners' Court (KCCC) in partnership with the Upper Guadalupe River Authority (UGRA) has plans to develop the Eastern Kerr County Regional Water Supply Project (EKCRWSP) to provide for conjunctive use of surface water and groundwater in high density growth areas of eastern Kerr County outside of the area serviced by the City of Kerrville. The EKCRWSP includes both water and wastewater facilities, and will draw on several proposed strategies to tap multipole water-supply sources (see Chapter 5, Strategy J-45).

Regionalization thus plays a key role in moving both surface water and groundwater supplies to the numerous end-users in the County. This *2021 Plateau Region Water Plan* continues to support regionalization by recognizing that future water supplies can best be shared in this high-growth community through cooperative management.