APPENDIX 5A
RECOMMENDED AND ALTERNATE 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 of new water produced ~~adequacy~~
- Chemical quality ~~Quality adequacy~~
- Reliability of water supply
- 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~~ 2023 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.

5A-1 WATER MANAGEMENT STRATEGIES FOR BANDERA COUNTY

5A 1.1 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) Water loss audit and main-line repair
- (J-2) Reuse treated wastewater effluent for irrigation of public spaces
- (J-3) Promote, design, and install rainwater harvesting systems on public buildings
- (J-4) Additional Lower Trinity Aquifer well outside the current cone-of-depression and lay necessary pipeline **(ALTERNATE)**
- (J-5) Additional Middle Trinity Aquifer wells within City water infrastructure area
- (J-6) Surface water acquisition, treatment and 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 is currently in Stage 4 of drought, which is considered critical conditions. During this stage, outdoor water use is prohibited, except for what is necessary for livestock. The implementation of various stages of drought over the past several years has ~~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 Water Loss Audit and Main-Line Repair

According to the 2022 TWDB Public Water System Water Loss Survey, the City of Bandera had real water losses (as opposed to apparent "paper" losses) of 36 acre-feet in 2022 (15 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy

will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes five miles of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $5,327,000. The strategy is estimated to generate a potential savings of five acre-feet of water per year throughout the planning period.

J-2 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 therefore 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 $2,117,000.

J-3 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 $83,000. This project will provide a firm supply of water even though some impact would be expected during drought conditions.

J-4 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~~ 1,949 in ~~2020~~ 2030; to ~~2,4421~~ 2,152 by ~~2070~~2080. 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 $7,067,000.

J-5 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 $1,115,000.

J-6 Surface Water Acquisition, Treatment and 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~~ February 2023 study report (389) titled Aquifer Storage and Recovery Report: Longevity Assessment for the City of Bandera Water Wells was prepared for the Plateau Region Water Planning Group and can be accessed for more strategy detail.

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~~ 2023, 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 adopted 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 $50,501,000.

5A 1.2 WATER MANAGEMENT STRATEGIES FOR BANDERA COUNTY FWSD #1

Bandera County Fresh Water Supply District #1 was created by the Bandera County Commissioners Court on April 16, 1961. It is the mission of the District to provide the best quality of water at the most reasonable rate. Bandera County FWSD #1 obtains their water supply from groundwater within the Trinity Aquifer by means of four groundwater wells.

Although the supply-demand analysis (Chapter 4) does not project a future water-supply deficit for Bandera County FWSD #1, the following water management strategies are recommended to enhance the reliability of the future water-supply availability for residents.

- (J-7) Public conservation education - Bandera County FWSD #1
- (J-8) Additional groundwater well for Bandera County FWSD #1

J-7 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~~ four acre-feet per year. The annual cost of this project in 2030 is estimated to be $876. The total capital cost for this strategy is estimated to be $5,342.

J-8 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 $1,562,000.

5A 1.3 WATER MANAGEMENT STRATEGIES FOR BANDERA COUNTY-OTHER

Bandera County-Other has less than ~~23,000~~ 19,000 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) Aquifer 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-9) Water loss audit and main-line repair for Bridlegate Subdivision
- (J-10) Water loss audit and main-line repair for Flying L Ranch PUD
- (J-11) Additional groundwater well - Medina WSC
- (J-12) Drought management – San Antonio Basin
- (J-13) Vegetative management – San Antonio Basin
- (J-14) Additional groundwater wells to provide emergency supply near the volunteer fire Department **(ALTERNATE)**
- (J-15) Drought management – Nueces Basin

J-9 Water Loss Audit and Main-line Repair for Bridlegate Subdivision

According to the 2022 TWDB Public Water System Water Loss Survey, the Bridlegate Subdivision had a total water loss (as opposed to apparent "paper" losses) of seven acre-feet in 2022 (13 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes two miles of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $2,130,000. The strategy is estimated to generate a potential savings of one acre-foot of water per year throughout the planning period.

J-10 Water Loss Audit and Main-line Repair for Flying L Ranch PUD

According to the 2020 TWDB Public Water System Water Loss Survey, the Flying L Ranch PUD had a total water loss (as opposed to apparent "paper" losses) of 12 acre-feet in 2020 (19 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes one mile of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $1,065,000. The strategy is estimated to generate a potential savings of two acre-feet of water per year throughout the planning period.

J-11 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 $2,129,000.

J-12 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~~2030; 491 acre-feet/year in ~~2030~~2040; 516 acre-feet/year in ~~2040~~2050; 525 acre-feet/year in ~~2050~~2060; 533 acre-feet/year in ~~2060~~2070; and 537 acre-feet/year in ~~2070~~2080.

J-13 Vegetative Management – San Antonio Basin

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 PWPG has selected vegetative management as an appropriate water management strategy for several river basins within the Plateau Region. A more detailed description of this strategy is contained in Section 5.2.8 of this Chapter.

Reduced rainfall during drought-of-record conditions certainly reduces aquifer recharge potential. However, some rainfall (and thus recharge) still does occur. Research studies (see Chapter 5, Section 5.2.8) have documented potential recharge impacts resulting from vegetative management. Chapter 7,

Section 7.1.1 defines drought-of-record conditions pertaining to rainfall in the Plateau Region as being an average of 20 percent (five inch) reduction in rainfall per year during the 1950's drought and an average 40 percent (10 inch) reduction during more current years. Assuming the worst-case scenario of 40 percent reduction in precipitation will likewise result in 40 percent reduction in average recharge potential, the amount of supply produced for this strategy is 1,388 acre-feet per year.

J-14 Additional Groundwater Wells to Provide Emergency Supply near Volunteer Fire Department (ALTERNATE)

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 $7,527,000.

J-15 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. This strategy 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~~2030; 26 acre-feet/year in ~~2030~~2040; 27 acre-feet/year in ~~2040~~2050; 28 acre-feet/year in ~~2050~~2060; 28 acre-feet/year in ~~2060~~2070; and 28 acre-feet/year in ~~2070~~2080.

5A 1.4 WATER MANAGEMENT STRATEGIES FOR BANDERA COUNTY IRRIGATION

Bandera County has approximately ~~75~~ 957 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 but will leave an unmet need of 806 acre-feet per year throughout the planning period.

- (J-16) Irrigation scheduling – San Antonio Basin
- (J-17) Additional groundwater wells - San Antonio Basin

J-16 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, according to Best Management Practices for Agricultural Water Users, found on the TWDB's website.

Quantity, Reliability and Cost - According to the ~~2017~~2022 U.S. Ag Census, Bandera County had ~~55~~ 40 farms with irrigated land in ~~2017~~ 2022 and 10,060 acres of irrigated land, which gives ~~with~~ an average of ~~22~~ 252 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~~ 76 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-17 Additional Groundwater Wells – San Antonio Basin

The Trinity Aquifer has been identified as a potential source of water to meet a portion of 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 $399,000.

5A 1.5 WATER MANAGEMENT STRATEGIES FOR BANDERA COUNTY LIVESTOCK

Bandera County has a total projected ~~5~~ seven acre-feet per year of livestock water use shortage over the planning horizon. The water supply shortage occurs within the Nueces River Basin (20 acre-feet per year). All other river basins are projected to have a water supply surplus throughout the planning period.

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-18) Livestock conservation – Nueces Basin
- (J-19) Additional groundwater wells - Nueces Basin

J-18 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, providing 13 acre-feet per year in a water supply savings for the Nueces River Basin. No capital cost is assigned to this strategy.

J-19 Additional Groundwater Wells – 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 four new 20 gpm wells will be drilled to approximately 860 feet below the surface.

Quantity, Reliability, and Cost – The four new wells are assumed to supply an additional eight acre-feet per year, with a medium to high reliability based on competing demands. The total cost of this project will be approximately $671,000.

5A-2 WATER MANAGEMENT STRATEGIES FOR EDWARDS COUNTY

5A 2.1 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-20) Public Conservation Education
- (J-21) Water loss audit and main-line repair
- (J-22) Additional Groundwater Wells

J-20 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~~ two acre-~~foot~~feet per year. The annual cost of this project in ~~2020~~ 2030 is estimated to be $~~2081~~,148. The total capital cost for this strategy is estimated to be $5,555.

J-21 Water Loss Audit and Main-Line Repair

According to the 2022 TWDB Public Water System Water Loss Survey, the City of Rocksprings had a total water loss (as opposed to apparent "paper" losses) of 32 acre-feet in 2022 (15 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes two miles of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $2,130,000. The strategy is estimated to generate a potential savings of five acre-feet of water per year throughout the planning period.

J-22 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 online, 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 $1,020,000.

5A 2.2 WATER MANAGEMENT STRATEGIES FOR EDWARDS COUNTY-OTHER

Edwards County-Other has less than 550 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 Edwards-Trinity (Plateau) Aquifer for their water-supply needs, either on private wells or privately owned water-supply systems. In a few locations, the Nueces Alluvium Aquifer is a modest source of supply.

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

- (J-23) Additional groundwater well and RO treatment (Barksdale WSC)
- (J-24) Vegetative management – Nueces Basin

J-23 Additional Groundwater Well and RO Treatment (Barksdale WSC)

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 $317,000.

J-24 Vegetative Management

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 PWPG has selected vegetative management as an appropriate water management strategy for several river basins within the Plateau Region. A more detailed description of this strategy is contained in Section 5.2.8 of this Chapter.

Reduced rainfall during drought-of-record conditions certainly reduces aquifer recharge potential. However, some rainfall (and thus recharge) still does occur. Research studies (see Chapter 5, Section 5.2.8) have documented potential recharge impacts resulting from vegetative management. Chapter 7, Section 7.1.1 defines drought-of-record conditions pertaining to rainfall in the Plateau Region as being an average of 20 percent (five inch) reduction in rainfall per year during the 1950's drought and an average 40 percent (10 inch) reduction during more current years. Assuming the worst-case scenario of 40 percent reduction in precipitation will likewise result in 40 percent reduction in average recharge potential, the amount of supply produced for this strategy is 87 acre-feet per year.

5A 2.3 WATER MANAGEMENT STRATEGIES FOR EDWARDS COUNTY IRRIGATION

Edwards County has approximately 15 acre-feet of irrigation shortage in the Rio Grande 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. Edwards County, like many other counties within the Hill Country, is prone to extreme heat, persistent drought, and ever-growing demand of water.

The following water management strategies are recommended to enhance the reliability of the future water supply availability for the irrigation needs within Edwards County.

- (J-25) Irrigation scheduling – Rio Grande Basin

J-25 Irrigation Scheduling (Rio Grande Basin)

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, according to Best Management Practices for Agricultural Water Users, found on the TWDB's website.

Quantity, Reliability and Cost - According to the 2022 U.S. Ag Census, Edwards County had 17 farms with irrigated land in 2022 and 215,704 acres of irrigated land, which gives an average of 12,688 acres per farm. Assuming that scheduling would conserve 0.3 acre-feet per acre this results in a conservation savings of approximately 3,806 acre-feet per farm. 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.

5A 2.4 WATER MANAGEMENT STRATEGIES FOR EDWARDS COUNTY LIVESTOCK

Edwards County has a total projected water-supply surplus of 34 acre-feet per year throughout the planning period. However, within the Nueces River Basin, livestock has a projected shortage of 53 acre-feet in each decade throughout 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 is a more reliable source. The following water management strategies are recommended to enhance the reliability of the future water supply availability for livestock needs within Edwards County.

- (J-26) Livestock conservation – Nueces Basin

J-26 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, providing 51 acre-feet per year in a water supply savings for the Nueces River Basin. No capital cost is assigned to this strategy.

5A 2.5 WATER MANAGEMENT STRATEGIES FOR EDWARDS COUNTY MINING

Edwards County has approximately eight 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-27) Mining Conservation (Nueces Basin)
- (J-28) Additional groundwater well (Nueces Basin)

J-27 Mining Conservation (Nueces Basin)

Mining groundwater use in the Plateau Water Planning Area is primarily associated with oil and gas production. Water is needed for well drilling activities, formation fracing, and sand (proppant) mining plants. The PWPG encourages the use of alternative water sources when and where it is economically feasible to do so. For conservation of freshwater resources associated with fracing, on-site treatment of produced and/or flowback water allows for reuse of the water stream. There are numerous third-party vendors who offer mobile produced water recycling systems.

In 2018, approximately 10 percent of fracwater supply in the Permian Basin was recycled produced water. Conservation of 15 percent of Edwards County mining needs (Nueces Basin) would reduce mining needs by two acre-feet in all decades throughout the planning period. No capital cost is assigned to this project.

J-28 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 $154,000.

5A-3 WATER MANAGEMENT STRATEGIES FOR KERR COUNTY

5A 3.1 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~~2018). 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 a second Ellenburger Aquifer to provide additional water supply.

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~~ 1,445 acre-feet per year in ~~2020~~2030; increasing to ~~1,156~~ 3,231 acre-feet per year by ~~2070~~2080. Water management strategies that the City can consider as possible future sources of supply include the bulleted items below.

- (J-29) Increase wastewater reuse
- (J-30) Water loss audit and main-line repair for City of Kerrville
- (J-31) Additional Ellenburger Aquifer groundwater well
- (J-32) Increasing water treatment and ASR capacity

J-29 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 $23,355,000.

J-30 Water Loss Audit and Main-line Repair for City of Kerrville

According to the 2022 TWDB Public Water System Water Loss Survey, the City of Kerrville had a total water loss (as opposed to apparent "paper" losses) of 416 acre-feet in 2022 (10 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes 27 miles of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $28,757,000. The strategy is estimated to generate a potential savings of 42 acre-feet of water per year throughout the planning period.

J-31 Additional Ellenburger Aquifer Groundwater Well

This strategy assumes that one new water well 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 first well within the Ellenburger Aquifer 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 $38,542,000.

J-32 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 later 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 $21,621,000.

5A 3.2 WATER MANAGEMENT STRATEGIES FOR KERRVILLE SOUTH WATER

Kerrville South Water has a projected water supply deficit beginning in 2030 of 70 acre-feet per year, increasing to 173 acre-feet per year by 2080.

The following water management strategy is recommended to enhance the reliability of the future water supply availability for Kerrville South Water.

- (J-33) Additional groundwater wells

J-33 Additional Groundwater Well

This strategy assumes that two new water wells will be drilled in the Lower Trinity Aquifer, approximately 600 feet in depth. It is anticipated that the wells 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 200 acre-feet per year. The total estimated capital cost for this project is approximately $2,209,000.

5A 3.3 WATER MANAGEMENT STRATEGIES FOR KERR COUNTY-OTHER

Kerr County-Other has a projected population of ~~24,165~~ 20,501, excluding Kerrville and Kerrville South, in ~~2020~~ 2030, increasing to ~~28,949~~ 25,245 by ~~2070~~ 2080. 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 as a total, has a projected water supply surplus throughout the planning period, a small water supply deficit does exist within the Colorado Basin of approximately 79 acre-feet per year beginning in 2030, increasing to 101 acre-feet per year by 2080. 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."

The following water management strategies are recommended to enhance the reliability of the future water supply availability for Kerr County-Other.

- (J-34) Eastern Kerr County Regional Water Supply Project
- (J-35) Purchase water from EKCRWSP – Center Point
- (J-36) Purchase water from EKCRWSP – Center Point Taylor System
- (J-37) Water loss audit and main-line repair for Community Water Group WSC
- (J-38) Purchase water from EKCRWSP – Colorado Basin
- (J-39) Vegetative management - Guadalupe Basin

J-34 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 $156,421,000. UGRA is the sponsor for this regional project.

The *2026 Plateau Region Water Plan* projects only a limited amount of water-supply shortage for the rural Colorado 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. Construction of an 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. This Aquifer has been identified as a viable source for Kerr County and is also 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. 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. 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 $906,000.

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 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 project will be combined with water supplies generated in all projects that make up Strategy J-34 for distribution to the public.

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 2023, 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 $39,053,000, which includes 1,500-acre land purchase and survey cost of $11,049,000.

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 total estimated capital cost for this project is $48,636,000. Treated supplies more than 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 $1,881,000. 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 2040 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 $13,067,000.

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 2040 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 $52,888,000.

J-35 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-34). Water

supplies provided by the Project are derived from multiple sources and will be more reliable than existing individual sources. Although Center Point is not projecting a future water supply deficit, 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 $1,091 per acre foot for a total annual cost of $12,000.

J-36 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-34). 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 not projecting a water supply deficit, 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 $1,140 per acre foot for a total annual cost of $49,000.

J-37 Water Loss Audit and Main-line Repair for Community Water Group WSC

According to the 2020 TWDB Public Water System Water Loss Survey, the Community Water Group WSC had a total water loss (as opposed to apparent "paper" losses) of six acre-feet in 2020 (22 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes one mile of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $1,065,000. The strategy is estimated to generate a potential savings of one acre-foot of water per year throughout the planning period.

J-38 Purchase Water from EKCRWSP – Colorado Basin

Kerr County-Other is comprised of several small community utilities in Easter Kerr County that are expected to benefit from the construction of the Eastern Kerr County Regional Water Supply Project (Strategy J-34). Water supplies provided by the Project are derived from multiple sources and will be more reliable than existing individual sources. Utilities within County-Other will likely derive all its supply (102 acre-feet per year) from the Project in the future. The annual supply purchase cost is estimated at $1,137 per acre foot for a total annual cost of $116,000.

J-39 Vegetative Management – Guadalupe Basin

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 PWPG has selected vegetative management as an appropriate water management strategy

for several river basins within the Plateau Region. A more detailed description of this strategy is contained in Section 5.2.8 of this Chapter.

Reduced rainfall during drought-of-record conditions certainly reduces aquifer recharge potential. However, some rainfall (and thus recharge) still does occur. Research studies (see Chapter 5, Section 5.2.8) have documented potential recharge impacts resulting from vegetative management. Chapter 7, Section 7.1.1 defines drought-of-record conditions pertaining to rainfall in the Plateau Region as being an average of 20 percent (five inch) reduction in rainfall per year during the 1950's drought and an average 40 percent (10 inch) reduction during more current years. Assuming the worst-case scenario of 40 percent reduction in precipitation will likewise result in 40 percent reduction in average recharge potential, the amount of supply produced for this strategy is 131 acre-feet per year.

5A 3.4 WATER MANAGEMENT STRATEGIES FOR KERR COUNTY IRRIGATION

Kerr County has a projected water supply deficit in the Colorado Basin of 97 acre-feet per year throughout the planning period, and three acre-feet per year of a water supply deficit in the San Antonio Basin throughout the planning period. 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. Kerr County, like many other counties within the Hill Country, is prone to extreme heat, persistent drought, and ever-growing demand of water.

The following water management strategies are recommended to enhance the reliability of the future water supply availability for the irrigation needs within Kerr County.

- (J-40) Irrigation scheduling – Colorado Basin
- (J-41) Irrigation scheduling – San Antonio Basin

J-40 Irrigation Scheduling (Colorado Basin)

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, according to Best Management Practices for Agricultural Water Users, found on the TWDB's website.

Quantity, Reliability and Cost - According to the 2022 U.S. Ag Census, Kerr County had 67 farms with irrigated land in 2022 and 12,941 acres of irrigated land, which gives an average of 12,688 acres per farm. Assuming that scheduling would conserve 0.3 acre-feet per acre this results in a conservation savings of approximately 3,882 acre-feet per farm for the entire County. This supply volume was divided in half (1,941 acre-feet per year) and is shared with the same strategy for the San Antionio Basin. 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-41 Irrigation Scheduling (San Antonio Basin)

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, according to Best Management Practices for Agricultural Water Users, found on the TWDB's website.

Quantity, Reliability and Cost - According to the 2022 U.S. Ag Census, Kerr County had 67 farms with irrigated land in 2022 and 12,941 acres of irrigated land, which gives an average of 12,688 acres per farm. Assuming that scheduling would conserve 0.3 acre-feet per acre this results in a conservation savings of approximately 3,882 acre-feet per farm for the entire County. This supply volume was divided in half (1,941 acre-feet per year) and is shared with the same strategy for the Colorado Basin. 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.

5A 3.5 WATER MANAGEMENT STRATEGIES FOR KERR COUNTY LIVESTOCK

Kerr County is projected to have approximately 54 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.

The following water management strategies are recommended to enhance the reliability of the future water supply availability for the livestock needs within Kerr County.

- (J-42) Livestock conservation – Colorado Basin
- (J-43) Additional groundwater wells - Colorado Basin (ALTERNATE)
- (J-44) Livestock conservation - San Antonio Basin
- (J-45) Additional groundwater well - San Antonio Basin (ALTERNATE)

J-42 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. Six acre-feet per year is assumed for the Colorado Basin livestock conservation strategy. No capital cost is assigned to this strategy.

J-43 Additional Groundwater Well (Colorado 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 of acceptable quality for livestock use. Recharge to the Lower Trinity in Kerr County likely occurs primarily by lateral underflow from the north and west. This strategy assumes that three new wells 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 – Three new wells at 5-gpm each are assumed to supply an additional 24 acre-feet per year. The reliability of this supply is moderate, based on competing demands. The total cost of this project will be approximately $318,000.

J-44 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. Nine acre-feet per year is assumed for the San Antonio Basin livestock conservation strategy. No capital cost is assigned to this strategy.

J-45 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 of acceptable quality for livestock use. Recharge to the Lower Trinity in Kerr County likely occurs primarily by lateral underflow from the north and west. This strategy assumes that two new wells 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 two new 17-gpm wells are assumed to supply an additional 54 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 $255,000.

5A 3.6 WATER MANAGEMENT STRATEGIES FOR KERR COUNTY MINING

Kerr County is projected to have approximately 75 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-46) Mining conservation (Guadalupe Basin)
- (J-47) Additional groundwater wells (~~Colorado Basin~~ Guadalupe Basin)

J-46 Mining Conservation (Guadalupe Basin)

Mining groundwater use in the Plateau Water Planning Area is primarily associated with oil and gas production. Water is needed for well drilling activities, formation fracing, and sand (proppant) mining plants. The PWPG encourages the use of alternative water sources when and where it is economically feasible to do so. For conservation of freshwater resources associated with fracing, on-site treatment of produced and/or flowback water allows for reuse of the water stream. There are numerous third-party vendors who offer mobile produced water recycling systems.

In 2018, approximately 10 percent of fracwater supply in the Permian Basin was recycled produced water. Conservation of 15 percent of Kerr County mining needs (Guadalupe Basin) would reduce mining needs by 30 acre-feet in all decades throughout the planning period. No capital cost is assigned to this project.

J-47 Additional Groundwater Wells (~~Colorado Basin~~ Guadalupe Basin) ALTERNATE

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 three new 10-gpm wells are assumed to supply an additional 48 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 $360,000.

5A-4 WATER MANAGEMENT STRATEGIES FOR KINNEY COUNTY

5A 4.1 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~~ 1,077 in ~~2020~~ 2030; ~~increasing~~ decreasing to ~~1,971~~ 914 by ~~2070~~2080. 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-48) Increase supply to Spofford with new water line infrastructure
- (J-49) Increase storage facility

J-48 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 three 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 $13,196,000.

J-49 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-48 above).

Quantity, Reliability, and Cost – It is assumed that this strategy will provide an additional three acre-feet per year of water. The total estimated capital cost for this project is approximately $1,438,000.

5A 4.2 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 strategies are recommended to enhance the reliability of the Community's future water supply availability.

- (J-50) 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-50 Increase Storage Facility

The Fort Clark Springs MUD (District) currently has 989 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. 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 $2,499,000.

5A 4.3 WATER MANAGEMENT STRATEGIES FOR KINNEY COUNTY-OTHER

Kinney County-Other has a projected population of 502 individuals in 2030, decreasing to 426 individuals by 2080. This compilation of users known as County-Other is self-supplied and relies predominately on groundwater from the Edwards-Trinity (Plateau) Aquifer, Edwards (BFZ) and Austin Chalk Aquifer for their water supply needs. Although Kinney County is not projected to experience a water supply shortage within the planning period, planning for a reliable water supply is important to the communities. The following water management strategies are recommended to help enhance the future water supply availability.

- (J-51) Vegetative management (Nueces Basin)
- (J-52) Vegetative management (Rio Grande Basin)

J-51 Vegetative Management (Nueces Basin)

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 PWPG has selected vegetative management as an appropriate water management strategy for several river basins within the Plateau Region. A more detailed description of this strategy is contained in Section 5.2.8 of this Chapter.

Reduced rainfall during drought-of-record conditions certainly reduces aquifer recharge potential. However, some rainfall (and thus recharge) still does occur. Research studies (see Chapter 5, Section 5.2.8) have documented potential recharge impacts resulting from vegetative management. Chapter 7, Section 7.1.1 defines drought-of-record conditions pertaining to rainfall in the Plateau Region as being an average of 20 percent (five inch) reduction in rainfall per year during the 1950's drought and an average 40 percent (10 inch) reduction during more current years. Assuming the worst-case scenario of 40 percent reduction in precipitation will likewise result in 40 percent reduction in average recharge potential, the amount of supply produced for this strategy is 87 acre-feet per year.

J-52 Vegetative Management (Rio Grande Basin)

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 PWPG has selected vegetative management as an appropriate water management strategy for several river basins within the Plateau Region. A more detailed description of this strategy is contained in Section 5.2.8 of this Chapter.

Reduced rainfall during drought-of-record conditions certainly reduces aquifer recharge potential. However, some rainfall (and thus recharge) still does occur. Research studies (see Chapter 5, Section 5.2.8) have documented potential recharge impacts resulting from vegetative management. Chapter 7, Section 7.1.1 defines drought-of-record conditions pertaining to rainfall in the Plateau Region as being an average of 20 percent (five inch) reduction in rainfall per year during the 1950's drought and an average 40 percent (10 inch) reduction during more current years. Assuming the worst-case scenario of 40 percent reduction in precipitation will likewise result in 40 percent reduction in average recharge potential, the amount of supply produced for this strategy is 87 acre-feet per year.

5A-5 WATER MANAGEMENT STRATEGIES FOR REAL COUNTY

5A 5.1 WATER MANAGEMENT STRATEGIES FOR THE CITY OF CAMP WOOD

The City of Camp Wood derives ~~all~~ the majority of 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. However, due to severe drought conditions, Old Faithful Spring is no longer a reliable source of water supply. The discharge from the Spring has been insufficient in meeting all the current needs. To help supplement Old Faithful Spring, the City is operating an additional small well, as backup, which is producing approximately 105 acre-feet per year. The City recognizes the need in developing a reliable, alternate source of supply. The City has been actively seeking funding assistance through various programs for disadvantage communities, to help support the development of two additional groundwater wells in the Edwards-Trinity (Plateau) Aquifer.

Due to the recent drought, the City of Camp Wood in August of 2024 appeared on the TCEQ's Public Water Supply Limiting Water Use list, seeking assistance for emergency funds earmarked for emergency groundwater supply wells. At this time, the City of Camp Wood reported having less than 90-days of reliable water supply.

~~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~~2030 of ~~134~~147 acre-feet per year; decreasing to ~~126~~64 acre-feet per year by ~~2070~~2080. The following water management strategies are recommended to enhance the reliability of the City's future water supply availability.

- (J-53) Public conservation education
- (J-54) Additional wells in the Edwards-Trinity (Plateau) Aquifer

J-53 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 one acre-foot per year. The annual cost of this project in 2030 is estimated to be $920. The total capital cost of this strategy is estimated to be $4,697.

J-54 Additional Wells 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 258 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 $2,531,000.

5A 5.2 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. 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 strategies are recommended to enhance the reliability of the City's future water supply availability.

- (J-55) Public conservation education
- (J-56) Drill additional well in the Lower Trinity Aquifer
- (J-57) Develop interconnection between wells within the City of Leakey

J-55 Public Conservation Education

The City of Leakey 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 one acre-foot per year. The annual cost of this project in 2030 is estimated to be $1,172. The total capital cost for this strategy is estimated to be $5,979.

J-56 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 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 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 $646,000.

J-57 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 $791,000.

5A 5.3 WATER MANAGEMENT STRATEGIES FOR REAL COUNTY-OTHER

The rural area of Real County-Other has less than ~~1,170~~ 1,940 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.

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-58) Water loss audit and main-line repair for Real Water Supply Corporation
- (J-59) Additional groundwater well for Oakmont Saddle Mountain Water Supply Corporation
- (J-60) Vegetative management (Nueces Basin)

J-58 Water Loss Audit and Main-line Repair for Real Water Supply Corporation

According to the 2022 TWDB Public Water System Water Loss Survey, Real WSC had a total water loss (as opposed to apparent "paper" losses) of six acre-feet in 2022 (22 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes one mile of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $1,065,000. The strategy is estimated to generate a potential savings of one acre-foot of water per year throughout the planning period.

J-59 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 watertight 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 $615,000. 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.

J-60 Vegetative Management (Nueces Basin)

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 PWPG has selected vegetative management as an appropriate water management strategy for several river basins within the Plateau Region. A more detailed description of this strategy is contained in Section 5.2.8 of this Chapter.

Reduced rainfall during drought-of-record conditions certainly reduces aquifer recharge potential. However, some rainfall (and thus recharge) still does occur. Research studies (see Chapter 5, Section 5.2.8) have documented potential recharge impacts resulting from vegetative management. Chapter 7, Section 7.1.1 defines drought-of-record conditions pertaining to rainfall in the Plateau Region as being an average of 20 percent (five inch) reduction in rainfall per year during the 1950's drought and an average 40 percent (10 inch) reduction during more current years. Assuming the worst-case scenario of 40 percent reduction in precipitation will likewise result in 40 percent reduction in average recharge potential, the amount of supply produced for this strategy is 87 acre-feet per year.

5A 5.4 WATER MANAGEMENT STRATEGIES FOR REAL COUNTY MANUFACTURING

Much of the water needs for manufacturing operations within Real County are self-supplied from private/company water wells. Projected manufacturing water-supply shortages in Real County begin in 2030 with a two acre-feet per year deficit held constant throughout the planning horizon. The following water management strategy is recommended to enhance the Manufacturing industry's future water-supply availability.

- (J-61) Manufacturing conservation

J-61 Manufacturing Conservation

The PWPG encourages the use of alternative water sources when and where it is economically feasible to do so. For conservation of freshwater resources manufacturing entities can follow several of these recommendations: (1) conduct a water audit, (2) install water-saving equipment, (3) reuse water, (4) harvest rainwater, (5) adopt water management technologies, and (6) set targets and incentives.

Conservation of 50 percent of Real County manufacturing needs in 2030 would reduce manufacturing needs by one acre-foot held constant throughout the planning period. This strategy does not provide enough water supply to absorb the projected water-supply deficit of two acre-feet per year. Most often, manufacturing companies will consider how best to implement the above recommendations for best management practices and resolve any expected water supply deficits. This strategy is not associated with any costs.

5A-6 WATER MANAGEMENT STRATEGIES FOR VAL VERDE COUNTY

5A 6.1 WATER MANAGEMENT STRATEGIES FOR THE CITY OF DEL RIO

The City of Del Rio is the only wholesale water provider / major 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, T~~the diminished supply availability from the Springs during drought periods requires Del Rio to consider other water supply options.

Recently, the City of Del Rio has been exploring an alternative source of water supply. Del Rio has completed one pilot well within the Edwards-Trinity (Plateau) Aquifer, drilled to a depth of approximately 200-250 feet. The pilot well was a success, producing roughly 3,223 acre-feet per year. The City recognizes the importance of transitioning away from the drought impacted spring flows, to a more reliable water-supply source that can sustain future growth. Therefore, the City has plans to drill a second well.

The following water management strategies are recommended to enhance the reliability of the City's future water supply availability.

- (J-62) Water loss audit and main-line repair for the City of Del Rio
- (J-63) Additional groundwater well
- (J-64) Water treatment plant expansion
- (J-65) 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:

- Installation of reverse osmosis at water treatment plant
- Water main replacement
- Collection system reconstruction

J-62 Water Loss Audit and Main-line Repair for the City of Del Rio

According to the 2022 TWDB Public Water System Water Loss Survey, the City of Del Rio had a total water loss (as opposed to apparent "paper" losses) of 2,366 acre-feet in 2022 (27 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes 84 miles of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $89,466,000. The strategy is estimated to generate a potential savings of 631 acre-feet of water per year throughout the planning period.

J-63 Additional Groundwater Well

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 $19,764,000.

J-64 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~~ 2040.

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 $10,489,000 with an estimated annual cost of $1,490,000.

J-65 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 $11,451,000.

5A 6.2 WATER MANAGEMENT STRATEGIES FOR VAL VERDE COUNTY-OTHER

The rural area of Val Verde County has a population projected at ~~15,152~~ 17,639 in ~~2020~~ 2030; increasing to ~~30,469~~ 18,402 by ~~2070~~2080. 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-66) Water loss audit and main-line repair for San Pedro Canyon Subdivision (Upper)
- (J-67) Water loss audit and main-line repair for Tierra del Lago
- (J-68) Vegetative management

J-66 Water Loss Audit and Main-line Repair for San Pedro Canyon Subdivision (Upper)

According to the 2021 TWDB Public Water System Water Loss Survey, San Pedro Canyon Subdivision (Upper) system had a total water loss (as opposed to apparent "paper" losses) of 11 acre-feet in 2021 (26 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes one mile of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $1,065,000. The strategy is estimated to generate a potential savings of three acre-feet of water per year throughout the planning period.

J-67 Water Loss Audit and Main-line Repair for Tierra Del Lago

According to the 2022 TWDB Public Water System Water Loss Survey, Tierra Del Lago system had a total water loss (as opposed to apparent "paper" losses) of nine acre-feet in 2022 (57 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water-supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This

strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes one mile of six-inch diameter pipe will be replaced, at a total estimated project capital cost of $1,065,000. The strategy is estimated to generate a potential savings of five acre-feet of water per year throughout the planning period.

J-68 Vegetative Management

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 PWPG has selected vegetative management as an appropriate water management strategy for several river basins within the Plateau Region. A more detailed description of this strategy is contained in Section 5.2.8 of this Chapter.

Reduced rainfall during drought-of-record conditions certainly reduces aquifer recharge potential. However, some rainfall (and thus recharge) still does occur. Research studies (see Chapter 5, Section 5.2.8) have documented potential recharge impacts resulting from vegetative management. Chapter 7, Section 7.1.1 defines drought-of-record conditions pertaining to rainfall in the Plateau Region as being an average of 20 percent (five inch) reduction in rainfall per year during the 1950's drought and an average 40 percent (10 inch) reduction during more current years. Assuming the worst-case scenario of 40 percent reduction in precipitation will likewise result in 40 percent reduction in average recharge potential, the amount of supply produced for this strategy is 87 acre-feet per year.

5A 6.3 WATER MANAGEMENT STRATEGIES FOR VAL VERDE COUNTY MINING

The mining industry in Val Verde County is projected to have a water supply deficit beginning in 2040 of six acre-feet per year, increasing to 38 acre-feet per year by 2080. 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-69) Mining conservation
- (J-70) Additional groundwater wells

J-69 Mining Conservation

Mining groundwater use in the Plateau Water Planning Area is primarily associated with oil and gas production. Water is needed for well drilling activities, formation fracing, and sand (proppant) mining plants. The PWPG encourages the use of alternative water sources when and where it is economically feasible to do so. For conservation of freshwater resources associated with fracing, on-site treatment of produced and/or flowback water allows for reuse of the water stream. There are numerous third-party vendors who offer mobile produced water recycling systems.

In 2018, approximately 10 percent of fracwater supply in the Permian Basin was recycled produced water. Conservation of 15 percent of Val Verde County mining needs (Rio Grande Basin) would reduce mining needs by 15 acre-feet in all decades throughout the planning period. No capital cost is assigned to this project.

J-70 Additional Groundwater Wells

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 three 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 $1,348,000.

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 Water Planning Group (PWPG) 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

Quantity, Quality and Reliability

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 1.2.8 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 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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