2021 SOUTH CENTRAL TEXAS REGIONAL WATER PLAN

VOLUME 2

Region L
South Central Texas Regional Water Planning Group

SOUTH CENTRAL TEXAS REGIONAL WATER PLANNING GROUP
NOVEMBER 5, 2020

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South Central Texas Regional Water Plan

B&V PROJECT NO. 192335

PREPARED FOR

South Central Texas Regional Water Planning Group

5 NOVEMBER 2020

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FINAL PLAN

SECTION 5.1: POTENTIALLY FEASIBLE WATER MANAGEMENT STRATEGIES

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List of Abbreviations

acft	Acre-Feet
acft/yr	Acre-Feet per Year
ACT	Antiquities Code of Texas
ANWR	Aransas National Wildlife Refuge
ARWA	Alliance Regional Water Authority
ASR	Aquifer Storage and Recovery
BFZ	Balcones Fault Zone
BMP	Best Management Practices
BOD_5	Biochemical Oxygen Demand
BSEACD	Barton Springs Edwards Aquifer Conservation District
CA	Certificate of Adjudication
$CBOD_5$	Carbonaceous Biochemical Oxygen Demand
CCMA	Cibolo Creek Municipal Authority
cfs	Cubic Feet per Second
CFU	Colony Forming Units
CPS	City Public Services
CPSE	City Public Service Energy
CRWA	Canyon Regional Water Authority
CVLGC	Cibolo Valley Local Government Corporation
DFC	Desired Future Condition
DOR	Drought-of-Record
Dow	Dow Chemical Company
EAA	Edwards Aquifer Authority
EAHCP	Edwards Aquifer Habitat Conservation Plan
EMST	Ecological Mapping System of Texas
EST	Elevated Storage Tank
EUWCD	Evergreen Underground Water Conservation District
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FRAT	Flow Regime Application Tool
GAM	Groundwater Availability Model
GBRA	Guadalupe-Blanco River Authority
GCD	Groundwater Conservation District
GCGCD	Guadalupe County Groundwater Conservation District
GCS	Gravity Conveyance System

GCUWCD	Gonzales County Underground Water Conservation District
GIS	Geographic Information System
GLO	General Land Office
GMA	Groundwater Management Area
GPCD	Gallons per Capita per Day
gpm	Gallons per Minute
GSA WAM	Guadalupe-San Antonio River Basin Water Availability Model
GST	Ground Storage Tank
HB	House Bill
HCPUA	Hays Caldwell Public Utility Agency
HDD	Horizontal Directional Drilling
HSPS	High Service Pump Station
IPaC	Information for Planning and Consultation
IRP	Initial Regular Permit
IWPP	Integrated Water Power Project
LGC	Local Government Corporation
MAG	Modeled Available Groundwater
MBTA	Migratory Bird Treaty Act
MBWSP	Mid-Basin Water Supply Project
MCL	Maximum Contaminant Level
MG	Million Gallon
mg/L	Milligrams per Liter
mgd	Million Gallons per Day
mL	Milliliter
MUD	Municipal Utility District
NHD	National Hydrography Dataset
NBU	New Braunfels Utilities
NHPA	National Historic Preservation Act
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Unit
NWI	National Wetlands Inventory
O&M	Operation and Maintenance
psi	Pounds per Square Inch
Region L	South Central Texas Region
RO	Reverse Osmosis

RWP	Regional Water Plan
SARA	San Antonio River Authority
SAWS	San Antonio Water System
SB	Senate Bill
SCTRWP	South Central Texas Regional Water Plan
SCTRWPG	South Central Texas Regional Water Planning Group
SCUCISD	Schertz-Cibolo-Universal City Independent School District
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
SS WSC	SS Water Supply Corporation
SSLGC	Schertz-Seguin Local Government Corporation
SUD	Special Utility District
SWP	State Water Plan
SWTP	Surface Water Treatment Plant
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
THC	Texas Historical Commission
TML	Texas Municipal League
TPWD	Texas Parks and Wildlife Department
TWA	Texas Water Alliance
TWDB	Texas Water Development Board
TX Hwy	Texas Highway
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	United States Environmental Protection Agency's
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAM	Water Availability Model
WCAC	Water Conservation Advisory Council
WCID	Water Control and Improvement District
WMS	Water Management Strategy
WRC	Water Recycling Center
WSC	Water Supply Corporation
WTP	Water Treatment Plant
WUG	Water User Group

WWP	Wholesale Water Provider
WWTP	Wastewater Treatment Plants

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CHAPTER 5: EVALUATION AND RECOMMENDATION OF WATER MANAGEMENT STRATEGIES

Water management strategies (WMSs) were identified and evaluated for the 2021 South Central Texas Regional Water Plan (SCTRWP). The following chapter includes a description of the process to identify WMSs, evaluate potentially feasible WMS, and select recommended WMS to meet future needs. More specifically, Section 5.1 describes the process to identify potentially feasible WMSs and includes brief descriptions of each potentially feasible WMS. Section 5.2 provides detailed evaluations of each potentially feasible WMS. Section 5.3 describes the recommended WMSs for each water user group (WUG) with identified needs during the planning horizon, and Section 5.4 describes the recommended WMSs for each wholesale water provider (WWP). Section 5.5 includes water conservation recommendations.

5.1 POTENTIALLY FEASIBLE WATER MANAGEMENT STRATEGIES

As part of Task 4B, the South Central Texas Regional Water Planning Group (SCTRWPG) prepared a Technical Memorandum to the Texas Water Development Board (TWDB) dated September 7, 2018. The Technical Memorandum included a documented process by which the South Central Texas Region (Region L) identified potentially feasible WMS.

The following process for identification of potentially feasible WMSs was adopted by the SCTRWPG at the November 3, 2017, Regional Water Planning Group public meeting:

1. SCTRWPG recognizes that the 2021 SCTRWP is an update of the 2016 SCTRWP:
    a. Updated population and municipal water demand projections are based on the data from the State Demographer's Office.
    b. The Texas Water Development Board (TWDB) has shifted population and water demand projections away from city-based WUGs to utility-based WUGs.
    c. There are updates in the methodologies for calculating non-municipal water demand projections.
    d. The groundwater availability will incorporate the modeled available groundwater (MAG) values from the groundwater management area (GMA) process.
    e. TWDB allows for a MAG peaking factor.
    f. The Edwards Aquifer Habitat Conservation Plan (EAHCP) has been approved and is being implemented successfully.
    g. Environmental Flow Standards by the Texas Commission on Environmental Quality (TCEQ) are defined for the river basins of the South Central Texas Regional Planning Area.

These changes will affect the demand projections, existing supplies, and/or new supplies from WMSs. Hence, the SCTRWPG will be evaluating WMSs from the 2016 SCTRWP to determine if they are still viable in the 2021 SCTRWP.

2. Current water planning information, including specific WMSs of interest, will be solicited from WUGs and WWPs in summer 2018:
    a. Solicitation of planning information will include a draft list of WMSs deemed potentially feasible to meet projected needs.
    b. The draft list will generally include the recommended WMSs in the 2016 SCTRWP, WMSs in local water plans, and/or other strategies perceived to be of interest to WUGs/WWPs.
    c. WUGs/WWPs will be encouraged to classify each WMS on its draft list as recommended, alternative, or rejected.
3. Considering information responsive to the solicitation and information from required technical evaluations, lists of potentially feasible WMSs will be prepared and comments received beginning with the August 2018 meeting of the SCTRWPG. Additional information may follow in subsequent SCTRWPG meetings.
4. Additional WMSs may be brought forth to the SCTRWP, so long as the WMS is presented to the SCTRWPG by the May 2019 SCTRWPG meeting.
5. The SCTRWPG will use the “Minimum Standards for Water Management Strategies,” “Designation of Recommended and Alternative Strategies,” and “Establishment of Management Supply” guiding principles in the development of the regional water plan (RWP).

Item No. 5 of the above-process identifies three guiding principles for use in the development of the SCTRWP. The above-referenced guiding principles are provided, as follows (refer to Chapter 8 for more information about the guiding principles and their development):

PRINCIPLE VII MINIMUM STANDARDS FOR WATER MANAGEMENT STRATEGIES

Adopted: November 2, 2017

For a proposed strategy to be designated by the SCTRWPG as a water management strategy in the regional water plan, the proposed strategy must:

a. supply water, reduce water demands, or otherwise satisfy one or more identified needs;
b. include an evaluation and description consistent with standards used by the SCTRWPG and its technical consultants as required by TWDB Rules;
c. satisfy all relevant requirements established by the TWDB, including environmental flow standards;
d. identify one or more entities, with sufficient ability and willingness to implement the strategy, as being the strategy’s sponsor(s);

e. identify all entities, as reasonably possible, who own any existing or planned infrastructure or existing permit that could be affected by the proposed strategy as being strategy participants; and

f. identify groundwater conservation districts or TCEQ with jurisdiction over the proposed strategy.

PRINCIPLE VIII RECOMMENDED WATER MANAGEMENT STRATEGIES

Adopted: November 2, 2017

The SCTRWPG strives to develop an regional water plan that recommends water management strategies sufficient to supply water to all identified needs projected in the planning horizon for the region.

The SCTRWPG prefers designating water management strategies as recommended or alternative using a consensus approach while respecting the strategy sponsor(s)' wishes.

Prior to designating any water management strategies as recommended, the SCTRWPG will review the water management strategies to evaluate costs and environmental sensitivity of each water management strategy per TWDB Rules.

PRINCIPLE IX MANAGEMENT SUPPLY

Adopted: November 2, 2017

The cumulative supply of the recommended water management strategies may include an amount of supply in excess of the amount needed to meet regional needs as considered necessary by the SCTRWPG to allow for such things as uncertainty associated with long-term planning, problems with project implementation, changing weather conditions, flexibility of sponsors in choosing projects to implement, and changes in project viability.

<u>Identified Needs without a Recommended Water Management Strategy</u>

For water needs that are not satisfied by recommended water management strategies, the SCTRWPG will provide a narrative explaining why the need is not satisfied.

<u>Alternative Strategies in the Regional Water Plan</u>

The SCTRWPG will include alternative water management strategies that sponsors wish to have identified as alternatives to one or more of their recommended water management strategies.

<u>Conceptual Approaches (Water Management Strategies Needing Further Study) in the Regional Water Plan</u>

The SCTRWPG will acknowledge conceptual and innovative approaches to developing water supplies, reducing water demand, and increasing efficiency of supplying water as may be proposed by others, but need further study. (SCTRWPG Guiding Principles, 2017, p. 28 – 30.)

Using the process described above, 33 potentially feasible WMS were identified (Table 5.1-1). On January 23, 2020, the SCTRWPG selected all 33 of the potentially feasible WMS to be considered as recommended WMSs; no alternative WMS were selected by the SCTRWPG for the 2021 SCTRWP. Table 5.1-1 identifies the potentially feasible and recommended WMSs.

Table 5.1-1 Potentially Feasible and Recommended Water Management Strategies

POTENTIALLY FEASIBLE AND RECOMMENDED WATER MANAGEMENT STRATEGIES	FOR BRIEF DESCRIPTION, SEE SECTION:	FOR DETAILED EVALUATION, SEE SECTION:
Advanced Water Conservation	5.1.1	5.2.1
Drought Management	5.1.2	5.2.2
Edwards Transfers	5.1.3	5.2.3
Local Groundwater	5.1.4	5.2.4
Local Groundwater Conversions	5.1.5	5.2.5
Surface Water Rights	5.1.6	5.2.6
Balancing Storage	5.1.7	5.2.7
Facilities Expansion	5.1.8	5.2.8
Recycled Water Strategies	5.1.9	5.2.9
San Antonio Water System (SAWS) Expanded Local Carrizo Project	5.1.10	5.2.10
SAWS Expanded Brackish Groundwater Project	5.1.11	5.2.11
Alliance Regional Water Authority (ARWA)/Guadalupe-Blanco River Authority (GBRA) Project (Phase 1)	5.1.12	5.2.12
ARWA Project (Phase 2)	5.1.13	5.2.13
ARWA Project (Phase 3)	5.1.14	5.2.14
GBRA Mid-Basin Project (Phase 2)	5.1.15	5.2.15
GBRA Lower Basin Storage	5.1.16	5.2.16
GBRA Lower Basin New Appropriation	5.1.17	5.2.17
GBRA Victoria County Steam-Electric Project	5.1.18	5.2.18
Canyon Regional Water Authority (CRWA) Wells Ranch (Phase 3)	5.1.19	5.2.19
CRWA Siesta Project	5.1.20	5.2.20
CRWA Brackish Carrizo-Wilcox Project	5.1.21	5.2.21
Cibolo Valley Local Government Corporation (CVLGC) Carrizo Project	5.1.22	5.2.22
Schertz-Sequin Local Government Corporation (SSLGC) Expanded Carrizo Project	5.1.23	5.2.23
SSLGC Expanded Brackish Wilcox Project	5.1.24	5.2.24

POTENTIALLY FEASIBLE AND RECOMMENDED WATER MANAGEMENT STRATEGIES	FOR BRIEF DESCRIPTION, SEE SECTION:	FOR DETAILED EVALUATION, SEE SECTION:
New Braunfels Utilities (NBU) ASR	5.1.25	5.2.25
NBU Trinity Well Field Expansion	5.1.26	5.2.26
City of Victoria ASR	5.1.27	5.2.27
City of Victoria Groundwater-Surface Water Exchange	5.1.28	5.2.28
SS Water Supply Corporation (WSC) Brackish Carrizo-Wilcox Project	5.1.29	5.2.29
Martindale Alluvial Well	5.1.30	5.2.30
Maxwell WSC Trinity Well	5.1.31	5.2.31
County Line Special Utility District (SUD) Trinity Well Field	5.1.32	5.2.32
County Line SUD Brackish Edwards Project	5.1.33	5.2.33

Consideration of Other Potentially-Feasible WMS

A well field project for the City of Kenedy was initially identified and explored as a potentially feasible WMS. However, the City of Kenedy's well field project was not developed to a level where it could be appropriately evaluated for inclusion as a potentially feasible WMS, in accordance with the Region L process and guiding principles. Therefore, the SCTRWPG elected not to include the City of Kenedy well field project as a potentially feasible WMS. The City of Kenedy and their representatives were advised that they may request an amendment to the 2021 SCTRWP to add the WMS in the future, if desired.

As indicated in Table 5.1-1, the SCTRWPG recommended inclusion of several Aquifer Storage and Recovery (ASR) strategies and brackish groundwater desalination strategies in the 2021 SCTRWP. The SCTRWPG includes WMSs in the RWP at the request of WUG or WWP sponsors. For the 2021 SCTRWP, seawater desalination was not included as a recommended WMS because it was not requested for inclusion by WUGs and the majority of needs in the region can be met by fresh water, groundwater, brackish groundwater, reuse and conservation WMSs. There are several seawater desalination facilities currently being planned within Texas; seawater desalination may become a feasible and cost-effective strategy for Region L in the future.

Potential for Aquifer Storage and Recovery Projects to Meet Significant Identified Needs

In accordance with Title 31 of the Texas Administrative Code (TAC) Section 357.34(h), if a Regional Water Planning Area (RWPA) has significant identified water needs, the Regional Water Planning Group (RWPG) shall provide a specific assessment of the potential for Aquifer Storage and Recovery (ASR) projects to meet those needs. At the August 1, 2019, RWPG meeting, the SCTRWPG defined the threshold of significant water needs to be a WUG or use type with an identified need of 10,000 ac-ft/yr or greater. WUGs or use types meeting this definition in the 2021 SCTRWP include New Braunfels, San

Antonio Water System (SAWS), San Marcos, Victoria, Irrigation, and Mining. The following provides a summary of the potential for ASR projects to meet significant identified water needs in Region L:

- New Braunfels: To meet New Braunfels' significant identified needs, the SCTRWPG recommended the New Braunfels Utilities (NBU) ASR Project in the 2021 SCTRWP. An evaluation of the NBU ASR Project can be found in Section 5.2.25.
- SAWS: SAWS already has an ASR facility in operation, the H2Oaks Center, for which a water treatment plant expansion is included as a recommended WMS in the 2021 SCTRWP. The WMS evaluation for the SAWS ASR WTP expansion project can be found in Section 5.2.8.
- San Marcos: A full strategy evaluation of the potential for ASR projects to meet San Marcos' significant identified water needs was not conducted because their needs have been met through a variety of cost-effective WMSs, including Advanced Water Conservation, ARWA/GBRA Project (Phase 1), ARWA Project (Phase 2), and potable and non-potable reuse. Given the location and aquifer characteristics in the area, an ASR project could potentially be developed to meet additional needs for San Marcos in the future.
- Victoria: To meet Victoria's significant identified needs, the SCTRWPG recommended the City of Victoria ASR Project in the 2021 SCTRWP. An evaluation of the Victoria ASR Project can be found in Section 5.2.27.
- Irrigation and Mining: A full strategy evaluation of ASR was not conducted for Irrigation or Mining in Region L because implementation of ASR may be considered cost-prohibitive compared to the cost of surface water and/or groundwater projects.

The following subsections provide brief descriptions of each of the potentially feasible and recommended WMSs included in the 2021 SCTRWP. Descriptions include the dependable (firm) water supply during drought and an estimated annual unit cost (in September 2018 dollars) for water at full operating capacity during the debt service period (if applicable). Evaluations for each of these potentially feasible WMSs can be found in Section 5.2.

5.1.1 Advanced Water Conservation

The goal of this WMS is to increase water conservation for irrigation, municipal, industrial, steam-electric, and mining use types and thereby reduce freshwater use within the planning area. The general methods to accomplish this objective are as follows:

- Reduce per capita water use in the municipal water use category;
- Recycle and reuse water and substitute reclaimed water (treated municipal and industrial wastewater) for use in some industries, steam-electric power generation, and mining; and
- Improve irrigation efficiencies to reduce the quantity of water use in agriculture per acre irrigated.

Best management practices (BMPs) for water conservation are included in this advanced water conservation WMS. In addition, the WMS includes estimates of potential water conservation demand reductions and associated costs of water conservation for municipal WUGs. A variety of conservation measures are recommended as described in the Water Conservation Advisory Council (WCAC) BMP

Guide,[1] any combination of which can be used to meet the specific goals for a municipality or utility. Planned additional municipal water conservation focused on these BMPs could effectively increase supply through demand reduction in the South Central Texas Region by 167,148 acre-feet per year (acft/yr) in the year 2070, with unit costs ranging from $600 per acft/yr to $770 per acft/yr.

Subsection 5.2.1 includes a detailed discussion of this WMS, including implementation decades and demand reduction volumes for each sponsor. Section 5.5 includes the SCTRWPG's recommendations regarding water conservation.

5.1.2 Drought Management

Drought management is the periodic activation of approved drought contingency plans resulting in short-term demand reduction and/or restriction. This reduction in demand is then considered a "supply" source. Using this approach, an entity may make the conscious decision not to develop firm water supplies greater than or equal to projected water demands with the understanding that demands will have to be reduced or go unmet during times of drought. Using this rationale, an economic impact of not meeting projected water demands can be estimated and compared with the costs of other potentially feasible WMSs in terms of annual unit costs. This WMS is considered for implementation in the 2020 decade.

On October 3, 2019, the TWDB released the Drought Management Costing Tool to estimate economic impacts of the water volumes reduced by implementation of drought management strategies for the 2021 RWP. As described in the TWDB provided Drought Management Costing Tool User Manual, "the primary purpose of the tool is to provide WUG level costs and the expected household level residential water savings associated with policy-imposed restrictions or reduction on residential water use." The SCTRWPG selected a total demand reduction of 5 percent water use reduction scenarios for WUGs that exhibited needs in the 2020 decade. Using the Drought Management Costing Tool, the 5 percent yield for applicable WUGs was 2,225 acft/yr and annual costs were $174,556 in 2020. While SAWS does not have a need in 2020, the utility has chosen to implement WUG-specific drought reduction targets for each decade during the planning horizon, resulting in a 2070 demand reduction of 56,588 acft/yr at a total annual cost of $20,258,504. Including SAWS, the 2020 yield for this WMS is expected to be 14,176 acft/yr.

Subsection 5.2.2 includes a detailed discussion of this WMS.

5.1.3 Edwards Transfers

The Edwards Aquifer Authority (EAA) was created in 1993 by Senate Bill (SB) 1477 of the 73rd Texas Legislature. This bill, which is typically called The Edwards Aquifer Authority Act (The Act), has been amended many times in subsequent legislative sessions. Requirements of the EAA pursuant to The Act include the following:

- Issuing permits for all non-exempt wells;
- Limiting permitted withdrawals to 572,000 acft/yr; and

[1] "Best Management Practices for Municipal Water Users." Texas Water Development Board. Austin, Texas. May 2019.

- Enforcing water management practices, procedures, and methods to ensure that the continuous minimum springflows of the Comal Springs and the San Marcos Springs are maintained to protect endangered and threatened species to the extent required by federal law.

Since the EAA began to issue initial regular permits (IRPs) for wells, there have been numerous transfers of the water rights associated with these permits among interested parties. Subject to requirements in The Act and EAA rules related to the base and unrestricted portions of water rights associated with irrigated agriculture, many historical transfers have been from irrigation to municipal use. The Edwards Transfers WMS in the 2021 SCTRWP focuses on the future of such irrigation to municipal transfers.

The EAA has issued IRPs for municipal, industrial, and irrigation water use totaling 571,600 acft/yr. However, MAG for the aquifer is 264,906 acft/yr in all decades, according to what would be available in a drought scenario under full implementation of the EAHCP. Considering full implementation of the EAHCP, the 2070 firm volume from the Edwards Transfers WMS is 5,906 acft/yr, with an assumed annual unit cost of $1,242 per acft.

Subsection 5.2.3 includes a detailed discussion of this WMS, including implementation decades and volumes for each sponsor.

5.1.4 Local Groundwater

The local groundwater WMS involves the phased development or expansion of well fields in the Carrizo-Wilcox, Trinity, Gulf Coast, Leona Gravel, and Yegua-Jackson aquifers for the purposes of meeting local needs. Local groundwater is the recommended WMS for 17 municipal WUGs and four non-municipal WUGs. Many WUGs in Region L commonly use local aquifers for their supply. Where local groundwater supplies are available, there is generally a preference for groundwater as a source because it is (1) readily available at different locations within a distribution system, (2) relatively inexpensive, and (3) often requires minimal treatment compared to surface water. Planned implementation of this strategy provides new dependable supplies totaling 28,240 acft/yr in 2070, and estimated unit costs ranging from $54/acft/yr to $1,317/acft/yr.

Subsection 5.2.4 includes a detailed discussion of this WMS, including implementation decades and volumes for each sponsor.

5.1.5 Local Groundwater Conversions

The local groundwater conversions WMS is intended to be used by WUGs where another WMS would be the primary recommended strategy (i.e., local groundwater WMS) to meet their needs but there is no groundwater availability because of existing permits and limited MAG estimates. This strategy includes purchasing and/or leasing existing irrigation or mining groundwater permits and changing the type of use to municipal use. The local groundwater conversions are intended to be used within the same county and between willing sellers and willing buyers.

For the 2021 SCTRWP, Karnes City was identified to use local groundwater conversions as a WMS.

Subsection 5.2.5 includes a detailed discussion of this recommended WMS, including implementation decades and volumes for each sponsor.

5.1.6 Surface Water Rights

The surface water rights WMS is included to explicitly recognize that use of water supplies made available under existing water rights by lease or purchase agreements between willing buyers and willing sellers is an activity consistent with the 2021 SCTRWP. The additions of diversion points or types and places of use for existing surface water rights are also activities consistent with the 2021 RWP; if necessary, authorizations are obtained pursuant to TCEQ rules and applicable law.

Subsection 5.2.6 includes a detailed discussion of this recommended WMS.

5.1.7 Balancing Storage

The WMSs included in the 2021 SCTRWP are sized and scheduled to meet seasonal and daily variations of demand, but without storage, some current and proposed supplies may not be fully reliable during extended droughts. The balancing storage WMS involves implementing ASR and/or surface storage facilities.

The balancing storage WMS is recommended to explicitly recognize that storage is needed for the following:

- Firm up supplies from run-of-river diversions or interruptible groundwater sources; and
- Ensure that supplies delivered through long distance conveyance facilities are available to meet daily and seasonal demands.

The addition of balancing storage on the surface or underground is consistent with the 2021 SCTRWP as long as necessary authorizations are obtained pursuant to the TCEQ and/or groundwater conservation district (GCD) rules and applicable law.

Subsection 5.2.7 includes a detailed discussion of this recommended WMS.

5.1.8 Facilities Expansion

Several WUGs are interested in projects to expand major components of their existing infrastructure (facilities) so they can continue to provide a safe and reliable water supply to their customers during the planning period beginning in the 2020 decade. These facilities expansions are independent of any potential WMSs to acquire a new water supply and, instead, are intended to address expected future improvements to the water system, such as the installation of new water transmission facilities or additional water treatment. Additionally, these facilities expansions could include new transmission facilities designated to move water from multiple WMSs throughout an area.

The facilities expansions WMS allows WUGs and WWPs to better utilize their existing supplies and facilitate the implementation of new supplies from other WMSs. The WMS includes 11 facilities expansion projects for eight entities. The capacities of the expansion projects range from 2,200 acft/yr to 84,100 acft/yr, with corresponding annual costs of $12,994,000 and $113,039,000, respectively.

Subsection 5.2.8 includes a detailed discussion of this recommended WMS, including implementation decades and volumes for each sponsor.

5.1.9 Recycled Water Strategies

Recycled water programs are defined as projects that utilize treated wastewater effluent as a replacement for water supply, reducing the overall demand for fresh water supply. Recycled water typically involves a capital project connecting the treatment plant discharge facilities to an individual area that has a relatively high, localized use that can be met with non-potable water. Examples most frequently include the irrigation of golf courses and other public lands and specific industries or industrial use areas. Few entities, if any, would be capable of utilizing their entire effluent capacity for recycled water at present; long term, it is likely that increased pressure on water supplies will result in increased emphasis on recycled water. Downstream needs, both water rights and environmental instream uses, would have to be met. Any remaining flows after these needs are met could potentially be utilized. Virtually any water supply entity with a wastewater treatment plant could pursue a recycled water alternative, provided that downstream water rights do not have a claim for the entire return flow.

All possible recycled water projects considered for implementation within Region L are classified as reuse projects. Recycled water quality and system design requirements are regulated by TCEQ by 30 TAC §210. TCEQ allows two types of recycled water as defined by the use of the water and the required water quality:

- Type 1 – Public or food crops generally can come in contact with recycled water; and
- Type 2 – Public or food crops cannot come in contact with recycled water.

Trends across the country indicate that criteria for unrestricted recycled water will likely tend to become more stringent over time. The water quality required for Type 1 recycled water is more stringent with lower requirements for oxygen demand (biochemical oxygen demand [BOD_5] or carbonaceous biochemical oxygen demand [$CBOD_5$]), turbidity, and fecal coliform levels.

The required improvements to implement a recycled water program would be expected to vary considerably between entities according to the upgrades required both in treatment and distribution. Therefore, cost estimates received from participating entities were used when available.

Subsection 5.2.9 includes a detailed discussion of this recommended WMS, including implementation decades and volumes for each sponsor.

5.1.10 SAWS Expanded Local Carrizo

SAWS currently produces approximately 9,900 acft/yr of groundwater from the local Carrizo Aquifer, located on the SAWS H_2Oaks Center property in southern Bexar County; it is north/northeast of its ASR well field. As part of the SAWS Expanded Local Carrizo Project, the current well field will be expanded to produce an additional 21,000 acft/yr of water from 11 wells constructed in three phases (includes two contingency wells) beginning in the 2040 decade. Raw water from the wells will be delivered to the H_2Oaks Water Treatment Plant (WTP) for treatment and then be delivered to the SAWS distribution system through either the existing east side integration pipeline or the new west side integration pipeline. The cost of water is estimated to be $120/acft/yr. It is noted that the 2017 SAWS Water Management Plan estimates the unit cost for the SAWS Expanded Local Carrizo Project to be $690 acft/yr, which includes the ASR program costs and H_2Oaks WTP expansion. For purposes of the

2021 SCTRWP, the costs associated with the H_2Oaks WTP expansion for the ASR program are included in the facilities expansion WMS (refer to Subsection 5.2.8). As such, the costs presented for the SAWS Expanded Local Carrizo Project WMS are for the groundwater well field expansion only.

Subsection 5.2.10 includes a detailed discussion of this recommended WMS.

5.1.11 SAWS Expanded Brackish Groundwater Project

SAWS currently owns and operates a Carrizo-Wilcox brackish groundwater desalination project in Bexar County (Phase 1). This WMS evaluation includes SAWS' plans to expand its Carrizo-Wilcox Aquifer brackish groundwater project into Wilson County through four additional phases (Phase 2 through 5). Phases 2 and 3 are planned to be implemented in the 2040 decade and Phase 4 and 5 in the 2060 decade. The approximate locations of the well fields were provided by SAWS and selected primarily on the basis of favorable well yields and water quality, with consideration of available property. This strategy includes treatment of the raw water at a desalination WTP near the H_2Oaks Center. The treated water would be pumped with water recovered from the nearby ASR well field to the SAWS distribution system through SAWS integration pipelines. Concentrate will be disposed of via deep well injection in Wilson County near the existing SAWS brackish concentrate injection wells.

When complete, the SAWS Expanded Brackish Groundwater Project (Phases 2 through 5) will produce approximately 62.6 million gallons per day (mgd) (70,160 acft/yr) of additional potable water, with a unit cost of $1,403/acft/yr in 2060.

Subsection 5.2.11 includes a detailed discussion of this recommended WMS.

5.1.12 ARWA/GBRA Project (Phase 1)

The ARWA and GBRA Phase 1 WMS includes the development of approximately 30,000 acft/yr groundwater supply from the Carrizo-Wilcox Aquifer in Gonzales and Caldwell counties, with approximately 15,000 acft/yr allocated to ARWA and approximately 15,000 acft/yr allocated to GBRA. This WMS is a joint project between ARWA and GBRA, which seeks to implement Phase 1 of ARWA's Carrizo groundwater project and Phase 1 of GBRA's Mid-Basin Water Supply Project beginning in the 2020 decade. By working together, the two entities are seeking to achieve capital and operational costs savings from economies of scale and to avoid unnecessary construction of additional pipelines.

The planned facilities for Phase 1 include well fields for both ARWA and GBRA from the Carrizo-Wilcox Aquifer, a WTP, a booster pump station, two elevated storage tanks, a high service pump station expansion and associated ground storage tank in San Marcos, and approximately 85 miles of pipelines. For ARWA the annual cost is $1,430 per acft, and for GBRA the annual cost is $721 per acft.

Subsection 5.2.12 includes a detailed discussion of this recommended WMS.

5.1.13 ARWA Project (Phase 2)

ARWA plans to develop a new well field that would provide 21,000 acft/yr of water supply for ARWA beginning in the 2040 decade. The ARWA Project (Phase 2) would expand upon a joint project with GBRA entitled the ARWA/GBRA Project (Phase 1) (refer to Subsection 5.2.12 for details on the WMS evaluation). Both Phase 1 and Phase 2 include development of raw groundwater supply from the Carrizo-Wilcox Aquifer in Caldwell County.

Planned facilities for Phase 2 include a new well field for ARWA from the Carrizo-Wilcox Aquifer to increase groundwater supply, a 28 mgd expansion to the Phase 1 WTP, an expansion to increase the capacity of the booster pump station that was implemented in Phase 1, two 10 million gallon ground storage tanks at the expanded booster pump station, and supplementary delivery volumes to the ARWA delivery points. An additional 48 inch diameter pipeline parallel to the Phase 1 pipeline to the booster station is also planned for Phase 2. The implementation is planned for 2040. This option produces potable water at an estimated annual cost of $635 per acft.

Subsection 5.2.13 includes a detailed discussion of this recommended WMS.

5.1.14 ARWA Project (Phase 3)

ARWA plans to develop a direct potable reuse WTP that would provide approximately 5,494 acft/yr of water supply for ARWA beginning in the 2060 decade. Phase 3 includes advanced treatment of wastewater effluent for direct potable reuse and construction of new pipelines for delivery of treated water and disposal of blended effluent concentrate. Planned facilities will be located within Caldwell and Hays counties. The ARWA Project (Phase 3) would expand upon the two prior projects: the joint project with the GBRA called the ARWA/GBRA Project (Phase 1) (refer to Subsection 5.2.12 for a details on the WMS evaluation) and the ARWA Project (Phase 2) (refer to Subsection 5.2.13 for a details on the WMS evaluation). This option produces potable water at an estimated annual unit cost of $2,001 per acft per year. The annual cost is estimated to be $11,171,000 per year.

Subsection 5.2.14 includes a detailed discussion of this recommended WMS.

5.1.15 GBRA Mid-Basin Project (Phase 2)

The GBRA Mid-Basin Project (Phase 2) WMS would divert surface water from the Guadalupe River near the City of Gonzales to a new WTP for delivery to GBRA customers, with excess treated water injected into a new ASR well field beginning in the 2030 decade. The WTP and ASR well field will be located northwest of the City of Gonzales, and pipelines would be constructed to deliver treated water to customers. The total finished water pipeline route length is 75 miles, paralleling existing right-of-way for nearly 55 miles. The project is expected to have a firm yield of 27,000 acft/yr. The annual cost is estimated to be $40,281,000 per year, and the annual unit cost of additional firm supply is approximately $1,492/acft per year.

Subsection 5.2.15 includes a detailed discussion of this recommended WMS.

5.1.16 GBRA Lower Basin Storage Project

The GBRA and Dow Chemical Company (Dow), individually and collectively, own surface water rights in the lower Guadalupe-San Antonio River Basin (the GBRA/Dow Water Rights) authorizing diversions from the run-of-river flow of the Guadalupe River totaling 172,501 acft/yr. To firm up the run-of-river supplies of water available under the GBRA/Dow Water Rights, a 12,763 acft off-channel reservoir is considered for implementation beginning in the 2020 decade. The estimated project firm yield is 59,780 acft/yr. The annual cost is estimated to be $6,603,000, and the annual unit cost is estimated to be $110 per acft.

Subsection 5.2.16 includes a detailed discussion of this recommended WMS.

5.1.17 GBRA Lower Basin New Appropriation

The GBRA Lower Basin new appropriation WMS involves a new appropriation from the Guadalupe River in Calhoun County to divert up to 189,484 acft/yr, with up to a 500 cubic feet per second (cfs) diversion rate (within the existing 622 cfs) and off-channel storage of up to 200,000 acre-feet (acft). The project would use existing gravity-flow diversion facilities located immediately upstream of GBRA's Saltwater Barrier and Diversion Dam and a proposed 150,000 acft off-channel reservoir in Calhoun County. The diversions and storage will serve municipal and industrial water users in GBRA's 10 county statutory district and are the subject of Application No. 12482 for surface water rights pending before the TCEQ. The firm supply from this strategy, with a 150,000 acft off-channel reservoir, is 40,500 acft/yr available at a unit cost of $658/acft/yr for raw water at the reservoir. This WMS is planned for implementation in the 2030 decade.

Subsection 5.2.17 includes a detailed discussion of this recommended WMS.

5.1.18 GBRA Victoria County Steam-Electric Project

The GBRA Victoria County Steam-Electric Project involves the development of a reliable supply of cooling water to serve a future power plant in Victoria County. Approximately 23,925 acft/yr of water from the Lower Basin new appropriation WMS (refer to Subsection 5.2.17 for the WMS evaluation) would be diverted from the GBRA Main Canal and delivered to steam-electric users in Victoria County. Annual costs are estimated to be $13,196,000. This option produces potable water at an estimated annual cost of $552 per acft. This WMS is planned for implementation in the 2030 decade.

Subsection 5.2.18 includes a detailed discussion of this recommended WMS.

5.1.19 CRWA Wells Ranch (Phase 3)

CRWA is planning to expand its existing Wells Ranch Project to provide an additional 3,500 acft/yr in 2020, increasing to 7,000 acft/yr by 2030. The project includes 6 to 11 new wells made up of a combination of Carrizo Aquifer wells and Wilcox Aquifer wells. Raw water from the wells would be delivered to the CRWA Wells Ranch WTP, which will require expansion, for treatment and disinfection before the water is delivered to the CRWA distribution system. The proposed wells are to be constructed in a new well field in Guadalupe County.

For the Wells Ranch Phase 3 Project, groundwater production and well spacing in the Carrizo-Wilcox Aquifer are regulated by the Guadalupe County Groundwater Conservation District. In November 2016, GMA-13 established the desired future condition (DFC) for the Carrizo-Wilcox, Queen City, and Sparta aquifers. Using the approved DFC, TWDB determined that the MAG for 2070 in the Carrizo-Wilcox Aquifer is 47,833 acft/yr for Guadalupe County.

Annual costs are estimated to be $9,308,000. This option produces potable water at an estimated annual cost of $1,330 per acft.

Subsection 5.2.19 includes a detailed discussion of this recommended WMS.

5.1.20 CRWA Siesta Project

The CRWA Siesta Project includes diversions from Cibolo Creek in Wilson County under existing and amended water rights along with treated effluent from wastewater treatment facilities operated by the San Antonio River Authority (SARA), Cibolo Creek Municipal Authority (CCMA), the City of Marion, and/or Green Valley SUD. Should treated effluent from wastewater treatment facilities not be available, the project could include brackish groundwater as an alternate backup source. The CRWA Siesta Project involves the acquisition/lease of additional water rights and the amendment of surface water right CA No. 19-1155 presently held by CRWA in order to increase authorized diversions from Cibolo Creek by CRWA from 42 acft/yr to 5,042 acft/yr. The firm yield of the CRWA Siesta Project at the Siesta Cattle Company site is to be available to the CRWA members via the existing CRWA Mid-Cities Pipeline. The annual cost for the CRWA Siesta Project is $12,456,000, yielding a unit cost of water of $2,470 per acft/yr. This WMS project is planned for implementation in the 2060 decade.

Subsection 5.2.20 includes a detailed discussion of this recommended WMS.

5.1.21 CRWA Brackish Carrizo-Wilcox Project

The CRWA Brackish Carrizo-Wilcox Project includes developing a brackish groundwater supply from the Carrizo-Wilcox Aquifer in Guadalupe and Wilson counties for members of CRWA with service areas in Bexar, Guadalupe, and Wilson counties. The project is designed to produce an annual water supply of 14,700 acft/yr (13.1 mgd) with a peak demand of 17.1 mgd beginning in 2030. The well fields are planned for northern Wilson County and southern Guadalupe County, along Highway 123. The WTP and site of concentrate disposal will be in the vicinity of the well fields. Treated water will be transferred to the existing Liessner Booster Station for distribution to participating water utilities.

This WMS builds on a preliminary assessment of potential brackish groundwater supplies from the Carrizo-Wilcox Aquifer in a target area that is generally a 10 to 20 mile wide band that is south of Interstate 10 and between Loop 410 and Seguin. Planned facilities for the CRWA Brackish Carrizo-Wilcox Project include two new well fields from the Carrizo-Wilcox Aquifer in Wilson and Guadalupe counties; wells, pumps, and collector pipelines; a 17.1 mgd WTP with desalination; a 12 mile treated water transmission pipeline, pump stations, and one ground storage tank; and five injection wells for disposal of desalination concentrate. The annual cost is estimated to be $23,451,000, and the annual unit cost is estimated to be $1,595 per acft.

Subsection 5.2.21 includes a detailed discussion of this recommended WMS.

5.1.22 CVLGC Carrizo Project

The CVLGC comprises the cities of Schertz and Cibolo. CVLGC is considering a Carrizo-Wilcox Aquifer well field project in Wilson County. The general location of the planned well field is north of US 87 and east of Stockdale. Land use and groundwater availability were taken into consideration for selection of the well field. The project will supply 10,000 acft/yr of treated water to the partnering entities beginning in the 2030 decade.

The Carrizo-Wilcox Aquifer is one of four major aquifers in the South Central Texas Water Planning Region. Overall, the water quality of the Carrizo-Wilcox Aquifer is suitable for use as a water supply, except for elevated concentrations of iron and manganese in many areas.

The planned well field is in the confined part of the Carrizo-Wilcox Aquifer and is located approximately 7 miles downdip of the outcrop. According to available hydrogeologic information, wells in this area would be capable of producing more than 2,000 gallons per minute (gpm) and would range in depth from 1,000 to 1,500 ft deep. The target aquifer is the Carrizo Sand instead of the Wilcox Group for water quality and depth considerations. The annual cost is estimated at $12,302,000, and the annual unit cost of additional firm supply is approximately $1,230/acft.

Subsection 5.2.22 includes a detailed discussion of this recommended WMS.

5.1.23 SSLGC Expanded Carrizo Project

The Schertz-Seguin Water Supply Project, owned and operated by SSLGC, currently holds permits to pump 19,362 acft/yr of groundwater from the Carrizo Aquifer in western Gonzales County at its existing Carrizo well field. For this proposed WMS, SSLGC plans to expand into a new well field in Guadalupe County, which will provide a supply of 6,000 acft/yr beginning in the 2020 decade. SSLGC has obtained a permit for 4,035 acft/yr from the Carrizo Aquifer in southeastern Guadalupe County, and a permit for 1,290 acft/yr from the Wilcox Aquifer in southeastern Guadalupe County. SSLGC needs to obtain additional permits for 675 acft/yr.

The SSLGC Expanded Carrizo Project will be located in a new well field in southeastern Guadalupe County on lands owned or leased by SSLGC. After treatment at a new WTP, water will be transported via a shared pipeline between SSLGC and CVLGC, which will run parallel to SSLGC's existing transmission pipeline. The primary recipients of the water are the cities of Schertz and Seguin. SSLGC also provides some water to the cities of Selma, Universal City, Springs Hill WSC, and SAWS. The annual cost is estimated at $7,239,000, and the annual unit cost of additional firm supply is about $1,207/acft.

Subsection 5.2.23 includes a detailed discussion of this recommended WMS.

5.1.24 SSLGC Expanded Brackish Wilcox Project

SSLGC is planning an expansion of its well field in the brackish Wilcox Aquifer in Gonzales County. The expansion consists of seven new wells, each with a peak flow capacity of 800 gpm. The brackish Wilcox well field will provide a total of 5,000 acft/yr of supply beginning in the 2040 decade.

Raw water from the Wilcox has a total dissolved solids (TDS) of approximately 1,500 mg/L. Currently at the Gonzales well field, SSLGC has a permit for 19,363 acft/yr of water from the Carrizo, which has a TDS of approximately 300 mg/L. SSLGC will blend the raw Carrizo water with the raw brackish Wilcox water and treat the blended water at the existing WTP. The current WTP is to be expanded from 35 mgd to 40 mgd to handle the new capacity from the Gonzales well field. The treated yield will be transferred to the distribution system via the existing SSLGC pipeline.

The proposed wells are in the confined part of the Wilcox Aquifer and are approximately 12 miles downdip of the outcrop. Hydrogeologic maps of the aquifer in this area suggest that wells would be capable of producing in excess of 800 gpm and would range in depth from 1,800 to 2,400 feet. The annual cost is estimated at $3,316,000, and the annual unit cost of additional firm supply is about $663/acft.

Subsection 5.2.24 includes a detailed discussion of this recommended WMS.

5.1.25 NBU ASR Project

NBU has plans to firm up its existing water supply with the addition of an ASR project (utilizing dual-purpose wells) to its water system. NBU's ASR strategy is designed to accomplish the following:

- Provide a long-term supply during drought-of-record (DOR);
- Create an opportunity to increase utilization of existing permits, which postpones acquisition of new water supplies;
- Defer construction of a second WTP;
- Meet seasonal demands when restrictions are imposed;
- Meet demands at the ends of the distribution system;
- Provide an emergency supply;
- Minimize construction of new facilities;
- Provide for efficient use of existing distribution system; and
- Minimize environmental impacts.

Like any ASR project, the purpose is to store water during times of plentiful water supply and to recover the water during times of water shortage. NBU's ASR project was designed to consider both the short-term and long-term time frames. For the short-term or annual cycle, water is stored during winter and spring and recovered during the summer. For the long-term or multi-year cycle, water is stored over several years or even decades to provide emergency supply during a major drought.

The project will consist of up to 10 dual-purpose wells for recharge and recovery. Each of the wells is anticipated to have a recovery capacity of about 694 gpm and a recharge capacity of about 347 gpm. The project will increase NBU's firm supply incrementally by 10,818 acft/yr beginning in the 2020 decade. The stored water volume of water within the aquifer will be 7,000 acft with an additional 7,000 acft buffer zone volume that would remain in the aquifer, resulting in a target storage volume of 14,000 acft. The NBU ASR project is designed to work in conjunction with the surface WTP expansion, which is designed to provide increased capacity to treat water for storage in the ASR project. The annual cost is estimated at $5,001,000, and the annual unit cost of additional firm supply is about $462/acft.

Subsection 5.2.25 includes a more detailed discussion of this recommended WMS.

5.1.26 NBU Trinity Well Field Expansion

Beginning in the 2030 decade, NBU plans to expand upon the existing Trinity well field. The project includes drilling additional groundwater wells, expansion of the existing membrane treatment facility, and addition of a new ground storage tank and a new pump station to connect to the existing NBU distribution system. The project will expand the well field from four wells to eight wells and increase the supply of the Trinity well field by 3,360 acft/yr. For purposes of this WMS, it is assumed that four wells are feasible and that each well has a peak capacity of 1.0 mgd and a depth of 620 feet.

An assessment of groundwater availability consists of calculating a water balance of the Trinity Aquifer in Comal County between the supply, as determined by from the MAG, and the estimated demands from current users. The MAG for the Trinity Aquifer in Comal County is 43,768 acft/yr for 2020 through 2070. As shown, the annual costs, including debt service, operation and maintenance (O&M), power, and groundwater leases, are estimated to be $2,303,000. This option produces potable water at an estimated annual cost of $685/acft.

Subsection 5.2.26 includes a more detailed discussion of this recommended WMS.

5.1.27 City of Victoria ASR Project

Through most of its history, the City of Victoria (Victoria) relied on locally available groundwater supplies withdrawn from the Gulf Coast Aquifer. To support continued growth, limit drawdowns in aquifer levels, and maintain water quality, Victoria obtained a new surface water appropriation (P#5466) in the 1990s, authorizing diversions from the Guadalupe River. Subject to the senior water rights of others and special conditions requiring streamflow passage for environmental protection, however, supplies available under P#5466 are severely limited during drought. Since the 1990s, Victoria obtained six additional surface water rights senior in priority to P#5466 from willing sellers.

Victoria plans to firm up its existing water supply with the addition of an ASR project to its water system. The Victoria ASR WMS involves conducting the necessary studies and testing to obtain the TCEQ permits needed to allow for aquifer storage, acquisition of necessary well injection, drilling, and production permits, and installation of appurtenant facilities, thereby enhancing the firm surface water supply available to Victoria. The six surface water rights held by Victoria total 27,007 acft/yr. When fully developed, the ASR project is anticipated to include 15 new wells that are each capable of recovering at a rate of approximately 1,600 gpm and recharging at a rate of approximately 800 gpm to have an ASR firm supply of 7,900 acft/yr beginning in the 2020 decade. The annual cost is estimated at $3,042,000, and the annual unit cost of additional firm supply is about $385/acft.

Subsection 5.2.27 includes a detailed discussion of this recommended WMS.

5.1.28 City of Victoria Groundwater/Surface Water Exchange

Historically, the Victoria has relied primarily on locally available groundwater supplies withdrawn from the Gulf Coast Aquifer. To support continued growth, limit drawdowns in aquifer levels, and maintain water quality, Victoria obtained a surface water appropriation (P#5466) in the 1990s authorizing diversions of up to 20,000 acft/yr from the Guadalupe River. Subject to the senior water rights of others and special conditions requiring inflow passage for environmental protection, however, supplies available under P#5466 are severely limited during drought. Since the 1990s, Victoria has obtained six additional surface water rights senior in priority to P#5466 and totaling 7,007 acft/yr from willing sellers. Each of these rights has been amended to allow diversions for municipal uses at the same location as P#5466. Two of these water rights, totaling 4,939 acft/yr, include provisions for offset of surface water diversions with discharged groundwater during drought. This groundwater offset effectively firms up these previously interruptible surface water rights.

The Victoria groundwater/surface water exchange WMS involves the potential amendment of additional Victoria surface water rights to authorize groundwater offset, thereby enhancing the firm surface water supply available to Victoria. Victoria has up to 22,068 acft/yr in additional surface water rights that could potentially be amended to authorize groundwater offset during a drought beginning in the 2020 decade. Physical groundwater production capacity (27,081 acft/yr) slightly exceeds authorized surface water diversions on an annual basis. Production capacity authorized by the Victoria County GCD for the listed wells, however, is limited to 8,544 acft/yr. A cost estimate is not provided for this WMS because the physical facilities and surface water and groundwater permits are already in place.

Subsection 5.2.28 includes a detailed discussion of this recommended WMS.

5.1.29 Brackish Wilcox Groundwater for SS WSC

The Brackish Wilcox groundwater for SS WSC WMS was a recommended WMS in the 2016 SCTRWP. It includes development of a 1,120 acft/yr brackish groundwater supply from the Carrizo-Wilcox Aquifer in Wilson County to meet the needs of SS WSC. It is designed to produce an average annual water supply of 1.0 mgd and a peak demand of 2.0 mgd beginning in the 2060 decade. The facilities include Carrizo-Wilcox Aquifer wells to provide a brackish groundwater supply, WTP for pretreatment and desalination, delivery of treated water to the existing distribution system, and concentrate disposal to a deep injection well.

Groundwater production and well spacing in the Carrizo-Wilcox Aquifer are regulated by the Evergreen Underground Water Conservation District. In November 2016, GMA-13 established the DFC for the Carrizo-Wilcox, Queen City, and Sparta aquifers. Using the approved DFC, TWDB determined that the MAG for 2070 in the Carrizo-Wilcox Aquifer is 111,093 acft/yr for Wilson County. The annual costs, including debt service, O&M, power, and groundwater leases, are estimated to be $3,260,000. This option produces potable water at an estimated cost of $2,911 per acft per yr.

Subsection 5.2.29 includes a detailed discussion of this recommended WMS.

5.1.30 Martindale Alluvial Well

Martindale WSC plans to add a well in the quaternary alluvium near the San Marcos River. This project is projected for the 2030 decade and will have a firm yield of 240 acft/yr. The new source of water for Martindale WSC will be delivered to the existing WTP across the San Marcos River. The annual cost is estimated to be $111,000, and the annual unit cost of additional firm supply is about $463/acft.

Subsection 5.2.30 includes a detailed discussion of this recommended WMS.

5.1.31 Maxwell WSC Trinity Well Field

Maxwell WSC plans to add a well in the Trinity Aquifer in the 2040 decade that will develop a firm supply of 230 acft/yr. The new source of water for Maxwell WSC will be treated via brackish water treatment at the well field and delivered to the existing distribution system via a new 16 inch pipeline that will replace the existing infrastructure.

The project is anticipated to consist of one new well in the Trinity Aquifer with a pumping capacity of approximately 250 gpm. In this region of the Trinity Aquifer, the depth of the well is expected to be approximately 1,200 feet, and the water is anticipated to have a TDS concentration of approximately 2,000 mg/L. Most of the wells in the proposed well field area are completed in the overlying Edwards Aquifer, and therefore, little data exist on the deeper Trinity Aquifer. Any potential project in the area should include test well drilling and evaluation to determine aquifer characteristics and water quality in the vicinity of the planned Trinity Aquifer wells. The project lies within the purview of the Barton Springs Edwards Aquifer Conservation District. The annual cost is estimated to be $980,000 per year, and the annual unit cost of additional firm supply is about $4,261 acft/yr.

Subsection 5.2.31 includes a detailed discussion of this recommended WMS.

5.1.32 County Line SUD Trinity Well Field

The County Line SUD plans to add a well field in the Trinity Aquifer as a new source of water. The project will be delivered to its system in a phased approach. Phase 1 is projected for the 2050 decade, and Phase 2 is projected for the 2060 for a total project firm yield of 740 acft/yr. Both phases are included and evaluated as part of this WMS.

The project will consist of three wells: two wells in Phase 1 and one well in Phase 2, each with an estimated pumping capacity of 350 gpm. In this downdip region of the Trinity Aquifer, the well depth is expected to be approximately 1,200 feet, and have a TDS concentration of 1,000 mg/L. This area is near the edge of the Trinity Aquifer system, and there are limited wells in the area; therefore, test hole drilling and evaluation is recommended prior to well installation to determine site-specific aquifer properties and water quality. The estimated project costs for: Phase 1 are $10,552,000 (Table 5.2.32-3) and for Phase 2 are $1,217,000. Costs assume cost sharing of relevant co-located facilities with the County Line SUD Brackish Edwards Project WMS (refer to Subsection 5.1.33).

Subsection 5.2.32 includes a detailed discussion of this recommended WMS.

5.1.33 County Line SUD Brackish Edwards Project

County Line SUD plans to add wells in the brackish portion of the Edwards Aquifer in a three-phased approach. Phases 1, 2, and 3 are projected for the 2050, 2060, and 2070 decades, respectively. The total project firm yield of the three phases is 1,500 acft/yr. All three phases are included and evaluated as part of this WMS. A new desalination WTP will be included to treat the brackish Edwards Aquifer water. This area is close to the transition zone of the Edwards Aquifer where water quality changes from fresh to brackish, and there are limited wells in the area; therefore, test hole drilling and evaluation is recommended prior to well installation to determine site-specific aquifer properties and water quality. Estimated project costs for Phase 1 are $11,185,000 and for Phases 2 and 3 are each $1,217,000. Costs assume cost sharing of relevant co-located facilities with the County Line SUD Trinity Well Field WMS (refer to Subsection 5.1.32).

Subsection 5.2.33 includes a more detailed discussion of this recommended WMS.

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FINAL PLAN

SECTION 5.2: WATER MANAGEMENT STRATEGY EVALUATIONS

South Central Texas Regional Water Plan

B&V PROJECT NO. 192335

PREPARED FOR

South Central Texas Regional Water Planning Group

5 NOVEMBER 2020

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5.2 WATER MANAGEMENT STRATEGY EVALUATIONS

Each potentially feasible WMS was evaluated on the basis of net quantity of water, reliability, financial costs, and environmental factors, which includes environmental and cultural considerations. Environmental considerations also includes impacts to agricultural resources.

Subsections in Chapter 5.2 include detailed evaluations for each of the potentially feasible WMSs. Quantitative reporting of these evaluations are included in Chapter 6.1: Cumulative Effects of Regional Water Plan Implementation and Consistency with Long-Term Protection of the State's Water, Agricultural, and Natural Resources.

The following provides information and methodologies used in this plan to evaluate the WMSs.

Net Quantity of Water

Analyses of yields were performed under drought conditions. Firm yields were determined by taking into account Senate Bill 3 environmental flow standards adopted in 30 TAC §298 and other recommended WMSs to ensure that no WMSs relied on the same water availability volume or rendered multiple WMSs mutually exclusive.

Surface Water

Future availability associated with surface water WMSs were based on the firm yield and firm diversion using TCEQ-approved WAMs (Run 3). WAM Run 3 assumes full exercise of existing surface water rights and zero effluent discharges unless specifically required by a surface water right. This method reflects conditions under which an associated permit application would be evaluated. Region L was granted a variance by TWDB to use the Flow Regime Application Tool (FRAT) in conjunction with the TCEQ-approved WAMs to evaluate environmental flows for new surface water WMSs (Refer to Appendix 3-A for more information regarding hydrologic assumptions).

Groundwater

Firm yield associated with new groundwater WMSs in the Carrizo-Wilcox, Trinity, Gulf Coast, and other minor aquifers were determined in accordance with Modeled Available Groundwater (MAG) estimates, as calculated by the TWDB on or before June 1, 2018. Where potentially feasible WMSs are contemplated that require new permits but allocated groundwater plus the WMS exceeds the MAG, then firm supplies within the MAG are shown, and supplemental groundwater may be obtained under existing permits through the Local Groundwater Conversions WMS.

Water Loss

Anticipated strategy water losses are taken into account and reported for each WMS type. For some WMSs, the percent water loss was calculated and the information is included in each WMS evaluation. The following provides a summary of anticipated strategy water losses.

- Conservation: Water conservation strategies are assumed to have no associated water losses. In some instances, projects are intended to decrease the water loss for existing infrastructure.

- Drought Management: Drought management strategies are assumed to have no associated water losses.
- Edwards Transfers: Strategies involving transfers of water rights are assumed to have no additional water losses associated with the use of existing infrastructure.
- Local Groundwater Conversions: Strategies involving type conversions of groundwater permits are assumed to have no additional water losses associated with the use of existing infrastructure.
- Surface Water Rights: Strategies involving transfers of water rights are assumed to have no additional water losses associated with the use of existing infrastructure.
- Balancing Storage: Recommended and alternative surface water strategies such as new reservoirs have water losses associated with evaporation. ASR reduces the water losses associated with evaporation from a reservoir, but there can be water losses due to recovery efficiency from the aquifer. Migration rates vary depending on the aquifer used for storage, and impacts will depend on how long the stored water remains in the aquifer. Recovery efficiency will have some impacts on water volume but should have negligible impacts on the firm yield volumes.
- Facilities Expansion: Facilities expansion or new infrastructure such as pump stations and transmission pipelines are assumed to have negligible water losses.
- Direct Reuse: Direct reuse or recycled water strategies are assumed to have minimal water losses.
- Indirect Reuse: Indirect reuse that includes obtaining a bed and banks permit is assumed to have minimal losses since the yield already incorporates any water lost due to transportation, evaporation, seepage, and channel or other associated carriage losses.
- New or Expanded Groundwater Development: Groundwater expansion strategies that assume additional yield from existing infrastructure have no additional water losses associated with them. Groundwater expansion, development, and importation strategies that require new infrastructure are assumed to have negligible water losses.
- Direct Potable Reuse using Reverse Osmosis: Reuse strategies using RO have losses associated with treatment technologies and disposal of brine concentrate. Each Direct Potable Reuse WMS has a calculated percent water loss indicated in the WMS evaluation.
- Aquifer Storage and Recovery: ASR strategies have losses due to recovery efficiency from the aquifer. Each WMS has a calculated percent water loss.
- Off-channel Reservoirs: Surface water strategies that include new OCR have water losses associated with evaporation. If water is transmitted via open channel canals, there are also water losses associated with evaporation.
- Brackish Groundwater Desalination: Brackish groundwater desalination strategies include water loss associated with desalination treatment technologies and disposal of brine concentrate. Each brackish groundwater desalination WMS has a calculated percent water loss indicated in the WMS evaluation.

Reliability

Reliability is an assessment of the availability of the specified water quantity to the user over time. If the quantity of water is available to the user all the time, then the strategy has a high reliability. If the quantity of water is contingent on other factors, reliability will be lower. The SCTRWPG developed a reliability evaluation matrix (Table 5.2 -1) that was used in conjunction with other implementation considerations to quantify the reliability of WMSs. Each WMS evaluation includes an assessment of reliability.

Table 5.2 -1 Reliability Evaluation Matrix

SCORE	RELIABILITY
1	Low
2	Low to Medium
3	Medium
4	Medium to High
5	High

Financial Costs

Financial costs were evaluated using the Unified Costing Model developed by the TWDB. Capital costs, debt service, annual O&M costs, and unit costs of water are shown in the 2021 SCTRWP in September 2018 dollars. Costs do not include distribution of water within a WUG after treatment.

For the Drought Management WMS (Refer to Section 5.2.2), the costs were evaluated using the TWDB Drought Management Tool, which estimates the economic costs of foregone water use.

Environmental Considerations

Environmental considerations were evaluated for each potentially feasible WMS based on information provided by sponsors, available published information, maps and recent aerial photography, including available geographic information system (GIS) shapefiles. The project locations shown on maps in this chapter are conceptual in nature and are not meant to represent actual locations of facilities. Siting of facilities are subject to studies, designs, engineering, and/or contract negotiations to be determined by the project's sponsor later. Therefore, as projects enter the detailed design phases, it should be noted that potential environmental impacts identified in this analysis could be avoided or reduced through such approaches as facility layout or alignment adjustments, changes in construction methods, and construction timing.

Data were obtained from various environmental sources and compiled into a GIS using ArcGIS software. Environmental datasets were overlaid on defined conceptual project boundaries or alignments for each WMS to determine potential project effects on (1) vegetation and land use; (2) aquatic resources; (3) impacts to agricultural resources; and (3) threatened, endangered species of concern. Data were obtained from the following sources:

- Aerial photography: ESRI ArcGIS Online Basemap Map Services and Google Earth;
- U.S. Geological Survey (USGS) 7.5 minute topographic quadrangle maps;
- Barnes, V. E. 1983, Project Director. Geologic Atlas of Texas. University of Texas Bureau of Economic Geology;
- U.S. Fish and Wildlife Service (USFWS) Critical Habitat maps and county threatened and endangered species lists;
- U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS): Soil Data Mart, Web Soil Survey and PLANTS Database;
- Texas Parks and Wildlife Department (TPWD) Ecological Mapping System of Texas (EMST) vegetation mapping;
- TPWD county species list and Texas Natural Diversity Database;
- USFWS National Wetland Inventory (NWI) Maps;
- USGS National Hydrography Dataset (NHD) Maps; and
- Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM).

The TPWD county species lists were updated on March 30, 2020, which was after the SCTRWPG performed evaluations of WMS and after the Initially Prepared Plan (IPP) was submitted to the TWDB and made available for public review. The evaluations of impacts to threatened and endangered species and species of greatest conservation need (SGCN) included in this regional water plan were based on the TPWD county species lists available at the time of WMS evaluation. Project implementation would require independent review of impacts to threatened and endangered species and SGCN as part of the regulatory permitting for the project. Most updates in the TPWD county species lists reflected additions, deletions, or revisions of SGCN. Revisions to state-listed species included updates to freshwater mussels to reflect taxonomic revisions and updates to the status of black-capped vireo and bald eagle, which are no longer considered endangered or threatened.

Invasive Species

While not specifically evaluated in the WMS, it is worth noting that aquatic ecosystems and water projects in Region L are at significant risk of impacts from aquatic exotic species, particularly the invasive zebra mussel (*Dreissena polymorpha*). The zebra mussel is native to Eurasia and made its way North America around 1988, when it was first detected in Lake Saint Claire, Michigan. This species is a broadcast spawner with potential to attach itself on many surfaces in lakes and rivers, including boats, anchors, docks, and machinery. The microscopic larval stage (called veligers) is easily transported in bilge water, ballast water, live wells, and other methods of moving water overland from infested areas to other waterways.[1] Once thought to be thermally limited to cold water, the species appears to adapt

[1] Churchill, C.J. and S. Baldys. 2012. USGS zebra mussel monitoring program for North Texas— Fact sheet 2012-3077. Prepared for U.S. Department of Interior and U.S. Geological Survey. Available online at: https://pubs.usgs.gov/fs/2012/3077/pdf/fs2012-3077.pdf. Accessed August 2020

quickly, and it is unclear whether there will be any limit to the southern limit of their range expansion in North America.[2]

The zebra mussel is a filter feeder with propensity for reaching extremely high densities, with proven ability to clarify water of infested waterways and negatively impact native species by effectively removing plankton at the base of the food chain.[3] Zebra mussels create millions of dollars in damage per year to hydroelectric powerplants and water-processing infrastructure, with an estimated price tag of $3.1 billion from 1991-2001. Zebra mussels may also create taste and odor issues in the affected waterbody.[4] A large zebra mussel die-off in Austin Water tunnels created a foul smell coming from Austin area taps in February 2019 -- despite the water being safe to drink, residents were hesitant to do so because of the foul smell.[5]

The zebra mussel was confirmed within Lake Texoma in April 2009 and has since spread south to other parts of Texas. The species was first detected in Lake Belton in 2013 and has continued its steady progression south. Texas Parks and Wildlife Department (TPWD) indicates 21 Texas lakes are classified as infested (established, reproducing populations); including Canyon Lake in Comal County.[6] TPWD currently identifies zebra mussel positive lakes (adults or larvae are detected) at nine locations, including Lakes Dunlap, McQueeney, and Placid in Guadalupe County. TPWD maintains a regularly updated webpage with map showing lakes with positive zebra mussel identifications and maps, located at https://tpwd.texas.gov/huntwild/wild/species/exotic/zebramusselmap.phtml.

A more recent invasive species in Region L, the apple snail (*Pomacea* sp.) is a large (up to 15cm), aquatic gastropod originally from Argentina. Apple snails were first documented in Texas in 1990 and have primarily remained in the southeastern part of the state, mostly around Houston.[7] However, 105 apple snails and many egg sacs were discovered when the San Antonio River was drained along the River Walk at the end of October 2019.[8] This may represent a significant range expansion for the species within Texas. The apple snails lay bright pink egg masses above the waterline, which is often the first indication a waterbody is infested. A female can lay eggs every 5-14 days and these eggs will actually drown if submerged (TID 2019).[9]

Apple snails are voracious predators of aquatic plants and may reach significant densities, thereby stripping the local ecosystem of plant life. Additionally, apple snails are known to carry rat lungworm

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[2] Olson, J., J.J. Robertson, T.M. Swannack, R.F. McMahon, W.H. Nowlin, and A.N. Schwalb. 2018. Dispersal of zebra mussels, Dreissena polymorpha, downstream of an invaded reservoir. *Aquatic Invasions, 13*(2): 199-209.
[3] Ibid.
[4] Churchill and Baldys. 2012.
[5] Prendergast, M. 2019. "Austin Water confirms that smell was dead zebra mussels." *KXAN*. Austin, Texas. Published February 8, 2019.
[6] Texas Parks and Wildlife Department (TPWD). 2020. The zebra mussel threat— Updated July 2020. Available online at: https://tpwd.texas.gov/huntwild/wild/species/exotic/zebramusselmap.phtml. Accessed August 2020.
[7] Texas Invasive Species Institute (TISI). 2014. Apple snail— *Pomacea maculata.* Available online at: http://www.tsusinvasives.org/home/database/pomacea-maculata Accessed August 2020.
[8] Patton, M.C. 2020. "Texans encouraged to report sighting of giant apple snails. *KSAT*. San Antonio, Texas. Published May 19, 2020.
[9] Texas Invasives Database (TID). 2019. *Pomacea maculate*— Apple snail. Available online at: https://www.texasinvasives.org/animal_database/detail.php?symbol=15 Accessed August 2020.

(*Angiostongylus cantonensis*), a parasite that infects humans and other mammals.[10] Severe infections from the parasite may cause eosinophilic meningitis and scar the brain.

Other aquatic invasive species of concern include tilapia (*Oreochromis aurea*) and sailfin catfish (*Pterygoplichthys disjunctivus*). These non-native invasive species can compete with native species for food items and disrupt habitat for native species.

Cultural Resources

Cultural resources were evaluated for each potentially feasible WMS using a cultural resources records review and statistical analysis to estimate the probability of a WMS project area containing cultural resources. The Texas Archeological Sites Atlas (Atlas) was the primary source for the records review as it provides information on the nature and location of previously recorded cultural resources sites, locations of National Register of Historic Places (NRHP) districts and properties, sites designated as State Antiquities Landmarks, Official Texas Historical Markers, Recorded Texas Historic Landmarks, linear historic features, and cemeteries. The Atlas was reviewed for defined conceptual project boundaries or alignments for each WMS by an archaeologist to determine if any known archaeological or historic sites were recorded within or immediately adjacent to the conceptual project areas.

Potential impacts to cultural resource sites were modeled using a modified maximum entropy statistical analysis. The model assigns highest scores to locales that possess or have a statistically greater likelihood of containing intact archaeological deposits based on recorded archaeological site attributes. These areas were defined by their proximity to natural water sources, such as streams, and typically included a 150 meter buffer on either side of the feature to capture areas of potentially high archaeological site probability. Intermediate probability scores were assigned to areas having a slightly elevated probability for containing archaeological deposits but are not typically associated with soil and/or stratigraphic integrity (e.g., slopes, uplands, or evident disturbance). Intermediate probability areas also include identified buildings, roads, or trails that have a potential to be historical in age identified during the review of historical aerials and topographic maps of the area. These features include a 50 meter buffer to capture areas of potential moderate probability. Lowest probability scores were defined as locales where archaeological resources are likely absent or have low probability to be present based on recorded datasets (e.g., uplands, evident disturbance, or very recent alluvial floodplains).

Results of the cultural resource statistical analyses were collated to generate baseline cultural resource assessment scores. These scores were then modified based on the number and types of known cultural resources identified during the above process. The following variables determined the modifier value added to the baseline cultural resources assessment score for each occurrence: NRHP-listed/eligible cultural resources sites/cemeteries received a +5 modifier; NRHP-undetermined cultural resource sites received a +2.5 modifier; potential historic-age structures/unclassified linear features/historical markers received a +1 modifier; NRHP-ineligible site received a +5 modifier. The frequency of cultural resource sites combined with the project alignment's mean archaeological probability generated the final cultural resource assessment scores presented for each WMS. When viewed as a series, a higher cultural

[10] Ibid.

resource assessment score indicates greater archaeological probability for known and unknown cultural resources sites to be within the project area. As the WMS boundaries remain in the conceptual stage, more precise evaluation requires the project footprint to be fully defined.

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5.2.1 Advanced Water Conservation

5.2.1.1 Description of Water Management Strategy

Water conservation measures are defined as practices, techniques, programs, and technologies that will protect water resources, reduce consumption of water, reduce the loss or waste of water, or improve the efficiency in the use of water so that a water supply is made available for future or alternative uses. Water conservation is typically a non-capital intensive alternative that water supply entities can and should pursue. The goal of this WMS is to increase water conservation and thereby reduce freshwater use within the South Central Texas Region. The general methods to accomplish this objective are to (1) reduce per capita water use in the municipal water use category; (2) recycle and reuse water and substitute reclaimed water (treated municipal and industrial wastewater) for use in some industries, steam-electric power generation, and mining; and (3) improve irrigation efficiencies to reduce the quantity of water use in agriculture per acre irrigated. Because irrigation demand reduction volumes and costs associated with those reductions cannot be quantified precisely, volumes and costs are entered as zero values for the purposes of the RWP.

BMPs for water conservation are also included in this WMS evaluation[1]. In addition, the WMS includes estimates of potential water conservation demand reductions and associated costs of water conservation for municipal WUGs. This WMS is considered for implementation beginning in the 2020 decade.

Municipal Water Conservation

For regional water planning purposes, municipal water use is defined as residential and commercial water use. Municipal water supply is used primarily for drinking, sanitation, cleaning, cooling, fire protection, and landscape watering for residential, commercial, and institutional establishments. Such water is supplied by both public and private utilities and, in areas not served by water utilities, is supplied by individual households. A key parameter of municipal water use within a typical city or water service area is the number of gallons used per person per day (per capita water use). The objective of municipal water conservation programs is to reduce the per capita water use parameter without adversely affecting the quality of life of the people involved. This can be achieved through the following:

- Use of low flow plumbing fixtures (e.g., toilets, shower heads, and faucets that are designed for low quantities of flow per unit of use);
- The selection and use of more efficient water-using appliances (e.g., clothes washers and dishwashers);
- Modifying and/or installing lawn and landscaping systems to use grass and plants that require less water;
- Repair of plumbing and water-using appliances to reduce leaks; and
- Modification of personal behavior that controls the use of plumbing fixtures, appliances, and lawn watering methods.

[1] Water Conservation Implementation Task Force. Report to the 79th Legislature, Texas Water Development Board, Special Report. Austin, Texas. November 2004.

Expected water-efficiency savings are incorporated into the current TWDB municipal water demand projections (See Chapter 2) and include estimated or anticipated savings due to state and federal specifications for fixture and appliance design. The savings projected by the TWDB includes complete replacement of existing plumbing fixtures to water-efficient fixtures by the year 2045. The projections also assume that all new construction includes water-efficient plumbing fixtures.

The 1991 State Water Efficient Plumbing Act established minimum standards for plumbing fixtures sold in Texas. The standards for new plumbing fixtures, as specified by the State Water Efficient Plumbing Act and updated by the TCEQ, are shown in Table 5.2.1-1. The TCEQ has established rules requiring the labeling of both plumbing fixtures and water-using appliances sold in Texas. The labels must specify the rates of flow for plumbing fixtures and lawn sprinklers, and the amounts of water used per cycle for clothes washers and dishwashers.

Table 5.2.1-1 Standards for Plumbing Fixtures[2]

FIXTURE	STANDARD
Toilets*	1.28 gallons per flush
Shower Heads	2.50 gpm at 80 pounds per square inch (psi)
Urinals	0.50 gallons per flush
Faucet Aerators	2.20 gpm at 60 psi
Drinking Water Fountains	Self-closing valve
*HB 2667 of the 81st Texas Legislature, 2009.	

The TWDB has estimated that new plumbing fixtures in dwellings, offices, and public places will be a reduction in per capita water use of approximately 20 GPCD, in comparison to what would have occurred with previous generations of plumbing fixtures[3]. The estimated water conservation effect of 20 GPCD was obtained using data found in Table 5.2.1-2.

Table 5.2.1-2 Water Conservation Potentials of Low Flow Plumbing Fixtures

PLUMBING FIXTURE	WATER SAVINGS (GPCD)
Toilets and Showerheads	16.0
Additional Savings (High Efficiency Toilet)*	1.63
Faucet Aerators – 2.2 gpm	2.0
Urinals – 1.0 gpm	0.3
Total	**20.03 (~20 GPCD)**

[2] Title 30, Texas Administrative Code, (30 TAC) Section 290.252; 30 TAC, Chapter 290, Subchapter G; and Texas Health and Safety Code 372.
[3] "Water Conservation Impacts on Per Capita Water Use." Water Planning Information, Texas Water Development Board. Austin, Texas, 1992.

PLUMBING FIXTURE	WATER SAVINGS (GPCD)
* TWDB, 2013.	

In 2001, the Texas Legislature amended the Texas Water Code to require RWPGs to consider water conservation and drought management measures for each WUG with a need (projected water shortage). Beginning in 2004, the Water Conservation Implementation Task Force initially provided a BMP guide for use by RWPGs[4]. In 2007, the Task Force was succeeded by the Water Conservation Advisory Council (WCAC), enacted by the 80th Texas Legislature with the passage of SB 3 and HB 4. The council's primary roles include monitoring trends in water conservation implementation and technologies for potential inclusion as BMPs. Since its inception, WCAC has continually worked with TWDB and TCEQ to update the "Best Management Practices Guide."

A variety of conservation measures are recommended as described in the WCAC BMP Guide[5], any combination of which can be used to meet the specific goals for a municipality or utility. Conservation can be achieved using a variety of strategies, including the following:

- **Conservation Analysis and Planning**
  - Conservation Coordinator
  - Cost-Effectiveness Analysis
  - Water Survey for Single-Family and Multi-Family Customers
  - Customer Characterization
- **Financial**
  - Water Conservation Pricing
  - Wholesale Agency Assistance Programs
- **System Operations**
  - Metering of all New Connections and Retrofitting of Existing Connections
  - System Water Audit and Water Loss
- **Landscaping**
  - Athletic Field Conservation
  - Golf Course Conservation
  - Landscape Irrigation Conservation and Incentives
  - Park Conservation
  - Residential Landscape Irrigation Evaluations
  - Outdoor Watering Schedule

[4] Water Conservation Implementation Task Force. Report to the 79th Legislature, Texas Water Development Board, Special Report. Austin, Texas. November 2004.
[5] "Best Management Practices for Municipal Water Users." Texas Water Development Board. Austin, Texas. May 2019.

- **Education and Public Awareness**
  - Public Information
  - School Education
  - Public Outreach and Education
  - Partnerships with Nonprofit Organizations
- **Rebate, Retrofit, and Incentive Programs**
  - Conservation Programs for Industrial, Commercial, and Institutional Accounts
  - Residential Clothes Washer Incentive Program
  - Residential Toilet Replacement Programs
  - Showerhead, Aerator, and Toilet Flapper Retrofit Program
  - Water-Wise Landscape Design and Conversion Programs
  - Customer Conservation Rebates
  - Plumbing Assistance Programs for Economically Disadvantaged Customers
- **Conservation Technology**
  - New Construction Graywater
  - Rainwater Harvesting and Condensate Reuse[6]
  - Reuse of Reclaimed Water[6]
- **Regulatory Enforcement**
  - Prohibition of Wasting Water
  - Conservation Ordinance Planning and Development

In addition to the BMP Guide, entities must submit a water conservation plan if they meet one or more of the following conditions:[7]

- The entity is a retail public water supplier with 3,300 or more connections;
- The entity is applying to the TWDB for financial assistance of more than $500,000; or
- The entity has certain surface water rights through the TCEQ.

Submitted water conservation plans must meet certain minimum requirements and be updated every five years. The water conservation plans should include a utility profile, an evaluation of the applicant's water and wastewater system and customer use characteristics, to identify water conservation opportunities. The plans should also set specific and quantifiable five-year and ten-year conservation

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[6] While Rainwater Harvesting, Condensate Reuse, and Reuse of Reclaimed Water are included in the WCAC Municipal BMP Guide as water conservation measures, they are not classified as water conservation measures by the TWDB for regional water planning purposes or in DB22.

[7] "Evaluation of Best Management Practices in Certain Water Conservation Plans", Biennial Report to the Texas Legislature, 85th Legislative Session. Texas Water Development Board, 2017.

goals for water loss programs and municipal and residential uses in GPCD with a schedule. More information and resources to develop water conservation plans can be found on the TWDB website[8].

In addition to the BMP Guide and required water conservation plans, the WCAC recommends use of a standardized methodology to determine per capita municipal water use. A standardized methodology would allow consistent evaluations and comparisons of water conservation measures' effectiveness among cities located in different climates and parts of Texas. The WCAC further recommends GPCD targets and goals that should be considered by retail public water suppliers, as follows:

- "All public water suppliers that are required to prepare and submit water conservation plans should establish targets for water conservation, including specific goals for per capita water use and for water loss programs using appropriate water conservation BMPs"; and
- "Municipal Water Conservation Plans required by the state shall include per capita water-use goals, with targets and goals established by an entity giving consideration to a minimum annual reduction of one percent in total GPCD, based upon a five-year moving average, until such time as the entity achieves a total GPCD of 140 GPCD or less."

The Texas WCAC provides information on best management practices and continuing development of water conservation resources, expertise, and progress evaluation. More information is available on the WCAC website at www.savetexaswater.org. The SCTRWPG considered these recommendations and incorporated them into the Region L Advanced Water Conservation Goals (see the Advanced Water Conservation section for a description of additional conservation goals and accompanying tables).

Anticipated per capita water use for Region L WUGs as a result of passive water conservation is shown in Table 5.2.1-3, which represents the effects of low flow plumbing fixtures. These per capita water uses were used to project water demands for each municipal WUG (See Chapter 2). The table includes a list of 139 municipal WUGs in the South Central Texas Region, arranged in order of lowest to highest per capita water use in year 2011 (baseline). Projected per capita water use represents the anticipated impacts of low flow plumbing fixtures for each decade from 2020 through 2070. **For most WUGs, additional GPCD savings are expected when the Advanced Water Conservation strategy goals are applied** (See Section 5.2.1.2: Available Yield for a description of Advanced Water Conservation GPCD goals and accompanying yield or savings).

Table 5.2.1-3 Projected Per-Capita Water Use with Passive Conservation (GPCD)

NO.	WATER USER GROUP	COUNTY	YEAR 2011 (GPCD)	PROJECTED WATER USE WITH PASSIVE CONSERVATION (GPCD)[1]					
				2020	2030	2040	2050	2060	2070
1	Randolph Air Force Base	Bexar	60	60	60	60	60	60	60
2	County Line Water Supply Corporation (WSC)	Hays	71	62	60	60	60	60	60
3	Port O'Connor Municipal Utility District (MUD)	Calhoun	79	70	66	63	62	62	61

[8] Texas Water Development Board, Water Conservation Plans website: http://www.twdb.texas.gov/conservation/municipal/plans/index.asp

Table 5.2.1-3 Projected Per-Capita Water Use with Passive Conservation (GPCD)

NO.	WATER USER GROUP	COUNTY	YEAR 2011 (GPCD)	PROJECTED WATER USE WITH PASSIVE CONSERVATION (GPCD)[1]					
				2020	2030	2040	2050	2060	2070
4	Green Valley Special Utility District (SUD)	Guadalupe	81	70	66	63	62	62	61
5	Guadalupe-Blanco River Authority	Calhoun	82	72	68	65	64	64	64
6	Springs Hill WSC	Guadalupe	88	79	75	73	72	71	71
7	East Medina County SUD	Medina	89	80	76	74	73	73	73
8	Kendall County Water Control and Improvement District (WCID) 1	Kendall	94	85	81	79	78	78	77
9	Picosa WSC	Wilson	95	85	81	79	77	77	77
10	Kyle	Hays	97	91	89	89	88	88	88
11	La Coste	Medina	99	88	84	81	79	79	79
12	Maxwell WSC	Caldwell	100	91	87	85	84	84	84
13	Medina River West WSC	Medina	100	91	88	85	84	83	83
14	Kirby	Bexar	102	91	87	84	83	83	83
15	Lackland Air Force Base	Bexar	103	95	91	88	87	86	86
16	Benton City WSC	Atascosa	104	97	94	93	92	92	92
17	Point Comfort	Calhoun	104	94	89	86	85	85	85
18	Martindale WSC	Caldwell	105	95	92	90	89	88	88
19	Converse	Bexar	106	97	94	93	92	92	92
20	Victoria County WCID 1	Victoria	107	97	93	90	88	88	88
21	Yancey WSC	Medina	108	100	97	95	94	94	94
22	Goforth SUD[2]	Hays	109	100	97	96	95	95	95
23	Creedmoor-Maha WSC[2]	Caldwell	110	99	94	92	91	90	90
24	County-Other, Guadalupe	Guadalupe	111	104	102	100	100	100	100
25	County-Other, La Salle	La Salle	111	103	100	98	97	97	97
26	Wimberley WSC	Hays	111	99	96	96	96	96	96
27	County-Other, Victoria	Victoria	114	104	100	97	96	96	96
28	County-Other, Wilson	Wilson	114	106	103	102	101	101	101
29	Quail Creek MUD	Victoria	114	104	100	97	96	95	95
30	County-Other, Caldwell	Caldwell	115	106	102	100	99	100	99

Table 5.2.1-3 Projected Per-Capita Water Use with Passive Conservation (GPCD)

NO.	WATER USER GROUP	COUNTY	YEAR 2011 (GPCD)	PROJECTED WATER USE WITH PASSIVE CONSERVATION (GPCD)[1]					
				2020	2030	2040	2050	2060	2070
31	County-Other, Calhoun	Calhoun	115	104	100	99	99	99	99
32	County-Other, Refugio	Refugio	116	106	102	99	97	97	97
33	SS WSC	Wilson	116	108	105	104	103	103	103
34	County-Other, Gonzales	Gonzales	118	107	102	101	101	100	101
35	County-Other, Hays[2]	Hays	118	110	107	105	104	104	104
36	County-Other, Kendall	Kendall	118	109	106	103	102	102	102
37	Canyon Lake Water Service[2]	Comal	119	112	110	109	109	109	109
38	County-Other, Goliad	Goliad	119	109	105	103	102	102	101
39	Kendall West Utility	Kendall	120	111	107	105	104	104	104
40	McCoy WSC[2]	Atascosa	120	111	107	105	104	103	103
41	Polonia WSC[2]	Caldwell	120	111	107	105	104	104	104
42	Poteet	Atascosa	121	110	106	103	102	101	101
43	Atascosa Rural WSC	Bexar	122	113	110	108	108	107	107
44	Tri Community WSC	Caldwell	122	113	109	107	106	106	106
45	Marion	Guadalupe	123	112	108	105	104	104	104
46	County-Other, Medina	Medina	124	116	112	110	109	109	109
47	County-Other, Atascosa	Atascosa	125	115	110	107	106	106	106
48	County-Other, Bexar	Bexar	126	118	113	110	110	109	109
49	County-Other, Frio	Frio	127	115	111	111	110	110	110
50	San Antonio Water System[3]	Bexar	127	--	--	--	--	--	--
51	County-Other, DeWitt	DeWitt	131	122	118	114	113	112	112
52	County-Other, Dimmit	Dimmit	132	123	119	116	115	115	115
53	County-Other, Karnes	Karnes	134	127	124	123	122	122	122
54	Port Lavaca	Calhoun	135	125	121	118	116	116	116
55	Cibolo	Guadalupe	136	129	127	127	127	127	127
56	East Central SUD	Bexar	136	126	121	119	117	117	117
57	County-Other, Uvalde	Uvalde	137	127	123	120	119	118	118
58	Elmendorf	Bexar	137	129	126	125	125	124	124

Table 5.2.1-3 Projected Per-Capita Water Use with Passive Conservation (GPCD)

NO.	WATER USER GROUP	COUNTY	YEAR 2011 (GPCD)	PROJECTED WATER USE WITH PASSIVE CONSERVATION (GPCD)[1]					
				2020	2030	2040	2050	2060	2070
59	Crystal Clear WSC	Guadalupe	138	128	125	122	121	121	121
60	Lockhart	Caldwell	138	128	124	122	121	121	121
61	Luling	Caldwell	138	127	123	121	120	119	119
62	Devine	Medina	140	131	127	123	122	121	121
63	Universal City	Bexar	143	134	130	128	127	126	126
64	Seguin	Guadalupe	147	137	133	131	130	129	129
65	Nixon	Gonzales	148	139	135	132	131	131	131
66	San Marcos	Hays	148	137	134	132	131	131	131
67	South Buda WCID 1	Hays	151	142	138	137	136	136	136
68	Big Wells	Dimmit	152	142	138	135	133	132	133
69	Schertz	Guadalupe	152	144	141	140	139	139	139
70	Selma	Bexar	153	147	145	145	145	144	144
71	Poth	Wilson	154	143	139	136	135	135	135
72	Water Services	Bexar	154	144	139	136	135	135	135
73	Sunko WSC	Wilson	155	145	141	139	138	138	138
74	Aqua WSC[2]	Caldwell	156	147	143	141	140	140	140
75	Woodsboro	Refugio	156	146	141	138	138	137	138
76	Oak Hills WSC	Wilson	158	149	146	144	144	143	143
77	County-Other, Zavala	Zavala	159	148	142	142	142	141	141
78	Seadrift	Calhoun	159	149	144	141	140	140	140
79	County-Other, Comal	Comal	160	151	147	144	142	142	142
80	Batesville WSC	Zavala	162	152	147	144	143	143	143
81	Leon Valley	Bexar	162	153	148	145	144	143	143
82	Waelder	Gonzales	162	153	149	147	146	146	146
83	Charlotte	Atascosa	163	152	148	146	144	144	144
84	Natalia	Medina	163	153	148	145	144	144	144
85	The Oaks WSC	Bexar	164	156	153	152	151	151	151
86	Carrizo Hill WSC	Dimmit	166	155	151	149	148	147	147

Table 5.2.1-3 Projected Per-Capita Water Use with Passive Conservation (GPCD)

NO.	WATER USER GROUP	COUNTY	YEAR 2011 (GPCD)	PROJECTED WATER USE WITH PASSIVE CONSERVATION (GPCD)[1]					
				2020	2030	2040	2050	2060	2070
87	Live Oak	Bexar	167	158	155	153	151	151	151
88	Yorktown	DeWitt	167	157	153	149	148	148	148
89	Buda[2]	Hays	168	160	159	158	157	157	157
90	Yoakum[2]	DeWitt	168	159	155	151	149	149	149
91	Karnes City	Karnes	177	167	163	160	158	158	158
92	Refugio	Refugio	180	170	166	162	161	161	161
93	Texas State University	Hays	180	170	167	166	165	165	165
94	Moore WSC	Frio	182	173	170	169	167	167	167
95	Lytle	Atascosa	183	173	168	166	164	164	164
96	Medina County WCID 2	Medina	186	178	174	171	170	170	170
97	Pearsall	Frio	186	177	173	171	170	169	169
98	Smiley	Gonzales	189	180	176	173	171	171	171
99	Goliad	Goliad	190	179	175	172	171	170	171
100	Asherton	Dimmit	191	180	175	174	174	174	174
101	New Braunfels	Comal	191	182	179	178	177	177	176
102	El Oso WSC[2]	Karnes	192	183	178	175	173	173	173
103	Runge	Karnes	192	182	177	174	174	173	173
104	Wingert Water Systems	Comal	192	178	179	179	179	179	179
105	West Medina WSC	Medina	194	184	181	179	177	177	177
106	Knippa WSC	Uvalde	196	186	182	179	177	177	177
107	Encinal WSC	La Salle	197	187	183	180	178	178	178
108	Hondo	Medina	198	189	185	183	181	181	181
109	Crystal City	Zavala	199	188	184	181	180	180	180
110	Jourdanton	Atascosa	199	189	184	182	181	180	180
111	La Vernia	Wilson	199	189	185	183	182	182	182
112	Stockdale	Wilson	199	188	183	181	180	180	180
113	Bexar County WCID 10	Bexar	201	192	188	186	185	185	184
114	Boerne	Kendall	201	192	189	188	187	187	187

Table 5.2.1-3 Projected Per-Capita Water Use with Passive Conservation (GPCD)

NO.	WATER USER GROUP	COUNTY	YEAR 2011 (GPCD)	PROJECTED WATER USE WITH PASSIVE CONSERVATION (GPCD)[1]					
				2020	2030	2040	2050	2060	2070
115	Pleasanton	Atascosa	205	195	191	188	187	187	186
116	Windmill WSC	Uvalde	206	196	192	189	188	187	187
117	Falls City	Karnes	209	200	196	192	191	191	191
118	Dilley	Frio	220	211	207	205	203	203	203
119	Uvalde	Uvalde	220	210	206	203	201	201	201
120	Floresville	Wilson	223	212	208	206	205	205	205
121	Sabinal	Uvalde	224	214	210	207	206	205	205
122	Gonzales	Gonzales	231	221	217	214	213	213	213
123	Victoria	Victoria	235	225	221	218	217	216	216
124	Air Force Village II Inc	Bexar	236	226	223	220	219	219	219
125	Fair Oaks Ranch	Bexar	244	236	234	233	232	232	231
126	Cuero	DeWitt	246	237	232	229	227	227	227
127	Carrizo Springs	Dimmit	252	242	237	234	233	233	233
128	Gonzales County WSC	Gonzales	252	243	240	237	236	236	236
129	Alamo Heights	Bexar	255	244	240	237	236	236	236
130	Zavala County WCID 1	Zavala	265	255	250	247	246	246	246
131	Castroville	Medina	272	263	259	255	253	253	253
132	Cotulla	La Salle	289	279	274	271	270	269	269
133	Shavano Park	Bexar	290	282	279	277	276	276	276
134	Loma Alta Chula Vista Water System	Zavala	296	285	281	278	277	276	276
135	KT Water Development	Comal	311	303	300	299	298	298	298
136	Garden Ridge	Comal	323	314	311	310	309	309	309
137	Kenedy	Karnes	361	351	347	343	343	342	342
138	Clear Water Estates Water System	Comal	1,090	1,081	1,079	1,078	1,077	1,076	1,076
139	Fort Sam Houston	Bexar	1,903	1,893	1,891	1,888	1,887	1,887	1,886

Table 5.2.1-3 Projected Per-Capita Water Use with Passive Conservation (GPCD)

NO.	WATER USER GROUP	COUNTY	YEAR 2011 (GPCD)	PROJECTED WATER USE WITH PASSIVE CONSERVATION (GPCD)[1]					
				2020	2030	2040	2050	2060	2070

[1] Passive water conservation effects are a result of low flow plumbing fixtures. Projected per capita water uses are estimated by the TWDB and used in calculating municipal water demands for WUGs in Chapter 2.

[2] WUGs are split between Region L and other regions (Regions K, P, G, and/or N). Values in the table represent Region L portion of municipal per capita water use.

[3] SAWS has identified utility-specific Advanced Water Conservation goals that are described and quantified in Section 5.2.1.5 entitled, "San Antonio Water System (SAWS) Advanced Water Conservation". Please see Table 5.2.1-12 for the GPCD as a result of passive water conservation .

Outdoor Water Conservation

In 2018, Texas Living Waters published the "Water Conservation by the Yard: A Statewide Analysis of Outdoor Water Savings Potential," which detailed regional and statewide projected conservation savings using effective outdoor watering education, technology, and restrictions. According to Texas Living Waters, effectively implementing outdoor watering restrictions can achieve much of the projected conservation savings identified in the 2017 State Water Plan (SWP).

Texas Living Waters calculated WUG-level estimated savings potential resulting from no more than twice per week outdoor watering restrictions for each regional water planning region. The estimated potential savings is based on the level of effort (low and high) expended to educate and enforce outdoor watering restrictions. For the South Central Texas Region, the potential savings percentage ranges from 3.5 percent (low effort education/enforcement) to 8.5 percent (high effort education/enforcement) of the total municipal demand. Texas Living Waters' research indicates that education and enforcement have a direct impact on the effectiveness of outdoor watering restrictions. The Texas Living Waters calculations applied to the Region L Municipal Demands identified in the 2017 SWP are detailed in Table 5.2.1-4 and Table 5.2.1-5. If no more than twice per week watering restrictions were implemented in the South Central Texas Region with a high level of education and enforcement effort, 39,871 acft/yr could be conserved relative to the projected 2020 municipal demands.

Table 5.2.1-4 Texas Living Waters Projected Municipal Savings From Outdoor Water Restrictions Based on Projected Future Municipal Demands For Region L Identified in the 2017 State Water Plan

PLANNING DECADE	2017 SWP REGION L MUNICIPAL DEMAND (ACFT/YR)	POTENTIAL WATER SAVINGS (ACFT/YR)	
		LOW EFFORT (3.5 PERCENT SAVINGS)	HIGH EFFORT (8.5 PERCENT SAVINGS)
2016	408,966	14,314	34,762
2020	469,065	16,417	39,871
2030	526,806	18,438	44,779
2040	582,421	20,385	49,506
2050	638,594	22,351	54,280

PLANNING DECADE	2017 SWP REGION L MUNICIPAL DEMAND (ACFT/YR)	POTENTIAL WATER SAVINGS (ACFT/YR)	
		LOW EFFORT (3.5 PERCENT SAVINGS)	HIGH EFFORT (8.5 PERCENT SAVINGS)
2060	694,556	24,309	59,037
2070	754,306	26,401	64,116

Table 5.2.1-5 Texas Living Waters Projected Municipal Savings as a Percentage of Region L Municipal Needs Identified in the 2017 State Water Plan

PLANNING DECADE	2017 SWP REGION L MUNICIPAL NEEDS (ACFT/YR)	WATER SAVINGS (% OF NEEDS)	
		LOW EFFORT	HIGH EFFORT
2020	72,636	23%	55%
2030	108,068	17%	41%
2040	148,627	14%	33%
2050	197,279	11%	28%
2060	249,846	10%	24%
2070	304,164	9%	21%

5.2.1.2 Available Yield

The purpose of the Advanced Water Conservation WMS is to evaluate the potential of additional municipal water conservation for inclusion in the RWP, which could meet part of the projected water needs (shortages) of each WUG for which a need (shortage) is projected. The Advanced Water Conservation WMS for municipal WUGs of Region L is based on the above-listed BMPs, WCAC guidelines for water-use targets and goals, as well as the quantities and costs of water conservation measures, as reported in TWDB's publication entitled, *Quantifying the Effectiveness of Various Water Conservation Techniques in Texas* (TWDB Water Conservation Publication). [9] The total yield from this WMS in 2070 is expected to be 167,148 acft/yr, and the decade of implementation varies depending on the WUG.

Region L Advanced Water Conservation Goals

For the 2021 RWP, the SCTRWPG established the following Region L Advanced Water Conservation goals:

- Conservation is recommended for every WUG in the South Central Texas Region.
- For municipal WUGs having year 2011 (baseline) water use of 140 GPCD or greater, the goal is to reduce per capita water use by 1 percent per year until 140 GPCD is reached; after which, the

[9] TWDB (2003). *Quantifying the Effectiveness of Various Water Conservation Techniques in Texas*; Appendix VI, Region L. Prepared by GDS Associates.

goal is to reduce per capita water use by 1/4 percent per year (0.25 percent per year) for the remainder of the planning period; and

- For municipal WUGs having year 2011 (baseline) water use of less than 140 GPCD, the goal is to reduce per capita water use by 1/4 percent per year for the remainder of the planning period.

A summary of municipal WUGs' water use and population is provided in Table 5.2.1-6. In year 2020, 66 municipal WUGs have a projected per capita water use less than 140 GPCD. These WUGs represent approximately 18 percent of the South Central Texas Region's population in 2020, and are projected to use approximately 19 percent of the Region's municipal water. In contrast, there are 73 WUGs in the South Central Texas Region with projected municipal per capita water use of 140 GPCD or more.

Table 5.2.1-6 South Central Texas Region Water User Groups and Municipal Per Capita Water Use

PER CAPITA WATER USE IN 2020 (GPCD)	NUMBER OF MUNICIPAL WUGS	PERCENT OF WUGS	PROJECTED POPULATION		MUNICIPAL WATER USE	
			2020	PERCENT OF TOTAL	2020 (ACFT/YR)	PERCENT OF TOTAL
Less than 140	66	47.48%	527,520	17.72%	83,149	19.26%
140 and Greater	73	52.52%	2,450,145	82.28%	348,529	80.74%
Totals	**139**	**100.00%**	**2,977,665**	**100.00%**	**431,678**	**100.00%**

The above Region L Advanced Water Conservation Goals were applied to WUGs in Region L and the resulting per capita water use goals are summarized in Table 5.2.1-7. It is important to note that for some WUGs, the low flow plumbing fixtures had a greater effect than the Region L goal. For these WUGS, no additional water conservation is considered.

San Antonio Water System (SAWS) has chosen to develop utility-specific conservation goals, beyond those included in the Region L Advanced Water Conservation goals described above. A description of the Advanced Water Conservation WMS for SAWS and accompanying tables are included in Section 5.2.1.5 entitled, "San Antonio Water System (SAWS) Advanced Water Conservation". For clarity, SAWS' conservation values are not included in Table 5.2.1-7 since they include additional advanced water conservation goals and meter infrastructure.

Table 5.2.1-7 Per Capita Water Use Goals for Region L WUGs, including Passive and Advanced Water Conservation

NO.	WATER USER GROUP	COUNTY	YEAR 2011 (GPCD)	PER CAPITA WATER USE GOALS VIA ADVANCED WATER CONSERVATION[1] (GPCD)					
				2020	2030	2040	2050	2060	2070
1	Randolph Air Force Base	Bexar	60	60	60	60	60	60	60
2	County Line WSC	Hays	71	62	60	60	60	60	60
3	Port O'Connor MUD	Calhoun	79	70	66	63	62	62	61
4	Green Valley SUD	Guadalupe	81	70	66	63	62	62	61
5	Guadalupe-Blanco River Authority	Calhoun	82	72	68	65	64	64	64

Table 5.2.1-7 Per Capita Water Use Goals for Region L WUGs, including Passive and Advanced Water Conservation

NO.	WATER USER GROUP	COUNTY	YEAR 2011 (GPCD)	PER CAPITA WATER USE GOALS VIA ADVANCED WATER CONSERVATION[1] (GPCD)					
				2020	2030	2040	2050	2060	2070
6	Springs Hill WSC	Guadalupe	88	79	75	73	72	71	71
7	East Medina County SUD	Medina	89	80	76	74	73	73	73
8	Kendall County WCID 1	Kendall	94	85	81	79	78	78	77
9	Picosa WSC	Wilson	95	85	81	79	77	77	77
10	Kyle	Hays	97	91	89	89	88	86	84
11	La Coste	Medina	99	88	84	81	79	79	79
12	Maxwell WSC	Caldwell	100	91	87	85	84	84	84
13	Medina River West WSC	Medina	100	91	88	85	84	83	83
14	Kirby	Bexar	102	91	87	84	83	83	83
15	Lackland Air Force Base	Bexar	103	95	91	88	87	86	86
16	Benton City WSC	Atascosa	104	97	94	93	92	92	90
17	Point Comfort	Calhoun	104	94	89	86	85	85	85
18	Martindale WSC	Caldwell	105	95	92	90	89	88	88
19	Converse	Bexar	106	97	94	93	92	92	91
20	Victoria County WCID 1	Victoria	107	97	93	90	88	88	88
21	Yancey WSC	Medina	108	100	97	95	94	94	93
22	Goforth SUD[2]	Hays	109	100	97	96	95	95	94
23	Creedmoor-Maha WSC[2]	Caldwell	110	99	94	92	91	90	90
24	County-Other, Guadalupe	Guadalupe	111	104	102	100	100	98	96
25	County-Other, La Salle	La Salle	111	103	100	98	97	97	96
26	Wimberley WSC	Hays	111	99	96	96	96	96	96
27	County-Other, Victoria	Victoria	114	104	100	97	96	96	96
28	County-Other, Wilson	Wilson	114	106	103	102	101	101	98
29	Quail Creek MUD	Victoria	114	104	100	97	96	95	95
30	County-Other, Caldwell	Caldwell	115	106	102	100	99	100	99
31	County-Other, Calhoun	Calhoun	115	104	100	99	99	99	99
32	County-Other, Refugio	Refugio	116	106	102	99	97	97	97
33	SS WSC	Wilson	116	108	105	104	103	103	100

Table 5.2.1-7 Per Capita Water Use Goals for Region L WUGs, including Passive and Advanced Water Conservation

NO.	WATER USER GROUP	COUNTY	YEAR 2011 (GPCD)	PER CAPITA WATER USE GOALS VIA ADVANCED WATER CONSERVATION[1] (GPCD)					
				2020	2030	2040	2050	2060	2070
34	County-Other, Gonzales	Gonzales	118	107	102	101	101	100	101
35	County-Other, Hays[2]	Hays	118	110	107	105	104	104	102
36	County-Other, Kendall	Kendall	118	109	106	103	102	102	102
37	Canyon Lake Water Service[2]	Comal	119	112	110	109	108	105	103
38	County-Other, Goliad	Goliad	119	109	105	103	102	102	101
39	Kendall West Utility	Kendall	120	111	107	105	104	104	104
40	McCoy WSC[2]	Atascosa	120	111	107	105	104	103	103
41	Polonia WSC[2]	Caldwell	120	111	107	105	104	104	104
42	Poteet	Atascosa	121	110	106	103	102	101	101
43	Atascosa Rural WSC	Bexar	122	113	110	108	108	107	105
44	Tri Community WSC	Caldwell	122	113	109	107	106	106	105
45	Marion	Guadalupe	123	112	108	105	104	104	104
46	County-Other, Medina	Medina	124	116	112	110	109	109	107
47	County-Other, Atascosa	Atascosa	125	115	110	107	106	106	106
48	County-Other, Bexar	Bexar	126	118	113	110	110	109	109
49	County-Other, Frio	Frio	127	115	111	111	110	110	110
50	San Antonio Water System[3]	Bexar	127	--	--	--	--	--	--
51	County-Other, DeWitt	DeWitt	131	122	118	114	113	112	112
52	County-Other, Dimmit	Dimmit	132	123	119	116	115	115	114
53	County-Other, Karnes	Karnes	134	127	124	123	122	119	116
54	Port Lavaca	Calhoun	135	125	121	118	116	116	116
55	Cibolo	Guadalupe	136	129	127	126	123	120	117
56	East Central SUD	Bexar	136	126	121	119	117	117	117
57	County-Other, Uvalde	Uvalde	137	127	123	120	119	118	118
58	Elmendorf	Bexar	137	129	126	125	124	121	118
59	Crystal Clear WSC	Guadalupe	138	128	125	122	121	121	119
60	Lockhart	Caldwell	138	128	124	122	121	121	119
61	Luling	Caldwell	138	127	123	121	120	119	119

Table 5.2.1-7 Per Capita Water Use Goals for Region L WUGs, including Passive and Advanced Water Conservation

NO.	WATER USER GROUP	COUNTY	YEAR 2011 (GPCD)	PER CAPITA WATER USE GOALS VIA ADVANCED WATER CONSERVATION[1] (GPCD)					
				2020	2030	2040	2050	2060	2070
62	Devine	Medina	140	131	127	123	122	121	121
63	Universal City	Bexar	143	134	130	128	127	124	121
64	Seguin	Guadalupe	147	137	133	131	128	125	122
65	Nixon	Gonzales	148	138	135	132	128	125	122
66	San Marcos	Hays	148	137	134	132	128	125	122
67	South Buda WCID 1	Hays	151	139	136	132	129	126	123
68	Big Wells	Dimmit	152	139	135	132	129	126	123
69	Schertz	Guadalupe	152	139	135	132	129	126	123
70	Selma	Bexar	153	140	136	133	130	126	123
71	Poth	Wilson	154	141	136	133	130	126	123
72	Water Services	Bexar	154	141	136	133	130	126	123
73	Sunko WSC	Wilson	155	142	136	133	129	126	123
74	Aqua WSC[2]	Caldwell	156	143	137	134	130	127	124
75	Woodsboro	Refugio	156	143	137	134	130	127	124
76	Oak Hills WSC	Wilson	158	144	137	133	130	127	124
77	County-Other, Zavala	Zavala	159	145	137	134	131	128	124
78	Seadrift	Calhoun	159	145	137	134	131	128	124
79	County-Other, Comal	Comal	160	146	137	134	131	127	124
80	Batesville WSC	Zavala	162	148	138	135	131	128	125
81	Leon Valley	Bexar	162	148	138	135	131	128	125
82	Waelder	Gonzales	162	148	138	135	131	128	125
83	Charlotte	Atascosa	163	149	138	134	131	128	125
84	Natalia	Medina	163	149	138	134	131	128	125
85	The Oaks WSC	Bexar	164	150	139	135	132	129	125
86	Carrizo Hill WSC	Dimmit	166	152	139	136	132	129	126
87	Live Oak	Bexar	167	153	139	136	132	129	126
88	Yorktown	DeWitt	167	153	139	136	132	129	126
89	Buda[2]	Hays	168	153	139	135	132	129	126

Table 5.2.1-7 Per Capita Water Use Goals for Region L WUGs, including Passive and Advanced Water Conservation

NO.	WATER USER GROUP	COUNTY	YEAR 2011 (GPCD)	PER CAPITA WATER USE GOALS VIA ADVANCED WATER CONSERVATION[1] (GPCD)					
				2020	2030	2040	2050	2060	2070
90	Yoakum[2]	DeWitt	168	153	139	135	132	129	126
91	Karnes City	Karnes	177	162	146	137	134	131	127
92	Refugio	Refugio	180	164	149	138	134	131	128
93	Texas State University	Hays	180	164	149	138	134	131	128
94	Moore WSC	Frio	182	166	150	138	135	131	128
95	Lytle	Atascosa	183	167	151	139	135	132	129
96	Medina County WCID 2	Medina	186	170	154	139	136	132	129
97	Pearsall	Frio	186	170	154	139	136	132	129
98	Smiley	Gonzales	189	173	156	141	137	133	130
99	Goliad	Goliad	190	174	157	142	136	133	130
100	Asherton	Dimmit	191	174	158	143	137	134	130
101	New Braunfels	Comal	191	174	158	143	137	134	130
102	El Oso WSC[2]	Karnes	192	175	159	143	137	133	130
103	Runge	Karnes	192	175	159	143	137	133	130
104	Wingert Water Systems	Comal	192	175	159	143	137	133	130
105	West Medina WSC	Medina	194	177	160	145	137	134	130
106	Knippa WSC	Uvalde	196	179	162	146	138	134	131
107	Encinal WSC	La Salle	197	180	163	147	138	135	131
108	Hondo	Medina	198	181	164	148	138	134	131
109	Crystal City	Zavala	199	182	164	149	139	135	132
110	Jourdanton	Atascosa	199	182	164	149	139	135	132
111	La Vernia	Wilson	199	182	164	149	139	135	132
112	Stockdale	Wilson	199	182	164	149	139	135	132
113	Bexar County WCID 10	Bexar	201	184	166	150	139	135	132
114	Boerne	Kendall	201	184	166	150	139	135	132
115	Pleasanton	Atascosa	205	187	169	153	140	136	133
116	Windmill WSC	Uvalde	206	188	170	154	139	136	132
117	Falls City	Karnes	209	191	173	156	141	137	133

Table 5.2.1-7 Per Capita Water Use Goals for Region L WUGs, including Passive and Advanced Water Conservation

NO.	WATER USER GROUP	COUNTY	YEAR 2011 (GPCD)	PER CAPITA WATER USE GOALS VIA ADVANCED WATER CONSERVATION[1] (GPCD)					
				2020	2030	2040	2050	2060	2070
118	Dilley	Frio	220	201	182	164	149	139	135
119	Uvalde	Uvalde	220	201	182	164	149	139	135
120	Floresville	Wilson	223	204	184	167	151	138	135
121	Sabinal	Uvalde	224	205	185	167	151	139	136
122	Gonzales	Gonzales	231	211	191	173	156	141	137
123	Victoria	Victoria	235	215	194	176	159	144	137
124	Air Force Village II Inc	Bexar	236	216	195	176	159	144	138
125	Fair Oaks Ranch	Bexar	244	223	202	182	165	149	138
126	Cuero	DeWitt	246	225	203	184	166	150	138
127	Carrizo Springs	Dimmit	252	230	208	188	170	154	139
128	Gonzales County WSC	Gonzales	252	230	208	188	170	154	139
129	Alamo Heights	Bexar	255	233	211	191	172	156	141
130	Zavala County WCID 1	Zavala	265	242	219	198	179	162	146
131	Castroville	Medina	272	248	225	203	184	166	150
132	Cotulla	La Salle	289	264	239	216	195	177	160
133	Shavano Park	Bexar	290	265	240	217	196	177	160
134	Loma Alta Chula Vista Water System	Zavala	296	270	245	221	200	181	164
135	KT Water Development	Comal	311	284	257	232	210	190	172
136	Garden Ridge	Comal	323	295	267	241	218	197	179
137	Kenedy	Karnes	361	330	298	270	244	221	200
138	Clear Water Estates Water System	Comal	1,090	996	901	814	737	666	602
139	Fort Sam Houston	Bexar	1,903	1,738	1,572	1,422	1,286	1,163	1,052

[1] Region L water conservation goals for municipal WUGs with baseline (year 2011) water use of 140 GPCD and greater are to reduce per capita water use by 1 percent per year until the level of 140 GPCD is reached; after which, the goal is to reduce per capita water use by 1/4 percent per year for the remainder of the planning period. For municipal WUGs having per capita water use less than 140 GPCD in year 2011, the goal is to reduce per capita water use by 1/4 percent per year.

[2] WUGs are split between Region L and other regions (Regions K, P, G, and/or N). Values in the table represent Region L portion of WUG.

[3] SAWS has identified utility-specific Advanced Water Conservation goals that are described and quantified in Section 5.2.1.5 entitled, “San Antonio Water System (SAWS) Advanced Water Conservation”. Please see Table 5.2.1-12.

Conservation potentials were calculated for additional plumbing fixtures, clothes washer retrofits, and lawn irrigation conservation for each WUG in the South Central Texas Region. The effects of passive conservation from low flow plumbing fixtures are already included in the water demand projections and are deducted from the 20 GPCD plumbing fixtures conservation potentials for municipal water demand reduction before additional conservation measures are suggested. The conservation potentials for households in Region L were determined using the information in Table 5.2.1-8. The per capita water conservation needed by each WUG to meet the Region L goals for indoor (plumbing fixtures and clothes washer retrofits) and outdoor (lawn watering) water conservation are tabulated in Table 5.2.1-9.

Calculations for the Advanced Water Conservation WMS for municipal WUGs are presented below and include both indoor (plumbing fixtures and clothes washers) and outdoor (lawn watering and landscape irrigation) water conservation methods. The underlying methods and assumptions are as follows:

1. Indoor plumbing fixture water conservation potentials are 20 GPCD, a part of which has already been included in the per capita water use projections shown in Table 5.2.1-2, and is considered in the computations of quantities and costs of the municipal water conservation WMS;
2. Outdoor (lawn and landscape) water conservation is used to meet the projected conservation that is needed to meet the Region L municipal water goals, as stated above;
3. Costs of municipal water conservation were obtained from the TWDB Water Conservation Publication, and are as follows:
   - Plumbing fixture and clothes washer retrofit (Table 5.2.1-8)

     Rural areas $770 per acft;

     Suburban areas $681 per acft; and

     Urban areas $600 per acft.
   - Lawn watering and landscape water conservation: $524 per acft.

Table 5.2.1-8 Water Conservation Potentials, Costs of Various Water Conservation Techniques and Housing Combinations

WATER CONSERVATION TECHNIQUES*	LIFE (YEARS)	DISCOUNT FACTOR 6%	REGION L POTENTIAL SAVINGS (ACFT)	NUMBER OF PEOPLE AFFECTED	POTENTIAL SAVINGS (ACFT PER PERSON PER YEAR)	TOTAL COSTS ($)	COST PER ACFT OF WATER SAVED AMORTIZED AT 6%* ($)
Rural Areas							
SF Toilet Retrofit	25	0.0782	1,536	326,520	0.004705	12,300,668	626
SF Showerheads and Aerators	15	0.1029	805	326,520	0.002464	1,012,996	130
SF Clothes Washer Rebate	13	0.1129	1,843	326,520	0.005646	19,536,354	1,197
MF Toilet Retrofit	25	0.0782	65	11,083	0.005881	338,247	406
MF Showerheads and Aerators	15	0.1029	34	11,083	0.00308	18,040	54
MF Clothes Washer Rebate	8	0.161	8	11,083	0.000754	39,086	753
		Totals **	4,292	337,603	0.012713	33,245,391	$770**

Table 5.2.1-8 Water Conservation Potentials, Costs of Various Water Conservation Techniques and Housing Combinations

WATER CONSERVATION TECHNIQUES*	LIFE (YEARS)	DISCOUNT FACTOR 6%	REGION L POTENTIAL SAVINGS (ACFT)	NUMBER OF PEOPLE AFFECTED	POTENTIAL SAVINGS (ACFT PER PERSON PER YEAR)	TOTAL COSTS ($)	COST PER ACFT OF WATER SAVED AMORTIZED AT 6%* ($)
Suburban Areas							
SF Toilet Retrofit	25	0.0782	2,254	279,152	0.008075	16,144,438	560
SF Showerheads and Aerators	15	0.1029	1,181	279,152	0.00423	1,329,542	116
SF Clothes Washer Rebate	13	0.1129	2,705	279,152	0.00969	25,641,167	1,070
MF Toilet Retrofit	25	0.0782	222	37,787	0.005881	1,346,116	474
MF Showerheads and Aerators	15	0.1029	116	37,787	0.00308	71,793	63
MF Clothes Washer Rebate	8	0.161	33	37,787	0.00088	155,551	753
		Totals **	**6,512**	**316,939**	**0.020546**	**44,688,607**	**$681****
Urban Areas							
SF Toilet Retrofit	25	0.0782	4,406	936,489	0.004705	29,225,488	519
SF Showerheads and Aerators	15	0.1029	2,308	936,489	0.002464	2,406,805	107
SF Clothes Washer Rebate	13	0.1129	5,287	936,489	0.005646	46,416,952	991
MF Toilet Retrofit	25	0.0782	1,427	242,646	0.005881	8,420,679	461
MF Showerheads and Aerators	15	0.1029	747	242,646	0.00308	449,103	62
MF Clothes Washer Rebate	8	0.161	208	242,646	0.000857	973,056	753
		Totals **	**14,383**	**1,179,135**	**0.012198**	**87,892,082**	**$600****

* SF is single family and MF is multi-family residential housing. Potentials for water conservation in commercial sector estimated at zero because of expected poor participation.
** Weighted average of measures included. Used to obtain cost per acft of municipal water conservation for use in calculating unit and total costs for water conservation WMS for Region L.
Source: TWDB (2003). *Quantifying the Effectiveness of Various Water Conservation Techniques in Texas*. Prepared by GDS Associates.

The per capita municipal water use projections with Advanced Water Conservation is tabulated for each WUG in Table 5.2.1-9 and includes the following:

1. Low flow plumbing fixtures water conservation potentials, as provided by TWDB for use in the municipal water demand projections;
2. Additional plumbing fixtures and clothes washer water conservation calculated at 1.0 percent and 0.25 percent per year, respectively, as stated in the goals above; and
3. Lawn and landscape irrigation conservation potentials.

Table 5.2.1-9 Projected Reduction in Per Capita Municipal Water Use from Advanced Water Conservation

NO.	WATER USER GROUP	COUNTY	PROJECTED PER CAPITA WATER USE REDUCTION VIA ADVANCED WATER CONSERVATION (GPCD)[1]					
			2020	2030	2040	2050	2060	2070
1	Randolph Air Force Base	Bexar	0	0	0	0	0	0
2	County Line WSC	Hays	0	0	0	0	0	0
3	Port O'Connor MUD	Calhoun	0	0	0	0	0	0
4	Green Valley SUD	Guadalupe	0	0	0	0	0	0
5	Guadalupe-Blanco River Authority	Calhoun	0	0	0	0	0	0
6	Springs Hill WSC	Guadalupe	0	0	0	0	0	0
7	East Medina County SUD	Medina	0	0	0	0	0	0
8	Kendall County WCID 1	Kendall	0	0	0	0	0	0
9	Picosa WSC	Wilson	0	0	0	0	0	0
10	Kyle	Hays	0	0	0	1	3	5
11	La Coste	Medina	0	0	0	0	0	0
12	Maxwell WSC	Caldwell	0	0	0	0	0	0
13	Medina River West WSC	Medina	0	0	0	0	0	0
14	Kirby	Bexar	0	0	0	0	0	0
15	Lackland Air Force Base	Bexar	0	0	0	0	0	0
16	Benton City WSC	Atascosa	0	0	0	0	0	2
17	Point Comfort	Calhoun	0	0	0	0	0	0
18	Martindale WSC	Caldwell	0	0	0	0	0	0
19	Converse	Bexar	0	0	0	0	0	0
20	Victoria County WCID 1	Victoria	0	0	0	0	0	0
21	Yancey WSC	Medina	0	0	0	0	0	1
22	Goforth SUD[2]	Hays	0	0	0	0	0	1
23	Creedmoor-Maha WSC[2]	Caldwell	0	0	0	0	0	0
24	County-Other, Guadalupe	Guadalupe	0	0	0	0	2	4
25	County-Other, La Salle	La Salle	0	0	0	0	0	1
26	Wimberley WSC	Hays	0	0	0	0	0	0
27	County-Other, Victoria	Victoria	0	0	0	0	0	0
28	County-Other, Wilson	Wilson	0	0	0	0	0	3

Table 5.2.1-9 Projected Reduction in Per Capita Municipal Water Use from Advanced Water Conservation

NO.	WATER USER GROUP	COUNTY	PROJECTED PER CAPITA WATER USE REDUCTION VIA ADVANCED WATER CONSERVATION (GPCD)[1]					
			2020	2030	2040	2050	2060	2070
29	Quail Creek MUD	Victoria	0	0	0	0	0	0
30	County-Other, Caldwell	Caldwell	0	0	0	0	0	0
31	County-Other, Calhoun	Calhoun	0	0	0	0	0	0
32	County-Other, Refugio	Refugio	0	0	0	0	0	0
33	SS WSC	Wilson	0	0	0	0	0	3
34	County-Other, Gonzales	Gonzales	0	0	0	0	0	0
35	County-Other, Hays[2]	Hays	0	0	0	0	0	2
36	County-Other, Kendall	Kendall	0	0	0	0	0	0
37	Canyon Lake Water Service[2]	Comal	0	0	0	1	3	6
38	County-Other, Goliad	Goliad	0	0	0	0	0	0
39	Kendall West Utility	Kendall	0	0	0	0	0	0
40	McCoy WSC[2]	Atascosa	0	0	0	0	0	0
41	Polonia WSC[2]	Caldwell	0	0	0	0	0	0
42	Poteet	Atascosa	0	0	0	0	0	0
43	Atascosa Rural WSC	Bexar	0	0	0	0	0	2
44	Tri Community WSC	Caldwell	0	0	0	0	0	1
45	Marion	Guadalupe	0	0	0	0	0	0
46	County-Other, Medina	Medina	0	0	0	0	0	2
47	County-Other, Atascosa	Atascosa	0	0	0	0	0	0
48	County-Other, Bexar	Bexar	0	0	0	0	0	1
49	County-Other, Frio	Frio	0	0	0	0	0	0
50	San Antonio Water System[3]	Bexar	--	--	--	--	--	--
51	County-Other, DeWitt	DeWitt	0	0	0	0	0	0
52	County-Other, Dimmit	Dimmit	0	0	0	0	0	1
53	County-Other, Karnes	Karnes	0	0	0	0	3	6
54	Port Lavaca	Calhoun	0	0	0	0	0	0
55	Cibolo	Guadalupe	0	0	1	4	7	9
56	East Central SUD	Bexar	0	0	0	0	0	0

Table 5.2.1-9 Projected Reduction in Per Capita Municipal Water Use from Advanced Water Conservation

NO.	WATER USER GROUP	COUNTY	PROJECTED PER CAPITA WATER USE REDUCTION VIA ADVANCED WATER CONSERVATION (GPCD)[1]					
			2020	2030	2040	2050	2060	2070
57	County-Other, Uvalde	Uvalde	0	0	0	0	0	0
58	Elmendorf	Bexar	0	0	0	0	3	6
59	Crystal Clear WSC	Guadalupe	0	0	0	0	0	2
60	Lockhart	Caldwell	0	0	0	0	0	2
61	Luling	Caldwell	0	0	0	0	0	0
62	Devine	Medina	0	0	0	0	0	1
63	Universal City	Bexar	0	0	0	0	3	6
64	Seguin	Guadalupe	0	0	0	1	4	7
65	Nixon	Gonzales	0	0	1	3	6	9
66	San Marcos	Hays	0	0	0	3	6	9
67	South Buda WCID 1	Hays	3	3	5	7	10	13
68	Big Wells	Dimmit	3	2	2	4	7	10
69	Schertz	Guadalupe	5	6	8	11	14	17
70	Selma	Bexar	7	9	12	15	18	21
71	Poth	Wilson	3	3	4	6	9	12
72	Water Services	Bexar	3	3	3	5	8	11
73	Sunko WSC	Wilson	3	5	7	9	12	15
74	Aqua WSC	Caldwell	4	6	7	10	13	16
75	Woodsboro	Refugio	3	5	4	7	10	14
76	Oak Hills WSC	Wilson	5	10	11	14	17	20
77	County-Other, Zavala	Zavala	3	5	8	11	14	17
78	Seadrift	Calhoun	4	7	7	9	12	15
79	County-Other, Comal	Comal	5	10	10	12	15	18
80	Batesville WSC	Zavala	4	9	9	12	15	18
81	Leon Valley	Bexar	5	10	11	13	15	19
82	Waelder	Gonzales	5	12	13	15	18	21
83	Charlotte	Atascosa	4	10	11	13	16	19
84	Natalia	Medina	4	11	11	13	16	19

Table 5.2.1-9 Projected Reduction in Per Capita Municipal Water Use from Advanced Water Conservation

NO.	WATER USER GROUP	COUNTY	PROJECTED PER CAPITA WATER USE REDUCTION VIA ADVANCED WATER CONSERVATION (GPCD)[1]					
			2020	2030	2040	2050	2060	2070
85	The Oaks WSC	Bexar	6	15	17	19	22	25
86	Carrizo Hill WSC	Dimmit	3	12	13	15	18	21
87	Live Oak	Bexar	5	16	17	19	22	25
88	Yorktown	DeWitt	5	14	13	16	19	22
89	Buda	Hays	7	20	22	25	28	31
90	Yoakum	DeWitt	5	16	16	17	20	24
91	Karnes City	Karnes	6	17	22	24	27	30
92	Refugio	Refugio	6	17	25	27	30	33
93	Texas State University	Hays	6	19	28	31	34	37
94	Moore WSC	Frio	7	20	31	33	36	39
95	Lytle	Atascosa	5	17	27	29	32	35
96	Medina County WCID 2	Medina	8	20	32	34	38	41
97	Pearsall	Frio	7	20	32	34	37	40
98	Smiley	Gonzales	8	20	32	35	38	41
99	Goliad	Goliad	6	18	30	34	37	41
100	Asherton	Dimmit	6	17	32	37	40	43
101	New Braunfels	Comal	8	21	35	40	43	46
102	El Oso WSC	Karnes	7	20	32	36	39	43
103	Runge	Karnes	7	19	31	37	40	43
104	Wingert Water Systems	Comal	3	20	35	42	45	49
105	West Medina WSC	Medina	7	20	34	40	43	46
106	Knippa WSC	Uvalde	7	20	32	40	43	46
107	Encinal WSC	La Salle	7	20	32	40	43	46
108	Hondo	Medina	8	22	35	44	47	50
109	Crystal City	Zavala	7	19	32	41	45	48
110	Jourdanton	Atascosa	7	20	33	42	45	48
111	La Vernia	Wilson	7	21	34	44	47	50
112	Stockdale	Wilson	6	19	32	41	45	48

Table 5.2.1-9 Projected Reduction in Per Capita Municipal Water Use from Advanced Water Conservation

NO.	WATER USER GROUP	COUNTY	PROJECTED PER CAPITA WATER USE REDUCTION VIA ADVANCED WATER CONSERVATION (GPCD)[1]					
			2020	2030	2040	2050	2060	2070
113	Bexar County WCID 10	Bexar	8	22	36	46	49	52
114	Boerne	Kendall	8	23	37	48	51	54
115	Pleasanton	Atascosa	8	21	35	47	50	54
116	Windmill WSC	Uvalde	8	22	35	48	51	55
117	Falls City	Karnes	9	23	36	50	54	58
118	Dilley	Frio	10	25	40	55	65	68
119	Uvalde	Uvalde	9	24	39	53	63	66
120	Floresville	Wilson	9	24	39	54	66	70
121	Sabinal	Uvalde	10	25	40	54	66	70
122	Gonzales	Gonzales	10	26	42	57	72	76
123	Victoria	Victoria	11	27	43	58	73	79
124	Air Force Village II Inc	Bexar	11	28	44	60	75	82
125	Fair Oaks Ranch	Bexar	13	32	50	67	82	94
126	Cuero	DeWitt	12	29	45	61	77	89
127	Carrizo Springs	Dimmit	12	29	46	63	79	93
128	Gonzales County WSC	Gonzales	13	31	49	66	82	96
129	Alamo Heights	Bexar	11	30	47	64	80	95
130	Zavala County WCID 1	Zavala	13	31	49	67	84	99
131	Castroville	Medina	14	34	52	70	87	103
132	Cotulla	La Salle	15	35	55	74	93	110
133	Shavano Park	Bexar	17	39	60	80	98	115
134	Loma Alta Chula Vista Water System	Zavala	15	37	57	77	95	113
135	KT Water Development	Comal	19	43	66	88	108	126
136	Garden Ridge	Comal	19	44	68	91	112	130
137	Kenedy	Karnes	21	48	73	99	122	143
138	Clear Water Estates Water System	Comal	85	179	263	341	410	474
139	Fort Sam Houston	Bexar	155	318	466	601	724	834
		Total	793	1,893	2,843	3,653	4,349	4,976

Table 5.2.1-9 Projected Reduction in Per Capita Municipal Water Use from Advanced Water Conservation

NO.	WATER USER GROUP	COUNTY	PROJECTED PER CAPITA WATER USE REDUCTION VIA ADVANCED WATER CONSERVATION (GPCD)[1]					
			2020	2030	2040	2050	2060	2070

[1] Projected per capita water use reduction represents the difference between a WUG's GPCD with passive conservation and the GPCD with advanced water conservation.

[2] WUGs are split between Region L and other regions (Regions K, P, G, and/or N). Values in the table represent Region L portion of municipal per capita water use.

[3] SAWS has identified utility-specific Advanced Water Conservation goals that are described and quantified in Section 5.2.1.5 entitled, "San Antonio Water System (SAWS) Advanced Water Conservation". Please see Table 5.2.1-12.

Region L Advanced Water Conservation Demand Reduction (Yield)

In order to meet the Region L per capita water use goals, the estimated quantities of water conservation potential (or water demand reduction volumes) for Region L WUGs was calculated (Table 5.2.1-10 in acft/yr). The total yield from this WMS in 2070 is expected to be 167,148 acft/yr.

The information shown in Table 5.2.1-10 for each of the WUGs for which water conservation estimates have been calculated is illustrated using New Braunfels (Number 101 on the list). For example, with additional water conservation through plumbing fixtures, clothes washers retrofit, and lawn irrigation, the Advanced Water Conservation WMS would meet 2,240 acft/yr of projected need (shortages) in 2020; 7,168 acft/yr in 2060; and 8,631 acft/yr in 2070 (Table 5.2.1-10).

Table 5.2.1-10 Potential Municipal Water Demand Reduction (Yield) from Advanced Water Conservation (acft/yr)

NO.	WATER USER GROUP	COUNTY	PROJECTED DEMAND REDUCTION FROM ADVANCED WATER CONSERVATION WMS[1] (ACFT/YR)					
			2020	2030	2040	2050	2060	2070
1	Randolph Air Force Base	Bexar	0	0	0	0	0	0
2	County Line WSC	Hays	0	0	0	0	0	0
3	Port O'Connor MUD	Calhoun	0	0	0	0	0	0
4	Green Valley SUD	Guadalupe	0	0	0	0	0	0
5	Guadalupe-Blanco River Authority	Calhoun	0	0	0	0	0	0
6	Springs Hill WSC	Guadalupe	0	0	0	0	0	0
7	East Medina County SUD	Medina	0	0	0	0	0	0
8	Kendall County WCID 1	Kendall	0	0	0	0	0	0
9	Picosa WSC	Wilson	0	0	0	0	0	0
10	Kyle	Hays	0	0	0	52	266	480
11	La Coste	Medina	0	0	0	0	0	0

Table 5.2.1-10 Potential Municipal Water Demand Reduction (Yield) from Advanced Water Conservation (acft/yr)

NO.	WATER USER GROUP	COUNTY	PROJECTED DEMAND REDUCTION FROM ADVANCED WATER CONSERVATION WMS[1] (ACFT/YR)					
			2020	2030	2040	2050	2060	2070
12	Maxwell WSC	Caldwell	0	0	0	0	0	0
13	Medina River West WSC	Medina	0	0	0	0	0	0
14	Kirby	Bexar	0	0	0	0	0	0
15	Lackland Air Force Base	Bexar	0	0	0	0	0	0
16	Benton City WSC	Atascosa	0	0	0	0	0	60
17	Point Comfort	Calhoun	0	0	0	0	0	0
18	Martindale WSC	Caldwell	0	0	0	0	0	0
19	Converse	Bexar	0	0	0	0	0	8
20	Victoria County WCID 1	Victoria	0	0	0	0	0	0
21	Yancey WSC	Medina	0	0	0	0	0	11
22	Goforth SUD[2]	Hays	0	0	0	0	0	50
23	Creedmoor-Maha WSC[2]	Caldwell	0	0	0	0	0	0
24	County-Other, Guadalupe	Guadalupe	0	0	0	0	5	13
25	County-Other, La Salle	La Salle	0	0	0	0	0	5
26	Wimberley WSC	Hays	0	0	0	0	0	0
27	County-Other, Victoria	Victoria	0	0	0	0	0	0
28	County-Other, Wilson	Wilson	0	0	0	0	0	4
29	Quail Creek MUD	Victoria	0	0	0	0	0	0
30	County-Other, Caldwell	Caldwell	0	0	0	0	0	0
31	County-Other, Calhoun	Calhoun	0	0	0	0	0	0
32	County-Other, Refugio	Refugio	0	0	0	0	0	0
33	SS WSC	Wilson	0	0	0	0	16	159
34	County-Other, Gonzales	Gonzales	0	0	0	0	0	0
35	County-Other, Hays[2]	Hays	0	0	0	0	0	232
36	County-Other, Kendall	Kendall	0	0	0	0	0	6
37	Canyon Lake Water Service[2]	Comal	0	0	0	89	380	759
38	County-Other, Goliad	Goliad	0	0	0	0	0	0
39	Kendall West Utility	Kendall	0	0	0	0	0	9
40	McCoy WSC[2]	Atascosa	0	0	0	0	0	0

Table 5.2.1-10 Potential Municipal Water Demand Reduction (Yield) from Advanced Water Conservation (acft/yr)

NO.	WATER USER GROUP	COUNTY	PROJECTED DEMAND REDUCTION FROM ADVANCED WATER CONSERVATION WMS[1] (ACFT/YR)					
			2020	2030	2040	2050	2060	2070
41	Polonia WSC[2]	Caldwell	0	0	0	0	0	4
42	Poteet	Atascosa	0	0	0	0	0	0
43	Atascosa Rural WSC	Bexar	0	0	0	0	0	50
44	Tri Community WSC	Caldwell	0	0	0	0	0	2
45	Marion	Guadalupe	0	0	0	0	0	0
46	County-Other, Medina	Medina	0	0	0	0	0	27
47	County-Other, Atascosa	Atascosa	0	0	0	0	0	0
48	County-Other, Bexar	Bexar	0	0	0	0	0	16
49	County-Other, Frio	Frio	0	0	0	0	0	1
50	San Antonio Water System[3]	Bexar	--	--	--	--	--	--
51	County-Other, DeWitt	DeWitt	0	0	0	0	0	0
52	County-Other, Dimmit	Dimmit	0	0	0	0	0	2
53	County-Other, Karnes	Karnes	0	0	0	1	11	21
54	Port Lavaca	Calhoun	0	0	0	0	0	0
55	Cibolo	Guadalupe	0	0	43	267	545	875
56	East Central SUD	Bexar	0	0	0	0	0	0
57	County-Other, Uvalde	Uvalde	0	0	0	0	0	1
58	Elmendorf	Bexar	0	0	0	1	17	35
59	Crystal Clear WSC	Guadalupe	0	0	0	0	0	77
60	Lockhart	Caldwell	0	0	0	0	0	71
61	Luling	Caldwell	0	0	0	0	0	2
62	Devine	Medina	0	0	0	0	0	4
63	Universal City	Bexar	0	0	0	0	67	140
64	Seguin	Guadalupe	0	0	0	59	232	448
65	Nixon	Gonzales	1	1	3	11	23	38
66	San Marcos	Hays	0	0	54	395	949	1,706
67	South Buda WCID 1	Hays	4	6	12	21	38	60
68	Big Wells	Dimmit	3	2	2	4	7	11
69	Schertz	Guadalupe	242	375	622	971	1,428	1,967

Table 5.2.1-10 Potential Municipal Water Demand Reduction (Yield) from Advanced Water Conservation (acft/yr)

NO.	WATER USER GROUP	COUNTY	PROJECTED DEMAND REDUCTION FROM ADVANCED WATER CONSERVATION WMS[1] (ACFT/YR)					
			2020	2030	2040	2050	2060	2070
70	Selma	Bexar	62	109	154	202	253	309
71	Poth	Wilson	7	9	14	25	43	64
72	Water Services	Bexar	24	26	31	59	99	144
73	Sunko WSC	Wilson	17	32	47	71	106	145
74	Aqua WSC[2]	Caldwell	0	0	0	1	1	1
75	Woodsboro	Refugio	6	9	8	14	20	27
76	Oak Hills WSC	Wilson	30	72	101	142	192	248
77	County-Other, Zavala	Zavala	4	9	15	24	32	42
78	Seadrift	Calhoun	6	13	15	21	31	41
79	County-Other, Comal	Comal	117	264	296	388	520	671
80	Batesville WSC	Zavala	5	13	16	22	29	37
81	Leon Valley	Bexar	42	102	112	165	212	265
82	Waelder	Gonzales	7	18	21	27	35	44
83	Charlotte	Atascosa	8	27	33	43	57	73
84	Natalia	Medina	7	23	26	33	44	55
85	The Oaks WSC	Bexar	12	34	44	57	72	89
86	Carrizo Hill WSC	Dimmit	2	10	11	14	17	20
87	Live Oak	Bexar	57	171	183	205	237	271
88	Yorktown	DeWitt	12	35	36	43	52	60
89	Buda[2]	Hays	2	6	9	13	17	23
90	Yoakum[2]	DeWitt	13	40	40	45	53	63
91	Karnes City	Karnes	21	63	84	91	102	114
92	Refugio	Refugio	19	59	85	96	108	119
93	Texas State University	Hays	33	101	153	167	185	201
94	Moore WSC	Frio	5	14	24	27	31	36
95	Lytle	Atascosa	25	94	166	199	242	286
96	Medina County WCID 2	Medina	6	18	31	36	42	48
97	Pearsall	Frio	81	247	434	496	573	655
98	Smiley	Gonzales	5	15	26	31	36	42

Table 5.2.1-10 Potential Municipal Water Demand Reduction (Yield) from Advanced Water Conservation (acft/yr)

NO.	WATER USER GROUP	COUNTY	PROJECTED DEMAND REDUCTION FROM ADVANCED WATER CONSERVATION WMS[1] (ACFT/YR)					
			2020	2030	2040	2050	2060	2070
99	Goliad	Goliad	15	51	93	111	123	135
100	Asherton	Dimmit	7	24	47	57	65	72
101	New Braunfels	Comal	663	2,240	4,381	5,814	7,168	8,631
102	El Oso WSC[2]	Karnes	29	84	138	161	176	194
103	Runge	Karnes	10	28	46	55	59	64
104	Wingert Water Systems	Comal	5	40	86	102	111	119
105	West Medina WSC	Medina	9	30	54	70	79	90
106	Knippa WSC	Uvalde	6	18	31	42	47	54
107	Encinal WSC	La Salle	8	25	44	58	68	77
108	Hondo	Medina	87	260	450	599	675	754
109	Crystal City	Zavala	60	196	353	496	573	654
110	Jourdanton	Atascosa	38	125	232	326	382	442
111	La Vernia	Wilson	15	55	109	157	188	219
112	Stockdale	Wilson	13	49	98	143	171	201
113	Bexar County WCID 10	Bexar	51	141	234	310	340	372
114	Boerne	Kendall	139	496	1,009	1,551	1,936	2,352
115	Pleasanton	Atascosa	95	307	565	846	985	1,130
116	Windmill WSC	Uvalde	15	43	75	111	125	141
117	Falls City	Karnes	6	17	26	36	39	42
118	Dilley	Frio	50	145	248	362	453	501
119	Uvalde	Uvalde	193	552	945	1,384	1,744	1,942
120	Floresville	Wilson	79	270	523	819	1,118	1,283
121	Sabinal	Uvalde	20	57	96	141	182	203
122	Gonzales	Gonzales	96	271	465	690	941	1,081
123	Victoria	Victoria	809	2,199	3,642	5,158	6,705	7,516
124	Air Force Village II Inc	Bexar	9	27	46	62	78	85
125	Fair Oaks Ranch	Bexar	117	334	587	831	1,141	1,423
126	Cuero	DeWitt	91	233	367	503	637	744
127	Carrizo Springs	Dimmit	77	210	346	498	645	784

Table 5.2.1-10 Potential Municipal Water Demand Reduction (Yield) from Advanced Water Conservation (acft/yr)

NO.	WATER USER GROUP	COUNTY	PROJECTED DEMAND REDUCTION FROM ADVANCED WATER CONSERVATION WMS[1] (ACFT/YR)					
			2020	2030	2040	2050	2060	2070
128	Gonzales County WSC	Gonzales	109	289	490	717	966	1,233
129	Alamo Heights	Bexar	103	279	440	600	752	892
130	Zavala County WCID 1	Zavala	24	65	113	168	225	283
131	Castroville	Medina	46	109	167	225	283	336
132	Cotulla	La Salle	67	180	303	443	589	737
133	Shavano Park	Bexar	42	109	185	269	356	444
134	Loma Alta Chula Vista Water System	Zavala	12	34	57	84	112	140
135	KT Water Development	Comal	28	78	146	228	321	421
136	Garden Ridge	Comal	108	300	553	781	1,102	1,449
137	Kenedy	Karnes	86	200	304	409	505	593
138	Clear Water Estates Water System	Comal	54	142	253	386	534	695
139	Fort Sam Houston	Bexar	213	436	639	824	993	1,144
		Total	**4,589**	**12,765**	**21,937**	**31,255**	**41,117**	**51,219**

[1] Projected demand reduction is the volume of water (acft/yr) needing to be conserved in order to reach the Region L conservation goals presented in Table 5.2.1-7.

[2] WUGs are split between Region L and other regions (Regions K, P, G, and/or N). Values in the table represent Region L portion of projected demand reduction to meet Advanced Water Conservation Goals.

[3] SAWS has identified utility-specific Advanced Water Conservation goals that are described and quantified in Section 5.2.1.5 entitled, "San Antonio Water System (SAWS) Advanced Water Conservation". Please see Table 5.2.1-12.

Reliability

Since this strategy is a demand reduction, the reliability is high (reliability score = 5).

5.2.1.3 Environmental Considerations

Advanced Water Conservation is not expected to have negative impacts on natural, cultural or agricultural resources. While increased conservation may increase concentrations of influent to wastewater treatment facilities, the wastewater treatment facilities would be expected to improve treatment technologies in order to meet discharge permit requirements that maintain receiving water quality standards. Strategies to encourage reduced lawn watering and/or replacement of lawns with water-conserving landscaping could result in environmentally beneficial increases in landscape species diversity and drought tolerance.

5.2.1.4 Engineering and Costing

The estimated total costs of municipal water conservation for each individual WUG are shown in Table 5.2.1-11. This includes estimates for additional plumbing fixtures, clothes washers retrofit, and lawn irrigation. The costs depend upon quantity of water conservation potential, as well as location (i.e., rural, suburban, or urban). For example, San Marcos (Number 66 on the list) has a water conservation potential of 54 acft/yr in 2040, with a cost $32,551, and a potential of 1,706 acft/yr in 2070 at a cost of $1,023,689 (Table 5.2.1-10 and Table 5.2.1-11, respectively).

Total cost for implementation and administration of the Advanced Water Conservation WMS to meet the Region L goals of reducing per capita water use at the 1 percent and 0.25 percent rates, as described at the beginning of this analysis, in 2020 is $3,140,036, increasing to $14,960,833 in 2040, and to $34,855,576 in 2070; Table 5.2.1-11).

Table 5.2.1-11 Estimated Costs for Advanced Water Conservation WMS

NO.	WATER USER GROUP	AREA	COST PER ACRE FOOT ($)	ANNUAL COSTS OF ADVANCED WATER CONSERVATION WMS[1]					
				2020	2030	2040	2050	2060	2070
1	Randolph Air Force Base	Suburban	$681	$0	$0	$0	$0	$0	$0
2	County Line WSC	Suburban	$681	$0	$0	$0	$0	$0	$0
3	Port O'Connor MUD	Rural	$770	$0	$0	$0	$0	$0	$0
4	Green Valley SUD	Suburban	$681	$0	$0	$0	$0	$0	$0
5	Guadalupe-Blanco River Authority	Urban	$600	$0	$0	$0	$0	$0	$0
6	Springs Hill WSC	Suburban	$681	$0	$0	$0	$0	$0	$0
7	East Medina County SUD	Rural	$770	$0	$0	$0	$0	$0	$0
8	Kendall County WCID 1	Rural	$770	$0	$0	$0	$0	$0	$0
9	Picosa WSC	Rural	$770	$0	$0	$0	$0	$0	$0
10	Kyle	Suburban	$681	$0	$0	$0	$35,115	$180,936	$327,070
11	La Coste	Rural	$770	$0	$0	$0	$0	$0	$0
12	Maxwell WSC	Suburban	$681	$0	$0	$0	$0	$0	$0
13	Medina River West WSC	Rural	$770	$0	$0	$0	$0	$0	$0
14	Kirby	Urban	$600	$0	$0	$0	$0	$0	$0
15	Lackland Air Force Base	Urban	$600	$0	$0	$0	$0	$0	$0
16	Benton City WSC	Rural	$770	$0	$0	$0	$0	$0	$46,427
17	Point Comfort	Rural	$770	$0	$0	$0	$0	$0	$0

Table 5.2.1-11 Estimated Costs for Advanced Water Conservation WMS

NO.	WATER USER GROUP	AREA	COST PER ACRE FOOT ($)	ANNUAL COSTS OF ADVANCED WATER CONSERVATION WMS[1]					
				2020	2030	2040	2050	2060	2070
18	Martindale WSC	Suburban	$681	$0	$0	$0	$0	$0	$0
19	Converse	Suburban	$681	$0	$0	$0	$0	$0	$5,516
20	Victoria County WCID 1	Rural	$770	$0	$0	$0	$0	$0	$0
21	Yancey WSC	Rural	$770	$0	$0	$0	$0	$0	$8,376
22	Goforth SUD[2]	Suburban	$681	$0	$0	$0	$0	$0	$34,050
23	Creedmoor-Maha WSC[2]	Rural	$770	$0	$0	$0	$0	$0	$0
24	County-Other, Guadalupe	Suburban	$681	$0	$0	$0	$0	$3,516	$9,183
25	County-Other, La Salle	Rural	$770	$0	$0	$0	$0	$0	$3,630
26	Wimberley WSC	Rural	$770	$0	$0	$0	$0	$0	$0
27	County-Other, Victoria	Rural	$770	$0	$0	$0	$0	$0	$0
28	County-Other, Wilson	Rural	$770	$0	$0	$0	$0	$149	$3,334
29	Quail Creek MUD	Suburban	$681	$0	$0	$0	$0	$0	$0
30	County-Other, Caldwell	Rural	$770	$0	$0	$0	$0	$0	$0
31	County-Other, Calhoun	Rural	$770	$0	$0	$0	$0	$0	$0
32	County-Other, Refugio	Rural	$770	$0	$0	$0	$0	$0	$0
33	SS WSC	Rural	$770	$0	$0	$0	$0	$12,337	$122,154
34	County-Other, Gonzales	Rural	$770	$0	$0	$0	$0	$0	$0
35	County-Other, Hays[2]	Suburban	$681	$0	$0	$0	$0	$0	$158,242
36	County-Other, Kendall	Rural	$770	$0	$0	$0	$0	$0	$4,956
37	Canyon Lake Water Service[2]	Suburban	$681	$0	$0	$0	$60,609	$258,780	$516,879
38	County-Other, Goliad	Rural	$770	$0	$0	$0	$0	$0	$0
39	Kendall West Utility	Rural	$770	$0	$0	$0	$0	$0	$6,684
40	McCoy WSC[2]	Suburban	$681	$0	$0	$0	$0	$0	$0
41	Polonia WSC[2]	Suburban	$681	$0	$0	$0	$0	$0	$2,467
42	Poteet	Rural	$770	$0	$0	$0	$0	$0	$0
43	Atascosa Rural WSC	Rural	$770	$0	$0	$0	$0	$0	$38,360

Table 5.2.1-11 Estimated Costs for Advanced Water Conservation WMS

NO.	WATER USER GROUP	AREA	COST PER ACRE FOOT ($)	ANNUAL COSTS OF ADVANCED WATER CONSERVATION WMS[1]					
				2020	2030	2040	2050	2060	2070
44	Tri Community WSC	Suburban	$681	$0	$0	$0	$0	$0	$1,585
45	Marion	Suburban	$681	$0	$0	$0	$0	$0	$0
46	County-Other, Medina	Rural	$770	$0	$0	$0	$0	$0	$21,150
47	County-Other, Atascosa	Rural	$770	$0	$0	$0	$0	$0	$0
48	County-Other, Bexar	Suburban	$681	$0	$0	$0	$0	$0	$11,211
49	County-Other, Frio	Rural	$770	$0	$0	$0	$0	$0	$982
50	San Antonio Water System[3]	Urban	$600	--	--	--	--	--	--
51	County-Other, DeWitt	Rural	$770	$0	$0	$0	$0	$0	$0
52	County-Other, Dimmit	Rural	$770	$0	$0	$0	$0	$0	$1,858
53	County-Other, Karnes	Rural	$770	$0	$0	$0	$863	$8,295	$16,294
54	Port Lavaca	Rural	$770	$0	$0	$0	$0	$0	$0
55	Cibolo	Suburban	$681	$0	$0	$29,473	$181,843	$371,419	$596,201
56	East Central SUD	Suburban	$681	$0	$0	$0	$0	$0	$0
57	County-Other, Uvalde	Rural	$770	$0	$0	$0	$0	$0	$424
58	Elmendorf	Suburban	$681	$0	$0	$0	$759	$11,256	$23,517
59	Crystal Clear WSC	Rural	$770	$0	$0	$0	$0	$0	$59,498
60	Lockhart	Suburban	$681	$0	$0	$0	$0	$0	$48,465
61	Luling	Rural	$770	$0	$0	$0	$0	$0	$1,237
62	Devine	Rural	$770	$0	$0	$0	$0	$0	$2,873
63	Universal City	Suburban	$681	$0	$0	$0	$0	$45,534	$95,460
64	Seguin	Suburban	$681	$0	$0	$0	$39,948	$157,890	$305,278
65	Nixon	Rural	$770	$750	$818	$2,334	$8,609	$17,855	$29,545
66	San Marcos	Urban	$600	$0	$0	$32,551	$236,919	$569,349	$1,023,689
67	South Buda WCID 1	Suburban	$681	$2,606	$3,843	$7,844	$14,456	$25,595	$41,073
68	Big Wells	Rural	$770	$2,269	$1,475	$1,818	$2,976	$5,372	$8,391
69	Schertz	Suburban	$681	$165,003	$255,520	$423,322	$661,256	$972,398	$1,339,361
70	Selma	Suburban	$681	$41,891	$73,983	$104,848	$137,498	$172,142	$210,204
71	Poth	Rural	$770	$5,189	$6,691	$10,884	$19,533	$33,200	$49,105
72	Water Services	Urban	$600	$14,105	$15,596	$18,463	$35,352	$59,173	$86,290

Table 5.2.1-11 Estimated Costs for Advanced Water Conservation WMS

NO.	WATER USER GROUP	AREA	COST PER ACRE FOOT ($)	ANNUAL COSTS OF ADVANCED WATER CONSERVATION WMS[1]					
				2020	2030	2040	2050	2060	2070
73	Sunko WSC	Rural	$770	$13,216	$24,816	$35,960	$54,363	$81,514	$111,681
74	Aqua WSC[2]	Rural	$770	$0	$0	$0	$770	$770	$770
75	Woodsboro	Rural	$770	$4,689	$6,629	$6,238	$11,044	$15,328	$20,755
76	Oak Hills WSC	Suburban	$681	$20,430	$49,371	$68,883	$96,465	$130,526	$168,762
77	County-Other, Zavala	Rural	$770	$3,451	$7,083	$11,684	$18,161	$24,368	$32,167
78	Seadrift	Rural	$770	$4,942	$10,098	$11,712	$16,425	$23,821	$31,643
79	County-Other, Comal	Rural	$770	$90,162	$203,418	$227,973	$298,392	$400,386	$516,721
80	Batesville WSC	Rural	$770	$3,938	$10,302	$12,045	$16,556	$22,668	$28,744
81	Leon Valley	Urban	$600	$25,012	$61,201	$67,303	$98,730	$127,366	$159,192
82	Waelder	Rural	$770	$5,222	$13,571	$16,338	$20,721	$27,072	$34,076
83	Charlotte	Rural	$770	$6,095	$20,700	$25,027	$32,895	$43,991	$55,922
84	Natalia	Rural	$770	$5,480	$17,923	$20,380	$25,750	$33,903	$42,350
85	The Oaks WSC	Urban	$600	$7,225	$20,218	$26,350	$34,271	$43,424	$53,195
86	Carrizo Hill WSC	Rural	$770	$1,905	$7,385	$8,563	$10,773	$13,130	$15,461
87	Live Oak	Suburban	$681	$38,816	$116,232	$124,910	$139,779	$161,537	$184,748
88	Yorktown	Rural	$770	$9,254	$27,277	$27,406	$33,430	$39,932	$46,382
89	Buda[2]	Suburban	$681	$1,362	$4,086	$6,129	$8,853	$11,577	$15,663
90	Yoakum[2]	Rural	$770	$9,747	$30,980	$31,182	$34,733	$41,184	$48,351
91	Karnes City	Rural	$770	$16,026	$48,829	$64,530	$69,717	$78,511	$87,839
92	Refugio	Rural	$770	$14,862	$45,514	$65,499	$73,950	$82,779	$91,620
93	Texas State University	Suburban	$681	$22,240	$68,964	$104,141	$114,028	$125,646	$136,959
94	Moore WSC	Rural	$770	$3,498	$10,817	$18,297	$20,789	$23,965	$27,894
95	Lytle	Suburban	$681	$16,941	$63,827	$112,932	$135,777	$164,868	$194,546
96	Medina County WCID 2	Rural	$770	$4,736	$13,609	$24,066	$27,824	$32,714	$37,126
97	Pearsall	Rural	$770	$62,503	$190,551	$333,889	$381,874	$441,504	$504,617
98	Smiley	Rural	$770	$3,994	$11,309	$19,982	$23,486	$28,086	$32,674
99	Goliad	Rural	$770	$11,526	$39,501	$71,432	$85,190	$94,332	$104,319
100	Asherton	Rural	$770	$5,679	$18,607	$36,246	$44,188	$49,879	$55,204
101	New Braunfels	Urban	$600	$398,011	$1,344,167	$2,628,390	$3,488,484	$4,300,880	$5,178,526

Table 5.2.1-11 Estimated Costs for Advanced Water Conservation WMS

NO.	WATER USER GROUP	AREA	COST PER ACRE FOOT ($)	ANNUAL COSTS OF ADVANCED WATER CONSERVATION WMS[1]					
				2020	2030	2040	2050	2060	2070
102	El Oso WSC[2]	Rural	$770	$22,658	$64,895	$106,119	$123,945	$135,904	$149,042
103	Runge	Rural	$770	$7,661	$21,589	$35,511	$42,408	$45,520	$49,305
104	Wingert Water Systems	Suburban	$681	$3,270	$27,402	$58,574	$69,670	$75,287	$80,766
105	West Medina WSC	Rural	$770	$7,164	$22,797	$41,438	$53,608	$60,988	$69,530
106	Knippa WSC	Rural	$770	$4,300	$13,921	$24,216	$32,009	$36,499	$41,479
107	Encinal WSC	Rural	$770	$6,300	$19,387	$33,748	$44,776	$52,148	$59,304
108	Hondo	Rural	$770	$67,323	$200,286	$346,655	$461,556	$520,033	$580,802
109	Crystal City	Rural	$770	$46,296	$150,541	$272,176	$382,073	$441,417	$503,328
110	Jourdanton	Rural	$770	$29,003	$96,548	$178,941	$250,912	$294,316	$340,566
111	La Vernia	Rural	$770	$11,687	$42,605	$83,796	$120,876	$144,854	$168,897
112	Stockdale	Rural	$770	$9,743	$37,454	$75,701	$109,758	$132,032	$154,723
113	Bexar County WCID 10	Rural	$770	$38,954	$108,618	$180,472	$238,794	$262,023	$286,588
114	Boerne	Suburban	$681	$94,632	$338,021	$687,296	$1,056,238	$1,318,098	$1,601,782
115	Pleasanton	Rural	$770	$72,948	$236,736	$435,117	$651,528	$758,350	$870,461
116	Windmill WSC	Rural	$770	$11,176	$33,256	$57,809	$85,114	$96,072	$108,313
117	Falls City	Rural	$770	$4,825	$12,834	$20,252	$27,853	$30,391	$32,286
118	Dilley	Rural	$770	$38,710	$111,410	$191,112	$279,017	$348,555	$385,838
119	Uvalde	Rural	$770	$148,301	$424,734	$727,640	$1,065,867	$1,342,727	$1,495,517
120	Floresville	Rural	$770	$61,152	$208,104	$402,338	$630,909	$860,542	$988,234
121	Sabinal	Rural	$770	$15,656	$43,801	$74,155	$108,559	$140,473	$156,164
122	Gonzales	Rural	$770	$74,026	$208,530	$357,805	$531,188	$724,200	$832,296
123	Victoria	Urban	$600	$485,612	$1,319,337	$2,185,029	$3,094,669	$4,022,992	$4,509,802
124	Air Force Village II Inc	Rural	$770	$6,786	$20,606	$35,192	$47,917	$60,122	$65,496
125	Fair Oaks Ranch	Suburban	$681	$79,546	$227,665	$399,630	$566,010	$776,824	$968,946
126	Cuero	Rural	$770	$70,158	$179,132	$282,744	$387,387	$490,629	$572,811
127	Carrizo Springs	Rural	$770	$59,569	$161,709	$266,575	$383,185	$496,303	$603,647
128	Gonzales County WSC	Rural	$770	$83,741	$222,838	$377,382	$552,110	$744,202	$949,047
129	Alamo Heights	Suburban	$681	$70,470	$189,818	$299,827	$408,389	$511,919	$607,397
130	Zavala County WCID 1	Rural	$770	$18,192	$50,216	$86,756	$129,128	$173,386	$218,148

Table 5.2.1-11 Estimated Costs for Advanced Water Conservation WMS

NO.	WATER USER GROUP	AREA	COST PER ACRE FOOT ($)	ANNUAL COSTS OF ADVANCED WATER CONSERVATION WMS[1]					
				2020	2030	2040	2050	2060	2070
131	Castroville	Rural	$770	$35,323	$83,995	$128,878	$173,548	$217,847	$258,698
132	Cotulla	Rural	$770	$51,812	$138,541	$232,977	$340,781	$453,604	$567,605
133	Shavano Park	Suburban	$681	$28,557	$74,523	$125,983	$183,287	$242,430	$302,637
134	Loma Alta Chula Vista Water System	Rural	$770	$9,530	$26,051	$43,920	$64,935	$86,127	$107,975
135	KT Water Development	Suburban	$681	$18,741	$53,350	$99,164	$155,021	$218,490	$286,736
136	Garden Ridge	Suburban	$681	$73,295	$204,418	$376,917	$532,052	$750,578	$986,600
137	Kenedy	Rural	$770	$66,189	$154,185	$234,300	$315,200	$388,987	$456,415
138	Clear Water Estates Water System	Suburban	$681	$36,441	$96,585	$172,541	$262,909	$363,811	$473,079
139	Fort Sam Houston	Urban	$600	$127,514	$261,856	$383,123	$494,365	$595,513	$686,390
			Total	**$3,140,036**	**$8,733,205**	**$14,960,833**	**$21,310,705**	**$27,985,050**	**$34,855,576**

[1] Annual costs of Advanced Water Conservation WMS are the unit costs multiplied by the demand reduction volume shown in Table 5.2.1-10.

[2] WUGs are split between Region L and other regions (Regions K, P, G, and/or N). Values in the table represent Region L portion of projected demand reduction to meet Advanced Water Conservation Goals.

[3] SAWS has identified utility-specific Advanced Water Conservation goals that are described and quantified in Section 5.2.1.5 entitled, "San Antonio Water System (SAWS) Advanced Water Conservation". Please see Table 5.2.1-12.

5.2.1.5 San Antonio Water System (SAWS) Advanced Water Conservation

San Antonio Water System (SAWS) has chosen to develop utility-specific conservation goals, beyond those included in the Region L Advanced Water Conservation goals described in Section 5.2.1.2. The decadal savings and costs for SAWS Advanced Water Conservation are presented in Table 5.2.1-12.

SAWS is currently planning to adopt Advanced Meter Infrastructure (AMI) as a conservation strategy. An AMI fixed network system automates the meter reading process with two way communications from utility to meter. The network collects, delivers, and analyzes data regarding how and when usage takes place. This strategy is designed to provide the utility with more information to proactively prevent water loss and manage customers and resources. In addition, more information will be available to customers, encouraging participation in conservation efforts. Advanced meter infrastructure can promote conservation through improved reporting, thereby reducing demand and increasing the available supply. SAWS estimates a 5-7 percent water savings as a byproduct of information being available to customers through the customer service portal.

Over a period of five years, SAWS plans to install 500,000 active meters in its distribution system, with 100,000 meters installed each year between 2022 and 2026. Annual and unit costs are summarized in

Table 5.2.1-12. The total capital cost is expected to be approximately $208,060,000. Including engineering and feasibility studies, financing, other contingencies, and interest, the total project cost is $288,606,000.

As demonstrated in the table below, the projected per capita water use for SAWS with only passive conservation is 117 GPCD in 2020, with a reduction down to 110 GPCD by 2070. However, these values represent only the effects of passive conservation, which is the implementation of low flow plumbing and fixtures. SAWS currently implements advanced water conservation measures and plans to implement the AMI program in the 2020 decade, which would effectively bring the per capita water use down to 105 GPCD in 2020, with a reduction down to 74 GPCD by 2070 (See Table 5.2.1-12).

Table 5.2.1-12 SAWS Advanced Water Conservation Goals and Strategies

	2020	2030	2040	2050	2060	2070
Per Capita Water Use (GPCD)[1]						
With Passive Conservation (From Table 5.2.1-3)	117	114	111	110	110	110
Demand Reduction via Advanced Water Conservation + SAWS AMI	12	22	29	32	34	36
With Advanced Water Conservation + SAWS AMI	**105**	**92**	**82**	**78**	**76**	**74**
Advanced Water Conservation						
Yield (acft/yr)	24,367	50,667	74,313	89,629	102,682	115,929
Unit Costs($/acft/yr)	$600	$600	$600	$600	$600	$600
Annual Cost ($/yr)	$14,620,200	$30,400,200	$44,587,800	$53,777,400	$61,609,200	$69,557,400
SAWS Advanced Meter Infrastructure Project						
Yield (acft/yr)	426	606	510	0	0	0
Unit Costs($/acft/yr)	$52,554	$36,944	$4,080	$0	$0	$0
Annual Cost ($/yr)	$22,388,000	$22,388,000	$2,081,000	$0	$0	$0

1 The GPCD goals identified for regional planning purposes do not match the GPCD goals included in the *SAWS 2017 Water Management Plan*. SAWS utilized internal population and water demand projections; whereas TWDB prescribes these volumes for statewide planning consistency which resulted in significantly lower demands.

5.2.1.6 Recent and Recommended Water Conservation Legislation and Policies

Since the "Water Conservation Advisory Council Report to the 85th Texas Legislature (2016)," three of WCAC's recommendations have been enacted as new legislation and policies: (1) the need for trained water loss auditors, HB 1573; (2) designation of a water conservation coordinator, HB 1648; and (3) addition of non-voting member to RWPGs, SB 1511. The recent report, "Water Conservation Advisory Council Report to the 86th Texas Legislature (2018)," included five legislative recommendations to advance water conservation in Texas:

1. **Enhanced data collection, management, and accessibility** – Via increased available appropriations to the TWDB;
2. **Funding a statewide water conservation public awareness program** – Via available appropriation of up to $3 million per year to the TWDB;
3. **Maintain funding for agricultural water conservation and research programs** – Via funding for research, education, and training with BMPs that reduce evapotranspiration, and financial assistance programs focused on improving water use efficiency in agricultural irrigation**;**
4. **Funding to enhance the accuracy and value of water loss audits** – Via $500,00 appropriation to the TWDB for an expanded water loss program to assist utilities in the design and implementation of water loss audits and another $500,000 for competitive grants for up to six utilities to conduct pilot projects for validating water loss audits; and
5. **Restore funding for the Texas Ag Water Efficiency Education & Demonstration Project facility** – Via funding for the education, research, and development of agricultural water conservation initiatives.

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5.2.2 Drought Management

5.2.2.1 Description of Water Management Strategy

Drought management is the periodic activation of approved drought contingency plans (DCPs) resulting in short-term demand reduction and/or restriction. This reduction in demand is then considered a "supply" source. Using this approach, an entity may make the conscious decision not to develop firm water supplies greater than or equal to projected water demands with the understanding that demands will have to be reduced or go unmet during times of drought. Using this rationale, an economic impact of not meeting projected water demands can be estimated and compared with the costs of other potentially feasible WMSs in terms of annual unit costs.

Figure 5.2.2-1 is a water supply planning example of the visual methodology completed in the 2017 SWP and 2016 RWPs. For each WUG with an identified shortage or need during the planning period, a future water supply plan was developed consisting of one or more WMSs. In each case, the planned future water supply was greater than the projected dry weather demand to allow for droughts more severe than the drought of record, uncertainty in water demand projections, and/or available supply from recommended WMSs. This difference between planned water supply and projected dry weather demand is called management supply in Region L.

Figure 5.2.2-2 illustrates how a drought management WMS could alter the planning paradigm for WUGs with projected needs. Instead of identifying WMSs to meet the projected need, planned water supply remains below the projected dry weather water demand. The difference between these two lines represents the drought management WMS. Under this concept, water demand of a WUG would be reduced by activating a drought contingency plan to reduce demands, resulting in unmet needs. This strategy of demand reduction or water restriction could negate the need for WMSs to meet the full projected need of the WUG. Basically, using this approach, the WUG is planning to manage water shortages through DCP activation or water restriction, if needed. This concept is more fully illustrated on Figure 5.2.2-3, which shows that, in any given year, the actual demand may be above or below the planned supply. During times in which the demand exceeds supply, the WUG would experience shortages and incur associated economic impacts.

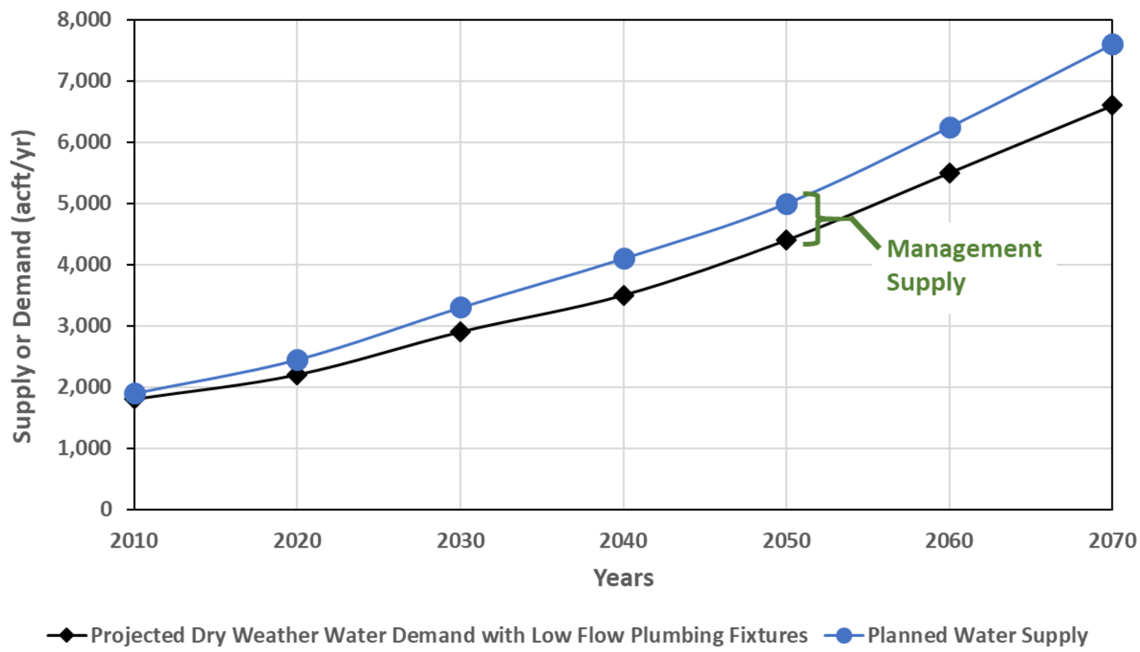

Figure 5.2.2-1 Example - Typical Water Supply Planning

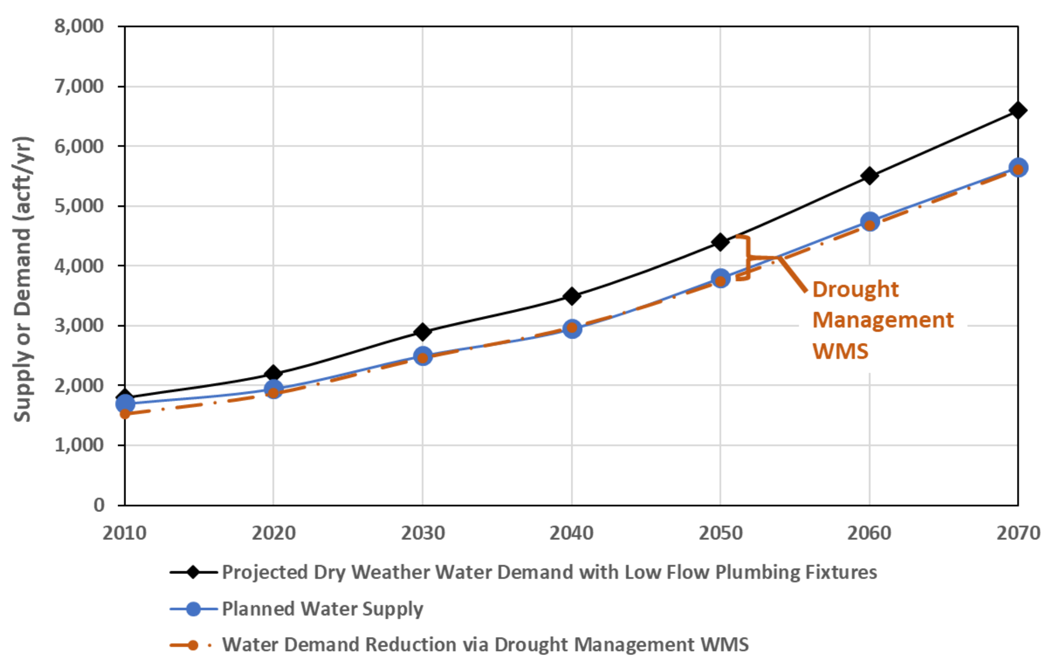

Figure 5.2.2-2 Example - Drought Management WMS Planning Application

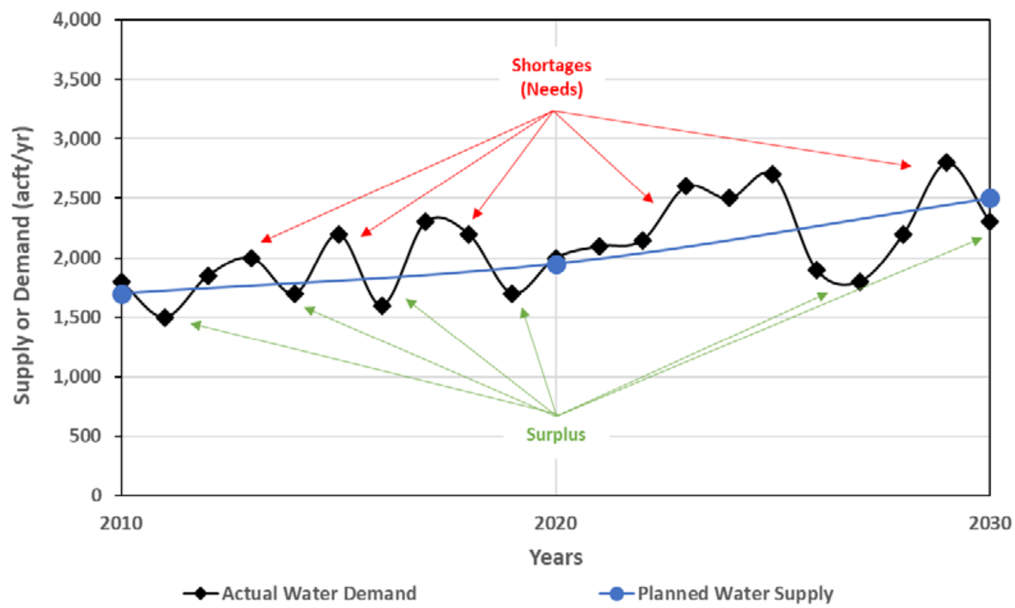

Figure 5.2.2-3 Example - Annual Water Demand and Planned Water Supply

5.2.2.2 Drought Management Strategy Methodology

On October 3, 2019, the TWDB released the Drought Management Costing Tool to estimate socioeconomic impacts and evaluate economic impact of the water volumes reduced by implementation of drought management strategies for the 2021 RWPs. As described in the TWDB-provided Drought Management Costing Tool User Manual, "the primary purpose of the tool is to provide WUG level costs and the expected household level residential water savings associated with policy-imposed restrictions or reduction on residential water use." The tool utilizes various inputs – user supplied percentage reductions in use; census household size data; population projections; and Texas Municipal League (TML) price and quantity data – to estimate reductions in water use and consumer costs (Figure 5.2.2-4). The following subsections summarize the components and features that comprise the Drought Management Costing Tool. More details can be found in the TWDB user manual.

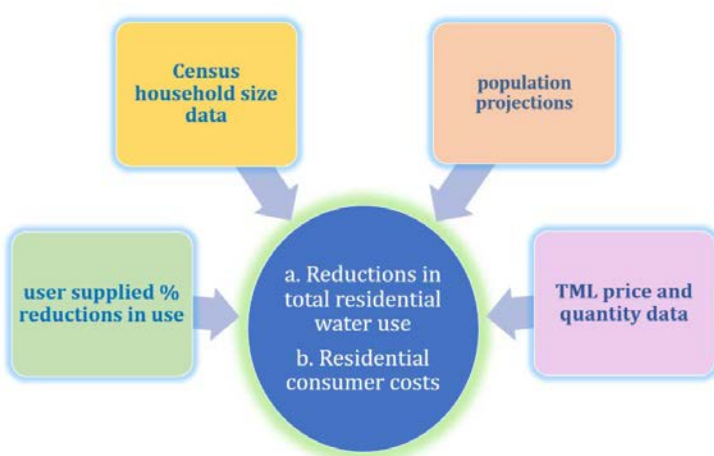

Figure 5.2.2-4 Costing Data and Output (TWDB, 2019)

TML Data

The TML generated water demand curves for WUGs from the 2016 annual cost and usage surveys. Parameters that were used included population, fees for 5,000 and 10,000 gallons of usages, and average monthly gallon usage for each household in the WUG's associated cities. These data were compiled to determine the expected price for the average monthly water use for the WUGs.

Analysis Assumptions

The following are the key assumptions in the development of the Drought Management Costing tool (TWDB, 2019):

1. The relevant demand functions are only for residential outdoor water use. Historical studies have revealed that approximately 30 percent of residential use within the state is for outdoor water use. Therefore, this tool only allows potential reductions less than or equal to 30 percent of normal water use due to drought management strategies.
2. Only residential water use reductions are examined. Available data did not support similar estimates for commercial water use.
3. County-other WUGs are not included in this costing tool.
4. Year 2010 household size data (WUG-specific where possible) are employed to determine the number of households in each decade, using the TWDB adopted projected populations. These baseline household sizes are not assumed to adjust over time.
5. Baseline data from TML for average monthly prices and quantities (per household) from the year 2016 were used in developing the demand functions for the various WUGs. Where possible, WUG-specific data was used. Proxy values that were based on planning region and three city size classifications were assigned to WUGs with no TML survey results.
6. Final cost estimates are expressed in Year 2018 dollars to be consistent with the WMS costing requirements in the 2022 SWP.

Use of the Costing Tool

The Microsoft Excel-based tool is composed of three major components (tabs within the workbook; TWDB, 2019):

1. **Data Entry:** User data entry form for decade-specific desired reductions in water use by region and WUG;
2. **Final Summary:** A summary of the key parameters and final cost (economic impact) and water savings estimates; and
3. **Population and Households:** Reference tab with background information on the number of households according to the 2010 census data and the Board-adopted 2020 through 2070 WUG and region level population projections.

For the purposes of the SCTRWPG and the drought management WMS, only total annual water reduction (in acft; described as yield) and total annual cost (in 2018 dollars) data for the Region L WUGs were obtained from the Drought Management Costing Tool. Total annual water reduction or yield by WUG is described in Section 5.2.2.3 and detailed in Table 5.2.2-1. Total annual costs are described in Section 5.2.2.6 and detailed in Table 5.2.2-3. Drought Management was not included as a recommended WMS for County-Other WUGs in the 2021 RWP due to data limitations for determining drought management supplies for these WUGs.

In contrast to the 2016 SCTRWP, risk factors for each WUG are calculated and incorporated into the costing tool by the TWDB. As such, risk factors are not discussed in the current cycle.

5.2.2.3 Yield from Drought Management Strategy

The TWDB defines "total annual water reduction" in the costing tool user manual as "... all household water use due to drought management plan implementation based on percentage of reduction," which is estimated via:

$$\frac{\left[\left(\frac{population}{household\ size}\right) * 12 * (monthly\ reduction\ in\ gallons)\right]}{325{,}851\,\frac{gal}{acft}}\ [\textbf{in acft}].$$

As described above, the SCTRWP defines "total annual water reduction" for this WMS as yield that is based on the SCTRWPG set percent reduction in demand. The yield is considered a "supply" for participating WUGs because the reduction in demand "reduces" the associated needs. For the Drought Management WMS, 5 percent, 10 percent, 15 percent, and 20 percent scenarios were applied to whole WUGs, regardless of split region, that exhibited needs in the 2020 decade. These values are summarized in Table 5.2.2-1. For the 2021 planning cycle, the SCTRWP selected 5 percent demand reduction for all applicable WUGs. This WMS is expected to have a total yield in 2020 of 14,176 acft/yr and is considered for implementation in the 2020 decade. In 2070, the total yield is expected to be 56,588 acft/yr.

Table 5.2.2-1 Drought Management WMS Yield

ENTITY	COUNTY	2020 YIELD (ACFT)			
		5% (CHOSEN BY RWPG)	10%	15%	20%
Air Force Village II, Inc.	Bexar	3	7	10	13
Alamo Heights	Bexar	50	99	149	199
Atascosa Rural WSC	Bexar	59	118	177	236
Bexar County WCID 10	Bexar	33	66	99	132
Castroville	Medina	17	34	50	67
Clear Water Estates Water System	Comal	4	7	11	14
Converse	Bexar	101	202	303	405

ENTITY	COUNTY	2020 YIELD (ACFT)			
		5% (CHOSEN BY RWPG)	10%	15%	20%
Crystal Clear WSC	Hays	92	184	276	368
East Medina County SUD	Medina	43	87	130	173
El Oso WSC [1]	Karnes	19	38	57	75
Elmendorf	Bexar	8	16	24	32
Fort Sam Houston	Bexar	5	9	14	18
Garden Ridge	Comal	47	94	141	187
Goforth SUD [1]	Caldwell	109	217	326	434
Hondo	Medina	51	101	152	202
Karnes City	Karnes	23	45	68	91
Kirby	Bexar	32	64	96	127
KT Water Development	Comal	7	15	22	30
La Coste	Medina	8	16	24	32
Lackland Air Force Base	Bexar	67	134	201	268
Leon Valley	Bexar	65	129	194	258
Live Oak	Bexar	48	96	144	191
Lytle	Atascosa	18	36	53	71
Martindale WSC	Caldwell	21	42	62	83
Natalia	Medina	6	13	19	25
Oak Hills WSC	Wilson	28	56	83	111
Pearsall	Frio	26	52	79	105
SS WSC	Wilson	95	189	284	378
Sabinal	Uvalde	14	27	41	55
Seguin	Guadalupe	228	455	683	910
Shavano Park	Bexar	47	94	141	188
The Oaks WSC	Bexar	9	18	26	35
Universal City	Bexar	192	385	577	770
Uvalde	Uvalde	103	205	308	411
Victoria	Victoria	490	980	1,470	1,959
West Medina WSC	Medina	7	15	22	29

ENTITY	COUNTY	2020 YIELD (ACFT)			
		5% (CHOSEN BY RWPG)	10%	15%	20%
Wingert Water Systems	Comal	10	20	30	40
Yancey WSC	Medina	40	80	121	161
	Total	**2,225**	**4,445**	**6,667**	**8,883**

[1] WUGs are split between Region L and other regions (Regions K or N). Split region specific Region L volumes are detailed in Section 5.3.

As shown in the above table, the yield from this WMS is expected to be 2,225 acft/yr. SAWS has chosen to develop utility-specific drought management reduction savings, which are summarized in Table 5.2.2-2. Including SAWS, the total yield from the Drought Management WMS is expected to be 14,176 acft/yr, 31,476 acft/yr, 45,677 acft/yr, 49,377 acft/yr, 53,109 acft/yr, and 56,588 acft/yr in 2020, 2030, 2040, 2050, 2060, and 2070, respectively.

Table 5.2.2-2 SAWS Drought Management Reduction

DECADE	2020	2030	2040	2050	2060	2070
% Reduction (Drought Management)	5	12	16	16	16	16
Drought Management Savings (acft/yr)	11,951	31,476	45,677	49,377	53,109	56,588
Total Annual Cost (2018 $)	1,183,149	8,057,856	16,352,366	17,676,966	19,013,022	20,258,504

5.2.2.4 Environmental Considerations

Drought Management is not expected to have negative impacts on natural, cultural or agricultural resources. Because the drought management water management strategy would only be implemented during extreme drought conditions and for short periods of time, water treatment facilities would have little time and opportunity to respond to the increased pollutant concentrations by constructing advanced treatment. They may need to expend more resources and chemicals to treat the higher concentration influent and in some cases the increased concentrations could lead to exceeding WWTP permit limits and short-term negative impacts to receiving water quality.

Strategies to encourage reduced lawn watering and/or replacement of lawns with water-conserving landscaping could result in environmentally beneficial increases in landscape species diversity and drought tolerance.

5.2.2.5 Reliability

The reliability of this supply is considered medium (reliability score = 3).

5.2.2.6 Drought Management Strategy Costs

TWDB defines "total annual cost" in the costing tool user manual as "[…] adverse monetary impacts of possible restrictions on water use for the residential water user," which is estimated via:

$$(average\ unit\ cost\ per\ acft) * (yield)\ [\mathbf{in\ 2018}\ \$].$$

Using this approach, an entity may make the conscious decision not to develop firm water supplies greater than or equal to projected water demands with the understanding that demands will have to be reduced or go unmet during times of drought. Using this rationale, an economic impact of not meeting projected water demands can be estimated and compared with the costs of other potentially feasible WMSs in terms of annual unit costs.

From the data presented in Table 5.2.2-1, annual cost data were obtained for the 5 percent, 10 percent, 15 percent, and 20 percent scenarios applied to the WUGs that exhibited needs in the 2020 decade. These values were determined to compare with other potentially feasible WMSs and are summarized in Table 5.2.2-3. The decadal percent reductions, yields, and costs for SAWS are presented in Table 5.2.2-2. For the 2021 planning cycle, the SCTRWP selected 5 percent demand reduction for all applicable WUGs.

Table 5.2.2-3 Total Annual Cost for Drought Management WMS

ENTITY	ENTITY	2020 TOTAL ANNUAL COST (2018 $)			
		5% (CHOSEN BY RWPG)	10%	15%	20%
Air Force Village II, Inc.	Bexar	$382	$1,612	$3,840	$7,254
Alamo Heights	Bexar	$4,414	$18,636	$44,397	$83,861
Atascosa Rural WSC	Bexar	$5,234	$22,101	$52,652	$99,454
Bexar County WCID 10	Bexar	$2,929	$12,368	$29,464	$55,654
Castroville	Medina	$1,833	$7,741	$18,442	$34,835
Clear Water Estates Water System	Comal	$407	$1,717	$4,092	$7,729
Converse	Bexar	$9,040	$38,171	$90,936	$171,769
Crystal Clear WSC	Hays	$8,176	$34,522	$82,244	$155,350
East Medina County SUD	Medina	$3,856	$16,280	$38,786	$73,262
El Oso WSC [1]	Karnes	$1,677	$7,080	$16,866	$31,858
Elmendorf	Bexar	$1,868	$7,888	$18,793	$35,497
Fort Sam Houston	Bexar	$530	$2,236	$5,328	$10,064
Garden Ridge	Comal	$3,004	$12,683	$30,215	$57,074
Goforth SUD [1]	Caldwell	$9,656	$40,769	$97,127	$183,462
Hondo	Medina	$4,519	$19,080	$45,455	$85,859

ENTITY	ENTITY	2020 TOTAL ANNUAL COST (2018 $)			
		5% (CHOSEN BY RWPG)	10%	15%	20%
Karnes City	Karnes	$2,568	$10,842	$25,829	$48,788
Kirby	Bexar	$1,968	$8,310	$19,797	$37,394
KT Water Development	Comal	$859	$3,628	$8,644	$16,328
La Coste	Medina	$577	$2,434	$5,799	$10,954
Lackland Air Force Base	Bexar	$5,954	$25,140	$59,892	$113,129
Leon Valley	Bexar	$7,222	$30,493	$72,645	$137,219
Live Oak	Bexar	$2,726	$11,509	$27,419	$51,791
Lytle	Atascosa	$804	$3,395	$8,089	$15,278
Martindale WSC	Caldwell	$2,381	$10,054	$23,952	$45,243
Natalia	Medina	$689	$2,911	$6,935	$13,099
Oak Hills WSC	Wilson	$2,470	$10,430	$24,847	$46,933
Pearsall	Frio	$1,759	$7,425	$17,690	$33,414
SS WSC	Wilson	$8,404	$35,481	$84,529	$159,667
Sabinal	Uvalde	$657	$2,775	$6,611	$12,487
Seguin	Guadalupe	$19,898	$84,014	$200,152	$378,064
Shavano Park	Bexar	$3,635	$15,347	$36,561	$69,059
The Oaks WSC	Bexar	$1,004	$4,241	$10,103	$19,083
Universal City	Bexar	$12,608	$53,232	$126,817	$239,543
Uvalde	Uvalde	$4,500	$18,999	$45,263	$85,496
Victoria	Victoria	$29,970	$126,540	$301,463	$569,429
West Medina WSC	Medina	$845	$3,566	$8,496	$16,047
Wingert Water Systems	Comal	$1,149	$4,850	$11,554	$21,825
Yancey WSC	Medina	$3,572	$15,082	$35,930	$67,869
	Total	**$173,744**	**$733,582**	**$1,747,654**	**$3,301,121**

[1] WUGs are split between Region L and other regions (Regions K or N). Split region specific L costs are detailed in Section 5.3.

5.2.3 Edwards Transfers

5.2.3.1 Description of Water Management Strategy

The EAA was created in 1993 by Senate Bill 1477 of the 73rd Texas Legislature. This bill, which is typically called The Act, has been amended many times in subsequent legislative sessions. Requirements of the EAA pursuant to The Act include the following:

- Issuing permits for all non-exempt wells;
- Limiting permitted withdrawals to 572,000 acft/yr; and
- Enforcing water management practices, procedures, and methods to ensure that the continuous minimum springflows of the Comal Springs and the San Marcos Springs are maintained to protect endangered and threatened species to the extent required by federal law (e.g. the Edwards Aquifer Habitat Conservation Plan (EAHCP), EAA critical period rules, etc.).

Since the EAA began to issue Initial Regular Permits (IRPs) for wells, there have been numerous transfers of the water rights associated with these permits among interested parties. Subject to requirements in The Act and EAA rules related to the base and unrestricted portions of water rights associated with irrigated agriculture, many historical transfers have been from irrigation to municipal use. The Edwards Transfers WMS in the 2021 SCTRWP focuses on the future of such irrigation to municipal transfers.

5.2.3.2 Available Yield

Section 1.15 of The Act provides that the EAA shall manage withdrawals and points of withdrawal from the aquifer by granting permits, and Section 1.34 of The Act specifies the manner in which water rights may be transferred, as follows:

- Water withdrawn from the aquifer must be used within the boundaries of the authority.
- The authority by rule may establish a procedure by which a person who installs water conservation equipment may sell the water conserved.
- A permit holder may lease permitted water rights, but a holder of a permit for irrigation use may not lease more than 50 percent of the irrigation water rights initially permitted. The user's remaining irrigation water rights must be used in accordance with the original permit and must pass with transfer of the irrigated land.
- Subject to approval by the authority, the owner of historically irrigated land may sever all or a portion of the remaining water rights for the historically irrigated land which has become developed land in the same proportion as the proportion of developed land and undeveloped land or for which the owner of the historically irrigated land has demonstrated that all or a portion of the land is land no longer practicable to farm. Water rights used for irrigation tied to a portion of land that cannot be developed because of its topography or its location in a floodplain may be included in the proportion of land considered developed land. Water rights for use in irrigation severed under this subsection may change in purpose or place of use. Rules adopted to implement this subsection may not expand the type of land considered developed land or land considered land no longer practicable to farm. The approval of a severance under this section is subject to a contested case hearing in accordance with authority rules.

In accordance with these and many other provisions of The Act, the EAA has issued IRPs for municipal, industrial, and irrigation water use totaling 571,600 acft/yr. During a drought scenario and full implementation of the EAHCP, the total permitted amount is limited to MAG availability of approximately 264,906 acft/yr[1] in all decades. However, the Edwards Aquifer transferability is most constrained by the amount of enrollment in the EAA's Voluntary Irrigation Suspension Program Option (VISPO) and ASR programs. As of November 5, 2019, the EAA reported a total enrolled volume of approximately 87,023 acft/yr[2] that, while legally transferrable, due to the nature of the EAHCP's VISPO and ASR programs, cannot be relied upon to be available for withdrawal during a repeat of the drought of record.

Table 5.2.3-1, Column E details the transfer potential of each county with drought-stage implementation of the EAHCP based on the EAA's Critical Period Management (CPM) Plan.[3] Therefore, it is anticipated that all recommended Edwards transfers shown as part of this WMS will involve leasing or purchasing Edwards Aquifer rights from irrigation permit holders.

Table 5.2.3-1 Historical Edwards Transfers and Remaining Unrestricted Transfer Potential

A	B	C	D	E
COUNTY	USE TYPE	EAA ESTIMATED PERMITS[1] (ACFT/YR)	EAA ENROLLED ASR AND VISPO PERMITS[2] (ACFT/YR)	ESTIMATED REMAINING UNRESTRICTED TRANSFER POTENTIAL[3] (ACFT/YR)
Atascosa	Municipal	375	0	227
	Industrial[4]	0	0	0
	Irrigation	1,738	1,756	233
	Subtotal	**2,113**	**1,756**	**460**
Bexar	Municipal	309,509	94	187,149
	Industrial[4]	24,625	581	14,316
	Irrigation	18,420	10,309	834
	Subtotal	**352,554**	**10,985**	**202,300**

[1] Availability is derived from limitations imposed by the EAA Act and from contractual obligations associated with the Edwards Aquifer Habitat Conservation Plan (EAHCP). It should be noted, for long term planning purposes, programs contained within the EAHCP and associated with its fifteen-year incidental take permit may be adjusted as the plan is resubmitted for approval upon the expiration of the permit.
[2] Under full implementation of the EAHCP (assumed to accomplished by 12/31/2020) this amount will be 91,795 acft/yr.
[3] Edwards Aquifer Authority. "Critical Period/Drought Management". April 2019. https://www.edwardsaquifer.org/business-center/groundwater-permit-holder/critical-period-drought-management/

A	B	C	D	E
COUNTY	USE TYPE	EAA ESTIMATED PERMITS[1] (ACFT/YR)	EAA ENROLLED ASR AND VISPO PERMITS[2] (ACFT/YR)	ESTIMATED REMAINING UNRESTRICTED TRANSFER POTENTIAL[3] (ACFT/YR)
Comal	Municipal	13,547	0	7,042
	Industrial[4]	8,623	0	4,481
	Irrigation	1,613	1	838
	Subtotal	**23,783**	**1**	**12,362**
Guadalupe	Municipal	11	0	7
	Industrial[4]	354	0	214
	Irrigation	0	0	0
	Subtotal	**365**	**0**	**221**
Hays	Municipal	8,702	0	6,210
	Industrial[4]	2,736	0	1,953
	Irrigation	499	1	355
	Subtotal	**11,937**	**1**	**8,518**
Medina	Municipal	14,884	6	8,966
	Industrial[4]	4,161	244	2,264
	Irrigation	65,933	25,292	14,448
	Subtotal	**84,978**	**25,541**	**25,678**
Uvalde	Municipal	8,009	2,000	3,355
	Industrial[4]	512	70	273
	Irrigation	87,349	46,669	11,739
	Subtotal	**95,870**	**48,739**	**15,367**
Edwards Aquifer Area Totals				
	Municipal	**355,037**	**2,100**	**212,956**
	Industrial[4]	**41,011**	**895**	**23,501**
	Irrigation	**175,552**	**84,028**	**28,449**
	Subtotal	**571,600**	**87,023 [5]**	**264,906**

A	B	C	D	E
COUNTY	USE TYPE	EAA ESTIMATED PERMITS[1] (ACFT/YR)	EAA ENROLLED ASR AND VISPO PERMITS[2] (ACFT/YR)	ESTIMATED REMAINING UNRESTRICTED TRANSFER POTENTIAL[3] (ACFT/YR)

[1] EAA estimated permit values before any transfers as of October 21, 2019
[2] EAA enrolled ASR and VISPO permits as of November 5, 2019
[3] Reliable supply estimated based on EAA CPM reductions per county and MAG limitations
[4] "Industrial" is manufacturing, steam electric, mining, and livestock uses
[5] Overall availability will ultimately be 91,795 acft/yr at full enrollment; however geographic distribution of the additional limitation is unknown until the additional VISPO agreements are executed

In the 2021 SCTRWP, Edwards Transfers are included to meet projected needs of all municipal WUGs that are currently, wholly, or largely dependent on the Edwards Aquifer for water supply. WUGs and their corresponding firm supplies for which Edwards Transfers are recommended are shown in Table 5.2.3-2. This WMS has a 2070 firm supply of 5,906 acft/yr and is planned for implementation in 2020.

Table 5.2.3-2 Firm Supply from Edwards Transfers (acft/yr)

ENTITY	FIRM SUPPLY FROM EDWARDS TRANSFERS BY DECADE (ACFT/YR)					
	2020	2030	2040	2050	2060	2070
ATASCOSA COUNTY						
TRANSFERS TO ATASCOSA COUNTY WUGS FROM MEDINA COUNTY						
Lytle*	350	400	450	500	600	650
SUBTOTAL	--	--	--	--	--	--
BEXAR COUNTY						
Alamo Heights**	464	388	307	181	105	32
Leon Valley**	92	115	150	299	328	356
Selma	0	31	88	123	172	223
Shavano Park**	103	129	139	117	113	104
Universal City**	175	171	150	114	115	119
SUBTOTAL	**834**	**834**	**834**	**834**	**833**	**834**
MEDINA COUNTY						
Castroville	300	200	150	100	0	0
East Medina County SUD	150	250	300	400	450	500

ENTITY	FIRM SUPPLY FROM EDWARDS TRANSFERS BY DECADE (ACFT/YR)					
	2020	2030	2040	2050	2060	2070
Hondo	500	500	450	425	500	500
La Coste	100	100	100	100	100	100
Natalia	125	150	150	200	200	200
West Medina WSC	75	75	75	75	75	75
Yancey WSC	100	225	300	350	400	450
TRANSFERS TO BEXAR COUNTY WUGS FROM MEDINA COUNTY						
Alamo Heights**	340	341	233	188	108	41
Leon Valley**	79	113	122	300	304	302
Shavano Park**	87	123	113	127	114	99
Universal City**	0	158	121	124	50	0
SUBTOTAL	**1,856**	**2,635**	**2,564**	**2,889**	**2,901**	**2,917**
UVALDE COUNTY						
Sabinal	150	150	150	125	125	125
Uvalde	2,138	2,195	2,074	1,947	1,911	2,030
SUBTOTAL	**2,288**	**2,345**	**2,224**	**2,072**	**2,036**	**2,155**
COUNTY TOTALS						
TOTAL FIRM SUPPLY	**5,328**	**5,814**	**5,622**	**5,795**	**5,770**	**5,906**
IRP VALUE PERMITS NEEDED**	**8,462**	**9,259**	**8,958**	**9,270**	**9,237**	**9,442**

* Due to transfer volume limitations in Atascosa County, Lytle is obtaining water through Medina County

** Due to transfer volume limitations in Bexar County, Alamo Heights, Leon Valley, Shavano Park, and Universal City are obtaining additional water from Medina County

*** Assumes that the IRP amount and exclusion of the enrolled ASR and VISPO volumes, will be reduced based on county specific CPM and MAG limitations

Water Loss

Strategies involving transfers of water rights are assumed to have no additional water losses associated with the use of existing infrastructure.

5.2.3.3 Environmental Considerations

No major environmental issues are associated with this strategy. The transferred water that will be withdrawn from the aquifer is already permitted; only the locations of withdrawals will be changed. As the recommended transfers will generally be from central or eastern urban areas to central or western rural (or suburban) areas (i.e. transfer from east to west due to hydrologic constraints), withdrawal centers will be somewhat further from Comal and San Marcos Springs, which could result in incremental springflow enhancement. One associated concern may arise from Edwards Transfers whereby irrigators who are legally allowed to transfer their irrigation rights decide to stop irrigating and utilize their land for dryland crops and/or grassland. A decision to convert cropland to native grasses could speed the process of reaching a mature plant community and reduce the opportunity for soil erosion through water and winds. Such a decision could provide habitat for native Texas wildlife, including the Texas horned lizard, tortoises, deer, raptors, and other desert grassland species. No impacts to cultural resources are anticipated since this strategy does not involve construction.

5.2.3.4 Engineering and Costing

Pursuant to February 6, 2014, discussions with the SCTRWPG, it is assumed for planning purposes that the cost of Edwards Transfers will be estimated as the average unit cost of firm, non-Edwards WMSs recommended for SAWS, NBU, and San Marcos plus integration costs ($258 per acft/yr; adjusted from 2013 dollars) for facility upgrades. In other words, the cost for these transfers is based on the "replacement cost" of water (i.e., what it would cost a large municipality to construct and operate a project or projects to replace the Edwards water leased to other municipalities). Hence, the assumed annual unit cost for Edwards Transfers is $1,242 per acft; estimated annual costs are summarized by decade in Table 5.2.3-3.

5.2.3.5 Implementation Considerations

Leasing and purchase of Edwards Aquifer irrigation rights for transfer to municipal and industrial uses are active at the present time. As the existing Edwards Aquifer supply used to quantify needs reported in the 2021 SCTRWP is based on the assumption of full EAHCP implementation, the key implementation issue for the Edwards Transfers strategy is expected to be willingness of rural or suburban communities to buy or lease Edwards supplies at costs substantially greater than previously experienced.

Table 5.2.3-3 Annual Costs for Edwards Transfers ($)

ENTITY	ANNUAL COST FOR EDWARDS TRANSFERS BY DECADE*					
	2020	2030	2040	2050	2060	2070
ATASCOSA COUNTY						
Lytle	$434,874	$496,999	$559,124	$621,249	$745,498	$807,623
SUBTOTAL	**$434,874**	**$496,999**	**$559,124**	**$621,249**	**$745,498**	**$807,623**
BEXAR COUNTY						
Alamo Heights**	$998,372	$906,111	$670,608	$457,623	$265,004	$90,802
Leon Valley**	$212,856	$284,531	$337,746	$743,573	$786,157	$817,165

ENTITY	ANNUAL COST FOR EDWARDS TRANSFERS BY DECADE*					
	2020	2030	2040	2050	2060	2070
Selma	$0	$38,476	$109,811	$153,222	$214,079	$276,985
Shavano Park**	$236,157	$312,572	$313,114	$302,991	$282,059	$252,971
Universal City**	$218,462	$408,782	$336,717	$296,957	$205,182	$148,458
SUBTOTAL	**$1,665,846**	**$1,950,471**	**$1,767,996**	**$1,954,366**	**$1,752,480**	**$1,586,382**
MEDINA COUNTY						
Castroville	$372,749	$248,499	$186,375	$124,250	$0	$0
East Medina County SUD	$186,375	$310,624	$372,749	$496,999	$559,124	$621,249
Hondo	$621,249	$621,249	$559,124	$528,061	$621,249	$621,249
La Coste	$124,250	$124,250	$124,250	$124,250	$124,250	$124,250
Natalia	$155,312	$186,375	$186,375	$248,499	$248,499	$248,499
West Medina WSC	$93,187	$93,187	$93,187	$93,187	$93,187	$93,187
Yancey WSC	$124,250	$279,562	$372,749	$434,874	$496,999	$559,124
SUBTOTAL	**$1,677,371**	**$1,863,746**	**$1,894,808**	**$2,050,120**	**$2,143,308**	**$2,267,557**
UVALDE COUNTY						
Sabinal	$186,375	$186,375	$186,375	$155,312	$155,312	$155,312
Uvalde	$2,656,958	$2,727,775	$2,576,955	$2,418,841	$2,374,659	$2,521,984
SUBTOTAL	**$2,843,332**	**$2,914,150**	**$2,763,330**	**$2,574,153**	**$2,529,971**	**$2,677,296**
COUNTY TOTALS						
TOTAL ANNUAL COST	**$5,992,284**	**$6,311,600**	**$6,253,968**	**$6,282,228**	**$6,455,483**	**$6,789,183**

* SCTRWPG (2/6/2014) - Costs for Edwards Transfers shall be estimated as the average unit cost of firm, non-Edwards water management strategies recommended for SAWS, NBU, and San Marcos (plus integration costs for facility upgrades at $258 per acft/yr) multiplied by the total firm supply needed

** Inclusive of Edwards Transfer volume costs from Medina County

Reliability

The reliability of this supply is considered medium (reliability score = 3) because of uncertainty involved in negotiations between willing buyers and willing sellers of existing Edwards Aquifer permits.

5.2.4 Local Groundwater

5.2.4.1 Description of Water Management Strategy

Local Groundwater is the recommended WMS for ten municipal WUGs and four non-municipal WUGs. Many WUGs in Region L commonly use local aquifers for their supply. Where local groundwater supplies are available, there is generally a preference for groundwater as a source because it is (1) readily available at different locations within a distribution system, (2) relatively inexpensive, and (3) often requires minimal treatment compared to surface water. The implementation decade for this WMS varies depending on the sponsor. More information on the yield and implementation decade can be found in Section 5.2.4.2.

For the purposes of this study, WUGs are divided into municipal and non-municipal categories. Non-municipal WUGs include mining and manufacturing at the county level.

The purposes of this WMS evaluation are the following:

- Evaluate the existing sources of water for each WUG in the Region. Identify those WUGs that (1) rely solely on groundwater from a single aquifer or have limited options for future supplies and (2) have projected needs during the planning horizon that are likely not to be met by other WMSs.
- Evaluate the production capacity from the selected WUGs' existing wells, their permitted water rights, and how those compare to the MAG. Determine which entities are limited by the capacity of their existing wells and which are limited by their permitted water rights.
- Determine if additional water is available in the aquifers that the selected WUGs are currently using and if limited by the capacity of existing wells. If there is sufficient water available within the constraints of the MAG, then determine the number of new wells required to meet their projected needs by decade, according to the needs plus the capacities and depths of existing wells in the area. Estimate costs for new wells and system expansion using the uniform costing model.

Several WUGs may rely solely on groundwater from a single aquifer and also have projected needs, but because they have other plans or strategies to meet their projected needs, local groundwater is not the recommended WMS for those entities.

The evaluation of Local Groundwater WMSs for each WUG is at a reconnaissance level and was based on data from the following sources:

- Information prepared for the South Central Texas Regional Water Planning Group on projected water demands for each of the WUGs;
- Estimated system capacity for each WUG through 2070, based on TCEQ reported system information; and
- Compilation of publicly available information for each WUG from TCEQ and TWDB.

5.2.4.2 Available Yield for Municipal WUGs

Local Groundwater is the recommended WMS for 18 municipal WUGs that (1) rely on groundwater as a sole source, (2) are expected to have a water shortage by 2070, and (3) do not have sufficient permitted or production capacities to meet their expected needs. The projected needs, recommended new wells, and projected yield for the ten municipal WUGs are shown in Table 5.2.4-1 and Table 5.2.4-2.

Carrizo-Wilcox Aquifer

- Atascosa Rural WSC;
- Benton City WSC;
- Floresville;
- Karnes City[1];
- Luling;
- Oak Hills WSC;
- Picosa WSC;
- Poth; and
- Pearsall.

Trinity Aquifer

- Clear Water Estates Water System;
- Garden Ridge;
- Kendall West Utility;
- KT Water Development;
- Water Services; and
- Wingert Water Systems.

Gulf Coast Aquifer

- Calhoun County-Other; and
- El Oso

Yegua-Jackson Aquifer

- Karnes City[1]

New Wells to Meet Projected Needs

Ten of the above WUGs need new wells to meet projected needs. Production and/or drilling permits for these wells may be required in accordance with specific GCD rules. The above WUGs will be able to meet their projected needs with the recommended new wells (and associated permits) without exceeding the designated MAG. Maps are provided to show the general locations of municipal WUGs that rely on the Carrizo-Wilcox Aquifer (Figure 5.2.4-1), Trinity Aquifer (Figure 5.2.4-2), and Gulf Coast Aquifer (Figure 5.2.4-3). Capacities, production rates, and assumed depth for each municipal WUG is provided in Table 5.2.4-3.

[1] Karnes City supplies are limited by the Carrizo-Wilcox Aquifer MAG in Karnes County. In combination with this WMS, it is planned that Karnes City would utilize the Local Groundwater Conversions WMS of the Carrizo-Wilcox and Yegua-Jackson Aquifers.

Table 5.2.4-1 Summary of Municipal Local Groundwater Projects

WUG	COUNTY	AQUIFER	PROJECT YIELD (ACFT/YR) 2020	2030	2040	2050	2060	2070
Atascosa Rural WSC	Atascosa	Carrizo-Wilcox Aquifer	1,049	2,098	2,098	2,098	2,098	2,098
County-Other, Calhoun	Calhoun	Gulf Coast Aquifer System	0	0	0	0	412	412
El Oso WSC	Bee	Gulf Coast Aquifer System	12	13	18	20	45	47
Floresville	Wilson	Carrizo-Wilcox Aquifer	0	0	828	828	1,654	1,656
Karnes City[1]	Karnes	Carrizo-Wilcox Aquifer	134	134	134	134	134	134
Karnes City[1]	Karnes	Yegua-Jackson Aquifer	310	310	310	310	310	310
KT Water Development	Comal	Trinity Aquifer	161	161	322	483	483	644
Luling	Caldwell	Carrizo-Wilcox Aquifer	0	353	353	706	706	1,059
Pearsall	Frio	Carrizo-Wilcox Aquifer	807	807	1,614	1,614	1,614	1,614
Water Services	Bexar	Trinity Aquifer	0	252	252	315	379	504
Wingert Water Systems	Comal	Trinity Aquifer	296	296	296	296	296	296
		Total	**2,769**	**4,424**	**6,225**	**6,804**	**8,131**	**8,774**

[1] The Karnes City Local Groundwater project will require groundwater conversion needed to meet the needs of Karnes City. See Section 5.2.5 for more details.

Table 5.2.4-2 Projected Wells and Available Project Yield for Municipal WUGs

WUG	COUNTY	TYPE	NEEDS (ACFT/YR) 2020	2030	2040	2050	2060	2070	TOTAL WELLS	PROJECT YIELD[1] (ACFT/YR)
Carrizo-Wilcox Aquifer										
Atascosa Rural WSC	Atascosa	Projected Needs*	871	1,119	1,353	1,588	1,811	2,017	2	2,098
		New Wells	1	1	0	0	0	0		
		Total Wells	2	2	2	2	2	2		
Floresville	Wilson	Projected Needs*	0	0	245	608	961	1,281	2	1,656
		New Wells	0	0	1	0	1	0		
		Total Wells	0	0	1	1	2	2		
Karnes City[1]	Karnes	Projected Needs*	319	305	280	267	256	232	1	444
		New Wells	1	0	0	0	0	0		
		Total Wells	1	1	1	1	1	1		

WUG	COUNTY	NEEDS (ACFT/YR) TYPE	2020	2030	2040	2050	2060	2070	TOTAL WELLS	PROJECT YIELD[1] (ACFT/YR)
Luling	Caldwell	Projected Needs*	0	49	227	412	608	799	3	1,059
		New Wells	0	1	0	1	0	1		
		Total Wells	0	1	1	2	2	3		
Pearsall	Frio	Projected Needs*	611	771	913	1,061	1,206	1,340	2	1,614
		New Wells	1	0	1	0	0	0		
		Total Wells	1	1	2	2	2	2		
Trinity Aquifer										
KT Water Development	Comal	Projected Needs*	26	136	249	364	479	589	4	644
		New Wells	1	0	1	1	0	1		
		Total Wells	1	1	2	3	3	4		
Water Services, Inc.	Bexar	Projected Needs*	0	40	143	260	376	485	8	504
		New Wells	0	4	0	1	1	2		
		Total Wells	0	4	4	5	6	8		
Wingert Water Systems	Comal	Projected Needs*	32	108	185	185	185	185	1	296
		New Wells	1	0	0	0	0	0		
		Total Wells	1	1	1	1	1	1		
Gulf Coast Aquifer										
County-Other, Calhoun	Calhoun	Projected Needs*	0	0	0	0	1	37	1	412
		New Wells	0	0	0	0	1	0		
		Total Wells	0	0	0	0	1	1		
El Oso WSC	Bee (Region N)	Projected Needs*	37	50	26	31	176	185	1	120
		New Wells	1	0	0	0	0	0		
		Total Wells	1	1	1	1	1	1		
Yegua-Jackson Aquifer[2]										

WUG	COUNTY	NEEDS (ACFT/YR)							TOTAL WELLS	PROJECT YIELD[1] (ACFT/YR)
		TYPE	2020	2030	2040	2050	2060	2070		
Karnes City	Karnes	Projected Needs*	319	305	280	267	256	232	1	444
		New Wells	1	0	0	0	0	0		
		Total Wells	1	1	1	1	1	1		

* Projected Needs in acft/yr
[1] Project Yield based on full project implementation. WMS supplies vary based on well development and adhering to MAG availability. See Section 5.3 for WMS supply volumes.
[2] Yegua-Jackson Aquifer noted based on groundwater conversion needed to meet the needs of Karnes City. See Section 5.2.5 for more details.

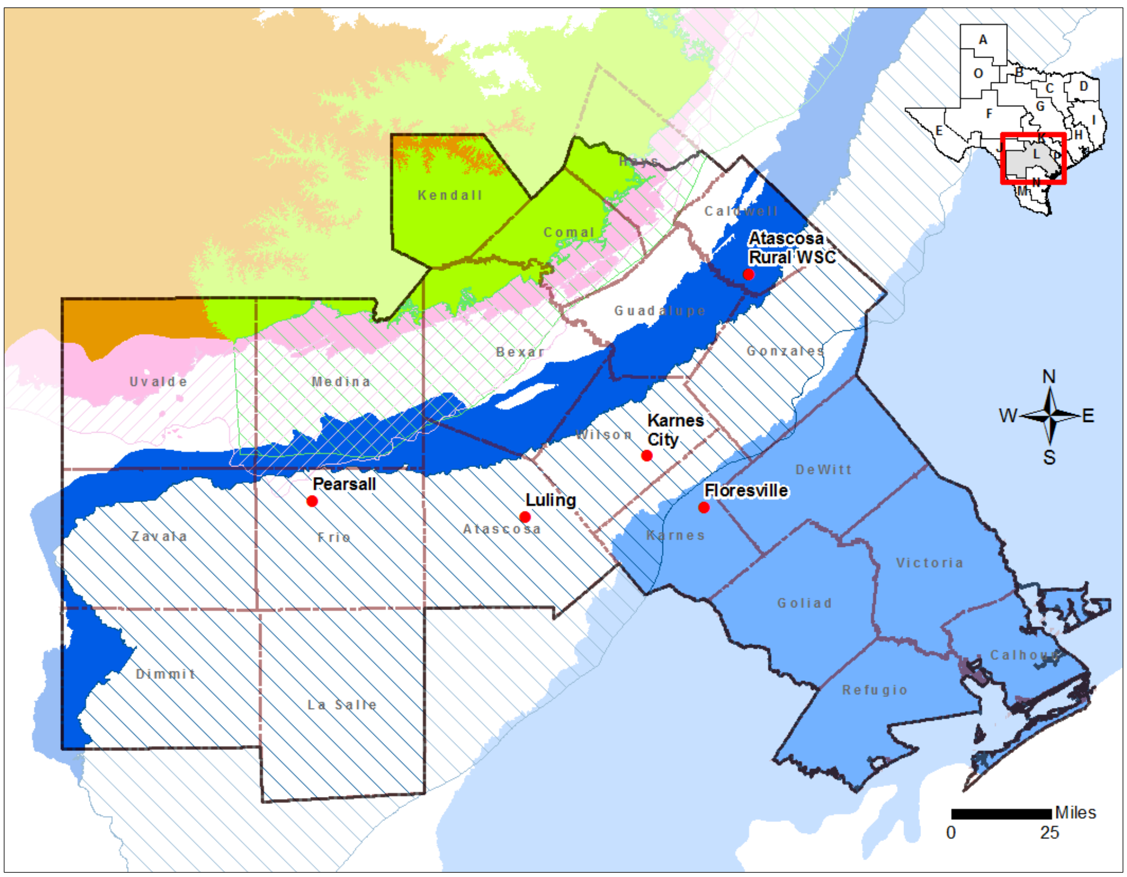

Figure 5.2.4-1 General Location of Municipal WUGs Relying on Carrizo-Wilcox Aquifer

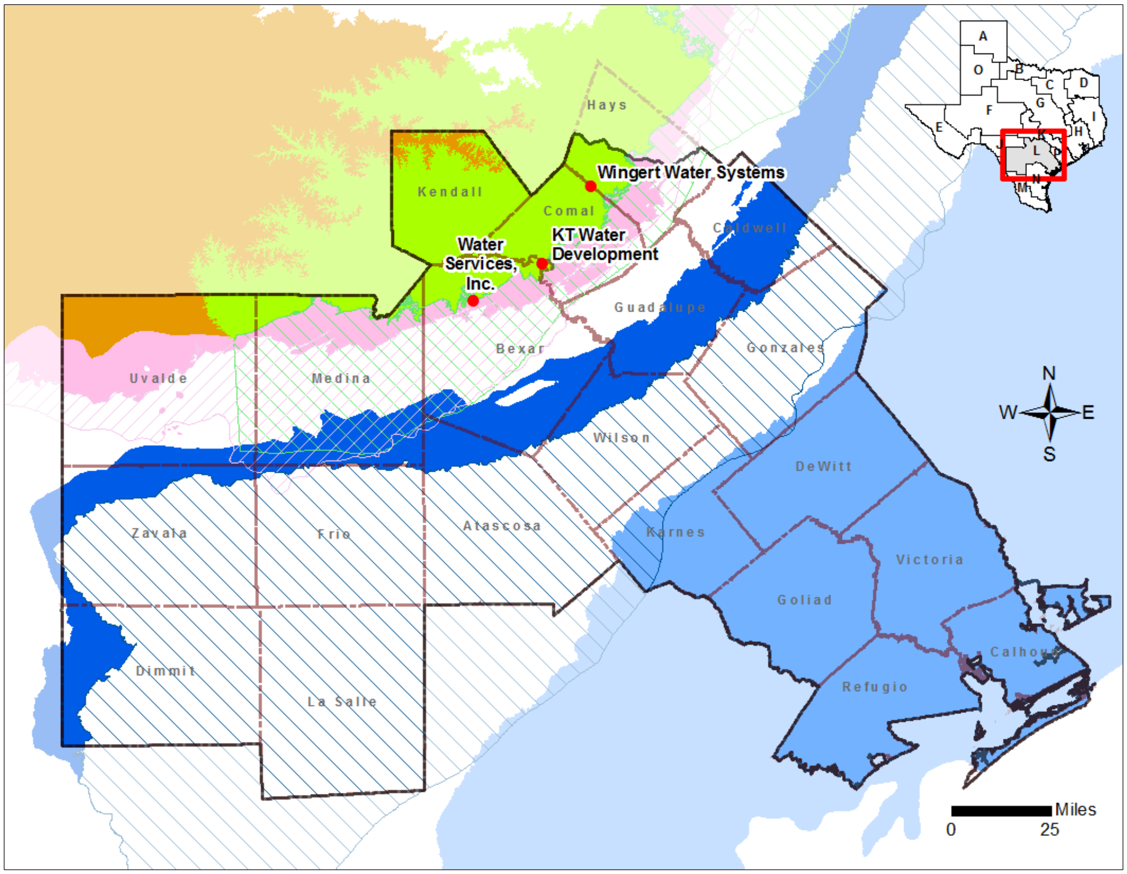

Figure 5.2.4-2 General Location of Municipal WUGs Relying on Trinity Aquifer

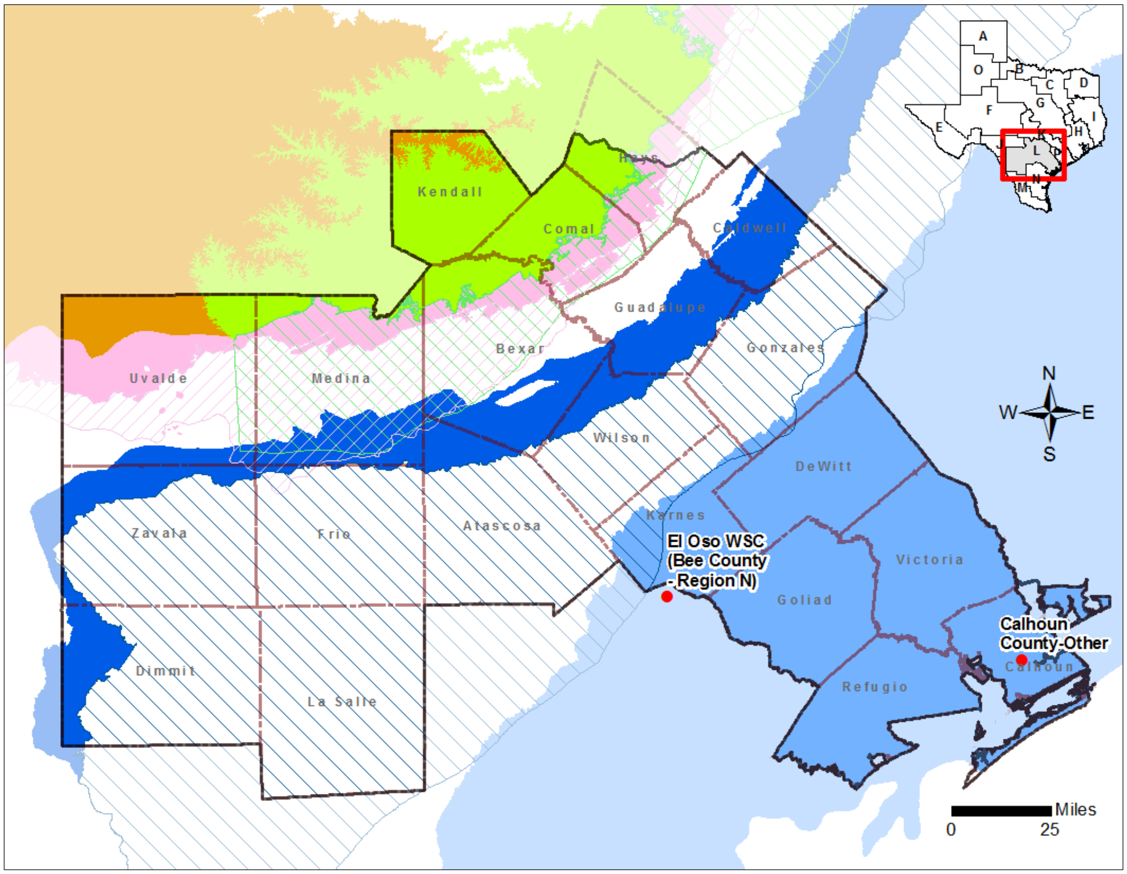

Figure 5.2.4-3 General Location of Municipal WUGs Relying on Gulf Coast Aquifer

Table 5.2.4-3 Capacity, Rate, and Depth of New Wells

WUG	COUNTY	TOTAL WELLS	AVERAGE CAPACITY OF EXISTING WELLS (GPM)	ASSUMED PRODUCTION RATE OF NEW WELLS (ACFT/YR)	ASSUMED DEPTH (FT)
Atascosa Rural WSC	Bexar	2	650	1,048	2,000
County-Other, Calhoun	Calhoun	1	510	411	250
El Oso WSC	Bee (Region N)	1	75	121	500
Floresville	Wilson	2	1,026	828	1,100
Karnes City	Karnes	2	550	444	3,800
KT Water Development	Comal	4	200	161	550
Luling	Caldwell	3	438	353	400
Pearsall	Frio	2	1,000	807	1,500
Water Services, Inc.	Bexar	8	78	63	600

WUG	COUNTY	TOTAL WELLS	AVERAGE CAPACITY OF EXISTING WELLS (GPM)	ASSUMED PRODUCTION RATE OF NEW WELLS (ACFT/YR)	ASSUMED DEPTH (FT)
Wingert Water Systems	Hays	1	367	296	450

New Permits or Increased Permit Production Limits

There are seven WUGs that (1) rely on groundwater as a sole source and (2) are expected to have a water shortage by 2070. However, these seven WUGs are not limited by the capacity in their existing well(s) to meet their projected needs. They are currently limited only by their permitted capacities, so they can meet their projected needs by acquiring new permits or increasing the production limits on their existing permits. Therefore, the Local Groundwater strategy is recommended as a WMS for the following seven permit-limited WUGs:

- Benton City WSC;
- Clear Water Estates Water System;
- Garden Ridge;
- Kendall West Utility;
- Oak Hills WSC;
- Picosa WSC; and
- Poth.

Benton City WSC, Oak Hills WSC, Picosa WSC, and the City of Poth have production capacity in their existing Carrizo-Wilcox wells that will allow them to meet projected needs. Garden Ridge currently uses both the Edwards-Balcones Fault Zone (BFZ) and Trinity Aquifers and has production capacity in the existing Trinity Aquifer wells that allow the city to meet projected needs. Clearwater Estates Water System and Kendall West Utility have production capacity in their existing Trinity Aquifer wells that allow them to meet projected needs. The recommended strategy for the above entities is to apply for new permits or permit modifications to increase their permitted capacities. Because there is no new or expanded infrastructure associated with new permits or expanded production permit limits, there are no associated costs for these WUGs. Estimated permit capacity increases are summarized in Table 5.2.4-4.

Table 5.2.4-4 Local Groundwater Permit Capacity Increase (acft/yr)

WUG	COUNTY	2020	2030	2040	2050	2060	2070
Benton City WSC	Atascosa	0	0	0	0	153	345
Clear Water Estates Water System	Comal	627	806	987	1,171	1,352	1,528
Garden Ridge	Comal	918	1,241	1,638	1,788	2,184	2,565
Kendall West Utility	Kendall	0	282	561	902	1,365	1,596

WUG	COUNTY	2020	2030	2040	2050	2060	2070
Oak Hills WSC	Wilson	475	675	875	1,050	1,200	1,350
Picosa WSC	Wilson	0	0	19	58	99	137
Poth	Wilson	0	0	0	0	35	97
	Total	**2,020**	**3,004**	**4,080**	**4,969**	**6,388**	**7,618**

5.2.4.3 Available Yield for Non-Municipal WUGs

Local Groundwater is the recommended WMS for four non-municipal WUGs that (1) rely on groundwater as a sole source, (2) are expected to have a water shortage by 2070, and (3) do not have sufficient permitted or production capacities to meet their expected shortages. Mining in Comal County relies on the Edwards-BFZ and the Trinity Aquifer; projected needs must be met from the Trinity Aquifer because no new rights are available from the Edwards-BFZ Aquifer. Mining and manufacturing in DeWitt County rely on the Gulf Coast Aquifer System as a sole source. Mining in Uvalde County relies on the Edwards-BFZ aquifer; however, due to MAG limitations, they are utilizing the Local Conversions WMS from the Leona Gravel Aquifer to meet their needs.

The projected needs and recommended new wells are shown in Table 5.2.4-6 and Table 5.2.4-6. Maps are provided to show the general locations of non-municipal WUGs that rely on the Trinity and Leona Gravel Aquifers (Figure 5.2.4-4), and Gulf Coast Aquifer (Figure 5.2.4-5). All of the above entities are in need of new wells, and associated new permits for groundwater extraction, to meet projected needs.

Table 5.2.4-5 Summary of Non-Municipal Local Groundwater Projects

WUG	COUNTY	AQUIFER	PROJECT YIELD (ACFT/YR)					
			2020	2030	2040	2050	2060	2070
Manufacturing, Dewitt	Dewitt	Gulf Coast Aquifer System	0	242	242	242	242	242
Manufacturing, Karnes	Karnes	Yegua-Jackson Aquifer	0	0	232	231	242	242
Mining, Comal	Comal	Trinity Aquifer	4,116	5,566	7,018	8,228	9,206	9,185
Mining, Dewitt	Dewitt	Gulf Coast Aquifer System	1,937	1,937	1,937	1,937	1,937	1,937
Mining, Uvalde[1]	Uvalde	Leona Gravel Aquifer	242	242	242	242	242	242
		Total	**6,295**	**7,987**	**9,671**	**10,880**	**11,869**	**11,848**

[1] Noted Local Groundwater project will require groundwater conversion needed to meet the needs of this project. See Section 5.2.5 for more details.

Table 5.2.4-6 Projected Wells and Available Project Yield for Non-Municipal WUGs

WUG	COUNTY	NEEDS							TOTAL WELLS	PROJECT YIELD (ACFT/YR)
		TYPE	2020	2030	2040	2050	2060	2070		
Gulf Coast Aquifer										
Mining, DeWitt County	DeWitt	Projected Needs*	1,718	1,595	362	2	0	0	8	1,937
		New Wells	8	0	0	0	0	0		
		Total Wells	8	8	8	8	8	8		
Manufacturing, DeWitt County	DeWitt	Projected Needs*	0	22	10	0	0	0	1	242
		New Wells	0	1	0	0	0	0		
		Total Wells	0	1	1	1	1	1		
Leona Gravel Aquifer										
Mining, Uvalde County[2]	Uvalde	Projected Needs*	102	102	102	102	102	102	1	242
		New Wells	1	0	0	0	0	0		
		Total Wells	1	1	1	1	1	1		
Trinity Aquifer										
Mining, Comal County	Comal	Projected Needs*	3,861	5,201	6,491	7,617	8,849	8,849	41	9,206
		New Wells	17	6	6	5	7	0		
		Total Wells	17	23	29	34	41	41		
Yegua-Jackson Aquifer										
Manufacturing, Karnes County	Karnes	Projected Needs*	0	0	113	155	155	155	1	242
		New Wells	0	0	1	0	0	0		
		Total Wells	0	0	1	1	1	1		
* Projected Needs in acft/yr										

[2] Mining, Uvalde supplies are limited by the Edwards-BFZ Aquifer MAG in Uvalde County. In combination with this WMS, it is planned that Mining, Uvalde would utilize the Local Groundwater Conversions WMS of the Leona Gravel Aquifer.

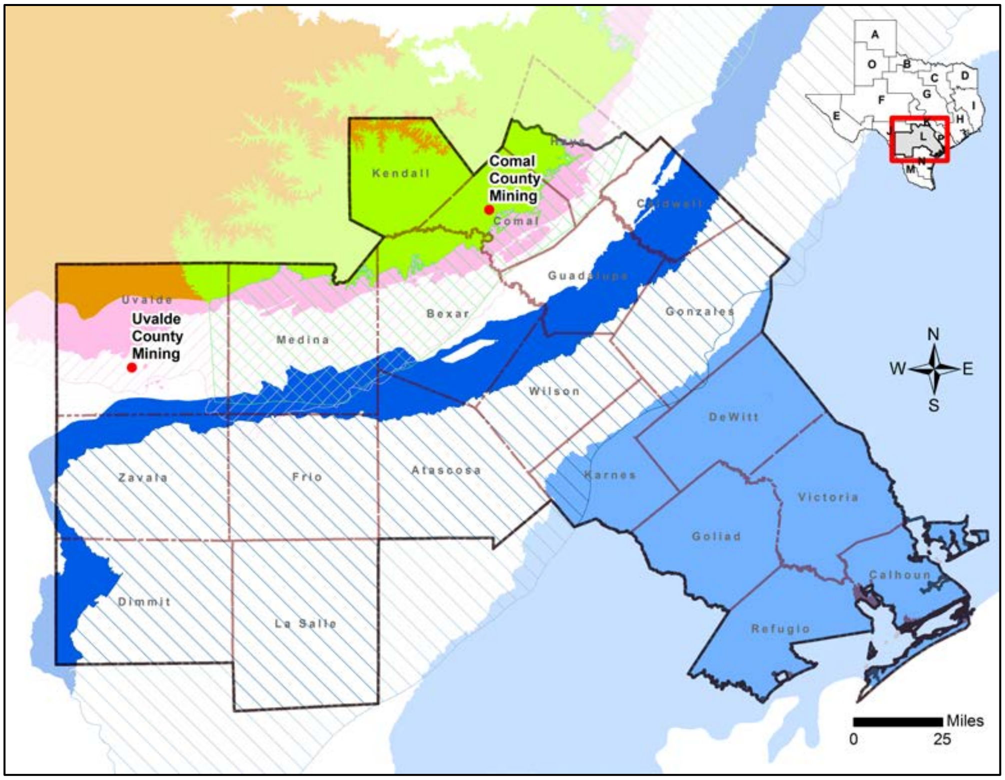

Figure 5.2.4-4 General Location of Non-Municipal WUGs Relying on Trinity Aquifer and Leona Gravel Aquifer

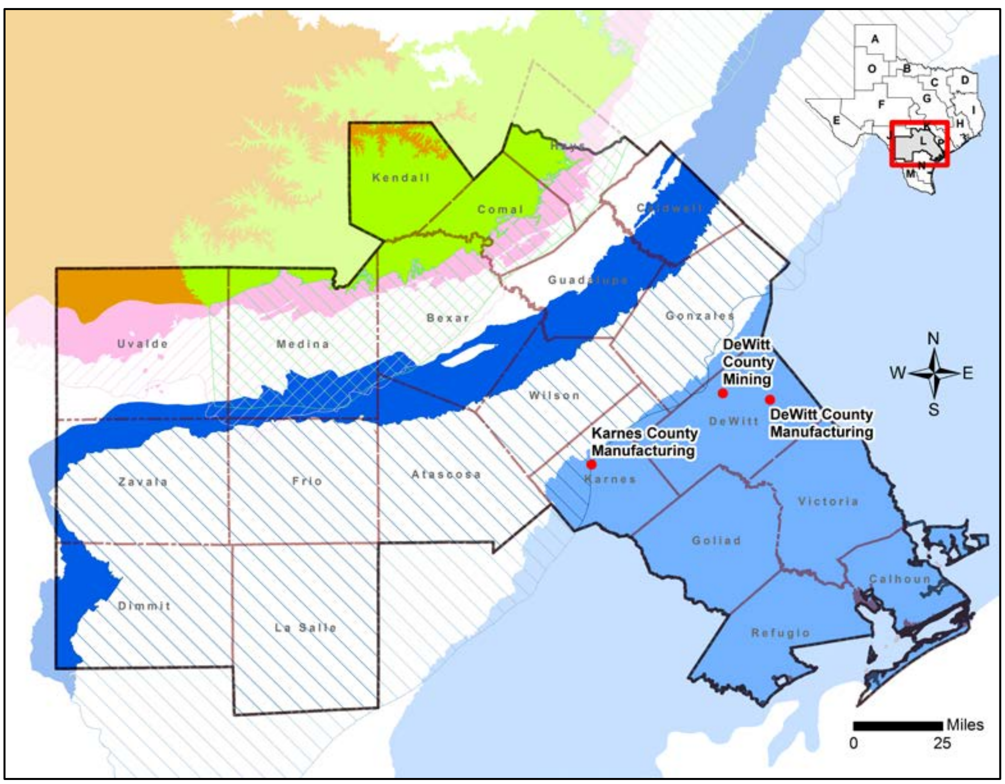

Figure 5.2.4-5 General Location of Non-Municipal WUGs Relying on Gulf Coast Aquifer

For counties with mining and manufacturing water shortages, the following assumptions were made:

- Well capacity is 150 gpm;
- Well construction standards are consistent with non-potable wells;
- System improvements were $5,000 per well;
- Water quality treatment costs were not included;
- Facilities would be constructed on land owned or leased by the operators; and
- Power cost is calculated from an estimate of a typical water lift for medium sized wells in the county.

5.2.4.4 Environmental Considerations

A summary of the projected needs and cost estimates for development of local groundwater The Local Groundwater WMS could result in minor to moderate impacts to land use, vegetation, protected species, aquatic resources, cultural resources and agricultural land uses from well field expansions and associated facility construction and upgrades. Individual projects would require site-specific reviews to determine requirements for environmental permitting and field data collection, if needed. supplies

5.2.4.5 Engineering and Costing

A summary of the projected needs and cost estimates for development of local groundwater supplies for municipal WUGs is provided in Table 5.2.4-7. Costs associated with non-municipal WUGs is provided in Table 5.2.4-8. The costs for the local groundwater WMSs do include the cost of disinfection treatment. Costs do not include (1) expenses attributed to regional water level declines that may necessitate the lowering of pumps or replacement of older wells, (2) expenses for removing high concentrations of metals such as iron and manganese, or (3) expenses for cooling water from deep well extraction.

Table 5.2.4-7 Local Groundwater Associated Costs for Municipal WUGs

WUG	COUNTY	AQUIFER	COST OF FACILITIES	TOTAL PROJECT COSTS	ANNUAL COSTS*	PROJECT YIELD (ACFT/YR)	UNIT COST ($ PER ACFT/YR)
Atascosa Rural WSC	Bexar	Carrizo-Wilcox	$4,615,000	$6,490,000	$982,000	2,098	$468
County-Other, Calhoun	Calhoun	Gulf Coast System	$1,060,000	$1,502,000	$293,000	412	$711
El Oso WSC	Bee (Region N)	Gulf Coast System	$554,000	$809,000	$158,000	120	$1,317
Floresville	Wilson	Carrizo-Wilcox	$3,886,000	$5,477,000	$858,000	1,656	$518
Karnes City	Karnes	Carrizo-Wilcox & Yegua-Jackson	$2,935,000	$4,080,000	$502,000	444	$1,131

WUG	COUNTY	AQUIFER	COST OF FACILITIES	TOTAL PROJECT COSTS	ANNUAL COSTS*	PROJECT YIELD (ACFT/YR)	UNIT COST ($ PER ACFT/YR)
Luling	Caldwell	Carrizo-Wilcox	$2,822,000	$4,038,000	$669,000	1,059	$632
Pearsall	Frio	Carrizo-Wilcox	$4,384,000	$6,140,000	$910,000	1,614	$564
KT Water Development	Comal	Trinity	$2,477,000	$3,596,000	$519,000	644	$806
Water Services, Inc.	Bexar	Trinity	$2,928,000	$4,378,000	$539,000	504	$1,069
Wingert Water Systems	Hays	Trinity	$1,025,000	$1,463,000	$258,000	296	$872
*Includes amortization at 3.5% for 20 years, operation and maintenance (O&M), and power costs.							

Table 5.2.4-8 Local Groundwater Associated Costs for Non-Municipal WUGs

WUG	COUNTY	AQUIFER	COST OF FACILITIES	TOTAL PROJECT COSTS	ANNUAL COSTS*	PROJECT YIELD (ACFT/YR)	UNIT COST ($/ACFT/YR)
Mining, Comal	Comal	Trinity	$7,143,000	$10,202,000	$815,000	11,616	$70
Mining, DeWitt	DeWitt	Gulf Coast	$925,000	$1,333,000	$107,000	1,936	$55
Mining, Uvalde	Uvalde	Leona Gravel	$105,000	$153,000	$13,000	242	$54
Manufacturing, DeWitt	DeWitt	Gulf Coast	$116,000	$167,000	$14,000	242	$56
Manufacturing, Karnes	Karnes	Yegua-Jackson	$130,000	$188,000	$15,000	242	$65
*Includes amortization at 3.5% for 20 years, O&M, and power costs.							

5.2.4.6 Implementation Considerations

Because of the generalized and reconnaissance nature of this evaluation, each individual entity or WUG should conduct more thorough and site-specific evaluations for any new well. The owner or WUG should work with professional engineers and hydrogeologists to evaluate details specific to their existing system and their local hydrogeologic conditions and refine cost estimates accordingly. Considerations for water quality are especially important for any water that may not meet Safe Drinking Water Act requirements. For all new wells, local GCD regulations and reporting should be followed, along with applicable requirements of TCEQ and TWDB.

During times of drought, WUGs should be aware that the saturated thickness and, therefore, the associated well capacity, may be impacted by drawdown from nearby operating wells.

Reliability

This strategy was developed in accordance with MAG values for the appropriate aquifer and county. As such, it is considered to be reliable supply (reliability score = 5) that will not compromise the DFCs as established by the of the relevant GCD (where applicable) and GMA.

5.2.5 Local Groundwater Conversions

5.2.5.1 Description of Water Management Strategy

The Local Groundwater Conversions WMS is intended to be used by WUGs where the Local Groundwater WMS (Section 5.2.4) would be the primary recommended strategy to meet their needs but there is no groundwater availability because of existing permits and limited MAG estimates. This strategy includes purchasing and/or leasing existing irrigation or mining groundwater permits, and changing the type of use to municipal use. The Local Groundwater Conversions are intended to be used within the same county and between willing sellers and willing buyers.

For the 2021 SCTRWP, Karnes City and Uvalde Mining were identified as WUGs that could utilize Local Groundwater Conversions as a WMS through conversions from the Carrizo-Wilcox and Yegua-Jackson, and Leona Gravel Aquifers, respectively. Karnes City was initially identified through the Local Groundwater WMS (Section 5.2.4) to meet needs, but was found to be limited by the Carrizo Aquifer MAG in Karnes County.[1] Thus, Karnes City would convert water from Karnes Mining and Irrigation users to meet their needs through this strategy. Uvalde Mining was initially identified through the Local Groundwater WMS (Section 5.2.4) to meet needs, but was found to be limited in the Edwards-BFZ and Leona Gravel MAGs in Uvalde County.[2] Thus, Uvalde Mining would convert from Uvalde Irrigation to meet their needs through this strategy.

5.2.5.2 Available Yield

The available supply from the Local Groundwater Conversions WMS is limited to the firm supply under existing irrigation or mining groundwater permits within the same county as the municipal WUG seeking to acquire additional supply via use type conversion. Table 5.2.5-1 details the projected decadal needs of Karnes City that would require purchasing and/or leasing existing irrigation or mining groundwater permits and changing the type of use to municipal use. Additionally, Table 5.2.5-2 details the projected decadal needs of Uvalde Mining that would require purchasing and/or leasing existing irrigation or mining groundwater permits and changing the type of use to municipal use. This WMS is considered for implementation beginning in the 2020 decade.

[1] The Carrizo-Wilcox Aquifer is MAG limited in Wilson County where there are several recommended WMSs. It is assumed that Karnes City will be utilizing local groundwater conversions to get the full water volume that is needed for the recommended project.

[2] The Edwards-BFZ and Leona Gravel Aquifers are MAG limited in Uvalde County where there are several recommended WMSs. It is assumed that Mining Uvalde will be utilizing local groundwater conversions to get the full water volume that is needed for the recommended projects.

Table 5.2.5-1 Projected Well and Available Project Yield for Karnes City

USER	COUNTY	AQUIFER	CONVERSION ENTITY	VOLUME (ACFT/YR) 2020	2030	2040	2050	2060	2070
Volume needed for Karnes City Local Groundwater WMS *				**444**	**444**	**444**	**444**	**444**	**444**
Local Carrizo-Wilcox Groundwater Available				**0**	**0**	**15**	**92**	**92**	**92**
Remaining Volume to be Obtained by Local Groundwater Conversions				**444**	**444**	**429**	**352**	**352**	**352**
Karnes City	Karnes	Carrizo Wilcox	Irrigation, Karnes	42	42	42	42	42	42
		Carrizo Wilcox	Mining, Karnes	92	92	77	0	0	0
		Yegua-Jackson	Irrigation, Karnes	310	310	310	310	310	310
Total Converted Water Rights				**444**	**444**	**429**	**352**	**352**	**352**
*See Section 5.2.4 for details on the Local Groundwater WMS									

Table 5.2.5-2 Projected Well and Available Project Yield for Mining, Uvalde

USER	COUNTY	AQUIFER	CONVERSION ENTITY	VOLUME (ACFT/YR) 2020	2030	2040	2050	2060	2070
Volume needed for Uvalde, Mining Local Groundwater WMS *				**242**	**242**	**242**	**242**	**242**	**242**
Local Carrizo-Wilcox Groundwater Available				**0**	**0**	**0**	**0**	**0**	**0**
Remaining Volume to be Obtained by Local Groundwater Conversions				**242**	**242**	**242**	**242**	**242**	**242**
Mining, Uvalde	Uvalde	Leona Gravel	Irrigation, Uvalde	242	242	242	242	242	242
Total Converted Water Rights				**242**	**242**	**242**	**242**	**242**	**242**
*See Section 5.2.4 for details on the Local Groundwater WMS									

5.2.5.3 Environmental and Cultural Considerations

Environmental and cultural issues associated with the local groundwater conversions are anticipated to be limited. The projects may result in agricultural impacts in the form of reductions in irrigated acreage.

5.2.5.4 Engineering and Costing

The cost associated with the local groundwater conversions WMS is limited to the negotiations between willing sellers and willing buyers. Details associated with the costs necessary to develop groundwater infrastructure for Karnes City and Uvalde Mining, if it were able to complete a successful transaction to meet its needs, can be found in the Local Groundwater WMS (Section 5.2.4).

5.2.5.5 Implementation Considerations

Implementation would require the ability to execute contractual agreements between the municipal WUG and the irrigators or mining entities and the ability to amend existing groundwater permits at the groundwater conservation district to add municipal use as a type. If the rules of the groundwater conservation district do not explicitly allow for the conversion of groundwater permits between use types, then such rules would need to be amended.

Reliability

The reliability is expected to be medium (reliability score = 3) because of uncertainty involved in purchasing existing irrigation or mining groundwater permits and changing the type of use to municipal use. There could be competing development that may impact the reliability of securing sufficient groundwater permits from willing sellers in order to protect the long-term productivity of the well fields.

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5.2.6 Surface Water Rights

5.2.6.1 Description of Water Management Strategy

The Surface Water Rights WMS is included to explicitly recognize that use of water supplies made available under existing water rights by lease or purchase agreements between willing buyers and willing sellers is an activity consistent with the 2021 SCTRWP. The additions of diversion points or types and places of use for existing surface water rights are also activities consistent with the 2021 RWP; if necessary, authorizations would be obtained pursuant to TCEQ rules and applicable law. Essentially, this strategy is to develop or enhance water supplies through lease or purchase of existing right(s) having consumptive use and/or impoundment authorizations. Diversion point(s), use type(s), and/or place(s) of use may be amended as long as there is no associated adverse impact on other water rights or the environment greater than that with full use prior to amendment (the "No Injury" rule).

It is important to note that this WMS is intended to address existing water rights (within currently authorized annual and instantaneous maximum diversion rates) and not applications for new surface water appropriations. Furthermore, this strategy focuses on maximizing beneficial use of existing run-of-river water rights as opposed to the development of new major reservoirs. As described in Chapter 3.2, existing firm supplies from major reservoirs are either committed to current steam-electric power generation uses (Coleto Creek Reservoir and Braunig and Calaveras lakes) or contracted for multiple uses (Canyon Reservoir).

Key applicable water law regarding amendment of existing water rights to facilitate lease/purchase agreements is found in Section 11.122 of the Texas Water Code, which requires water rights holders to obtain authorization from TCEQ to "change the place of use, purpose of use, point of diversion, rate of diversion, acreage to be irrigated, or otherwise alter a water right." Section 11.122 further provides that "an amendment, except an amendment to a water right that increases the amount of water authorized to be diverted or the authorized rate of diversion, shall be authorized if the requested change will not cause adverse impact on other water right holders or the environment on the stream of greater magnitude than under circumstances in which the permit, certified filing, or certificate of adjudication that is sought to be amended was fully exercised according to its terms and conditions as they existed before the requested amendment." This section is identified in the TCEQ rules as the "No Injury" rule. Pursuant to the "No Injury" rule, restrictions may be placed upon a right for which amendment is being sought in order to protect senior water rights. An example of such restrictions is subordination of an amended right to water rights situated between the existing and amended diversion locations.

5.2.6.2 Available Yield

Available yield of run-of-river surface water rights, whether before or after lease/purchase under the Surface Water Rights WMS, is determined using the applicable WAM. The Guadalupe-San Antonio River basin WAM[1] and the Nueces River basin WAM[2] are the primary tools applicable for consideration of water rights in the South Central Texas Regional Water Planning area (Region L). These WAMs perform

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[1] HDR Engineering, Inc. "Water Availability in the Guadalupe-San Antonio River Basin." Texas Natural Resource Conservation Commission. December 1999.

[2] HDR Engineering, Inc. "Water Availability in the Nueces River Basin., Texas Natural Resource Conservation Commission. October 1999.

the complex calculations accounting for relative seniority, authorized annual diversion, type(s) of use, maximum diversion rate, instream flow requirements, physical location, and authorized storage associated with a particular water right. These calculations are completed in the context of historical hydrology, as necessary to quantify firm diversion or available yield subject to DOR conditions. Information regarding current surface water rights in Region L is summarized in Appendix C of Volume I.

Example entities that have acquired existing surface water rights and/or are considering acquiring existing surface water rights in the future include the following:

- CRWA;
- City of Victoria;
- GBRA;
- NBU;
- SARA; and
- SAWS.

Water Loss

Strategies involving transfers of water rights are assumed to have no additional water losses associated with the use of existing infrastructure.

5.2.6.3 Environmental Issues

Potential environmental issues associated with implementation of the Surface Water Rights WMS are limited compared to other strategies because the source of water is existing water rights having prior authorizations for consumptive use. If an amendment to an existing water right is necessary to implement the strategy, Section 11.122 of the Texas Water Code indicates that only adverse impacts on the environment on the stream of greater magnitude than under circumstances in which the right sought to be amended was fully exercised prior to the amendment need be addressed. Environmental effects and impacts to agricultural land uses associated with new diversion, storage, transmission, treatment, and/or integration facilities necessary to use water available under existing rights must be addressed in accordance with applicable state and federal requirements.

5.2.6.4 Engineering and Costing

Estimated costs for purchase or lease of existing surface water rights are highly variable depending on location, reliability, and negotiations between willing buyers and sellers. Future acquisitions of specific water rights are not addressed herein.

5.2.6.5 Implementation Issues

Potentially significant implementation issues associated with the Surface Water Rights WMS include the following:

- Any potential effects on other water rights, streamflows, and freshwater inflows to bays and estuaries must be considered and quantified to the extent required by TCEQ rules and applicable state and federal law;

- Changes in the point of diversion may necessitate subordination of an amended right to water rights situated between the existing and amended diversion locations;
- Interbasin transfer of water made available under existing surface water rights may involve additional regulatory requirements to amend place of use and may introduce changes in relative priority and inflow passage for environmental flow needs; and
- Run-of-river water rights often require storage and/or groundwater to firm up supply for municipal water use.

Reliability

The reliability of this supply is considered medium (reliability score = 3) because of uncertainty involved in negotiations between buyers and sellers of existing water rights.

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5.2.7 Balancing Storage

5.2.7.1 Description of Water Management Strategy

WMSs of the 2021 SCTRWP are sized and scheduled to meet seasonal and daily variations of demand, but without storage, some current and proposed supplies may not be fully reliable during extended droughts. Several recommended strategies involve long distance pipelines of more than 40 miles in length that will be supplied from a combination of run-of-river diversions and groundwater. Thus, surface reservoirs, large scale ASR systems, or multipurpose reservoirs that are adequate in size to store surplus flows of surface water during periods of high streamflows, including flood flows, need to be available during extended periods of drought. The Balancing Storage WMS involves implementing such ASR and/or surface storage facilities to assist in satisfying applicable needs.

The Balancing Storage WMS is recommended to explicitly recognize that storage is needed to a) firm up supplies from run-of-river diversions or interruptible groundwater sources, and b) to ensure that supplies delivered through long distance conveyance facilities are available to meet daily and seasonal demands. The addition of balancing storage on the surface or underground (ASR) is consistent with the 2021 SCTRWP if necessary authorizations are obtained pursuant to the TCEQ and/or GCD rules and applicable law. Storage examples include the following:

- Develop or enhance water supplies through off-channel or underground (ASR) storage authorizations; and
- Off-channel or underground (ASR) storage may be added through amendment of existing surface water rights as long as there is no associated adverse impact on other water rights or the environment greater than that with full use prior to amendment (the “No Injury” rule). Additional regulatory requirements may apply.

5.2.7.2 Available Yield

Available yield associated with balancing storage is typically determined using the applicable surface WAM to simulate operations of the respective WMSs. The Guadalupe-San Antonio River Basin WAM,[1] the Nueces River Basin WAM,[2] the Flow Regime Application Tool (FRAT), the Groundwater Availability Models (GAMs), and spreadsheet models are the primary tools applicable for consideration of surface and groundwater flows in Region L.

Water Loss

Recommended and alternative surface water strategies such as new reservoirs have water losses associated with evaporation. ASR reduces the water losses associated with evaporation from a reservoir, but there can be water losses due to recovery efficiency from the aquifer. Migration rates vary depending on the aquifer used for storage, and impacts will depend on how long the stored water remains in the aquifer. Recovery efficiency will have some impacts on water volume but should have negligible impacts on the firm yield volumes.

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[1] HDR Engineering, Inc. “Water Availability in the Guadalupe-San Antonio River Basin.” Texas Natural Resource Conservation Commission. December 1999.
[2] HDR Engineering, Inc. “Water Availability in the Nueces River Basin.” Texas Natural Resource Conservation Commission. October 1999.

5.2.7.3 Environmental Issues

Potential environmental issues associated with implementation of the Balancing Storage WMS are limited to terrestrial habitat, as surface water or groundwater rights are existing and authorized for use and storage is off-channel or underground. Construction or upgrades of storage facilities could result in minor to moderate impacts to land use, vegetation, protected species, aquatic resources, cultural resources and agricultural land uses. Individual projects would require site-specific reviews to determine requirements for environmental permitting and field data collection, if needed.

5.2.7.4 Engineering and Costing

Estimated costs for development of balancing storage are highly variable depending on location, source water reliability, availability of embankment construction materials, and/or aquifer characteristics.

5.2.7.5 Implementation Considerations

The Balancing Storage WMS includes the following implementation considerations:

- Quantification and consideration of any potential effects on water rights, streamflows, and freshwater inflows to bays and estuaries to the extent required by TCEQ rules and applicable state and federal law;
- Run-of-river water rights often require surface storage and/or groundwater to firm up supply for municipal water use and a determination as to the most economically feasible of these is necessary;
- Acquisition of state, federal, and local permits;
- Environmental studies; and
- Relocations of affected roads, railroads, utilities, and cultural resources.

Reliability

This strategy would supply a highly reliable water source (reliability score = 5). Successful development of ASR or OCR is highly reliable. Challenges to ASR reliability include natural groundwater flow away from the ASR site and the associated drift of the storage bubble, thus reducing available supplies.

5.2.8 Facilities Expansion

5.2.8.1 Description of Water Management Strategy

Several WUGs are interested in projects to expand major components of their existing infrastructure (facilities) so they can continue to provide a safe and reliable water supply to their customers during the planning period. These facilities expansions are considered to be independent of any potential WMSs to acquire a new water supply and instead, are intended to address expected future improvements to the water system, such as the installation of new water transmission facilities or additional water treatment. Additionally, these facilities expansions could include new transmission facilities designated to move waters from multiple WMSs throughout an area. Facility expansions are assumed to begin in the 2020 decade unless otherwise stated.

The identification of the facilities expansions is based on responses from WUGs, WWPs, and/or representatives of the South Central Texas Regional Water Planning Group only. This WMS does not include an environmental assessment, as any environmental issues would likely be localized. Furthermore, cost estimates for each of these facilities expansions are limited and compiled herein using information from the sponsoring entity. Detailed cost estimates will be based on preliminary engineering designs by the engineer of the associated entities.

5.2.8.2 Available Yield

The Facilities Expansion WMS is intended to document the expansion of existing facilities for WUGs and WWPs that notified the South Central Texas Regional Water Planning Group about their plans during the request for information on their future water supply plans. The Facilities Expansion WMS allows these WUGs and WWPs to better utilize or otherwise expand their existing supplies and facilitate the implementation of new supplies from other WMSs. This WMS is considered for implementation beginning in the 2020 decade.

Table 5.2.8-1 provides a summary of the projects associated with the Facilities Expansion WMS, including the decade of implementation, capacity of expansion, and supply to be developed from this WMS. More-detailed descriptions are provided in subsequent paragraphs. WMS Supplies may differ from the capacities of infrastructure because facilities are frequently designed to meet peak demand, whereas the WMS supply is based on water availability and average flows. In some cases, water availability is limited by the MAG or water rights. Additionally, facilities are frequently designed for capacities larger than current supplies in order to meet future demands as a result of growth. Costs associated with these facilities expansion are summarized in Subsection 5.2.8.4.

Table 5.2.8-1 Facilities Expansion WMS Project Capacities and Supply

PROJECT	DESCRIPTION	CAPACITY OF EXPANSION (ACFT/YR)	WMS SUPPLY (ACFT/YR)					
			2020	2030	2040	2050	2060	2070
Atascosa Rural WSC Interconnects	12 in. dia. interconnections with East Medina SUD and City of Lytle	5,600	31	31	31	31	31	31
CRWA Lake Dunlap WTP Expansion	Expand Lake Dunlap WTP	2,300	1,040	1,040	1,040	1,040	1,040	1,040
CRWA Hays Caldwell WTP Expansion	Expand Hays Caldwell WTP	2,300	1,543	1,543	1,543	1,543	1,543	1,543
CPS Energy Direct Recycle Pipeline (Bexar Co. Steam-Electric)	Direct Pipeline from the Steven M. Clouse WRC to Calaveras Lake	50,000	0	50,000	50,000	50,000	50,000	50,000
GBRA Western Canyon WTP Expansion	Western Canyon WTP - 5 mgd WTP Expansion; Pump Station Improvements	5,600	0	0	0	0	1,725	1,566
Hays County Pipeline	10.2 mile, 36 in. dia. pipe and 8.8 mile, 16 in. dia. pipe	15,400	0	2,179	5,108	4,345	0	0
NBU South WTP Expansion	Expand South WTP	9,000	0	1	1	1	1	1
NBU-Seguin Interconnect	NBU-Seguin Interconnect	11,500	2,500	2,500	2,500	2,500	2,500	2,500
SAWS Western Integration Pipeline (Phase 2)	Western Integration Pipeline - Phase 2 (48 in. dia.)	84,100	1,406	4,000	4,000	4,000	4,000	4,000
SAWS Expanded ASR Treatment Plant	Expand ASR Treatment Plant	33,600	0	33,600	33,600	33,600	33,600	33,600

PROJECT	DESCRIPTION	CAPACITY OF EXPANSION (ACFT/YR)	WMS SUPPLY (ACFT/YR)					
			2020	2030	2040	2050	2060	2070
Springs Hill WSC Lake Placid WTP Expansion	Expansion of Lake Placid WTP; Pump station upgrade as necessary. New 16 in. dia. pipe bored under Guadalupe River along TX-46 (1,000 LF)	2,200 (2,800 acft/yr expansion with bored pipeline)	1,394	1,394	1,394	1,394	1,394	1,394

Atascosa Rural WSC

The Atascosa Rural WSC is interested in constructing 12-in diameter water transmission pipelines for interconnections with East Medina SUD and the City of Lytle. These interconnects would greatly increase the reliability of the utility and potentially provide a firm yield supply of 5 mgd or 5,600 acft/yr in the 2020 decade. Current WMS supplies are limited by MAG availability and are only made consistent with TWDB data. These volumes are not presentative of the physical projects.

CRWA Lake Dunlap WTP Expansion

CRWA is seeking an expansion of its Lake Dunlap WTP and transmission facilities to meet future needs. The facility currently has a capacity of 14.4 mgd or 16,100 acft/yr and the expansion is expected to provide an additional 2 mgd (2,300 acft/yr) in the 2020 decade. Current WMS supplies are limited by MAG availability and are only made consistent with TWDB data. These volumes are not presentative of the physical project.

CRWA Hays Caldwell WTP Expansion

CRWA is seeking an expansion to its Hays Caldwell WTP to treat an additional 2 mgd (2,300 acft/yr) water from San Marcos, Martindale, and others. In total, these expansions are currently planned to enable approximately 4 mgd (4,600 acft/yr) of firm yield supply in the 2020 decade. Current WMS supplies are limited by MAG availability and are only made consistent with TWDB data. These volumes are not presentative of the physical project.

City Public Service Energy Direct Recycle Pipeline

City Public Services (CPS) Energy is considering a direct reuse pipeline from SAWS' Steven M. Clouse Water Recycling Center (WRC) to its CPS Energy power plant lakes (Calaveras Lake and Lake Braunig). For purposes of this Regional Water Plan, SAWS is identified as the sponsor of this project. Addition of the pipeline will augment SAWS' delivery of recycle contract water to CPS Energy by up to 44.6 mgd (50,000 acft/yr) in the 2030 decade.

GBRA Western Canyon WTP Expansion

GBRA is seeking an expansion of its Western Canyon WTP and transmission facilities to meet future needs in western Comal County. The WTP expansion is expected to increase the treatment capacity and transmission pump stations of the plant from 11 mgd to 16 mgd – an increase of 5 mgd (5,600 act/yr).

GBRA expects these expansions to begin in the 2060 decade. Current WMS supplies are limited by MAG availability and are only made consistent with TWDB data. These volumes are not presentative of the physical project.

Hays County Pipeline

Hays County is currently securing water agreements for future supply to meet the needs of the Wimberley/Woodcreek area (Region L), the Dripping Springs area (Region K), and the Hays County-Other category (both Regions L and K). Several WMSs in this plan have been identified to meet the growing needs of the county; however, those strategies deliver water to points along the IH-35 corridor. GBRA is identified as the sponsor for this Hays County Pipeline Project, which would be a facilities expansion to help move these future supplies into and around the county to meet the needs over a widespread area. The strategy includes a 36-inch pipeline from the Kyle area, running along FM 150 toward Dripping Springs and a 16-inch spur pipeline running from the FM 150-RR 3237 split, along RR 3237, to the Wimberley area. Hays County estimates the capacity to provide up to 13.7 mgd (15,400 acft/yr) with these facilities expansion projects for Region L. Costs included in Subsection 5.2.8.4 represent the cost associated to meet only the needs for the Region L portion of Hays County. It is anticipated that Region K will have a facilities expansion project that will include a spur pipeline off the Region L strategy to meet the needs of Region K. GBRA expects these facilities to be developed in the 2030 decade. Current WMS supplies are limited by MAG availability and are only made consistent with TWDB data. These volumes are not presentative of the physical project.

NBU South WTP

NBU is seeking an expansion of its South WTP and transmission facilities to meet future needs of the service area. The WTP expansion is expected to increase the treatment capacity of the plant from 8 mgd to 16 mgd (9,000 acft/yr increase). Improvements to transmission pump stations will increase capacity to 16 mgd. NBU expects these facilities to be developed in the 2030 decade. Current WMS supplies are limited by MAG availability and are only made consistent with TWDB data. These volumes are not presentative of the physical project.

NBU-Seguin Interconnect

NBU is looking to construct an interconnect with the City of Seguin to receive an additional 2.2 mgd (2,500 acft/yr). This strategy includes a 55,000 foot long 16-inch pipeline and a new pumping station. These facility expansions would provide an increased capacity of 10.2 mgd (11,500 acft/yr). NBU expects these facilities to be developed in the 2020 decade. Current WMS supplies are limited by MAG availability.

SAWS Western Integration Pipeline

SAWS is looking to complete its Western Integration Pipeline, a water pipeline (48-inch to 60-inch in diameter) that would convey 75 mgd (84,100 acft/yr) of potable water from Southern Bexar County to Western Bexar County beginning in 2020. Current WMS supplies are limited by MAG availability and are only made consistent with TWDB data. These volumes are not representative of the physical project.

SAWS Expanded ASR Treatment Plant

SAWS is looking to expand its ASR Treatment Plant beginning in 2030. The expansion is necessary to accommodate the additional water from the Expanded Local Carrizo Project. The expanded ASR Treatment Plant would increase the plant's capacity by 30 mgd (33,600 acft/yr increase), resulting in a future capacity of 60 mgd. Costs and discussion here are only related to the expansion of the ASR WTP. Current WMS supplies are limited by MAG availability and are only made consistent with TWDB data. These volumes are not representative of the physical project. Expansion and costs of the SAWS wellfield are discussed in detail in Subsection 5.2.10 - SAWS Expanded Local Carrizo Project.

Springs Hill WSC Lake Placid WTP Expansion

Springs Hill WSC is interested in expanding its Lake Placid WTP. The WTP expansion is expected to increase the treatment capacity of the plant from 2 mgd to 4 mgd (2,200 act/yr) in the 2020 decade. Likewise, improvements to the WTP transmission pump stations will be necessary. Current WMS supplies are limited by MAG availability and are only made consistent with TWDB data. These volumes are not representative of the physical project.

Springs Hill WSC 16-inch Bored Pipeline Under the Guadalupe River

As part of the Springs Hill WSC Lake Placid WTP Expansion, Springs Hill WSC is interested in constructing a new 16-inch pipeline bored under the Guadalupe River along TX-46, which would increase capacity by up to 0.5 mgd (560 acft/yr) in the 2030 decade. The bored pipeline would be approximately 1,000 linear feet. Current WMS supplies are limited by MAG availability and are only made consistent with TWDB data. These volumes are not representative of the physical project.

Water Loss

Facilities expansion or new infrastructure such as pump stations and transmission pipelines are assumed to have negligible water losses.

5.2.8.3 Environmental and Cultural Considerations

Facilities expansions typically include adding or expanding water treatment plants, pipelines, pump station, and ground or elevated storage, many of which are on land and easements already owned by the WUG or WWP. During the permitting process for these facilities expansions, some facilities may require habitat studies and surveys for protected species and a cultural review. Detailed field surveys would typically be required for expansion projects involving new pipeline construction and/or expansion of facilities requiring extensive vegetation clearing, soil disturbance, or stream/wetland impacts. If a significant negative impact appears likely, some modifications to the project may be required. Mitigation may include compensation for net losses of wetlands where impacts are unavoidable.

5.2.8.4 Engineering and Costing

Preliminary engineering and costing have been completed for all facilities expansions not already included in other strategies. Costs are summarized in Table 5.2.8-2. Cost estimates were developed using 2021 Regional Water Planning methods and/or information provided by the sponsoring entity. All interconnections are assumed to be made by 12-inch diameter transmission pipelines, unless otherwise noted. The annual costs include debt service for a 20-year loan at 3.5 percent interest and operation and maintenance costs. A description of the facilities expansions requested by each WUG is presented in Subsection 5.2.8.1.

Table 5.2.8-2 Facilities Expansion Preliminary Costs

PROJECT	PROJECT COST	ANNUAL COST
Atascosa Rural WSC Interconnects • **East Medina SUD** • **Lytle**	 • $1,816,000 • $1,119,000	 • $141,000 • $133,000
CRWA Lake Dunlap WTP Expansion	$19,040,000	$2,417,000
CRWA Hays Caldwell WTP Expansion	$19,040,000	$2,417,000
CPS Energy Direct Recycle Pipeline (Bexar Co. Steam-Electric)	$35,589,000	$3,512,000
GBRA Western Canyon WTP Expansion	$23,953,000	$2,854,000
Hays County Pipeline	$25,486,000	$1,998,000
NBU South WTP Expansion	$27,701,000	$3,387,000
NBU-Seguin Interconnect	$2,428,000	$529,000
SAWS Western Integration Pipeline (Phase 2)	$113,039,000	$9,124,000
SAWS Expanded ASR Treatment Plant	$39,508,000	$6,631,000
Springs Hill WSC Lake Placid WTP Expansion	$12,994,000	$1,682,000
Springs Hill WSC 16-Inch Bored Pipeline Under the Guadalupe River	$490,000	$39,000

5.2.8.5 Implementation Considerations

Implementation considerations for the Facilities Expansion WMS are expected to vary widely with the type of projects, locations, and interested parties.

Reliability

This strategy was developed in accordance with WAM and/or GAM values for the appropriate area. As such, it is considered to be reliable supply (reliability score = 5) that will not compromise the DFCs as established by the GMA or the environmental flow standards as established by 30 TAC §298.

5.2.9 Recycled Water Strategies

5.2.9.1 Description of Water Management Strategy

Recycled water programs are defined as projects that utilize treated wastewater effluent as a replacement for water supply, reducing the overall demand for fresh water supply. Recycled water typically involves a capital project connecting the treatment plant discharge facilities to an individual area that has a relatively high, localized use that can be met with non-potable water. Examples most frequently include the irrigation of golf courses and other public lands and specific industries or industrial use areas. Few entities, if any, would be capable of utilizing their entire effluent capacity for recycled water at present; long term, it is likely that increased pressure on water supplies will result in increased emphasis on recycled water. Downstream needs, both water rights and environmental instream uses, would have to be met. Any remaining flows after these needs are met could potentially be utilized. Virtually any water supply entity with a wastewater treatment plant (WWTP) could pursue a recycled water alternative, provided that downstream water rights do not have a claim for the entire return flow.

All possible recycled water projects considered for implementation within Region L and described in the following chapter are classified as reuse projects.

Recycled water quality and system design requirements are regulated by the TCEQ under 30 TAC §210. TCEQ allows two types of recycled water as defined by the use of the water and the required water quality:

- Type 1 – Public or food crops generally can come in contact with recycled water.
- Type 2 – Public or food crops cannot come in contact with recycled water.

Current TCEQ criteria for recycled water are shown in Table 5.2.9-1. Trends across the country indicate that criteria for unrestricted recycled water will likely tend to become more stringent over time. The water quality required for Type 1 recycled water is more stringent with lower requirements for oxygen demand (biochemical oxygen demand [BOD_5] or carbonaceous biochemical oxygen demand [$CBOD_5$]), turbidity, and fecal coliform levels.

A general evaluation of recycled water for multiple WUGs with needs and potential wastewater sources were utilized to evaluate a broad range of potential recycled water supplies.

Table 5.2.9-1 TCEQ Criteria for Recycled Water

PARAMETER	ALLOWABLE LEVELS FOR RECYCLED WATER		
	TYPE 1	TYPE 2	
		FOR A SYSTEM OTHER THAN A POND	FOR A POND SYSTEM
BOD_5 or $CBOD_5$	5 mg/L	20 mg/L	30 mg/L
Turbidity	3 NTU	15 mg/L	--
Fecal Coliform[1]	20 CFU/100 mL	200 CFU/100 mL[1]	200 CFU/100 mL[1]

PARAMETER	ALLOWABLE LEVELS FOR RECYCLED WATER		
	TYPE 1	TYPE 2	
		FOR A SYSTEM OTHER THAN A POND	FOR A POND SYSTEM
Fecal Coliform (not to exceed) [2]	75 CFU/100 mL[2]	800 CFU/100 mL[2]	800 CFU/100 mL[2]
Enterococci[1]	4 CFU/100 mL[1]	35 CFU/100 mL[1]	35 CFU/100 mL[1]
Enterococci (not to exceed) [2]	9 CFU/100 mL[2]	89 CFU/100 mL[2]	89 CFU/100 mL[2]

[1] Geometric mean.
[2] Single grab sample.
NTU - nephelometric turbidity unit; CFU - colony forming units; mL - milliliter.

5.2.9.2 Evaluation of Submitted Reuse Water Management Strategies

City of Boerne (Non-potable)

The City of Boerne has two large neighborhoods under development with 3,400 homes in total. Each home within the new developments should have a lawn irrigation system via reclaimed water. At present, approximately 175 individual homes are served. Average consumption appears to be around 10,000 gallons/month/home. After full buildout, the city expects to be serving up to 1,500 acft of reclaimed water per year. Full buildout is expected to take about 15 years. Project costs for the construction of a new non-potable reuse water treatment plant estimated to exceed $9,000,000. This WMS is considered for implementation beginning in the 2020 decade.

Table 5.2.9-2 City of Boerne Reuse Project Yield (acft/yr)

	PROJECT YIELD (ACFT/YR)					
	2020	2030	2040	2050	2060	2070
City of Boerne Non-Potable Reuse	750	1,500	1,500	1,500	1,500	1,500

County Line SUD (Non-potable)

County Line SUD is beginning a phased project to develop a new reuse system for the future. In the first phase of the reuse system, County Line will provide reuse water to a nearby concrete plant (approximately 60,000 gpd) and several residential subdivisions to irrigate their parks/greenspaces. Potential end users in the future will include reuse services to new residential subdivisions as they develop and other irrigations meters as the reuse distribution system expands. The concrete plant should be a fairly consistent user year-round, but the subdivisions' irrigation usage will vary with the weather and time of year.

County Line has constructed a purple pipe that will link the reuse pump station to landscape/park irrigation meters within a subdivision that is being built and another that is expected to start construction in the near future. Current proposed projects include a non-potable reuse pump station and waterline improvements to deliver non-potable water to one of the water system's highest users.

The construction of a new 12 inch potable waterline will allow County Line SUD to convert an existing 4 inch potable water pipe along that same route alignment to reclaimed water, which will deliver the reuse water to the concrete plant. Project costs for the construction of a new non-potable reuse pump station and waterline improvements are estimated to exceed $8,456,000.

Other future improvements will be determined as potential non-potable water users are targeted. Ultimately, County Line SUD could have as much as 3 mgd of reuse water, but currently it is planning to build the new system up to around 0.5 mgd over the next 5 years or so. This WMS is considered for implementation beginning in the 2020 decade.

Table 5.2.9-3 County Line SUD Reuse Project Yield (acft/yr)

	PROJECT YIELD (ACFT/YR)					
	2020	2030	2040	2050	2060	2070
County Line SUD Non-Potable Reuse	560	1,120	1,680	2,240	2,800	3,360

City of Fair Oaks Ranch (Non-potable)

The City of Fair Oaks Ranch currently has a successful water reuse program that provides non-potable reuse water from its WWTP to a golf course for irrigation. The city is contractually obligated to provide all effluent from the WWTP to the golf course. The existing reuse system consists of a network of lines ranging from 6 to 8 inches, two chlorine stations, and three effluent storage ponds.

The city is planning to build a new WWTP that will be operational by 2028. The new WWTP will treat wastewater to provide additional effluent to be used for reuse. The new 0.6 mgd WWTP would require a new 2 mgd pump station and additional purple pipe. All effluent from the new WWTP would continue to be used by the golf course in accordance with the existing contract. Total project costs for the construction of a new 2 mgd pump station and approximately 6,000 linear feet of reuse pipe are estimated by a Fair Oaks Ranch consultant to cost $3,159,400. This WMS is considered for implementation beginning in the 2030 decade.

Table 5.2.9-4 Fair Oaks Ranch Reuse Project Yield (acft/yr)

	PROJECT YIELD (ACFT/YR)					
	2020	2030	2040	2050	2060	2070
Fair Oaks Ranch Non-Potable Reuse	0	672	672	672	672	672

Kendall County WCID No. 1 (Non-potable)

In 2017, Kendall County WCID No. 1 produced 73,806,067 gallons of reuse water directly from its sewer treatment plant. The reuse water (100 percent) is contracted to and used by the Buckhorn Golf Course, owned by Foresight Golf. The golf course is currently the only user under contract with the district. Because of construction of a sewer line to Center Point, it is anticipated that within the next 5 years the amount of reuse water generated from the sewer plant will increase by approximately 80 percent. At this time, there are no projects associated with the increased supply of potential reuse water. This WMS is considered for implementation beginning in the 2030 decade.

Table 5.2.9-5 Kendall County WCID No. 1 Reuse Project Yield (acft/yr)

	PROJECT YIELD (ACFT/YR)					
	2020	2030	2040	2050	2060	2070
Kendall County WCID No. 1 Non-Potable Reuse	180	180	180	180	180	180

SARA (Non-potable and Potable)

SARA has current reuse contracts with five customers: the Cities of Converse, Woodlake, and Universal City; Texas Landfill Management, LLC; and Alamo Community College. The combined contracts for the above entities currently total 1,657 acft/yr. Proposed reuse projects for the future include a contract to provide 5,000 acft/yr to the CRWA Siesta Project and several additional bed and banks permit authorizations, including WR No. 19-4195. In addition, potential demand for recycled water exists for future single-family development as well as existing and future commercial or park development.

Developing a recycled water program may provide a cost-effective strategy for meeting current and future water needs. In the future, SARA aims to discharge only the base flow requirement and utilize the rest of the WWTP effluent for direct reuse. According to a previous SARA study, the base flow requirements for Martinez and Salatrillo Creeks will total 4,344 acft/yr in 2070, which leaves approximately 24,000 acft/yr for the recycle program in 2070. The project cost for the infrastructure needed to support the projected increase in direct reuse is estimated to be $117,132,400. This WMS is considered for implementation beginning in the 2020 decade.

Table 5.2.9-6 SARA Reuse Project Yield (acft/yr)

	PROJECT YIELD (ACFT/YR)					
	2020	2030	2040	2050	2060	2070
SARA Non-Potable Reuse	1,000	6,750	12,500	18,200	21,100	24,000

SAWS (Non-potable and Potable)

SAWS currently supplies reuse to commercial, industrial irrigation, and electrical generation end users. In 2019, SAWS supplied 21,690 acft of reuse water, of which 6,587 acft went to golf courses and landscape irrigation. The remaining volume is for commercial, industrial, mixed uses, and stream augmentation. SAWS is now fully interconnected in the northern part of the city, allowing for recycle water to be delivered from both WWTPs. In addition to industrial and irrigation users, potential demand for recycled water exists for future municipal use as well as existing and future commercial development.

SAWS currently has an additional future indirect recycle program that is planning to increase its indirect reuse to 40,000 acft/yr by 2070. The total project cost for the infrastructure needed to support the projected increase in indirect reuse, such as conveyance, transmission, pump stations, and storage tanks, is estimated to be $196,963,000. The bed and banks permit for this project has already been submitted to the TCEQ. This WMS is considered for implementation beginning in the 2030 decade.

Table 5.2.9-7 SAWS Reuse Project Yield (acft/yr)

	PROJECT YIELD (ACFT/YR)					
	2020	2030	2040	2050	2060	2070
SAWS Indirect Reuse	0	5,000	5,000	15,000	25,000	40,000

City of San Marcos (Non-potable and Potable)

The existing recycled water conveyance system consists of an 18 inch diameter main from the San Marcos WWTP to a power plant. There is a 12 inch diameter extension to a cement plant and a planned extension to the proposed Paso Robles Golf Course. Current contracts for recycled water provide a commitment to the power plant but supply other users only on the basis of available supply. Although much of the city's parklands are maintained without supplemental irrigation, the parks along the San Marcos River are the centerpiece of the city's recreational tourist economy. The city's parks department has suggested that irrigating these parklands with recycled water could provide environmental and social benefits by reducing erosion potential along the river and improving the level of service of the local parks.

San Marcos is planning to expand and enhance its existing non-potable reuse system now, as well as initiate direct potable reuse as soon as the 2040 decade to provide potable water to customers. Planning for expansion of the recycled water system involved identifying potential users along the existing recycled water pipeline and along the route of a proposed pipeline to serve the Kissing Tree Development and Texas State University's thermal plants. Making recycled water available to the university would reduce demand for San Marcos River water and provide a benefit by allowing increased river flows through the areas of critical habitat. Additional extensions to serve the city's soccer complex and Gary ball fields would reduce potable water demands. Potential industrial users include a concrete products manufacturer and a concrete batch plant.

The San Marcos WWTP is not projected to have sufficient average effluent flows to meet future recycled water demand, but additional surface water rights can be obtained to blend with the treated water to meet future demands. A seasonal storage reservoir would be required so that peak demand could be met during periods of minimum WWTP flows. The recommended peak demand supply alternative is construction of a seasonal storage facility adjacent to the WWTP. The DPR project has been planned to supply 6,000 acft/yr by 2050. The effluent produced by the plant is Type 1 recycled water that should not require significant additional costs for treatment. Project costs estimated by a San Marcos consultant include costs for water treatment, water delivery, concentrate disposal, and O&M. The total project cost is estimated to exceed $106,770,000. San Marcos plans to recycle 100 percent of its WWTP discharge by 2070. This WMS for non-potable is considered for implementation beginning in the 2020 decade. This WMS for potable is considered for implementation beginning in the 2050 decade.

Table 5.2.9-8 San Marcos Reuse Project Yield (acft/yr)

	PROJECT YIELD (ACFT/YR)					
	2020	2030	2040	2050	2060	2070
San Marcos Non-Potable Reuse	1,826	1,971	1,971	1,971	1,971	1,971

	PROJECT YIELD (ACFT/YR)					
	2020	2030	2040	2050	2060	2070
San Marcos Potable Reuse	0	0	0	3,808	3,808	3,808
Potable Reuse Associated Water Losses	0	0	0	897	897	897

5.2.9.3 Discussion of Future Reuse in Region L

The following have been submitted by a sponsor but have no feasible project to include in the 2021 SCTRWP.

CCMA (Non-potable)

CCMA currently supplies reuse to five customers: Forum at Olympia Parkway, Mortellaro's Nursery, Schertz-Cibolo-Universal City Independent School District (SCUCISD), Olympia Hills Golf Course, and Randolph Air Force Base. Potential demand for recycled water exists for future single-family development as well as existing and future commercial or park development. Currently, a new contract with the City of Cibolo is being planned, as well as the latest contract with Universal City for 100 million gallons take or pay, with an additional option for 80 million gallons.

Developing a recycled water program may provide a cost-effective strategy for meeting current and future water needs. CCMA currently has permits pending for additional reclaimed water reservations and a bed and banks permit and is planning to divert 90 percent of its WWTP effluent to direct recycle customers by 2070. At this time, CCMA does not have any additional planned reclaimed water projects.

City of Kyle (Non-potable)

The City of Kyle's parks are presently maintained without supplemental irrigation of landscaping, playgrounds, or athletic fields. The primary demands of recycled water in the city are for the irrigation of public and private parks and public rights-of-way. In addition, potential demand for recycled water exists for future single-family development as well as existing and future commercial development. Developing a recycled water program may provide a cost-effective strategy for meeting current and future water needs while minimizing the discharge of nutrients to the Plum Creek watershed.

Recycled water has been in use in Kyle for well over a decade. The owners of the Plum Creek Golf Course have operated a recycled water system for golf course irrigation since 1998. However, this privately owned and operated system has a pumping and transmission capacity that is only suitable for the peak demand of the golf course. Furthermore, this system requires frequent maintenance to avoid service interruptions caused by clogged pumps. Expanding the use of recycled water in Kyle in a cost effective manner will likely require replacement of the existing system and operation as a public utility in conjunction with the water and wastewater utilities.

The Kyle WWTP presently discharges approximately 2 mgd of treated effluent. Average wastewater flows are projected to exceed 4 mgd by 2035, providing a source of recycled water that keeps pace with increasing recycled water demand. However, effluent water quality from Kyle WWTP will not meet Type 1 quality standards without additional treatment. To reduce capital and operations costs, additional treatment would be only for the effluent volume intended for the recycled water program. Currently, the city only has plans to develop a distribution system to move the reuse water in various parts of town, making it a viable sub utility in the future. The city plans to recycle 100 percent of its WWTP discharge by 2070. At this time, there are no projects associated with the increased supply of potential reuse water.

New Braunfels Utilities (Non-potable)

The primary purpose for developing a recycled water program in the City of New Braunfels is to enhance the appeal of the city's parklands and preserve limited water resources as the city's population grows. Approximately 172.8 acres of parkland is presently irrigated or will be irrigated in the future. A recycled water program designed to meet peak demand during drought conditions is estimated to have a maximum recycled water demand of about 904 acft/yr. Because of limited water resources and restrictions on outdoor irrigation during drought periods, recycled water has the potential to provide an efficient and drought resistant source of water for irrigation needed to preserve and enhance public parks and athletic fields. Park irrigation increases between March and September at the same time that water demand for residential irrigation increases. Currently, water from the Edwards Aquifer is pumped from NBU wells to supplement surface water supplies and meet seasonal peak demand. However, recycled water may be used for park irrigation and reduce the use of potable water from the Edwards Aquifer. In addition, using wastewater effluent as park irrigation may reduce the nutrient load that would ordinarily be discharged into the Comal and Guadalupe Rivers.

NBU currently operates a recycled water system that provides water to a 29-acre mixed use development called Sundance Park. Delivery of the recycled water is through approximately 0.75 miles of 10-inch pipeline from the Gruene WWTP. There are three ponds at Sundance Park that store effluent. The NBU contract provides for delivery of up to 2,000,000 gallons per month.

The NBU wastewater system has a total treatment capacity of 8.4 mgd associated with three WWTPs. The Gruene WWTP is located in the northeastern quadrant of the city on the Guadalupe River upstream of the confluence with the Comal River and has a reuse capacity of 16.3 million gallons per year. The North and South Kuehler WWTPs are located south of IH 35 on the Guadalupe River below the confluence with the Comal River.

NBU's most recent reuse project was to tie the reuse water produced from the North and South Keuhler WWTPs to a number of city parks. Unfortunately, there is currently no economical way of storing the reuse water between peak general and peak demand. The alternative solution to maintain this project required implementing a rotating schedule between the reuse customers to meet their weekly demands and a new distribution system capable of pumping the water to the customers. The cost for a new distribution system and the limited availability of reuse water for the customer moved the project to a low priority.

Further expansion of NBU's reuse program has been put on hold at this time, but the utility will continue to explore reuse projects in the future. NBU plans to recycle 100 percent of its WWTP discharge by 2070.

City of Seguin (Non-potable)

The City of Seguin has some contractual agreements in place to provide reuse water to CPS Energy at the Rio Nogales Power Plant. Between 2006 and 2017, the Rio Nogales Power Plant averaged 655 acft/yr with a maximum of 880 acft/yr and a minimum of 466 acft/yr. Seguin has made efforts to work cooperatively with CPS Energy at the Rio Nogales Power Plant to increase its usage of reuse water. Currently, Seguin is not at a point to provide any projections on that increase but will continue to explore avenues to expand its reuse program.

5.2.9.4 Environmental Considerations

A summary of environmental issues is presented in Table 5.2.9-9.

Table 5.2.9-9 Environmental Issues: General Recycled Water

GENERAL RECYCLED WATER	
Implementation Measures	Development of additional WWTP facilities, distribution pipelines, and pump stations. Avoidance of project locations on the Edwards Aquifer recharge zone is desirable.
Environmental Water Needs/ Instream Flows	Possible low impact on in-stream flows due to decreased effluent.
Bays and Estuaries	Possible low impact on freshwater inflows during drought due to decreased effluent.
Fish and Wildlife Habitat	Possible impacts depending on changes in volume of effluent and locations of recycled water projects.
Cultural Resources	Possible impacts depending on project location.
Threatened and Endangered Species	Possible impacts depending on project location and habitat requirements for listed species.
Agriculture	Possible agricultural land use impacts depending on project location
Comments	Assumes needed infrastructure will be in urbanized areas.

A potential positive effect of the Recycled Water Strategies WMS is the potential reduced need for additional groundwater and/or surface water projects that may have greater negative environmental effects through aquifer or stream withdrawals and additional transmission pipelines.

5.2.9.5 Engineering and Costing

The required improvements to implement a recycled water program would be expected to vary considerably between entities according to the upgrades required both in treatment and distribution. Therefore, cost estimates received from participating entities were used when available. While recent reuse reports and costs were obtained for future development from the Cities of Fair Oaks Ranch[1] and

[1] "Final Draft Water, Wastewater, & Reuse Master Report." Freese and Nichols, Inc. Prepared for City of Fair Oaks Ranch. 2019.

San Marcos[2], the reports did not calculate costs for 2070 conditions. The projected project costs and reclaimed water demands in the available reports were updated to September 2018 values and used to develop a unit cost per acft of reuse supply, which was then applied to 2070 demands (Table 5.2.9-10). An interest rate of 3.5 percent was assumed for a debt service of 20 years.

Recent reuse reports and costs were obtained for future development from County Line SUD's[3] reuse project. The information provided was used to develop a costing estimate using the uniform costing model (Table 5.2.9-10). While a report from SARA was not readily available, communications[4] with SARA indicated that its most recent direct reuse project had a $1,500 acft/yr unit cost in March of 2015, including annual debt service, O&M costs, and water charges. Costs were updated to report as September 2018 dollars. SAWS currently has a reuse system in place with a similar capacity to the expected expansion. Costs from the existing system were updated to September 2018 dollars and applied to the planned expansion. Project, annual, and unit costs can be found in Table 5.2.9-10 along with expected capacity. The Kendall County WCID No. 1 Reuse WMS is an increase of wastewater supply as a result of a new customer. Currently, no plans for new or necessary infrastructure were submitted, so it is assumed that no costs are associated with the supply increase at this time.

No current information was available for costing the reuse project for the City of Boerne so the uniform costing model was utilized to estimate a cost for the Water Treatment Plant, but is expected to exceed the cost estimate presented here. The projected project, annual, and unit costs for each of the reuse strategies is presented in Table 5.2.9-10.

Table 5.2.9-10 Costs for Reuse Projects

ENTITY	CAPACITY (ACFT)	PROJECT COSTS	ANNUAL COSTS	UNIT COSTS ($/ACFT)
City of Boerne	1,500	$9,575,000	$1,337,000	$891
County Line SUD	3,360	$28,256,000	$3,335,000	$993
City of Fair Oaks Ranch	672	$3,159,400	$271,000	$403
SARA	21,978	$117,132,400	$9,801,600	$1,613
SAWS	40,000	$196,963,028	$20,645,000	$516
San Marcos	5,779	$106,770,000		
• Non-Potable	1,971		2,828,000	1,435
• Potable	3,808		7,539,000	1,980

[2] "Direct Water Reuse Expansion Feasibility Study." RPS. Prepared for The City of San Marcos and Texas State University. September 2013.
[3] "County Line Reuse Plant Preliminary Cost Estimate." Southwest Engineers. Prepared for County Line SUD. May 9, 2019.
[4] Email. Raabe, Steve. March 6, 2015.

5.2.9.6 Implementation Considerations

This water supply option has been compared to the plan development criteria, as shown in Table 5.2.9-11, and the option meets each criterion. Each community that pursues recycled water will need to investigate concerns that would include, at a minimum, the following:

- Amount of treated effluent available, taking into consideration downstream water commitments and discharge permit restrictions;
- Potential users, primarily individual large-scale users that could utilize non-potable water (e.g., certain industries) and irrigated lands (e.g., golf courses and park areas); and
- Capital costs of constructing needed distribution systems connecting the treatment facilities to the areas of recycled water.

Recycled water requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to recycled water customers may include the following:

- USACE Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the United States for construction; and other activities;
- TPDES Storm Water Pollution Prevention Plan; and
- TPWD sand, shell, gravel, and marl permit for construction in state-owned streambeds.

Table 5.2.9-11 Comparison of General Recycled Water Option to Plan Development Criteria

IMPACT CATEGORY	COMMENT(S)
A. Water Supply	
1. Quantity	1. Potentially important source, up to 25 percent of demand.
2. Reliability	2. High reliability.
3. Cost	3. Reasonable.
B. Environmental factors	
1. Environmental Water Needs	1. Produces instream flows—low to moderate impact.
2. Habitat	2. Possible low impact.
3. Cultural Resources	3. None or low impact.
4. Bays and Estuaries	4. None or low impact.
5. Threatened and Endangered Species	5. Possible impact.
6. Wetlands	6. None or low impact.
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; benefit accrues to demand centers by more efficient use of available water supplies; no effect on navigation.

D. Threats to Agriculture and Natural Resources	Generally positive effect to agriculture and natural resources by avoiding need for new supplies.
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages.
F. Requirements for Inter-Basin Transfers	Not applicable.
G. Third-Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies.

Reliability

Supply amounts for this strategy were developed based on estimates of water use and related return flows to specific wastewater treatment plants. Where applicable, consideration was given for specific minimum by-pass flow requirements where required by water rights. This strategy is considered highly reliable (reliability score = 5). There is the potential for the reuse supplies to develop at a faster or slower rate, depending on the volume of return flows.

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5.2.10 SAWS Expanded Local Carrizo Project

5.2.10.1 Description of Water Management Strategy

SAWS currently produces approximately 9,900 acft/yr of groundwater from the local Carrizo Aquifer, located on the SAWS H_2Oaks Center property in southern Bexar County[1]; it is north/northeast of their ASR well field. As part of the SAWS Expanded Local Carrizo Project (a recommended WMS in the 2016 SCTRWP), the current well field will be expanded to produce an additional 21,000 acft/yr of water from 11 wells (including two contingency wells) constructed in three phases/well fields; all phases will be implemented in the 2040 decade. The WMS is based on the development of additional fresh groundwater from the Carrizo Sands of the Carrizo-Wilcox Aquifer (Figure 5.2.10-1). The wells in the Expanded Local Carrizo Project would be located northeast of the H_2Oaks Center. Raw water from the wells will be delivered to the H_2Oaks Center for treatment. Water will then be delivered to the SAWS distribution system through either the existing east side integration pipeline or the new west side integration pipeline.

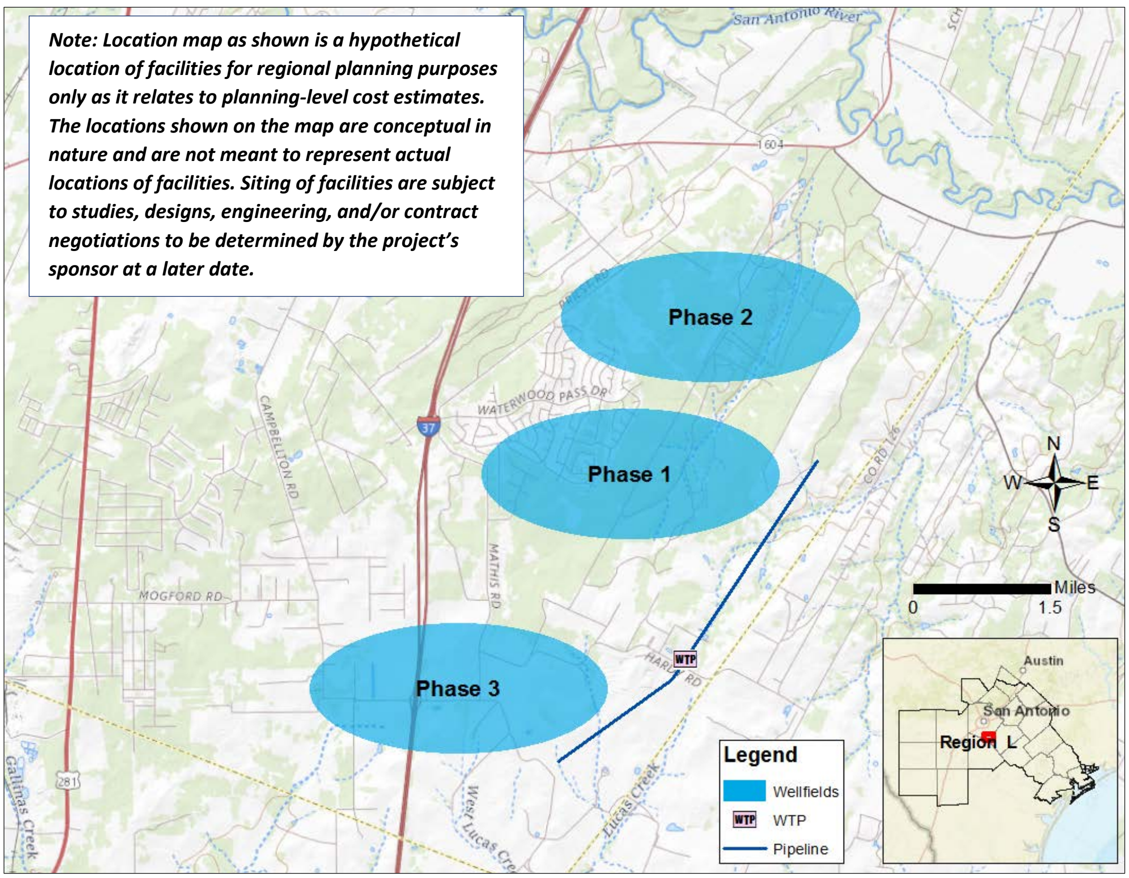

Figure 5.2.10-1 SAWS Expanded Local Carrizo Project Location

[1] SAWS 2017 Water Management Plan; https://www.saws.org/your-water/new-water-sources/2017-water-management-plan/

5.2.10.2 Available Yield

Based on available hydrogeologic information[2], the SAWS Expanded Local Carrizo Project consists of 11 wells constructed in three phases (Table 5.2.10-1). The expected depth for each new Carrizo Aquifer well will range from 550 to 600 feet below ground surface (average depth of 575 feet) and will produce approximately 1,380 gpm. The wells will be screened in the Carrizo Sand formation, just down-dip of the Carrizo Aquifer outcrop. Water in the Carrizo formation has a TDS concentration of less than 300 mg/L and relatively high concentrations of iron and manganese. High iron and manganese will require treatment at the H_2Oaks Center WTP before being sent to the distribution system.

Table 5.2.10-1 SAWS Expanded Local Carrizo Project Phases

PHASE	NUMBER OF WELLS	YIELD (ACFT/YR)	IMPLEMENTATION DECADE
1	4*	7,000	2040
2	4*	7,000	2040
3	3	7,000	2040
Total	**11**	**21,000**	**2040**
* Includes one contingency well in this phase.			

Several SAWS projects are located in the immediate vicinity of the SAWS Expanded Local Carrizo Project, including the following:

- The existing SAWS Local Carrizo Project;
- The existing SAWS brackish Wilcox Project;
- The SAWS ASR project that stores Edwards Aquifer water in the Carrizo Aquifer; and
- The planned SAWS Expanded Brackish Groundwater Project (See Section 5.2.11).

As part of future planning for this SAWS Expanded Local Carrizo Project, the cumulative effects of recharge operations and pumping should be thoroughly evaluated for SAWS operations and impacts to neighboring groundwater users. There is no local groundwater conservation district that regulates groundwater production or well spacing in the Carrizo Aquifer in Bexar County.

[2] Deeds et al. 2003, GAM for the Southern Carrizo Aquifer; http://www.twdb.texas.gov/groundwater/models/gam/czwx_s/CZWX_S_Full_Report.pdf?d=2327786.58

In November 2016, GMA-13 established the DFC for the Carrizo-Wilcox, Queen City Sparta Aquifer[3]. Based on the approved DFC, the TWDB has determined that the MAG for the Carrizo-Wilcox Aquifer in Bexar County is 78,807 acft/yr in 2070[4]. Historic groundwater production from the entire Carrizo-Wilcox Aquifer in Bexar County has been highly variable, ranging from less than 1,000 acft/yr to more than 10,000 acft/yr since 2008, with no discernable trend. Even if the largest estimated historic production of 10,464 acft/yr is used, over 68,000 acft/yr remaining in available MAG for additional projects.

Water Loss

Groundwater expansion strategies that assume additional yield from existing infrastructure have no additional water losses associated with them. Groundwater expansion, development, and importation strategies that require new infrastructure are assumed to have negligible water losses.

5.2.10.3 Environmental and Cultural Considerations

Environmental Considerations

Vegetation and Land Use

The project is located in the Post Oak Savannah ecoregion. As mapped by the Texas Parks and Wildlife Department (TPWD)[5], the project area mostly occurs within savannah grassland vegetation communities. Small areas of woody vegetation are mapped, including live oak motte and woodland, post oak motte and woodland, and mesquite shrubland. The proposed pipeline crosses riparian vegetation zones mapped by TPWD as riparian live oak forest, riparian deciduous shrubland, and riparian herbaceous vegetation.

Based on TPWD vegetation mapping, the project would not result in impacts to areas mapped as row crops or areas mapped as disturbance or tame grassland which may include pasture used for grazing or hay production.

The proposed well pads would result in conversion of land use from undeveloped vegetation or agricultural use (mostly open fields) to small areas of industrial use. Project pipeline easements would require removal of woody vegetation and long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each WMS to determine the best course of action regarding revegetation.

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[3] Texas Water Development Board, Groundwater Management Area 13 – Desired Future Conditions. http://www.twdb.texas.gov/groundwater/dfc/docs/summary/GMA13_DFC_2016.pdf?d=52712.51999999731

[4] Texas Water Development Board, Groundwater Management Area 13 – Modeled Available Groundwater, GR 17-027 MAG. http://www.twdb.texas.gov/groundwater/dfc/docs/summary/GMA13_MAG_2016b.pdf?d=52712.51999999731.

[5] TPWD. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

Aquatic Resources

The project area contains several unnamed intermittent streams and their associated floodplains. The project does not cross any water bodies designated as impaired in the Texas Integrated Report of 303(d) listed water bodies[6]. The National Wetlands Inventory (NWI) mapping shows two freshwater ponds in the project area. The project area does not contain impaired stream segments as defined by TCEQ or ecologically significant stream segments as designated by TPWD.

The project will require an on-site delineation of streams, ponds and wetlands. Well field facilities can typically be sited to avoid impacts to Waters of the United States, including wetlands. Stream crossing for pipeline construction would result in temporary stream impacts that would require U.S. Army Corps of Engineers (USACE) permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12 – Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including if there would be permanent impacts to over 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under stream (e.g., through horizontal directional drilling) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

Table 5.2.10-2 provides a summary of threatened, endangered and candidate species and species of concern that have potential to occur in Bexar County[7,8]. It should be noted that the county species lists are current as of August 9, 2019, but may be updated as new species information becomes available. Suitable habitat does not occur for any of the federally listed species, and there is low likelihood of suitable habitat for freshwater mussels. Suitable habitat may occur for state listed threatened species, including white-faced ibis (*Plegadis chihi*), Texas horned lizard (*Phrynosoma cornutum*), Texas indigo snake (*Drymarchon melanurus erebennus*), and Texas tortoise (*Gopherus berlandieri*).

There is potential for suitable habitat for numerous wildlife species designated by TPWD as Species of Greatest Conservation Need (SGCN) including American bumblebee (*Bombus pensylvanicus*), Strecker's chorus frog (*Pseudacris streckeri*), Woodhouse's toad (*Anaxyrus woodhousii*), western burrowing owl (*Athene cunicularia hypugaea*), American badger (*Taxidea taxus*), thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*), eastern spotted skunk (*Spilogale putorius*), and plains spotted skunk (*Spilogale putorius interrupta*). In addition, SGCN bat species may utilize structures and could therefore occur in developed areas. The SGCN list also includes numerous plant species. SGCN species do not have formal protected status but are being monitored by TPWD.

Since suitable habitat does not occur for federally-listed threatened or endangered species, consultation with the U.S. Fish and Wildlife Service (USFWS) would not be required. Site-specific field surveys would be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be

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[6] Texas Commission on Environmental Quality. 2018. 2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf.

[7] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Bexar County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[8] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation (IPaC) Resource List – Bexar County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources .

required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain their recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request pre-construction surveys to search for and relocate any protected species that occur in the project area.

The federal Migratory Bird Treaty Act (MBTA) protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct pre-construction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15.

Table 5.2.10-2 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for SAWS Expanded Local Carrizo Project, Bexar County, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Black-spotted newt	*Notophthalmus meridionalis*	N/A	T	Gulf Coastal Plain south of the San Antonio River; in resacas and bodies of water with firm bottoms and little or no vegetation. Also in wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; the absence of predatory fish is probably important.	Project area is outside the expected range of this species.
Cascade Caverns salamander	*Eurycea latitans*	N/A	T	Springs and caves in Guadalupe River, Medina River, and Cibolo Creek watersheds, all within the Edwards Aquifer.	Suitable karst habitat does not occur within the project area.
Comal Blind salamander	*Eurycea tridentifera*	N/A	T	Within aphotic zones of shallow limestone caves; found in springs and waters of caves.	Suitable karst habitat does not occur within the project area.
Mexican treefrog	*Smilisca baudinii*	N/A	SGCN	The subtropical Rio Grande embayment around Brownsville. May do well in association with human development and may tolerate relatively dry situations provided moist microclimates are available.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Strecker's chorus frog	*Pseudarcris streckeri*	N/A	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Suitable habitat may occur along the pipeline alignment and well field sites.
Texas salamander	*Eurycea neotenes*	N/A	SGCN	Cave streams, seeps, springs, and creek headwaters; Helotes and Leon Creek drainages.	Project is outside of the expected range of this species.
Valdina Farms sinkhole salamander	*Eurycea troglodytes*	N/A	SGCN	Isolated, intermittent pools of subterranean streams and sinkholes in Nueces, Frio, Guadalupe, and Pedernales watersheds within Edwards Aquifer area.	Project is outside of the expected range of this species.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur along the pipeline alignment and well field sites.
Arachnids					
Braken Bat Cave meshweaver	*Cicurina venii*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Cokendolpher Cave harvestman	*Texella cokendolpheri*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Government Canyon Bat Cave meshweaver	*Cicurina vespera*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Government Canyon Bat Cave spider	*Neoleptoneta microps*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Madla Cave meshweaver	*Cicurina madla*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
No accepted common name	*Tartarocreagris amblyopa*	N/A	SGCN	Karst features.	Suitable karst habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Robber Baron Cave meshweaver	*Cicurina baronia*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Arthropods					
No accepted common name	*Speodesmus falcatus*	N/A	SGCN	Karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Speodesmus ivyi*	N/A	SGCN	Subterranean obligate.	Suitable karst habitat does not occur in project area.
No accepted common name	*Speodesmus reddelli*	N/A	SGCN	Karst features.	Suitable karst habitat does not occur in project area.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat does not occur in project area; may fly over or forage in wetlands during migration.
Black-capped vireo	*Vireo articapilla*	DL	E	Patches of oak-juniper woodland with open grassy spaces; foliage must reach ground level for nesting cover.	Suitable habitat does not occur in project area; may fly over during migration.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur within project area; may fly over during migration.
Golden-cheeked warbler	*Setophaga chrysoparia*	E	E	Mixed stands of Ashe juniper and various oaks; edges of cedar brakes.	Suitable habitat does not occur in project area; may fly over during migration.
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also known to nest on manmade structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Suitable habitat does not occur in project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat may occur along the pipeline alignment and well field sites; may fly over or feed in area during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur within project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	SGCN	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Project is outside of the expected range of this species.
Tropical parula	*Setophaga pitiayumi*	N/A	T	Dense or open woods, brush, trees, and undergrowth along edges of river and resacas.	Suitable habitat does not occur within project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots, nests, and roosts in abandoned burrows.	Suitable habitat may occur along the pipeline alignment and well field sites.
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat may occur along the pipeline alignment and well field sites; may fly over during migration.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems [during migration].	Suitable habitat does not occur within project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Unlikely to occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat does not occur within project area; may fly over during migration.
Crustaceans					
A cave obligate isopod	*Speocirolana hardeni*	N/A	SGCN	Cave obligate.	Suitable karst habitat does not occur in project area.
Cascade Cave amphipod	*Stygobromus dejectus*	N/A	SGCN	Subaquatic, subterranean pools.	Suitable karst habitat does not occur in project area.
Ezell's Cave amphipod	*Stygobromus flagellates*	N/A	SGCN	Artesian wells.	Suitable karst habitat does not occur in project area.
No accepted common name	*Mexiweckelia hardeni*	N/A	SGCN	Cave obligate amphipod.	Suitable karst habitat does not occur in project area.
Fishes					
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat does not occur in project area.
River darter	*Percina shumardi*	N/A	SGCN	Confined to large rivers and lower parts of major tributaries; almost invariably found in deep chutes and riffles where current is swift and bottom composed of coarse gravel or rock.	Suitable habitat does not occur in project area.
Texas shiner	*Notropis amabilis*	N/A	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Suitable karst habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Toothless blindcat	*Trogloglanis pattersoni*	N/A	SGCN	Known from five artesian wells penetrating the San Antonio Pool of the Edwards Aquifer; found at depths of 305 to 582 meters.	Project would not affect groundwater.
Widemouth blindcat	*Satan eurystomus*	N/A	SGCN	Known from five artesian wells penetrating the San Antonio Pool of the Edwards Aquifer; found at depths of 305 to 582 meters.	Project would not affect groundwater.
Insects					
A cave obligate beetle	*Batrisodes shadeae*	N/A	SGCN	Cave obligate.	Suitable karst habitat does not occur in project area.
A ground beetle	*Rhadine exilis*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
A ground beetle	*Rhadine infernalis*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur along the pipeline alignment and well field sites.
No accepted common name	*Bombus variabilis*	N/A	SGCN	Parasite on other bumblebee species.	Suitable habitat may occur in the project area.
Helotes mold beetle	*Batrisodes venyivi*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Manfreda giant skipper	*Stallingsia maculosus*	N/A	SGCN	Subtropical mesquite scrub with a lot of Manfreda, on sandy or clay soils, either dry or moist. Apparently occasionally pine woodland.	Suitable habitat may occur along the pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
No accepted common name	*Cotinis boylei*	N/A	SGCN	South Texas coastal plains.	Suitable habitat unlikely to occur in the project area.
No accepted common name	*Cotalpa conclamara*	N/A	SGCN	Sandy soils and post oak.	Suitable habitat may occur along the pipeline alignment and well field sites.
No accepted common name	*Dichopetala catinata*	N/A	SGCN	Grassland, shrubland.	Suitable habitat may occur along the pipeline alignment and well field sites.
No accepted common name	*Dichopetala seeversi*	N/A	SGCN	Grassland, shrubland.	Suitable habitat may occur along the pipeline alignment and well field sites.
No accepted common name	*Lymantes nadineae*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in the project area.
No accepted common name	*Megachile parksi*	N/A	SGCN	Grassland shrubland	Suitable habitat may occur along the pipeline alignment and well field sites
No accepted common name	*Nectopsyche texana*	N/A	SGCN	Riparian/riverine habitats.	Suitable unlikely to occur in the project area.
No accepted common name	*Rhadine bullis*	N/A	SGCN	Cave obligate.	Suitable karst habitat does not occur in the project area.
No accepted common name	*Pygarctia lorula*	N/A	SGCN	Savannah, open woodland.	Suitable habitat may occur in the project area.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur along the pipeline alignment and well field sites.
Big brown bat	*Eptesicus fuscus*	N/A	SGCN	Woodlands or wooded areas.	Suitable habitat may occur along the pipeline alignment and well field sites.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls but will use buildings.	May use buildings/ structures in the project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Black bear	*Ursus americanus*	N/A	T	Juniper-oak habitat, bottomland hardwoods, floodplain forests, upland hardwoods with mixed pine.	Project is outside the expected range of this species.
Black-tailed prairie dog	*Cynomys ludovicianus*	N/A	SGCN	Short, flat, dry grasslands with sparse vegetation.	Project area is outside the expected range of this species.
Cave myotis bat	*Myotis velifer*	N/A	SGCN	Cave-dwelling, also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	May use buildings/ structures in the project area.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat may occur along the pipeline alignment and well field sites.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges and woodlands. Prefer wooded, brushy areas; tallgrass prairies.	Suitable habitat may occur along the pipeline alignment and well field sites.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Suitable habitat may occur along the pipeline alignment and well field sites.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur along the pipeline alignment and well field sites.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	May use buildings/ structures and forage along the pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps and marshes.	Unlikely to occur in the project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Use wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Low potential of suitable habitat within the project area.
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	SGCN	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur along the pipeline alignment and well field sites.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat may occur along the pipeline alignment and well field sites.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Prefer short-grass prairies; also occur in pastures and along fencerows. Excavate burrows or use abandoned pocket gopher or prairie dog burrows.	Suitable habitat may occur along the pipeline alignment and well field sites.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Low potential to occur in project area.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat may occur along the pipeline alignment and well field sites.
Western spotted skunk	*Spilogale gracilis*	N/A	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur along the pipeline alignment and well field sites.
White-nosed coati	*Nasua narica*	N/A	T	Canyons, riparian corridors, and woodlands.	Unlikely to occur within project area.
Mollusks					

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Golden orb	*Cyclonaias aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Unlikely to occur within project area.
Mimic cavesnail	*Phreatodrobia imitata*	N/A	SGCN	Subaquatic, only known from two wells penetrating the Edwards Aquifer.	Project would not affect groundwater.
No accepted common name	*Phreatodrobia conica*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Cyclonaias necki*	N/A	SGCN	Guadalupe River basin; moderate to large streams with flowing water.	Unlikely to occur within project area.
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	N/A	SGCN	Endemic to sandy regions of southern and south-central Texas.	Suitable sandy habitats may occur along the pipeline alignment and well field sites.
Big red sage	*Salvia pentstemonoides*	N/A	SGCN	Moist to seasonally wet, steep limestone outcrops on seeps within canyons or along creek banks; occasionally on clayey to silty soils of creek banks and terraces, in partial shade to full sun.	Suitable habitat does not occur within project area.
Bigflower cornsalad	*Valerianella stenocarpa*	N/A	SGCN	Usually along creek beds or in vernally moist grassy open areas.	Suitable habitat may occur along the pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Bracted twistflower	Streptanthus bracteatus	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Suitable habitat does not occur within project area.
Bristle nailwort	*Paronychia setacea*	N/A	SGCN	Eastern south-central Texas, occurring in sandy soils.	Suitable habitat may occur along the pipeline alignment and well field sites.
Buckley tridens	*Tridens buckleyanus*	N/A	SGCN	Juniper-oak woodlands on rocky limestone slopes.	Suitable habitat does not occur within project area.
Burridge greenthread	*Thelesperma burridgeanum*	N/A	SGCN	Sandy open areas.	Suitable sandy habitats may occur along the pipeline alignment and well field sites.
Corell's false dragon-head	*Physostegia correllii*	N/A	SGCN	Wet, silty clay loams on streamsides, in creek beds, irrigation channels, and roadside drainage ditches; or underlain by Austin Chalk limestone along gently flowing spring-fed creek in central Texas.	Low potential for suitable habitat to occur along the pipeline alignment and well field sites.
Elmendorf's onion	*Allium elmendorfii*	N/A	SGCN	Grassland openings in oak woodlands on deep, loose, well-drained sands; to the north it occurs in post oak-black hickory-live oak woodlands over Queen City and similar Eocene formations.	Suitable habitat may occur along the pipeline alignment and well field sites.
Glass Mountains coral-root	*Hexalectris nitida*	N/A	SGCN	Ashe juniper woodlands over limestone in Edwards Plateau.	Suitable habitat unlikely to occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Gravelbar brickellbush	*Brickellia dentata*	N/A	SGCN	Frequently scoured gravelly alluvial beds in creek and river bottoms.	Suitable habitat unlikely to occur within project area.
Hairy sycamore-leaf snowbell	*Styrax platanifolius ssp. stellatus*	N/A	SGCN	Usually in oak-juniper woodlands on steep rocky banks and ledges along intermittent or perennial streams, rarely far from some reliable source of moisture.	Suitable habitat does not occur within project area.
Heller's beardtongue	*Penstemon triflorus ssp. integrifolius*	N/A	SGCN	Rock outcrops and in grasslands associated with juniper-oak woodlands	Suitable habitat does not occur within project area.
Heller's marbleseed	*Omosmodium helleri*	N/A	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Suitable habitat does not occur within project area.
Hill Country wild-mercury	*Argythamnia aphoroides*	N/A	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands; also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Suitable habitat does not occur within project area.
Low spurge	*Euphorbia peplidion*	N/A	SGCN	Occurs in a variety of vernally moist situations in a number of natural regions.	Suitable habitat may occur along the pipeline alignment and well field sites.
Lundell's whitlow-wort	*Paronychia lundellorum*	N/A	SGCN	The Sand Sheet of eastern South Texas, in tight sandy soils over saline clay on microhighs within salty prairie grasslands, and in upper portions of saline flats surrounding short drainages and brackish basins typical of the South Texas Sand Sheet.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Narrowleaf brickellbush	*Brickellia eupatorioides var. gracillima*	N/A	SGCN	Moist to dry gravelly alluvial soils along riverbanks but also on limestone slopes.	Suitable habitat does not occur within project area.
Net-leaf bundleflower	*Desmanthus reticulatus*	N/A	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat may occur along the pipeline alignment and well field sites.
Osage Plains false foxglove	*Agalinis densiflora*	N/A	SGCN	Grasslands on shallow, gravelly, well-drained calcareous soils; prairies, dry limestone soils.	Suitable habitat may occur along the pipeline alignment and well field sites.
Parks jointweed	*Polygonella parksii*	N/A	SGCN	Mostly on deep, loose, whitish sand blowouts (unstable, deep, xeric, sandhill barrens) in Post Oak Savanna landscapes over the Carrizo and Sparta formations; also occurs in early successional grasslands, along rights-of-way, and on mechanically disturbed areas.	Suitable sandy habitats may occur along the pipeline alignment and well field sites.
Plateau loosestrife	*Lythrum ovalifolium*	N/A	SGCN	Banks and gravelly beds of perennial or strong intermittent streams on Edwards Plateau.	Suitable habitat does not occur within project area.
Plateau milkvine	*Matelea edwardsensis*	NA	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Suitable habitat does not occur within project area.
Sandhill woolywhite	*Hymenopappus carrizoanus*	N/A	SGCN	Disturbed or open areas in grasslands and post oak woodlands on deep sands derived from the Carrizo Sand and similar Eocene formations.	Suitable habitat may occur along the pipeline alignment and well field sites.
Siler's huaco	*Manfreda sileri*	N/A	SGCN	Rare in a variety of grasslands and shrublands on dry sites.	Suitable habitat may occur along the pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
South Texas rushpea	*Caesalpinia phyllanthoides*	N/A	SGCN	Tamaulipan thorn shrublands or grasslands on very shallow sandy to clayey soils over calcareous sandstone and caliche.	Low likelihood of suitable habitat within project area.
Spreading leastdaisy	*Chaetopappa effusa*	N/A	SGCN	Limestone cliffs, ledges, bluffs, steep hillsides, sometimes in seepy areas, oak-juniper, oak, or mixed deciduous woods, 300 to 500 meter elevation.	Low likelihood of suitable habitat within project area.
Sycamore-leaf snowbell	*Styrax platanifolius ssp. platanifolius*	N/A	SGCN	Rare throughout range, usually in oak-juniper woodlands on steep rocky banks and ledges along intermittent or perennial streams, rarely far from some reliable source of moisture.	Suitable habitat does not occur within project area.
Texas almond	*Prunus minutiflora*	N/A	SGCN	Variety of grassland and shrubland habitats, mostly on calcareous soils underlain by limestone.	Low likelihood of suitable habitat in project area.
Texas amorpha	*Amorpha roemeriana*	N/A	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes, sometimes on dry shelves above creeks.	Suitable habitat does not occur within project area.
Texas fescue	*Festuca versuta*	N/A	SGCN	Mesic woodlands on limestone-derived soils on stream terraces and canyon slopes.	Suitable habitat does not occur within project area.
Texas peachbush	*Prunus texana*	N/A	SGCN	Occurs at scattered sites in various well drained sandy situations; deep sand, plains and sand hills, grasslands, oak woods, 0 to 200 meter elevation.	Suitable habitat may occur along the pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas seymeria	*Seymeria texana*	N/A	SGCN	Grassy openings in juniper-oak woodlands on dry rocky slopes or rock outcrops in shaded canyons.	Suitable habitat does not occur within project area.
Threeflower penstemon	*Penstemon triflorus ssp. triflorus*	N/A	SGCN	Occurs sparingly on rock outcrops and in grasslands associated with juniper-oak woodlands.	Suitable habitat does not occur within project area.
Tree dodder	*Cuscuta exaltata*	N/A	SGCN	Parasitic on numerous woody plant species, including oak, walnut, sumac, grape, elm, and persimmon.	Suitable host species may occur in project vicinity.
Turnip-root scurfpea	*Pediomelum cyphocalyx*	N/A	SGCN	Grasslands and openings in juniper-oak woodlands on limestone substrates on the Edwards Plateau and in north-central Texas.	Low likelihood of suitable habitat in project area.
Woolly butterflyweed	*Gaura villosa ssp. parksii*	N/A	SGCN	Sandy soils of Rio Grande plains.	Low likelihood of suitable habitat in project area.
Wright's milkvetch	*Astralagus wrightii*	N/A	SGCN	Edwards Plateau.	Low likelihood of suitable habitat in project area.
Reptiles					
American alligator	*Alligator mississippiensis*	N/A	N/A	Inland natural rivers, swamps, marshes, coastal marshes, and manmade impoundments	Unlikely to occur in project area.
Cagle's map turtle	*Graptemys caglei*	N/A	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River System	Unlikely to occur in project area.
Common garter snake	*Thamnophis sirtalis*	N/A	SGCN	Marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur along the pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur along the pipeline alignment and well field sites.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat may occur along the pipeline alignment and well field sites.
Northern spot-tailed earless lizard	*Holbrookia lacerata*	N/A	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edward's Plateau.	Suitable habitat may occur along the pipeline alignment and well field sites.
Slender glass lizard	*Ophisaurus attenuatus*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannas, pine barrens, and oil fields.	Suitable habitat may occur along the pipeline alignment and well field sites.
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	N/A	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat may occur along the pipeline alignment and well field sites.
Texas garter snake	*Thamnophis sirtalis annectens*	N/A	SGCN	Marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur along the pipeline alignment and well field sites.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur along the pipeline alignment and well field sites.
Texas indigo snake	*Drymarchon melanurus erebennus*	N/A	T	South of the Guadalupe River and Balcones Escarpment, thornbrush chaparral woodland, particularly dense riparian corridors.	Suitable habitat may occur along the pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas tortoise	*Gopherus berlandieri*	N/A	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus.	Suitable habitat may occur along the pipeline alignment and well field sites.
Timber rattlesnake	*Crotalus horridus*	N/A	T	Swamps, floodplains, upland pine, deciduous woodland, riparian zones, and abandoned farmland. Limestone bluffs, sandy soil or black clay. Prefers dense ground cover, i.e., grapevines, palmetto.	Unlikely to occur in project area.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrow into soil or may use burrows made by other species.	Suitable habitat may occur along the pipeline alignment and well field sites.
Western hognose snake	*Heterodon nasicus*	N/A	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas (but not intensively cultivated), and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets. Seems to prefer sandy and loamy soils.	Suitable habitat may occur along the pipeline alignment and well field sites.
Western rattlesnake	*Crotalis viridis*	N/A	SGCN	Desert and prairie grassland; shrub desert rocky hillsides; edges of arid and semi-arid river breaks.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
T = Threatened E = Endangered C = Candidate DL = Delisted N/A = Not Applicable SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the National Historic Preservation Act (NHPA) and the Antiquities Code of Texas (ACT). Both are administered by the Texas Historical Commission (THC), the State Historic Preservation Office (SHPO) in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the Project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[9] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified one previously recorded archaeological site intersecting the project area. The site consists of a prehistoric campsite recommended as not eligible for inclusion in the National Register of Historic Places (NRHP) (THC 2019). In addition, the review identified one historic cemetery adjacent to the project area (Table 5.2.10-3). No potential historic buildings, structures, historical markers, or NRHP properties are known to be near the project.

The model used assessed overall archaeological potential within the project area to be low, ranging from 6 percent to 27 percent likelihood that the project area contains significant unidentified archaeological resources. The greatest probability areas were designated adjacent to existing drainages, the known archaeological site and cemetery.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 13.5. Based on the results of the background review, a structured cultural resources survey of the final design plan is recommended to assess the presence and significance of cultural resources within its boundaries.

Table 5.2.10-3 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological Site	Campsite	Prehistoric	Not Eligible	Intersect
Cemetery	John Shock Shely	Historic	None	Adjacent
			ASSESSMENT SCORE TOTAL:	13.5

[9] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

5.2.10.4 Engineering and Costing

Preliminary engineering and costing analyses have been performed for each of the three phases using 2021 Regional Water Planning methods. Project phasing and well locations, number of wells, and well pumping rates were provided by SAWS. Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and method for calculating unit costs. Costing procedures include all facilities required for water production, collection, and transmission but did not include costs of the H_2Oaks Center WTP expansion or expanding transmission facilities to deliver the treated water from the H_2Oaks Center to SAWS existing distribution system. Well fields will require wells and a collector pipeline. Well pumps will be sized to deliver the raw water to the H_2Oaks Center. Treated water will be either delivered to SAWS' distribution system by a new west side integration pipeline or the existing east side pipeline.

Phases 1, 2, and 3 of the SAWS Expanded Local Carrizo Project will each produce a uniform 6.25 mgd (7,000 acft/yr) of potable water for a total project firm yield of 18.75 mgd (21,000 acft/yr). Facilities for Phase 1 include a well field with three wells, plus an additional well for contingency. Facilities for Phase 2 include a well field with three wells, plus an additional well for contingency. Facilities for Phase 3 include a well field with three wells. Cost and information associated with water treatment plant expansion of the H_2Oaks WTP is discussed in Section 5.2.8 – Facilities Expansion WMS.

Region L cost estimates for the SAWS Expanded Local Carrizo Project WMS for each phase are detailed in Table 5.2.10-4 through 5.2.10-6. The total project cost estimate for all three phases are shown in Table 5.10-7. The Phase 1 estimated project cost is $8,587,000; the Phase 2 estimated project cost is $7,787,000; the Phase 3 estimated project cost is $7,114,000; and the total estimated project cost is $23,489,000. Annual costs include debt service for a 20-year loan at 3.5 percent interest and O&M costs, including power. Costs do not include a groundwater lease fee or groundwater district fee because the wells will be located on existing SAWS property where there is no groundwater conservation district. The cost of water is estimated to be $120 per acft/yr ($0.37 per 1,000 gallons). Additional cost would be incurred to transport the water to SAWS distribution system.

Table 5.2.10-4 Phase 1 Cost Estimate Summary

ITEM	ESTIMATED COSTS
Well Fields (Wells, Pumps, and Piping)	$6,126,000
TOTAL COST OF FACILITIES	**$6,126,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$2,144,000
Environmental & Archaeology Studies and Mitigation	$69,000
Land Acquisition and Surveying (35 acres)	$18,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$231,000
TOTAL COST OF PROJECT	**$8,587,000**

ANNUAL COST	
Debt Service (3.5%, 20 years)	$604,000
O&M	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$61,000
Pumping Energy Costs (1,975,805 kilowatt-hour [kW-hr] at 0.08 $/kW-hr)	$158,000
TOTAL ANNUAL COST	**$823,000**
Available Project Yield (acft/yr)	7,000
Annual Cost of Water* ($ per acft)	$118
Annual Cost of Water After Debt Service* ($ per acft)	$31
Annual Cost of Water* ($ per 1,000 gallons)	$0.36
Annual Cost of Water After Debt Service* ($ per 1,000 gallons)	$0.10
* Based on a peaking factor of 1.0.	

Table 5.2.10-5 Phase 2 Cost Estimate Summary

ITEM	ESTIMATED COSTS
Well Fields (Wells, Pumps, and Piping)	$5,532,000
TOTAL COST OF FACILITIES	**$5,532,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$1,936,000
Environmental & Archaeology Studies and Mitigation	$92,000
Land Acquisition and Surveying (35 acres)	$18,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$209,000
TOTAL COST OF PROJECT	**$7,787,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$55,000
O&M	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$55,000
Pumping Energy Costs (2,823,785 kilowatt-hour [kW-hr] at 0.08 $/kW-hr)	$226,000
TOTAL ANNUAL COST	**$829,000**

Available Project Yield (acft/yr)	7,000
Annual Cost of Water* ($ per acft)	$118
Annual Cost of Water After Debt Service* ($ per acft)	$40
Annual Cost of Water* ($ per 1,000 gallons)	$0.36
Annual Cost of Water After Debt Service* ($ per 1,000 gallons)	$0.12
* Based on a peaking factor of 1.0.	

Table 5.2.10-6 Phase 3 Cost Estimate Summary

ITEM	ESTIMATED COSTS
Well Fields (Wells, Pumps, and Piping)	$5,064,000
TOTAL COST OF FACILITIES	**$5,064,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$1,772,000
Environmental & Archaeology Studies and Mitigation	$69,000
Land Acquisition and Surveying (35 acres)	$18,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$191,000
TOTAL COST OF PROJECT	**$7,114,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$501,000
O&M	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$51,000
Pumping Energy Costs (3,865,190 kilowatt-hour [kW-hr] at 0.08 $/kW-hr)	$309,000
TOTAL ANNUAL COST	**$861,000**
Available Project Yield (acft/yr)	21,000
Annual Cost of Water* ($ per acft)	$123
Annual Cost of Water After Debt Service* ($ per acft)	$51
Annual Cost of Water* ($ per 1,000 gallons)	$0.38
Annual Cost of Water After Debt Service* ($ per 1,000 gallons)	$0.16
* Based on a peaking factor of 1.0.	

Table 5.2.10-7 Total Project Cost Estimate Summary (Phases 1 through 3)

ITEM	ESTIMATED COSTS
Well Fields (Wells, Pumps, and Piping)	$16,722,000
TOTAL COST OF FACILITIES	**$16,722,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$5,853,000
Environmental & Archaeology Studies and Mitigation	$230,000
Land Acquisition and Surveying (118 acres)	$55,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$629,000
TOTAL COST OF PROJECT	**$23,489,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$1,653,000
O&M	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$167,000
Pumping Energy Costs (8,841,215 kilowatt-hour [kW-hr] at 0.08 $/kW-hr)	$707,000
TOTAL ANNUAL COST	**$2,527,000**
Available Project Yield (acft/yr)	21,000
Annual Cost of Water* ($ per acft)	$120
Annual Cost of Water After Debt Service* ($ per acft)	$42
Annual Cost of Water* ($ per 1,000 gallons)	$0.37
Annual Cost of Water After Debt Service* ($ per 1,000 gallons)	$0.13
* Based on a peaking factor of 1.0.	

It is noted that in the SAWS provided 2017 Water Management Plan, the unit cost associated with the SAWS Expanded Local Carrizo Project is estimated to be $690 acft/yr, which is inclusive of the ASR Program Costs (including H_2Oaks WTP expansion). The H_2Oaks WTP expansion is included in the 2021 Region L Water Plan as part of the Facilities Expansion WMS (See Section 5.2.8). As such, the costs presented herein are for the groundwater well field expansion only.

5.2.10.5 Implementation Considerations

The SAWS Expanded Local Carrizo Project WMS is planned to be located north/northeast of the existing SAWS ASR well field (Figure 5.2.10-1), which stores Edwards Aquifer water in the Carrizo Aquifer. Groundwater withdrawals from the new SAWS Expanded Local Carrizo Project wells would affect groundwater gradients, flow rates, and mixing rates of SAWS' water stored in the nearby ASR well field. Increased extraction from the Carrizo Aquifer would increase movement of water from the ASR well field toward the Carrizo Aquifer wells and cause more rapid mixing of stored Edwards Aquifer groundwater with native Carrizo Aquifer groundwater. Implications of increased groundwater withdrawals should be fully evaluated during the planning and design phases and prior to implementation of the SAWS Expanded Local Carrizo Project.

Implementation of the SAWS Expanded Local Carrizo Project includes the following considerations:

- Verification of available groundwater quantity and well productivity;
- Verification of water quality for concentrations of constituents, such as TDS, chloride, sulfate, iron, manganese, and hydrogen sulfide;
- Potential for differing water qualities/chemical constituents in the water;
- Regulations by TCEQ; and
- Potential impacts on the following natural resources:
  - Endangered and threatened species;
  - Water levels in the aquifer, including potential dewatering of the current artesian part of the aquifer;
  - Baseflow in streams; and
  - Wetlands.
- Competition with others in the area for groundwater in the Carrizo Aquifer, including the following:
  - Private water purveyors;
  - Public water purveyors in the area; and/or
  - Future oil and gas drilling operations.

Reliability

Water from these sources is considered to be very reliable based on available hydrogeologic information from the existing nearby wells. Supply is considered to be medium because of the potential of differing well productivity and water quality, potential impacts to natural resources and Carrizo Aquifer user competition (reliability score = 4).

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5.2.11 SAWS Expanded Brackish Groundwater Project

5.2.11.1 Description of Water Management Strategy

As part of a multi-stage water supply plan, SAWS identified the Carrizo-Wilcox Aquifer in Wilson County as a potential source for its customers. SAWS currently owns and operates a brackish groundwater desalination project in Bexar County (Phase 1), which is currently online. This WMS evaluation includes SAWS' plans to expand its Carrizo-Wilcox Aquifer brackish groundwater project into Wilson County through four additional phases (Phases 2 through 5) (Figure 5.2.11-1). The approximate locations of the well fields were provided by SAWS and selected primarily on the basis of favorable well yields and water quality, with consideration of available property.

This strategy includes treatment of the raw water at a desalination WTP near the H_2Oaks Center. The treated water would be pumped with water recovered from the nearby ASR well field to the SAWS distribution system through SAWS integration pipelines. Concentrate will be disposed of via deep well injection in Wilson County near the existing SAWS brackish concentrate injection wells.

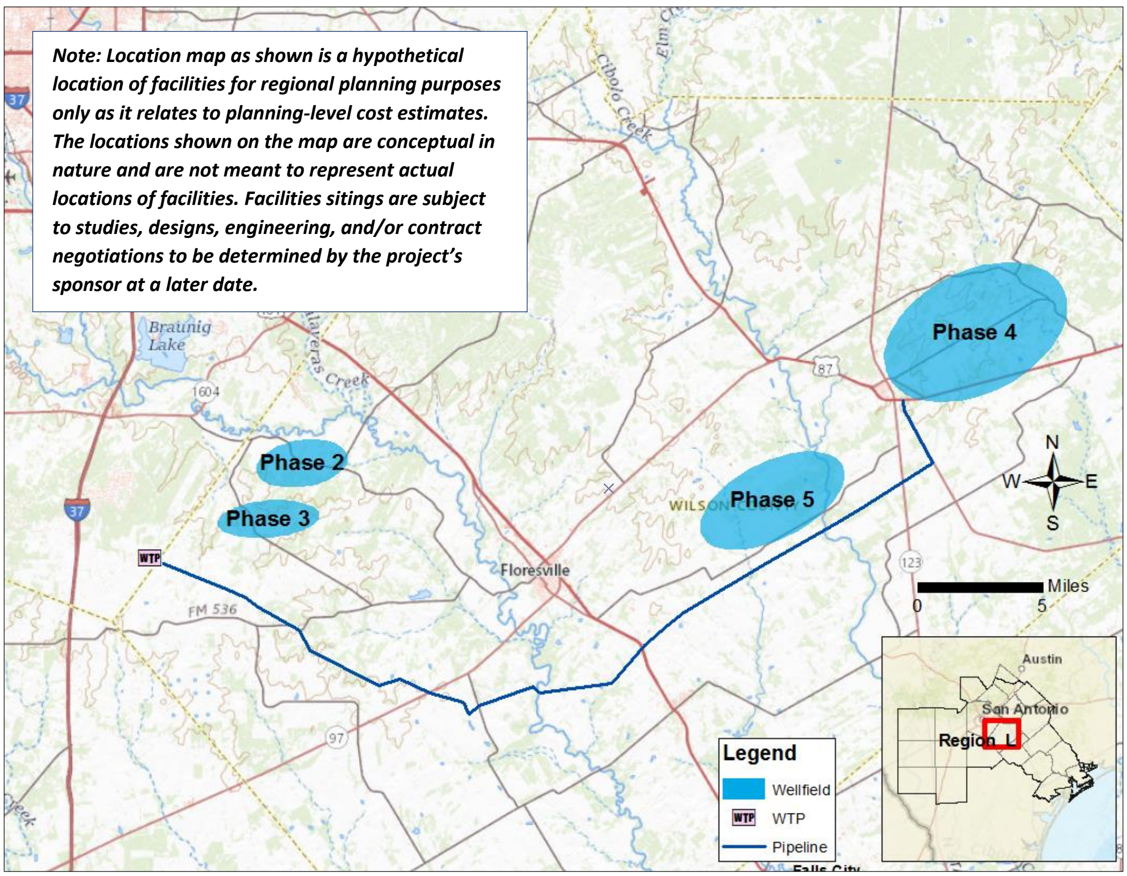

Figure 5.2.11-1 SAWS Expanded Brackish Groundwater Project Location

5.2.11.2 Available Yield

The TWDB's February 2003 report[1] showed the availability of brackish water in the Carrizo-Wilcox Aquifer in Region L to range from "moderate" to "high," while source water production costs ranged from "low" to "high." A study completed in July 2004[2] to evaluate the potential for a brackish groundwater source from the Wilcox Aquifer further defined the water quality and indicated that slightly brackish groundwater was available from the Wilcox Aquifer in Bexar County. A detailed study[3] was completed in October 2008 for SAWS on the hydrogeology, water quality, water treatment and facilities, disposal of concentrate, permitting, and procurement and financial considerations.

As previously stated, Phase 1 of SAWS Brackish Wilcox Project is currently online. This WMS would provide 70,160 acft/yr in the 2070 decade[4]. Table 5.2.11-1 provides a summary of the water management strategy yields for each phase by decade. Phases 2 and 3 of the project are located northeast of the existing ASR wells, in Wilson County. Both phases are planned for the 2040 decade. Phase 2 is designed to produce 12 mgd (13,440 acft/yr) of potable water, while Phase 3 is designed to produce 6 mgd (6,720 acft/yr) of potable water.

Phase 4 is located northeast of Stockdale in eastern Wilson County and is designed to produce 28.5 mgd (32,000 acft/yr) of potable water. Phase 4 is expected to be constructed in the 2060 decade.

Phase 5 is located northeast of Floresville in central Wilson County and is designed to produce 16 mgd (18,000 acft/yr) of potable water. Phase 5 is expected to be constructed in the 2060 decade.

Table 5.2.11-1. Decadal Water Management Strategy Yields by Phase (acft/yr)

PROJECT PHASE	VOLUME BY DECADE (ACFT/YR)					
	2020	2030	2040	2050	2060	2070
Phase 2	--	--	13,440	13,440	13,440	13,440
Phase 3	--	--	6,720	6,720	6,720	6,720
Phase 4	--	--	--	--	32,000	32,000
Phase 5	--	--	--	--	18,000	18,000
Total	**0**	**0**	**20,160**	**20,160**	**70,160**	**70,160**
Note: Phase 1 has already been implemented and is not included in this WMS evaluation.						

Wells for all four additional phases are expected to produce about 800 gallons per minute (gpm) and be around 2,300 feet deep. Water from the Carrizo-Wilcox Aquifer at this location is expected to have a

[1] LBG-Guyton Associates, "Brackish Groundwater Manual for Texas Regional Water Planning Groups," prepared for the Texas Water Development Board, February 2003.
[2] HDR Engineering, Inc., "Water Quality Characteristics of the Wilcox Aquifer in the Vicinity of San Antonio, TX," prepared for San Antonio Water System, July 2004.
[3] R.W. Beck, "Brackish Groundwater Desalination Feasibility Assessment Report," prepared for SAWS, October 2008.
[4] This project is limited by the MAG, for purposes of this plan and DB22, it is assumed that SAWS will utilize the "SAWS Expanded Brackish Groundwater (GW Conversion)" WMS Project to secure the remaining supplies for the project.

TDS concentration of about 1,500 milligrams per liter (mg/L). This strategy is designed to produce water at a uniform (baseload) rate.

The Evergreen Underground Water Conservation District regulates groundwater production and well spacing in the Carrizo-Wilcox Aquifer in Wilson County. In November 2016, Groundwater Management Area (GMA) 13 established the DFC for the Carrizo-Wilcox, Queen City Sparta Aquifer.[5] On the basis of the approved DFC, the TWDB determined that the MAG for the Carrizo-Wilcox Aquifer in Wilson County is 111,093 acft/yr in 2070.[6]

5.2.11.3 Environmental and Cultural Considerations

Environmental Considerations

Vegetation and Land Use

The project area occurs in the Post Oak Savannah ecoregion and crosses a variety of vegetation types, mostly open fields and pastures. As mapped by TPWD,[7] dominant vegetation types in the project area are savannah grassland and disturbance/tame grassland. Small areas of mapped woody vegetation communities include post oak motte and woodland and mesquite shrubland. The linear components of the project cross riparian vegetation zones along streams, mapped by TPWD as floodplain and riparian herbaceous vegetation, floodplain and riparian hardwood forest, and floodplain live oak and deciduous forest.

Based on TPWD vegetation mapping, the project may have the potential to impact 87 acres of agricultural resources, including 7 acres mapped as row crops, and 80 acres of disturbance or tame grassland which may include pasture areas used for grazing.

The proposed well pads and any new storage facilities would result in conversion of land use from undeveloped fields or agricultural use to small areas of industrial use. Project pipeline easements would require removal of woody vegetation and long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each WMS to determine the best course of action regarding revegetation.

Aquatic Resources

The project area contains several mapped streams and their associated floodplains including the San Antonio River, Wallace Branch, Mariana Branch, Marcelinas Creek, Cibolo Creek, and numerous

[5] Texas Water Development Board, Groundwater Management Area 13 – Desired Future Conditions. http://www.twdb.texas.gov/groundwater/dfc/docs/summary/GMA13_DFC_2016.pdf?d=52712.51999999731.
[6] Texas Water Development Board, Groundwater Management Area 13 – Modeled Available Groundwater, GR 17-027 MAG. http://www.twdb.texas.gov/groundwater/dfc/docs/summary/GMA13_MAG_2016b.pdf?d=52712.51999999731.
[7] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/

unnamed tributaries. The NWI mapping shows one freshwater forested/shrub wetlands and several ponds in the project area.

The project crosses Segment 1911 of the San Antonio River and Segment 1902 of Lower Cibolo Creek; these stream segments have been designated as impaired stream segments in the Texas Integrated Report of 303(d) listed water bodies.[8] This list identifies the water bodies or segments in Texas that do not meet assigned water quality standards. The project area does not contain ecologically significant stream segments as designated by TPWD.

The project will require an on-site delineation of streams, ponds, and wetlands. Well field facilities can typically be sited to avoid impacts to waters of the United States including wetlands. Stream crossing for pipeline construction would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including if there would be permanent impacts to over 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in pre-construction contours of waters of the United States. Utility crossings under streams (e.g., through horizontal directional drilling) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

Table 5.2.11-1 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Bexar and Wilson Counties.[9] [10] [11] [12] It should be noted that the county species lists are current as of August 9, 2019, but may be updated as new species information becomes available. Suitable habitat does not occur for any of the federally listed threatened or endangered species; however, two freshwater mussel species are under review for federal listing as threatened or endangered, and the project pipeline crosses streams that may provide suitable habitat for freshwater mussels. The black rail (*Laterallus jamaicensis*), also under federal review as a threatened species, has low potential to occur in wetland areas in the project region.

Suitable habitat may occur for the state listed threatened species white-faced ibis (*Plegadis ibis*), Texas horned lizard (*Phrynosoma cornutum*), and Texas tortoise (*Gopherus berlandieri*). The state-threatened bald eagle (*Haliaeetus leucocephalus*) has been observed in areas of the lower San Antonio River. There is potential for suitable habitat for numerous wildlife species designated by TPWD as SGCN including American bumblebee (*Bombus pensylvanicus*), Strecker's chorus frog (*Pseudacris streckeri*), Woodhouse's toad (*Anaxyrus woodhousii*), western burrowing owl (*Athene cunicularia hypugaea*), American badger (*Taxidea taxus*), thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*), eastern

[8] Texas Commission on Environmental Quality. 2018. 2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf.

[9] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Bexar County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[10] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Wilson County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[11] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Bexar County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.

[12] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Wilson County. https://ecos.fws.gov/ipac/location/FX45LGWSGVBZLJHV4APLVP7LU4/resources.

spotted skunk (*Spilogale putorius*), and plains spotted skunk (*Spilogale putorius interrupta*). In addition, SGCN bat species may utilize structures and could therefore occur in developed areas. The SGCN list also includes numerous plant species, including many for which detailed habitat requirements have not been developed by TPWD. SGCN species do not have formal protected status but are being monitored by TPWD. Migratory birds may occur in the project area, particularly in riparian zones.

Table 5.2.11-1 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for SAWS Expanded Brackish Project, Bexar and Wilson Counties, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Black-spotted newt	*Notophthalmus meridionalis*	N/A	T	Gulf Coastal Plain south of the San Antonio River; in resacas and bodies of water with firm bottoms and little or no vegetation. Also in wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; the absence of predatory fish is probably important.	Project area is outside the expected range of this species.
Cascade Caverns salamander	*Eurycea latitans*	N/A	T	Springs and caves in Guadalupe River, Medina River, and Cibolo Creek watersheds, all within the Edwards Aquifer.	Suitable karst habitat does not occur within the project area.
Comal blind salamander	*Eurycea tridentifera*	N/A	T	Within aphotic zones of shallow limestone caves; found in springs and waters of caves.	Suitable karst habitat does not occur within the project area.
Mexican treefrog	*Smilisca baudinii*	N/A	SGCN	The subtropical Rio Grande embayment around Brownsville. May do well in association with human development and may tolerate relatively dry situations provided moist microclimates are available.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Strecker's chorus frog	*Pseudarcris streckeri*	N/A	SGCN	Prairies, wooded floodplains, flats, marshes, and cultivated fields; sand substrates preferred.	Suitable habitat may occur along the pipeline alignment and well field sites.
Texas salamander	*Eurycea neotenes*	N/A	SGCN	Cave streams, seeps, springs, and creek headwaters; Helotes and Leon Creek drainages.	Project is outside of the expected range of this species.
Valdina Farms sinkhole salamander	*Eurycea troglodytes*	N/A	SGCN	Isolated, intermittent pools of subterranean streams and sinkholes in Nueces, Frio, Guadalupe, and Pedernales watersheds within Edwards Aquifer area.	Project is outside of the expected range of this species.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur along the pipeline alignment and well field sites.
Arachnids					
Braken Bat Cave meshweaver	*Cicurina venii*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Cokendolpher Cave harvestman	*Texella cokendolpheri*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Government Canyon Bat Cave meshweaver	*Cicurina vespera*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Government Canyon Bat Cave spider	*Neoleptoneta microps*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Madla Cave meshweaver	*Cicurina madla*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
No accepted common name	*Tartarocreagris amblyopa*	N/A	SGCN	Karst features.	Suitable karst habitat does not occur in project area.
Robber Baron Cave meshweaver	*Cicurina baronia*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Arthropods					
No accepted common name	*Speodesmus falcatus*	N/A	SGCN	Karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Speodesmus ivyi*	N/A	SGCN	Subterranean obligate.	Suitable karst habitat does not occur in project area.
No accepted common name	*Speodesmus reddelli*	N/A	SGCN	Karst features.	Suitable karst habitat does not occur in project area.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat may occur along the San Antonio River; may fly over during migration.
Black-capped vireo	*Vireo articapilla*	DL	E	Patches of oak-juniper woodland with open grassy spaces; foliage must reach ground level for nesting cover.	Suitable habitat does not occur in project area; may fly over during migration.
Black rail	*Laterallus jamaicensis*	PT	SGCN	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh.	Low probability of occurring in emergent wetland areas along the pipeline alignment and well field sites.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur within project area; may fly over during migration.
Golden-cheeked warbler	*Setophaga chrysoparia*	E	E	Mixed stands of Ashe juniper and various oaks; edges of cedar brakes.	Suitable habitat does not occur in project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Suitable habitat does not occur in project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable breeding habitat does not occur within project area; may fly over during migration and possible stopover in plowed fields during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur within project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	SGCN	Brackish marshes, shallow salt ponds and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Project is outside of the expected range of this species.
Swallow-tailed kite	*Elanoides forficatus*	N/A	SGCN	Lowland forest, especially swampy areas, ranges to open woodland; marshes, along rivers, lakes, and ponds. Nests high in tall trees in clearing or on forest woodland edge, usually pine, cypress, or deciduous trees.	Suitable habitat does not occur within project area; may fly over during migration.
Tropical parula	*Setophaga pitiayumi*	N/A	T	Dense or open woods, brush, trees, and undergrowth along edges of river and resacas.	Suitable habitat does not occur within project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots; nests and roosts in abandoned burrows.	Suitable habitat may occur along the pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat may occur along the pipeline alignment and well field sites; may fly over during migration.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems [during migration].	Suitable habitat does not occur within project area; may fly over during migration.
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Unlikely to occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous or pine-oak woodland.	Suitable habitat does not occur within project area; may fly over during migration.
Crustaceans					
A cave obligate isopod	*Speocirolana hardeni*	N/A	SGCN	Cave obligate.	Suitable karst habitat does not occur in project area.
Cascade Cave amphipod	*Stygobromus dejectus*	N/A	SGCN	Subaquatic, subterranean pools.	Suitable karst habitat does not occur in project area.
Ezell's Cave amphipod	*Stygobromus flagellates*	N/A	SGCN	Artesian wells.	Suitable karst habitat does not occur in project area.
No accepted common name	*Mexiweckelia hardeni*	N/A	SGCN	Cave obligate amphipod.	Suitable karst habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Fishes					
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat may occur along the portion of the pipeline alignment that crosses the San Antonio River and Cibolo Creek. Not expected in the well field sites.
River darter	*Percina shumardi*	N/A	SGCN	Confined to large rivers and lower parts of major tributaries; almost invariably found in deep chutes and riffles where current is swift and bottom composed of coarse gravel or rock.	Suitable habitat may occur along the portion of the pipeline alignment that crosses the San Antonio River. Not expected in the well field sites.
Texas shiner	*Notropis amabilis*	N/A	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Suitable habitat may occur along the portion of the pipeline alignment that crosses the San Antonio River. Not expected in the well field sites.
Toothless blindcat	*Trogloglanis pattersoni*	N/A	SGCN	Known from five artesian wells penetrating the San Antonio Pool of the Edwards Aquifer; found at depths of 305-582 meters.	Project would not affect groundwater.
Widemouth blindcat	*Satan eurystomus*	N/A	SGCN	Known from five artesian wells penetrating the San Antonio Pool of the Edwards Aquifer; found at depths of 305-582 meters.	Project would not affect groundwater.
Insects					
A cave obligate beetle	*Batrisodes shadeae*	N/A	SGCN	Cave obligate.	Suitable karst habitat does not occur in project area.
A ground beetle	*Rhadine exilis*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
A ground beetle	*Rhadine infernalis*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur along the pipeline alignment and well field sites.
No accepted common name	*Bombus variabilis*	N/A	SGCN	Parasite on other bumblebee species.	Suitable habitat may occur in the project area.
Helotes mold beetle	*Batrisodes venyivi*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Manfreda giant skipper	*Stallingsia maculosus*	N/A	SGCN	Subtropical mesquite scrub with a lot of Manfreda, on sandy or clay soils, either dry or moist. Apparently occasionally pine woodland.	Suitable habitat may occur along the pipeline alignment and well field sites.
No accepted common name	*Cotinis boylei*	N/A	SGCN	South Texas coastal plains.	Suitable habitat unlikely to occur in the project area.
No accepted common name	*Cotalpa conclamara*	N/A	SGCN	Sandy soils and post oak.	Suitable habitat may occur along the pipeline alignment and well field sites.
No accepted common name	*Dichopetala catinata*	N/A	SGCN	Grassland, shrubland.	Suitable habitat may occur along the pipeline alignment and well field sites.
No accepted common name	*Dichopetala seeversi*	N/A	SGCN	Grassland, shrubland.	Suitable habitat may occur along the pipeline alignment and well field sites.
No accepted common name	*Lymantes nadineae*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in the project area.
No accepted common name	*Megachile parksi*	N/A	SGCN	Grassland, shrubland.	Suitable habitat may occur along the pipeline alignment and well field sites

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
No accepted common name	*Nectopsyche texana*	N/A	SGCN	Riparian/riverine habitats.	Suitable habitat may occur along the pipeline alignment and well field sites
No accepted common name	*Rhadine bullis*	N/A	SGCN	Cave obligate.	Suitable karst habitat does not occur in the project area.
No accepted common name	*Pygarctia lorula*	N/A	SGCN	Savannah, open woodland.	Suitable habitat may occur along the pipeline alignment and well field sites.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur along the pipeline alignment and well field sites.
Big brown bat	*Eptesicus fuscus*	N/A	SGCN	Woodlands or wooded areas.	Suitable habitat may occur along the pipeline alignment and well field sites.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls but will use buildings.	May use buildings/ structures in the project area.
Black bear	*Ursus americanus*	N/A	T	Juniper-oak habitat, bottomland hardwoods, floodplain forests, upland hardwoods with mixed pine.	Project is outside the expected range of this species.
Black-tailed prairie dog	*Cynomys ludovicianus*	N/A	SGCN	Short, flat, dry grasslands with sparse vegetation.	Project area is outside the expected range of this species.
Cave myotis bat	*Myotis velifer*	N/A	SGCN	Cave-dwelling, also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	May use buildings/ structures in the project area.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat may occur along the pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges and woodlands. Prefer wooded, brushy areas; tallgrass prairies.	Suitable habitat may occur along the pipeline alignment and well field sites.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Suitable habitat may occur along the pipeline alignment and well field sites.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur along the pipeline alignment and well field sites.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	May use buildings/ structures and forage along the pipeline alignment and well field sites.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps and marshes.	Low potential of suitable habitat to occur along the pipeline alignment and well field sites.
Mountain lion	*Puma concolor*	N/A	SGCN	Use wide range of habitats, especially rocky areas, canyons, riparian zones and dense brush.	Low potential of suitable habitat within the project area.
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	SGCN	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur along the pipeline alignment and well field sites.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat may occur along the pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Prefer short-grass prairies, also occur in pastures and along fencerows. Excavate burrows or use abandoned pocket gopher or prairie dog burrows.	Suitable habitat may occur along the pipeline alignment and well field sites.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Low potential to occur in project area.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat may occur along the pipeline alignment and well field sites.
Western spotted skunk	*Spilogale gracilis*	N/A	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur along the pipeline alignment and well field sites.
White-nosed coati	*Nasua narica*	N/A	T	Canyons, riparian corridors, and woodlands.	Unlikely to occur within project area
Mollusks					
Golden orb	*Cyclonaias aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Potential to occur in perennial waterways along the pipeline alignment. Not expected in well field sites. This species is expected to be removed from the federal candidate list in the future.
Mimic cavesnail	*Phreatodrobia imitata*	N/A	SGCN	Subaquatic, only known from two wells penetrating the Edwards Aquifer.	Project would not affect groundwater.
No accepted common name	*Phreatodrobia conica*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Cyclonaias necki*	N/A	SGCN	Guadalupe River basin; moderate to large streams with flowing water.	Potential to occur in perennial waterways along the pipeline alignment. Not expected in well field sites. This species is expected to be state listed in the near future.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	N/A	SGCN	Endemic to sandy regions of southern and south-central Texas.	Suitable sandy habitats may occur along the pipeline alignment and well field sites.
Big red sage	*Salvia pentstemonoides*	N/A	SGCN	Moist to seasonally wet, steep limestone outcrops on seeps within canyons or along creek banks; occasionally on clayey to silty soils of creek banks and terraces, in partial shade to full sun.	Suitable habitat does not occur within project area.
Bigflower cornsalad	*Valerianella stenocarpa*	N/A	SGCN	Usually along creek beds or in vernally moist grassy open areas.	Suitable habitat may occur along the pipeline alignment and well field sites.
Bracted twistflower	Streptanthus bracteatus	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Suitable habitat does not occur within project area.
Bristle nailwort	*Paronychia setacea*	N/A	SGCN	Eastern south-central Texas, occurring in sandy soils.	Suitable sandy habitats may occur along the pipeline alignment and well field sites.
Buckley tridens	*Tridens buckleyanus*	N/A	SGCN	Juniper-oak woodlands on rocky limestone slopes.	Suitable habitat does not occur within project area.
Burridge greenthread	*Thelesperma burridgeanum*	N/A	SGCN	Sandy open areas.	Suitable sandy habitats may occur along the pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Corell's false dragon-head	*Physostegia correllii*	N/A	SGCN	Wet, silty clay loams on streamsides, in creek beds, irrigation channels and roadside drainage ditches; or underlain by Austin Chalk limestone along gently flowing spring-fed creek in central Texas.	Low potential for suitable habitat to occur along the pipeline alignment and well field sites.
Drummond's rushpea	*Caesalpinia drummondii*	N/A	SGCN	Open areas on sandy clay.	Suitable sandy habitats may occur along pipeline alignment and well field sites.
Elmendorf's onion	*Allium elmendorfii*	N/A	SGCN	Grassland openings in oak woodlands on deep, loose, well-drained sands; to the north it occurs in post oak-black hickory-live oak woodlands over Queen City and similar Eocene formations.	Suitable habitat may occur along the pipeline alignment and well field sites.
Glass Mountains coral-root	*Hexalectris nitida*	N/A	SGCN	Ashe juniper woodlands over limestone in Edwards Plateau.	Suitable habitat unlikely to occur within project area.
Gravelbar brickellbush	*Brickellia dentata*	N/A	SGCN	Frequently scoured gravelly alluvial beds in creek and river bottoms.	Suitable habitat unlikely to occur within project area.
Hairy sycamore-leaf snowbell	*Styrax platanifolius ssp. stellatus*	N/A	SGCN	Usually in oak-juniper woodlands on steep rocky banks and ledges along intermittent or perennial streams, rarely far from some reliable source of moisture.	Suitable habitat does not occur within project area.
Heartleaf evening primrose	*Oenothera cordata*	N/A	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Suitable habitat may occur along pipeline alignment and well field sites.
Heller's beardtongue	*Penstemon triflorus ssp. integrifolius*	N/A	SGCN	Rock outcrops and in grasslands associated with juniper-oak woodlands	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Heller's marbleseed	*Omosmodium helleri*	N/A	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Suitable habitat does not occur within project area.
Hill Country wild-mercury	*Argythamnia aphoroides*	N/A	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands, also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Suitable habitat does not occur within project area.
Low spurge	*Euphorbia peplidion*	N/A	SGCN	Occurs in a variety of vernally moist situations in a number of natural regions.	Suitable habitat may occur along the pipeline alignment and well field sites.
Lundell's whitlow-wort	*Paronychia lundellorum*	N/A	SGCN	The Sand Sheet of eastern South Texas, in tight sandy soils over saline clay on microhighs within salty prairie grasslands, and in upper portions of saline flats surrounding short drainages and brackish basins typical of the South Texas Sand Sheet.	Project area is outside the expected range of this species.
Narrowleaf brickellbush	*Brickellia eupatorioides var. gracillima*	N/A	SGCN	Moist to dry gravelly alluvial soils along riverbanks but also on limestone slopes.	Suitable habitat does not occur within project area.
Net-leaf bundleflower	*Desmanthus reticulatus*	N/A	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat may occur along the pipeline alignment and well field sites.
Osage Plains false foxglove	*Agalinis densiflora*	N/A	SGCN	Grasslands on shallow, gravelly, well drained calcareous soils; prairies, dry limestone soils.	Suitable habitat may occur along the pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Parks jointweed	*Polygonella parksii*	N/A	SGCN	Mostly on deep, loose, whitish sand blowouts (unstable, deep, xeric, sandhill barrens) in post oak savannah landscapes over the Carrizo and Sparta formations; also occurs in early successional grasslands, along rights-of-way, and on mechanically disturbed areas.	Suitable sandy habitats may occur along the pipeline alignment and well field sites.
Plateau loosestrife	*Lythrum ovalifolium*	N/A	SGCN	Banks and gravelly beds of perennial or strong intermittent streams on Edwards Plateau.	Suitable habitat does not occur within project area.
Plateau milkvine	*Matelea edwardsensis*	N/A	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Suitable habitat does not occur within project area.
Sandhill woolywhite	*Hymenopappus carrizoanus*	N/A	SGCN	Disturbed or open areas in grasslands and post oak woodlands on deep sands derived from the Carrizo Sand and similar Eocene formations.	Suitable habitat may occur along the pipeline alignment and well field sites.
Siler's huaco	*Manfreda sileri*	N/A	SGCN	Rare in a variety of grasslands and shrublands on dry sites.	Suitable habitat may occur along the pipeline alignment and well field sites.
South Texas rushpea	*Caesalpinia phyllanthoides*	N/A	SGCN	Tamaulipan thorn shrublands or grasslands on very shallow sandy to clayey soils over calcareous sandstone and caliche.	Low likelihood of suitable habitat within project area.
Spreading leastdaisy	*Chaetopappa effusa*	N/A	SGCN	Limestone cliffs, ledges, bluffs, steep hillsides, sometimes in seepy areas, oak-juniper, oak, or mixed deciduous woods, 300-500 meter elevation.	Low likelihood of suitable habitat within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Sycamore-leaf snowbell	*Styrax platanifolius ssp. platanifolius*	N/A	SGCN	Rare throughout range, usually in oak-juniper woodlands on steep rocky banks and ledges along intermittent or perennial streams, rarely far from some reliable source of moisture.	Suitable habitat does not occur within project area.
Texas almond	*Prunus minutiflora*	N/A	SGCN	Variety of grassland and shrubland habitats, mostly on calcareous soils underlain by limestone.	Low likelihood of suitable habitat in project area.
Texas amorpha	*Amorpha roemeriana*	N/A	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes, sometimes on dry shelves above creeks.	Suitable habitat does not occur within project area.
Texas beebalm	*Monarda viridissima*	N/A	SGCN	Endemic perennial herb of the Carrizo Sands; deep, well-drained sandy soils in openings of post oak woodlands.	Suitable habitat may occur along pipeline alignment and well field sites.
Texas fescue	*Festuca versuta*	N/A	SGCN	Mesic woodlands on limestone-derived soils on stream terraces and canyon slopes.	Suitable habitat does not occur within project area.
Texas peachbush	*Prunus texana*	N/A	SGCN	Occurs at scattered sites in various well drained sandy situations; deep sand, plains and sand hills, grasslands, oak woods, 0-200 meter elevation.	Suitable habitat may occur along the pipeline alignment and well field sites.
Texas seymeria	*Seymeria texana*	N/A	SGCN	Grassy openings in juniper-oak woodlands on dry rocky slopes or rock outcrops in shaded canyons.	Suitable habitat does not occur within project area.
Threeflower penstemon	*Penstemon triflorus ssp. triflorus*	N/A	SGCN	Occurs sparingly on rock outcrops and in grasslands associated with juniper-oak woodlands.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Tree dodder	*Cuscuta exaltata*	N/A	SGCN	Parasitic on numerous woody plant species, including oak, walnut, sumac, grape, elm and persimmon.	Suitable host species may occur in project vicinity.
Turnip-root scurfpea	*Pediomelum cyphocalyx*	N/A	SGCN	Grasslands and openings in juniper-oak woodlands on limestone substrates on the Edwards Plateau and in north-central Texas.	Low likelihood of suitable habitat in project area.
Woolly butterflyweed	*Gaura villosa ssp. parksii*	N/A	SGCN	Sandy soils of Rio Grande plains.	Low likelihood of suitable habitat in project area.
Wright's milkvetch	*Astralagus wrightii* var. *wrightii*	N/A	SGCN	Edwards Plateau.	Low likelihood of suitable habitat in project area.
Reptiles					
American alligator	*Alligator mississippiensis*	N/A	N/A	Inland natural rivers, swamps, marshes, coastal marshes, and manmade impoundments.	Suitable habitat may occur portions of the pipeline alignment that crosses the San Antonio River. Not expected in the well field sites.
Cagle's map turtle	*Graptemys caglei*	N/A	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River System.	Suitable habitat unlikely to occur within project area.
Common garter snake	*Thamnophis sirtalis*	N/A	SGCN	Marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur along the pipeline alignment and well field sites.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur along the pipeline alignment and well field sites.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat may occur along the pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Northern spot-tailed earless lizard	*Holbrookia lacerata lacerata*	N/A	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edward's Plateau	Suitable habitat may occur along the pipeline alignment and well field sites.
Slender glass lizard	*Ophisaurus attenuatus*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannas, pine barrens, and oil fields.	Suitable habitat may occur along the pipeline alignment and well field sites.
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	N/A	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat may occur along the pipeline alignment and well field sites.
Texas garter snake	*Thamnophis sirtalis annectens*	N/A	SGCN	Marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur along the pipeline alignment and well field sites.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur along the pipeline alignment and well field sites.
Texas indigo snake	*Drymarchon melanurus erebennus*	N/A	T	South of the Guadalupe River and Balcones Escarpment, thornbrush chaparral woodland, particularly dense riparian corridors.	Suitable habitat may occur along the pipeline alignment and well field sites.
Texas tortoise	*Gopherus berlandieri*	N/A	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus.	Suitable habitat may occur along the pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Timber rattlesnake	*Crotalus horridus*	N/A	T	Swamps, floodplains, upland pine and deciduous woodland, riparian zones, abandoned farmland. Limestone bluffs, sandy soil or black clay. Prefers dense ground cover, i.e., grapevines, palmetto.	Unlikely to occur in project area.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrow into soil or may use burrows made by other species.	Suitable habitat may occur along the pipeline alignment and well field sites.
Western hognose snake	*Heterodon nasicus*	N/A	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas (but not intensively cultivated), and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets. Seems to prefer sandy and loamy soils.	Suitable habitat may occur along the pipeline alignment and well field sites.
Western rattlesnake	*Crotalis viridis*	N/A	SGCN	Desert and prairie grassland; shrub desert rocky hillsides; edges of arid and semi-arid river breaks.	Project area is outside the expected range of this species.
T = Threatened E = Endangered C = Candidate DL = Delisted N/A = Not applicable SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

The project area is likely to contain suitable habitat for the federal candidate/state-threatened freshwater mussel species. Suitable habitat may occur in perennial rivers/streams and perennial pools of intermittent streams. If any such habitat would be affected by construction, presence/absence surveys and relocation of native mussel species would be required. Handling and relocation of aquatic species must be conducted by TPWD-permitted personnel and in accordance with an approved Aquatic Resources Relocation Plan. Furthermore, these candidate species may be listed as threatened or endangered during the project timeline; in which case, any species impacts would require USFWS consultation.

Site-specific field surveys would be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain its recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request pre-construction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct pre-construction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15. Although it is no longer on the federal endangered species list, the bald eagle is protected by the federal Bald and Golden Eagle Protection Act, which prohibits impacts to the eagles unless permitted by USFWS. Pre-construction surveys for active bird nests and presence of eagles are recommended.

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC, the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[13] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified four previously recorded archaeological sites intersecting or immediately adjacent (within 300 feet) to the project area. All four sites consist of prehistoric campsites with undetermined NRHP eligibility (THC 2019). In addition, the review identified 10 potentially historic-age buildings and three historic linear features intersecting or immediately adjacent to the project area. No cemeteries, historical markers, or NRHP properties are known to be near the project.

The model used assessed archaeological potential within the project area to include low to high potential zones, ranging from 6 percent to 89 percent likelihood for the project area to contain significant unidentified archaeological resources. The mean probability value returned by the model is 23 percent. The areas with greatest archaeological probability are located near the four previously

[13] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

documented archaeological sites, the 13 potential historic buildings and features, and landforms adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As previously discussed, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 32. On the basis of the results of the background review (Table 5.2.11-2), a structured cultural resources survey of the final design plan is recommended to assess the presence and significance of cultural resources within project boundaries.

Table 5.2.11-2 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological Site	Campsite	Prehistoric	Undetermined	Intersect
Archaeological Site	Campsite	Prehistoric	Undetermined	Intersect
Archaeological Site	Campsite	Prehistoric	Undetermined	Adjacent
Archaeological Site	Campsite	Prehistoric	Undetermined	Adjacent
None	9 Buildings	Historic	None	Adjacent
None	1 Building	Historic	None	Intersect
Southern Pacific Railroad	Linear Feature	Historic	None	Intersect
Chisholm Trail	Linear Feature	Historic	None	Intersect
Camino Real	Linear Feature	Historic	None	Intersect
			ASSESSMENT SCORE TOTAL:	**32**

5.2.11.4 Engineering and Costing

Preliminary engineering and costing analyses have been performed for both the production and injection well fields using 2021 Regional Water Planning methods. For Region L, Black & Veatch used the Uniform Costing Tool, which utilizes standard costing procedures and unit costs. The analysis includes all facilities required for water production, collection, transmission and treatment, and concentrate disposal. The well fields will require wells and a collector pipeline. Reverse osmosis technology is planned for the desalination process. Disposal of the concentrate is planned by deep well injection into the Edwards Limestone near the existing SAWS concentrate injection wells. Pumps in the well fields will be sized to deliver the raw water to the H_2Oaks Center. The desalination water treatment plant will be located on the SAWS property, adjacent to the H_2Oaks Center. The treated water will be delivered via integration pipelines that currently deliver water recovered from the existing local projects.

The design produces treated water with average TDS concentrations of about 450 mg/L. Pretreatment prior to the desalination process includes iron removal. The preliminary design has 70 percent of the raw water from the well field being sent to the desalination plant to remove dissolved solids. The desalination plant recovery rate is estimated to be 90 percent, meaning that 90 percent of the water entering the desalination plant passes through as purified water and 10 percent of the water remains as concentrated brine that contains the constituents removed from the purified water; therefore, the strategy water loss is estimated to be 10%. The desalinated water is blended back with 10 percent of the pretreated brackish water to produce a blended finished water with a TDS concentration of about 450 mg/L. The TDS concentration of the concentrate is estimated at about 15,000 mg/L.

Phase 2 will produce a uniform 12 mgd (13,440 acft/yr) of potable water from Wilson County. Facilities in this phase include a well field with 14 wells and expansion of the existing desalination plant. It will also require the construction of the concentrate pump station and pipeline, concentrate storage at the disposal site, and two new injection wells. Estimated costs for Phase 2 are detailed in Table 5.2.11-3.

Phase 3 will produce a uniform 6 mgd (6,720 acft/yr) of potable water from Wilson County. Facilities in this phase include a well field with seven wells and expansion of the existing desalination plant. It will also require the construction of the concentrate pump station and pipeline, concentrate storage at the disposal site, and one new injection well. Estimated costs for Phase 3 are detailed in Table 5.2.11-4.

Phase 4 will produce a uniform 28.55 mgd (32,000 acft/yr) of potable water from Wilson County. Facilities include a well field with 33 wells, which includes 6 backup wells. This phase will require expansion of the existing desalination plant. It will also require the construction of the concentrate pump station and pipeline, concentrate storage at the disposal site, and four new injection wells. Estimated costs for Phase 4 are detailed in Table 5.2.11-5.

Phase 5 will produce a uniform 16.06 mgd (18,000 acft/yr) of potable water. Facilities include a well field with 19 wells, which includes 3 backup wells, a raw water pump station at the well field, expansion of the water treatment plant, expansion of the concentrate pump stations, and two new concentrate injection wells. Estimated costs for Phase 5 are detailed in Table 5.2.11-6.

For planning purposes, groundwater leases and groundwater district export fees are assumed to be required. When complete, the SAWS Expanded Brackish Groundwater Project will produce approximately 62.6 mgd (70,160 acft/yr) of additional potable water. The blended finished water's TDS concentration will be approximately 450 mg/L. The Region L cost estimates for all phases 2 through 5 of the project are shown in Table 5.2.11-7.

Table 5.2.11-3 Phase 2 Cost Estimate Summary

ITEM	ESTIMATED COSTS
Primary Pump Station (12.6 mgd)	$4,824,000
Transmission Pipeline (42 in. dia.)	$4,397,000
Well Fields (wells, pumps, and piping)	$42,271,000
Water Treatment Plant Expansion (12 mgd)	$27,291,000
TOTAL COST OF FACILITIES	**$78,783,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$27,354,000
Environmental and Archaeology Studies and Mitigation	$1,661,000
Land Acquisition and Surveying (513 acres)	$1,993,000
Interest During Construction (3% for 2 years with a 0.5% return on investment)	$6,039,000
TOTAL COST OF PROJECT	**$115,830,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$8,150,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$467,000
Intakes and Pump Stations (2.5% of cost of facilities)	$121,000
Water Treatment Plant	$5,117,000
Pumping Energy Costs (9,039,148 kilowatt-hour [kW-h] at 0.08 $/kW-h)	$723,000
TOTAL ANNUAL COST	**$14,578,000**
Available Project Yield (acft/yr)	13,440
Annual Cost of Water ($ per acft)	$1,085
Annual Cost of Water After Debt Service ($ per acft)	$478
Annual Cost of Water ($ per 1,000 gallons)	$3.33
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$1.47
Based on a peaking factor of 1.0.	

Table 5.2.11-4 Phase 3 Cost Estimate Summary

ITEM	ESTIMATED COSTS
Primary Pump Station (6.3 mgd)	$2,377,000
Transmission Pipeline (42 in. dia.)	$4,397,000
Well Fields (wells, pumps, and piping)	$24,814,000
Water Treatment Plant Expansion (6 mgd)	$13,645,000
TOTAL COST OF FACILITIES	**$45,233,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$15,612,000
Environmental and Archaeology Studies and Mitigation	$1,248,000
Land Acquisition and Surveying (419 acres)	$1,719,000
Interest During Construction (3% for 2 years with a 0.5% return on investment)	$3,510,000
TOTAL COST OF PROJECT	**$67,322,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$4,737,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$292,000
Intakes and Pump Stations (2.5% of cost of facilities)	$59,000
Water Treatment Plant	$2,559,000
Pumping Energy Costs (2,143,087 kilowatt-hour [kW-h] at 0.08 $/kW-h)	$171,000
TOTAL ANNUAL COST	**$7,818,000**
Available Project Yield (acft/yr)	6,720
Annual Cost of Water ($ per acft)	$1,163
Annual Cost of Water After Debt Service ($ per acft)	$458
Annual Cost of Water ($ per 1,000 gallons)	$3.57
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$1.41
Based on a peaking factor of 1.0.	

Table 5.2.11-5 Phase 4 Cost Estimate Summary

ITEM	ESTIMATED COSTS
Primary Pump Station (30.1 mgd)	$36,084,000
Transmission Pipeline (42 in. dia.)	$81,699,000
Transmission Pump Station(s) & Storage Tank(s)	$29,349,000
Well Fields (wells, pumps, and piping)	$165,613,000
Water Treatment Plant Expansion (28.6 mgd)	$55,998,000
TOTAL COST OF FACILITIES	**$368,743,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$124,975,000
Environmental and Archaeology Studies and Mitigation	$5,998,000
Land Acquisition and Surveying (1,346 acres)	$5,198,000
Interest During Construction (3% for 2 years with a 0.5% return on investment)	$27,771,000
TOTAL COST OF PROJECT	**$532,685,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$37,480,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$2,502,000
Intakes and Pump Stations (2.5% of cost of facilities)	$1,563,000
Water Treatment Plant	$10,500,000
Pumping Energy Costs (123,248,465 kilowatt-hour [kW-h] at 0.08 $/kW-h)	$9,860,000
TOTAL ANNUAL COST	**$61,905,000**
Available Project Yield (acft/yr)	32,000
Annual Cost of Water ($ per acft)	$1,935
Annual Cost of Water After Debt Service ($ per acft)	$763
Annual Cost of Water ($ per 1,000 gallons)	$5.94
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$2.34
Based on a peaking factor of 1.0.	

Table 5.2.11-6 Phase 5 Cost Estimate Summary

ITEM	ESTIMATED COSTS
Transmission Pump Station(s) & Storage Tank(s)	$766,000
Well Fields (wells, pumps, and piping)	$54,114,000
Water Treatment Plant Expansion (16.1 mgd)	$30,013,000
TOTAL COST OF FACILITIES	**$84,893,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$29,713,000
Environmental and Archaeology Studies and Mitigation	$1,253,000
Land Acquisition and Surveying (271 acres)	$1,004,000
Interest During Construction (3% for 2 years with a 0.5% return on investment)	$6,428,000
TOTAL COST OF PROJECT	**$123,291,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$8,675,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$549,000
Intakes and Pump Stations (2.5% of cost of facilities)	$5,627,000
Water Treatment Plant	$340,000
Pumping Energy Costs (4,251,335 kilowatt-hour [kW-h] at 0.08 $/kW-h)	**$15,191,000**
TOTAL ANNUAL COST	$8,675,000
Available Project Yield (acft/yr)	18,000
Annual Cost of Water ($ per acft)	$844
Annual Cost of Water After Debt Service ($ per acft)	$362
Annual Cost of Water ($ per 1,000 gallons)	$2.59
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$1.11
Based on a peaking factor of 1.0.	

Table 5.2.11-7 Total Project Cost Estimate Summary (Phases 2 through 5)

ITEM	ESTIMATED COSTS
Primary Pump Station (30.1 mgd)	$36,084,000
Transmission Pipeline (42 in. dia.)	$81,699,000
Transmission Pump Station(s) & Storage Tank(s)	$29,349,000
Well Fields (wells, pumps, and piping)	$292,208,000
Water Treatment Plant Expansion (62.6 mgd)	$127,040,000
TOTAL COST OF FACILITIES	**$566,380,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$194,148,000
Environmental and Archaeology Studies and Mitigation	$8,898,000
Land Acquisition and Surveying (1,858 acres)	$7,640,000
Interest During Construction (3% for 2 years with a 0.5% return on investment)	$42,739,000
TOTAL COST OF PROJECT	**$819,805,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$57,682,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$3,768,000
Intakes and Pump Stations (2.5% of cost of facilities)	$1,563,000
Water Treatment Plant	$23,820,000
Pumping Energy Costs (168,933,085 kilowatt-hour [kW-h] at 0.08 $/kW-h)	$11,630,000
TOTAL ANNUAL COST	**$98,463,000**
Available Project Yield (acft/yr)	70,160
Annual Cost of Water ($ per acft)	$1,403
Annual Cost of Water After Debt Service ($ per acft)	$581
Annual Cost of Water ($ per 1,000 gallons)	$4.31
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$1.78
Based on a peaking factor of 1.0.	

5.2.11.5 Implementation Considerations

Implementation of the SAWS Expanded Brackish Groundwater Project includes the following considerations:

- Verification of available groundwater quantity and well productivity;
- Verification of water quality for concentrations of dissolved constituents, such as TDS, chloride, sulfate, iron, manganese, and hydrogen sulfide;
- Verification of the potential for deep well injection of concentrate;
- Verification that desalinated Carrizo-Wilcox Aquifer water is compatible with other water sources being used by customers and will meet all water quality requirements in the end user's distribution system;
- Potential for differing water qualities/chemical constituents in the water;
- Potential adverse impacts on other aquifers, including potential interaction between the Wilcox and Carrizo formations (additional research regarding potential interaction between the Wilcox and Carrizo formations has been suggested);
- Regulations by TCEQ;
- Regulations by and securing permits from the Evergreen Underground Water Conservation District; and
- Experience in operating and maintaining a desalination water treatment plant.

Additional implementation considerations may include impacts on the following:

- Endangered and threatened species;
- Water levels in the aquifer, including potential dewatering of the current artesian part of the aquifer;
- Baseflow in streams; and
- Wetlands.

Additional considerations include competition with others in the area for groundwater in the Carrizo Aquifer from the following:

- Private water purveyors;
- Public water purveyors in the area; and/or
- Future oil and gas drilling operations.

Reliability

Water from these sources is considered to be very reliable based on available hydrogeologic information from the studies completed in the area. Supply is considered to be medium because of the potential of differing well productivity and water quality, potential impacts to natural resources and Carrizo-Wilcox Aquifer user competition (reliability score = 4).

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5.2.12 ARWA/GBRA Project (Phase 1)

5.2.12.1 Description of Water Management Strategy

The ARWA and GBRA Phase 1 WMS includes the development of 30,000 acft/yr groundwater supply from the Carrizo-Wilcox Aquifer in Gonzales and Caldwell counties, with 15,000 acft/yr allocated to ARWA and 15,000 acft/yr allocated to GBRA[1]. This WMS is a joint project between ARWA and GBRA, which seeks to implement Phase 1 of ARWA's Carrizo groundwater project and Phase 1 of GBRA's Mid-Basin Water Supply Project. By working together, the two entities are seeking to achieve capital and operational costs savings from economies of scale and to avoid unnecessary construction of additional pipelines.

The WMS is designed to produce an average annual water supply of 33.6 mgd, which includes a 1.5 peaking factor for the ARWA supply and no peaking factor for GBRA. The following description is based on ARWA and GBRA current plans; these plans may be modified as the project progresses. The project facilities will be located east of New Braunfels, San Marcos, and Kyle (Figure 5.2.12-1). The planned facilities for Phase 1 include well fields for both ARWA and GBRA from the Carrizo-Wilcox Aquifer, a WTP, a booster pump station, two elevated storage tanks, a high service pump station expansion and associated ground storage tank in San Marcos, and approximately 85 miles of pipelines.

[1] If this project is limited by the MAG, it is assumed that ARWA or GBRA will utilize Local Groundwater Conversion WMS (See Section 5.2.5) to secure the remaining supplies for the project

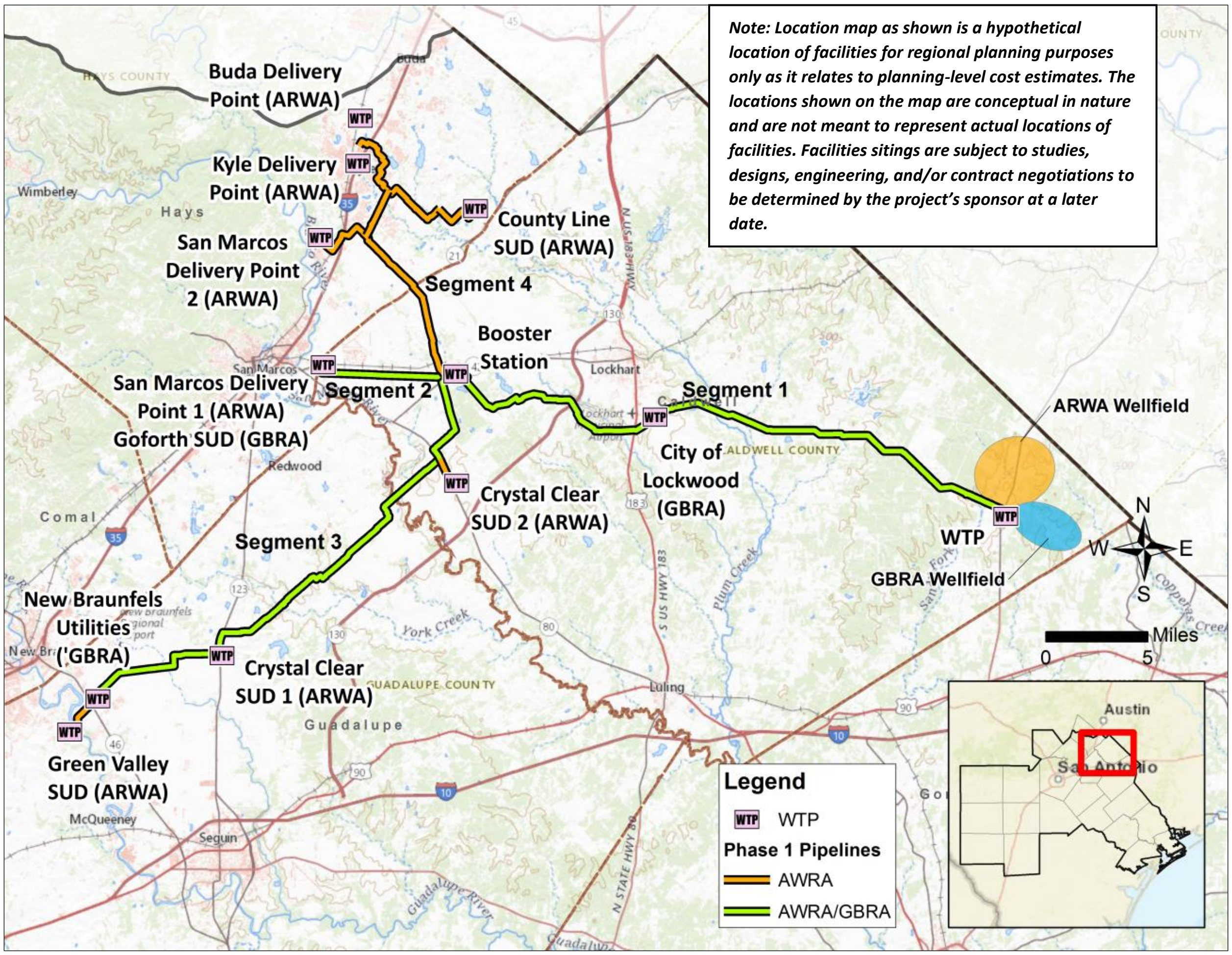

Figure 5.2.12-1 ARWA/GBRA Project (Phase 1) Location

5.2.12.2 Available Yield

As part of this process, ARWA and GBRA are each planning to develop well fields that supply an estimated total of 30,000 acft/yr from the Carrizo-Wilcox Aquifer. A total of 22 wells are proposed: 11 for ARWA and 11 for GBRA. Four of the 22 wells were recommended as contingency wells for operational flexibility or backup raw water supply. Well field details are provided in Table 5.2.12-1. This WMS is expected to be implemented and providing water for the 2020 decade.

Table 5.2.12-1 ARWA/GBRA Well Fields Details

DESCRIPTION	ARWA	GBRA
Number of Wells	11	11
Average Well Production Capacity (gpm)	1,044	1,027
Well Depth (ft)	~300	~300
Total Dissolved Solids Concentration (mg/L)	200	200

Raw water will be treated via filtration, iron and manganese removal, and other chemical injections at a planned 33.6 mgd WTP, located near the well fields (Figure 5.2.12-1). The treated water is proposed to be delivered to 11 locations: eight ARWA locations and three GBRA locations. Proposed delivery points and estimated volumes associated with Phase 1 are detailed in Table 5.2.12-2.

Table 5.2.12-2 Phase 1 Delivery Points

DELIVERY POINT / WUG END-USER	WWP SUPPLIER	PHASE 1 ANNUAL VOLUMES (ACFT/YR)
City of Lockhart	GBRA	3,000
Crystal Clear SUD (Delivery Point 1)	ARWA	2,348
Crystal Clear SUD (Delivery Point 2)	ARWA	212
New Braunfels	GBRA	8,000
Green Valley SUD	ARWA	1,595
San Marcos (Delivery Point 1) [a]	ARWA	2,519
Goforth SUD (at San Marcos Delivery Point 1) [b]	GBRA	3,999
San Marcos (Delivery Point 2) [a]	ARWA	2,861
County Line SUD	ARWA	478
Kyle Delivery Point	ARWA	4,225
Buda Delivery Point [b]	ARWA	762

[a] San Marcos plans to provide 2,786 acft/yr to Manufacturing, Comal in 2020. Starting in 2030 and continuing throughout the planning period, the San Marcos delivery volume will be 5,380 acft/yr.

[b] Buda and Goforth SUD are split WUGs between Region K and Region L. Volumes in this table are representative of the total volume for both regions. The Region L portion is described in Section 5.3.

Pipelines and Facilities

As described above, Phase 1 will include approximately 85 miles of pipelines and a booster pump station. Approximately 61 miles of the pipelines are planned to be shared by both ARWA and GBRA. The remaining 24 miles are planned to be solely used by ARWA. Additionally, ARWA plans to construct a 2 million gallon (MG) elevated storage tank (EST) near the County Line SUD and Buda delivery points, and GBRA plans to construct a 3.6 mgd pump station expansion and a 2.0 MG ground storage tank (GST) at the San Marcos WTP. Both ARWA and GBRA will proportionally share cost/storage for an additional 2 MG EST near Crystal Clear SUD 1. Shared pipeline and facility costs are planned to be proportionally split on the basis of flow, capacity, and peaking factor. Costs are further described in Section 5.2.12.4.

5.2.12.3 Environmental Considerations

Environmental Considerations

Vegetation and Land Use

The project area is located in the Post Oak Savannah and Blackland Prairie ecoregions and crosses a variety of vegetation types, mostly open fields, pastures, and riparian zones along streams. As mapped by TPWD,[2] dominant vegetation types in the project area are disturbance/tame grassland, mesquite shrubland, savanna grassland, and row crops. The linear components of the project cross riparian vegetation zones along streams, mapped by TPWD as floodplain and riparian herbaceous vegetation, floodplain and riparian hardwood forest, floodplain and riparian deciduous shrubland, and floodplain live oak forest. Vegetation within the well fields sites consists of savanna grasslands, mottes and woodlands, and shrublands.

Based on TPWD vegetation mapping, the project may have the potential to impact 1,032 acres of agricultural resources, including 228 acres mapped as row crops, and 804 acres of disturbance or tame grassland which may include pasture areas used for grazing.

Project pipeline easements would require removal of woody vegetation and long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each WMS to determine the best course of action regarding revegetation. Pipeline easements may also continue to be used for agricultural purposes.

Aquatic Resources

The project pipeline alignment crosses several mapped streams and their associated floodplains including the San Marcos River and Guadalupe River. The NWI mapping shows 10.3 acres of ponds, lakes, and riverine wetlands as well as emergent wetlands in the project area. The well field sites contain approximately 215 acres of mapped ponds, lakes, and riverine wetlands.

The project pipeline (Segment 3 on the above-referenced figure) crosses TCEQ Segment No. 1804A of Geronimo Creek, a tributary of the Guadalupe River. Geronimo Creek has been designated as impaired for bacteria in the Texas Integrated Report of 303(d) listed water bodies.[3] This list identifies the water bodies or segments in Texas that do not meet assigned water quality standards. The project pipeline (Segment 3) crosses the headwaters of Geronimo Creek, an ecologically significant stream segment designated by TPWD.

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[2] TPWD. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

[3] Texas Commission on Environmental Quality. 2018. 2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf

The project will require an on-site delineation of streams, ponds, and wetlands. Stream crossings for pipeline construction would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including if there would be permanent impacts to over 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under stream (e.g., through horizontal directional drilling) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

Table 5.2.12-3 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Caldwell, Gonzales, Guadalupe, and Hays counties[4],[5],[6],[7]. Suitable habitat for the federally endangered golden-cheeked warbler may occur along approximately 2,500 feet of the western extent of Pipeline Segment 4. The project will require an on-site habitat assessment to determine whether suitable habitat is present within this area. Suitable habitat does not occur for any other federally endangered species with the potential to occur in the project region. However, several freshwater mussel species are under review for federal listing as threatened or endangered, and the project pipeline crosses streams that may provide suitable habitat for freshwater mussels.

Suitable habitat may occur for several state listed threatened species including Texas horned lizard (*Phrynosoma cornutum*), Texas tortoise (*Gopherus berlandieri*), and timber rattlesnake (*Crotalus horridus*). Potentially suitable habitat may occur for numerous state wildlife, plant, and insect species designated by TPWD as SGCN. These species do not have formal protected status but are being monitored by TPWD. Migratory birds may occur in the project area, particularly in riparian zones and wetland areas.

Streams in the project area may contain suitable habitat for federal candidate/state-threatened freshwater mussel species. Suitable habitat may occur in perennial rivers/streams and perennial pools of intermittent streams. If any such habitat would be affected by construction, presence/absence surveys and relocation of native mussel species would be required. Handling and relocation of mussels and other aquatic species must be conducted by TPWD-permitted personnel and in accordance with an approved Aquatic Resources Relocation Plan. Furthermore, these candidate species may be listed as federally threatened or endangered during the project timeline; in which case, any species impacts would require USFWS consultation.

Site-specific field surveys would be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be

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[4] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Caldwell County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[5] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Gonzales County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[6] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Guadalupe County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[7] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Hays County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

used for the project, formal coordination with TPWD will likely be required to obtain its recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15. Preconstruction surveys for active bird nests are recommended.

Table 5.2.12-3 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for ARWA/GBRA Project (Phase 1), Caldwell, Gonzales, Guadalupe, and Hays Counties, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Barton Springs salamander	*Eurycea sosorum*	E	E	Outlets of Barton Springs and subterranean water-filled caverns; found under rocks, in gravel, or among aquatic vascular plants and algae.	Project is outside of the expected range of this species.
Blanco blind salamander	*Eurycea robusta*	N/A	T	Water-filled subterranean caverns; may inhabit deep levels of the Balcones Aquifer to the north and east of the Blanco River.	Suitable habitat unlikely to occur within the project area.
Blanco River Springs salamander	*Eurycea pterophila*	N/A	SGCN	Springs and caves in the Blanco River drainage.	Project is outside of the expected range of this species.
Houston toad	*Anaxyrus houstonensis*	E	E	Sandy soils near ephemeral pools and populations of loblolly pine.	Project is outside of the expected range of this species.
Pedernales River Springs salamander	*Eurycea sp. 6*	N/A	N/A	Known only from springs.	Project is outside of the expected range of this species.
San Marcos salamander	*Eurycea nana*	T	T	Headwaters of the San Marcos River downstream to about 0.5 mile past IH 35.	Project is outside of the expected range of this species.
Strecker's chorus frog	*Pseudarcris streckeri*	N/A	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Suitable habitat may occur within the project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas blind salamander	*Eurycea rathbuni*	E	E	Water-filled subterranean caverns along six miles of the San Marcos Spring Fault.	Project is outside of the expected range of this species.
Texas salamander	*Eurycea neotenes*	N/A	SGCN	Cave streams, seeps, springs, and creek headwaters; Helotes and Leon Creek drainages.	Project is outside of the expected range of this species.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur within the project area.
Arachnids					
No common accepted name	*Cicurina russelli*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Cicurina ubicki*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Texella mulaiki*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Texella renkesae*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Cicurina ezelli*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Texella diplospina*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Texella grubbsi*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Tartarocreagris grubbsi*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	N/A	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat may occur along the San Marcos and Guadalupe rivers; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Black-capped vireo	*Vireo atricapilla*	N/A	E	Oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces.	Suitable habitat does not occur in project area; may fly over during migration.
Black rail	*Laterallus jamaicensis*	PT	SGCN	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh	Suitable habitat may occur within the project area; may fly over during migration.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur within the project area; may fly over during migration.
Golden-cheeked warbler	*Setophaga chrysoparia*	E	E	Ashe juniper in mixed stands with various oaks (*Quercus* spp.). Edges of cedar brakes.	Suitable habitat may occur along approximately 2,500 feet of the western extent of pipeline Segment C (5). Suitable habitat does not occur in the remaining portions of the project area; may fly over during migration.
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also know to nest on manmade structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Unlikely to occur within project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie; feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat may occur within the project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur in project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	T	Brackish marshes, shallow salt ponds and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Suitable habitat does not occur in project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Red knot	*Calidris canutus rufa*	T	SGCN	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays.	Suitable habitat does not occur in project area; may fly over during migration.
Swallow-tailed kite	*Elanoides forficatus*	N/A	T	Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge.	Unlikely to occur within project area; may fly over during migration.
Tropical parula	*Setophaga pitiayumi*	N/A	T	Semi-tropical evergreen woodland along rivers and resacas.	Unlikely to occur within project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs, may use open areas such as vacant lots; nests and roosts in abandoned burrows.	Suitable wintering habitat may occur in project vicinity; may fly over during migration.
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat may occur in project vicinity; may fly over during migration.
White-tailed hawk	*Buteo albicaudatus*	N/A	T	Near coast on prairies, cordgrass flats, and scrub live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral.	Suitable habitat may occur in project vicinity; may fly over during migration.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems (during migration).	Suitable habitat does not occur in project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Unlikely to occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat may occur along the San Marcos and Guadalupe rivers; may fly over during migration.
Crustaceans					
Balcones Cave amphipod	*Stygobromus balconis*	N/A	SGCN	Subaquatic, subterranean obligate amphipod.	Project is outside of the expected range of this species.
Ezell's Cave amphipod	*Stygobromus flagellates*	N/A	SGCN	Known only from artesian wells.	Project is outside of the expected range of this species.
No accepted common name	*Texiweckelia texensis*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No accepted common name	*Palaemonetes texanus*	N/A	SGCN	River shrimp found in the Middle Guadalupe and San Marcos watersheds.	May occur in the Guadalupe and San Marcos rivers.
Texas troglobitic water slater	*Lirceolus smithii*	N/A	SGCN	Subaquatic, subterranean obligate, aquifer.	Project is outside of the expected range of this species.
Fishes					
American eel	*Anguilla rostrate*	N/A	SGCN	Coastal waterways below reservoirs.	May occur in the Guadalupe and San Marcos rivers.
Fountain darter	*Etheostoma fonticola*	E	E	San Marcos and Comal rivers; springs and spring-fed streams with dense beds of aquatic plants.	Project is outside of the expected range of this species.
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat may occur within the San Marcos and Guadalupe rivers within the project area.
Guadalupe darter	*Percina apristis*	N/A	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Suitable habitat may occur within the Guadalupe River within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Headwater catfish	*Ictalurus lupus*	N/A	SGCN	Limited to Rio Grande drainage; springs with sandy and rocky riffles, pools of clear creeks, runs, and small rivers.	Project is outside of the expected range of this species.
Ironcolor shiner	*Notropis chalybaeus*	N/A	SGCN	Often at the upstream ends of pools, with a moderate to sluggish current and sand, mud, silt, or detritus substrates.	Suitable habitat may occur within project area.
Plateau shiner	*Cyprinella lepida*	N/A	SGCN	Edwards Plateau portion of the Nueces basin; cool, clear, spring-fed headwater creeks.	Project is outside of the expected range of this species.
River darter	*Percina shumardi*	N/A	N/A	Large rivers and lower part of tributaries; deep chutes and riffles where current is swift, and bottom is coarse gravel or rock.	Suitable habitat may occur within project area.
Texas shiner	*Notropis amabilis*	N/A	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Suitable habitat may occur within project area.
Insects					
A cave obligate beetle	*Rhadine austinica*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
A mayfly	*Procloeon distinctum*	N/A	SGCN	Found in shoreline vegetation.	Suitable habitat may occur in the project area.
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in the project area.
Comal Springs diving beetle	*Comaldessus stygius*	N/A	SGCN	Known only from the outflows at Comal Springs; generally, inhabit the water column.	Project is outside the expected range of this species.
Comal Springs dryopid beetle	*Stygoparnus comalensis*	E	E	Found crawling on stream bottoms or along shores.	Project is outside of the expected range of this species.
Comal Springs riffle beetle	*Heterelmis comalensis*	E	E	Comal and San Marcos Springs.	Project is outside the expected range of this species.
Comanche harvester ant	*Pogonomyrmex comanche*	N/A	SGCN	Habitat description is not available at this time.	Suitable habitat may occur in the project area, particularly in areas of sandy soils.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Edwards Aquifer diving beetle	*Haideoporus texanus*	N/A	SGCN	Habitat poorly known; known from an artesian well in Hays County.	Project is outside the expected range of this species.
No accepted common name	*Rhadine insolita*	N/A	SGCN	Cave dwelling.	Project is outside the expected range of this species.
No accepted common name	*Batrisodes grubbsi*	N/A	SGCN	Cave dwelling.	Project is outside the expected range of this species.
No accepted common name	*Neotrichia juani*	N/A	SGCN	Riparian/riverine.	Suitable habitat may occur in the project area.
No accepted common name	*Oxyelophila callista*	N/A	SGCN	Woodlands.	Suitable habitat may occur in the project area.
No accepted common name	*Ochrotrichia capitana*	N/A	SGCN	Riparian/riverine.	Suitable habitat may occur in the project area.
No accepted common name	*Plauditus texanus*	N/A	SGCN	Riparian/riverine.	Suitable habitat may occur in the project area.
No accepted common name	*Xiphocentron messapus*	N/A	SGCN	Riparian/riverine.	Suitable habitat may occur in the project area.
No accepted common name	*Bombus variabilis*	N/A	SGCN	Grasslands and croplands.	Suitable habitat may occur in the project area.
No accepted common name	*Melanoplus alexanderi*	N/A	SGCN	Open oak savannahs.	Suitable habitat may occur in the project area.
San Marcos saddle-case caddisfly	*Protoptila arca*	N/A	SGCN	Known from an artesian well in Hays County.	Project is outside the expected range of this species.
Texas austrotinodes caddisfly	*Austrotinodes texensis*	N/A	SGCN	Ranges from cobble and gravel to limestone bedrock; many limestone outcroppings also found along streams.	Suitable habitat may occur in the project area.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur within project area.
Aransas short-tailed shrew	*Blarina hylophaga plumbea*	N/A	SGCN	Excavates burrows in sandy soils underlying mottes of live oak trees or in areas with little to no ground cover.	Suitable habitat may occur within project area.
Big brown bat	*Eptesicus fuscus*	N/A	SGCN	Woodlands or wooded areas.	Suitable habitat may occur within project area.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls, will use buildings.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Cave myotis bat	*Myotis velifer*	N/A	SGCN	Cave-dwelling, also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	Suitable habitat may occur within project area.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat may occur within project area.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges.	Suitable habitat may occur within project area.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Suitable habitat may occur within project area.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur within project area.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	Suitable habitat may occur within project area; may use buildings/ structures.
Mexican long-tongued bat	*Choeronycteris Mexicana*	N/A	SGCN	Riparian forest in Texas; roost in mines, large crevices, and caves.	Suitable habitat may occur within project area.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Suitable habitat may occur within project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Low potential for suitable habitat to occur within project area.
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	N/A	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Southern short-tailed shrew	*Blarina carolinensis*	N/A	SGCN	Various upland and wetland habitats, including moist deciduous woods, brushy areas, pine woodland and forest, mixed oak-pine-juniper woods.	Suitable habitat may occur within project area.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat may occur within project area.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Restricted to dry and sandy soils of open areas, such as grasslands, cultivated fields, meadows, roadsides, airfields, shrublands, and suburb lawns.	Suitable habitat may occur within project area.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat may occur within project area.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat may occur within project area.
Western spotted skunk	*Spilogale gracilis*	N/A	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur within project area.
White-nosed coati	*Nasua narica*	N/A	T	Canyons, riparian corridors, and woodlands.	Project area is outside the expected range of this species.
Woodland vole	*Microtus pinetorum*	N/A	SGCN	Includes grassy marshes, swamp edges, old-field/pine woodland ecotones, tallgrass fields; generally sandy soils.	Unlikely to occur within project area.
Mollusks					
False spike	*Fusconaia mitchelli*	N/A	T	Medium to large rivers; present in Guadalupe, Colorado, and Brazos river basins.	Potential to occur in perennial waterways along the pipeline alignments.
Glossy wolfsnail	*Euglandina texasiana*	N/A	SGCN	Terrestrial; south Texas, Rio Grande	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Golden orb	*Cyclonaias aurea*	N/A	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces river basins.	Potential to occur in perennial waterways along the pipeline alignments. This species was recently a federal candidate species, but its listing as federally threatened or endangered was not warranted as it is not a valid species.
No accepted common name	*Holospira goldfussi*	N/A	SGCN	Terrestrial snail; Edwards Plateau.	Project area is outside the expected range of this species.
No accepted common name	*Millerelix gracilis*	N/A	SGCN	Terrestrial snail; Edwards Plateau.	Project area is outside the expected range of this species.
No accepted common name	*Cyclonaias necki*	N/A	SGCN	Guadalupe River basin; moderate to large streams with flowing water.	Potential to occur in perennial waterways along the pipeline alignment.
No accepted common name	*Elimia comalensis*	N/A	SGCN	Aquatic; found in springs in Central Texas.	Project area is outside the expected range of this species.
No accepted common name	*Phreatodrobia conica*	N/A	SGCN	Subaquatic; subterranean obligate.	Project area is outside the expected range of this species.
No accepted common name	*Phreatodrobia micra*	N/A	SGCN	Subaquatic; subterranean obligate.	Project area is outside the expected range of this species.
No accepted common name	*Phreatodrobia plana*	N/A	SGCN	Subaquatic; subterranean obligate.	Project area is outside the expected range of this species.
No accepted common name	*Phreatodrobia punctata*	N/A	SGCN	Subaquatic; subterranean obligate.	Project area is outside the expected range of this species.
No accepted common name	*Phreatodrobia rotunda*	N/A	SGCN	Subaquatic; subterranean obligate.	Project area is outside the expected range of this species.
Texas fatmucket	*Lampsilis bracteata*	C	T	Colorado River basin; streams and rivers on sand, mud, and gravel substrates; mistakenly thought to occur in the Guadalupe River basin.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas pimpleback	*Cyclonaias petrina*	C	T	Colorado River basin; mud, gravel, and sand substrates in areas with slow flow rates; mistakenly thought to occur in the Guadalupe River basin.	Project area is outside the expected range of this species.
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	N/A	SGCN	Endemic to sandy regions of southern and south-central Texas.	Suitable habitat may occur within project area.
Bigflower cornsalad	*Valerianella stenocarpa*	N/A	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms.	Suitable habitat may occur within project area.
Big red sage	*Salvia pentstemonoides*	N/A	SGCN	Steep limestone outcrops on seeps within canyons or along creek banks; occasionally on clayey to silty soils of creek banks and terraces, in partial shade to full sun.	Project area is outside the expected range of this species.
Bracted twistflower	*Streptanthus bracteatus*	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Project area is outside the expected range of this species.
Bristle nailwort	*Paronychia setacea*	N/A	SGCN	Flowering vascular plant endemic to eastern southcentral Texas, occurs in sandy soils.	Suitable habitat may occur within project area.
Buckley tridens	*Tridens buckleyanus*	N/A	SGCN	Occurs in juniper-oak woodlands on rocky limestone slopes.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Buckley's spiderwort	*Tradescantia buckleyi*	N/A	SGCN	Occurs on sandy loam or clay soils in grasslands or shrublands underlain by the Beaumount Formation.	Project area is outside the expected range of this species.
Canyon mock-orange	*Philadelphus texensis* var. *ernestii*	N/A	SGCN	On outcrops of Cretaceous limestone exposed as rimrock along mesic canyons, usually in the shade of mixed evergreen-deciduous canyon woodland.	Project area is outside the expected range of this species.
Crestless onion	*Allium canadense var. ecristatum*	N/A	SGCN	Occurs on poorly drained sites on sandy substrates within coastal prairies of the Coastal Bend area (Carr 2015).	Project area is outside the expected range of this species.
Drummond's rushpea	*Caesalpinia drummondii*	N/A	SGCN	Open areas on sandy clay.	Project area is outside the expected range of this species.
Elmendorf's onion	*Allium elmendorfii*	N/A	SGCN	Grassland openings in oak woodlands on deep, loose, well-drained sands; to the north it occurs in post oak-black hickory-live oak woodlands over Queen City and similar Eocene formations.	Project area is outside the expected range of this species.
Engelmann's bladderpod	*Physaria engelmannii*	N/A	SGCN	Grasslands and calcareous rock outcrops in a band along the eastern edge of the Edwards Plateau.	Suitable habitat may occur within project area.
Florida pinkroot	*Spigelia texana*	N/A	SGCN	Woodlands on loamy soils along rivers in south Texas.	Suitable habitat may occur within project area.
Glass Mountains coral-root	*Hexalectris nitida*	N/A	SGCN	Under *Juniperus ashei* in woodlands over limestone on the Edwards Plateau, Callahan Divide, and Lampasas Cutplain.	Project area is outside the expected range of this species.
Gravelbar brickelbush	*Brickellia dentata*	N/A	SGCN	Frequently scoured gravelly alluvial beds in creek and river bottoms of Edwards Plateau.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Hall's prairie clover	*Dalea hallii*	N/A	SGCN	In grasslands on eroded limestone or chalk and in oak scrub on rocky hillsides.	Project area is outside the expected range of this species.
Heartleaf evening-primrose	*Oenothera cordata*	N/A	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Suitable habitat may occur within project area.
Heller's beardtongue	*Penstemon triflorus* ssp. *integrifolius*	N/A	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Suitable habitat may occur within project area.
Heller's marbleseed	*Omosmodium helleri*	N/A	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Project area is outside the expected range of this species.
Hill Country wild-mercury	*Argythamnia aphoroides*	N/A	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands, also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Project area is outside the expected range of this species.
Low spurge	*Euphorbia peplidion*	N/A	SGCN	Occurs in a variety of vernally-moist situations in a number of natural regions.	Suitable habitat may occur within project area.
Lundell's whitlow wort	*Paronychia lundellorum*	N/A	SGCN	The Sand Sheet of eastern South Texas, in tight sandy soils over saline clay on microhighs within salty prairie grasslands, and in upper portions of saline flats surrounding short drainages and brackish basins typical of the South Texas Sand Sheet.	Project area is outside the expected range of this species.
Narrowleaf brickelbush	*Brickellia eupatorioides* var. *gracillima*	N/A	SGCN	Occurs in a variety of vernally moist habitats in a number of natural regions.	Suitable habitat may occur within project area.
Net-leaf bundleflower	*Desmanthus reticulatus*	N/A	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Osage Plains false foxglove	*Agalinis densiflora*	N/A	SGCN	Grasslands on shallow, gravelly, well drained, calcareous soils; prairies, dry limestone soils.	Suitable habitat may occur within project area.
Parks jointweed	*Polygonella parksii*	N/A	SGCN	Mostly on deep, loose, whitish sand blowouts (unstable, deep, xeric, sandhill barrens) in post oak savannah landscapes over the Carrizo and Sparta formations; also occurs in early successional grasslands, along rights-of-way, and on mechanically disturbed areas.	Suitable habitat may occur within project area.
Plateau loosestrife	*Lythrum ovalifolium*	N/A	SGCN	Banks and gravelly beds of perennial (or strong intermittent) streams on the Edwards Plateau, Llano Uplift, and Lampasas Cutplain.	Project area is outside the expected range of this species.
Plateau milkvine	*Matelea edwardsensis*	N/A	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Project area is outside the expected range of this species.
Sandhill woolywhite	*Hymenopappus carrizoanus*	N/A	SGCN	Disturbed or open areas in grasslands and post oak woodlands on deep sands derived from the Carrizo Sand and similar Eocene formations.	Suitable habitat may occur within project area.
Sayersville blue eyes	*Nemophila sayersensis*	N/A	SGCN	Very sandy soils near stream edges.	Suitable habitat may occur within project area.
Scarlet leather-flower	*Clematis texensis*	N/A	SGCN	In oak-juniper woodlands in mesic rocky limestone canyons or along perennial streams.	Project area is outside the expected range of this species.
Shinner's sunflower	*Helianthus occidentalis* ssp. *plantagineus*	N/A	SGCN	Mostly in prairies on the Coastal Plain, with several slightly disjunct populations in the Pineywoods and South Texas Brush Country.	Suitable habitat may occur within project area.
South Texas spikesedge	*Eleocharis austrotexana*	N/A	SGCN	Wetlands on the coastal plain.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Spreading leastdaisy	*Chaetopappa effusa*	N/A	SGCN	Limestone cliffs, ledges, bluffs, steep hillsides, sometimes in seepy areas, oak-juniper, oak, or mixed deciduous woods, 300-500 meter elevation.	Project area is outside the expected range of this species.
Sycamore-leaf snowbell	*Styrax platanifolius* ssp. *platanifolius*	N/A	SGCN	Oak-juniper woodlands on steep rocky banks and ledges along intermittent or perennials streams.	Project area is outside the expected range of this species.
Texas amorpha	*Amorpha roemeriana*	N/A	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes, sometimes on dry shelves above creeks.	Project area is outside the expected range of this species.
Texas barberry	*Berberis swaseyi*	N/A	SGCN	Shallow calcareous stony clay of upland grasslands/shrublands over limestone as well as in loamier soils in openly wooded canyons and on creek terraces.	Project area is outside the expected range of this species.
Texas beebalm	*Monarda viridissima*	N/A	SGCN	Endemic perennial herb of the Carrizo Sands; deep, well-drained sandy soils in openings of post oak woodlands.	Suitable habitat may occur within project area.
Texas claret-cup cactus	*Echinocereus coccineus* var. *paucispinus*	N/A	SGCN	Occurs in rocky outcroppings, often in the partial-shade of oak and pine-oak woodlands and mixed conifer forest.	Project area is outside the expected range of this species.
Texas fescue	*Festuca versuta*	N/A	SGCN	Occurs in mesic woodlands on limestone-derived soils on stream terraces and canyon slopes.	Project area is outside the expected range of this species.
Texas milk vetch	*Astragalus reflexus*	N/A	SGCN	Grasslands, prairies, and roadsides on calcareous and clay substrates.	Suitable habitat may occur within project area.
Texas peachbush	*Primus texana*	N/A	SGCN	Occurs at scattered sites in various well drained sandy situations; deep sand, plains and sand hills, grasslands, oak woods, 0-200 meter elevation.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas seymeria	*Seymeria texana*	N/A	SGCN	Found primarily in grassy openings in juniper-oak woodlands on dry rocky slopes but sometimes on rock outcrops in shaded canyons.	Project area is outside the expected range of this species.
Texas sandmint	*Rhododon ciliatus*	N/A	SGCN	Open sandy areas in the Post Oak Belt of east-central Texas.	Suitable habitat may occur within project area.
Texas tauschia	*Tauschia texana*	N/A	SGCN	Occurs in loamy soils in deciduous forests or woodlands on river and stream terraces.	Suitable habitat may occur within project area.
Texas wild-rice	*Zizania texana*	E	E	Spring-fed river, in clear, cool, swift water mostly less than 1 meter deep, with coarse sandy soils.	Project area is outside the expected range of this species.
Threeflower penstemon	*Penstemon triflorus* ssp. *triflorus*	N/A	SGCN	Occurs sparingly on rock outcrops and in grasslands associated with juniper-oak woodlands.	Project area is outside the expected range of this species.
Topeka purple-coneflower	*Echinacea atrorubens*	N/A	SGCN	Occurring mostly in tallgrass prairie of the southern Great Plains, in blackland prairies but also in a variety of other sites like limestone hillsides.	Suitable habitat may occur within project area.
Tree dodder	*Cuscuta exaltata*	N/A	SGCN	Parasitic on various *Quercus*, *Juglans*, *Rhus*, *Vitis*, *Ulmus*, and *Diospyros* species as well as *Acacia berlandieri*.	Suitable habitat may occur within project area.
Turnip-root scurf	*Pediomelum cyphocalyx*	N/A	SGCN	Grasslands and openings in juniper-oak woodlands on limestone substrates on the Edwards Plateau and in north-central Texas.	Project area is outside the expected range of this species.
Warnock's coral-root	*Hexalectris warnockii*	N/A	SGCN	In leaf litter and humus in oak-juniper woodlands on shaded slopes and intermittent, rocky creekbeds in canyons.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Woolly butterflyweed	*Gaura villosa* ssp. *parksii*	N/A	SGCN	Sandy soils of Rio Grande plains.	Project area is outside the expected range of this species.
Wright's trichocoronis	*Trichocoronis wrightii* var. *wrightii*	N/A	SGCN	Riparian zones, wetlands, pond margins, wet meadows.	Suitable habitat may occur within project area.
Reptiles					
American Alligator	*Alligator mississippiensis*	N/A	N/A	Coastal marshes; inland natural rivers, swamps and marshes; manmade impoundments.	Low potential to occur within project area.
Cagle's map turtle	*Graptemys caglei*	N/A	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River System.	Suitable habitat may occur within project area.
Common garter snake	*Thamnophis sirtalis*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur within project area.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur within project area.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat may occur within project area.
Northern spot-tailed earless lizard	*Holbrookia lacerata lacerata*	N/A	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edwards Plateau.	Suitable habitat may occur within project area.
Slender glass lizard	*Ophisaurus attenuatus*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannahs, pine barrens, and oil fields.	Suitable habitat may occur within project area.
Spot-tailed earless lizard	*Holbrookia lacerata*	N/A	SGCN	Moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	N/A	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat may occur within project area.
Texas garter snake	*Thamnophis sirtalis annectens*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur within project area.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees.	Suitable habitat may occur within project area.
Texas map turtle	*Graptemys versa*	N/A	SGCN	Rivers with moderate current, abundant aquatic vegetation, and basking logs; also associated oxbows and lakes.	Project area is outside the expected range of this species.
Texas tortoise	*Gopherus berlandieri*	N/A	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus.	Suitable habitat may occur within project area.
Timber rattlesnake	*Crotalus horridus*	N/A	T	Swamps, floodplains, upland pine and deciduous woodland, riparian zones, abandoned farmland. Limestone bluffs, sandy soil, or black clay.	Low potential for suitable habitat to occur within project area.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrows into soil or may use burrows made by other species.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Western hognose snake	*Heterodon nasicus*	N/A	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets. Seems to prefer sandy and loamy soils.	Suitable habitat may occur within project area.

PT = Proposed Threatened
T = Threatened
E = Endangered
C = Candidate
DL = Delisted
N/A = Not applicable
SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC, the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[8] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

Background literature review identified eight previously recorded archaeological sites intersecting or immediately adjacent (within 300 feet) to the project area (Table 5.2.12-4; THC 2019). Two archaeological sites are prehistoric campsites with undetermined NRHP eligibility (THC 2019). The other six archaeological sites were all determined to be ineligible for listing in the NRHP. They include two prehistoric campsites; two historic farmsteads, one with an artifact scatter; one site with both historic and prehistoric artifacts; and one historic farmstead with a prehistoric artifact scatter within it. In addition, the review identified up to 132 potentially historic-age buildings and two cemeteries intersecting or immediately adjacent to the project area (Table 5.2.12-4; THC 2019). No historical markers or NRHP-listed properties are known to be near the project.

The model used assessed unrecorded archaeological site potential within the project area to include low to high potential zones, ranging from 4 percent to 96 percent likelihood for the landform crossed to contain significant unidentified archaeological resources. The areas with greatest archaeological probability are located near the eight previously documented archaeological sites and the landforms adjacent to existing drainages.

[8] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 187.0 (further information regarding methodology for developing the assessment score is provided in Section 5.2). On the basis of the results of the background review, SWCA recommends that a structured cultural resources survey of the final design plan be performed to accurately assess the presence and significance of identified and unrecorded cultural resources within its boundaries.

Table 5.2.12-4 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological Site	Artifact Scatter	Prehistoric/Historic	Ineligible	Intersect
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Ineligible	Intersect
Archaeological Site	Campsite	Prehistoric	Undetermined	Intersect
Archaeological Site	Campsite	Prehistoric	Undetermined	Intersect
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Ineligible	Intersect
Archaeological Site	Homestead and Artifact Scatter	Historic	Ineligible	Intersect
Archaeological Site	Farmstead	Historic	Ineligible	Adjacent
Archaeological Site	Farmstead and Lithic Artifact Scatter	Prehistoric/Historic	Ineligible	Adjacent
Santa Maria Aida	Cemetery	–	–	Adjacent
Salge Family	Cemetery	–	–	Intersect
None	132 Buildings	Historic	–	–
			ASSESSMENT SCORE TOTAL:	**187.0**

5.2.12.4 Engineering and Costing

Preliminary engineering and costing analyses have been performed using the 2021 Regional Water Planning methods. For Region L, Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and unit costs. The engineering and costing analysis for ARWA and GBRA for the Phase 1 project includes all the facilities required for water production from the Carrizo-Wilcox Aquifer including production wells, collector pipelines, a 33.6 mgd WTP, treated water pipelines, a booster pump station, pump station expansion and storage tank installation at the San Marcos WTP, and two ground storage tanks. Additionally, the estimated total cost for GBRA includes a $31 million one-time payment to Texas Water Alliance (San Jose Water) for purchase of groundwater. Facilities are located within Hays, Caldwell, Guadalupe, and Gonzales counties. Cost estimates were also provided for San Marcos since they will share the costs associated with the San Marcos WTP High Service Pump Station Expansion and GST.

The pipelines and booster pump station for Phase 1 were sized using the cumulative flow brought on by ARWA Phase 2, which is an additional 20,999 acft/yr. This will provide costs savings from avoiding additional excavation and pipeline layout to accommodate future ARWA flows. The ARWA Project (Phase 2), a separate WMS, will include additional wells needed for ARWA flows and a WTP expansion (refer to Subsection 5.2.13 for additional information on Phase 2).

Cost estimates were calculated for capital costs, annual debt service, operation and maintenance, power, land acquisition, and environmental mitigation for season and peak day demands. As this is a joint project between ARWA and GBRA, costs were divided proportionally according to volumes delivered, facilities, pipe use, and peaking factor. These costs are summarized in Table 5.2.12-5. The total project costs, including capital, are estimated to be $355,685,000. Of the total project costs, $228,365,000 is estimated for ARWA, $124,512,000 for GBRA, and $2,806,000 for San Marcos. The total annual costs are estimated to be $32,965,000. Of the total annual costs, $21,454,000 is estimated for ARWA, $9,134,000 for GBRA, and $703,000 for San Marcos. This option produces potable water at an estimated annual cost of $1,099 per acft. For ARWA the annual cost is $1,430 per acft, and for GBRA the annual cost is $721 per acft.

Table 5.2.12-5 Project Cost Estimate Summary

ITEM	TOTAL ESTIMATED COST FOR ALL FACILITIES	ESTIMATED COSTS FOR ARWA	ESTIMATED COSTS FOR GBRA	ESTIMATED COSTS FOR SAN MARCOS
Primary Pump Station (33.6 mgd)	$15,701,000	$9,421,000	$6,280,000	--
Booster Station (30.9 mgd)	$9,801,000	$6,390,000	$3,411,000	--
Transmission Pipeline (48 in. dia., 17.0 miles)	$36,307,000	$21,784,000	$14,523,000	--
Transmission Pipeline (42 in. dia., 36.8 miles)	$62,492,000	$47,753,000	$14,739,000	--
Transmission Pipeline (36 in. dia., 14.3 miles)	$26,307,000	$23,564,000	$2,743,000	--
Transmission Pipeline (30 in. dia., 5.8 miles)	$9,472,000	$6,555,000	$2,917,000	--
Transmission Pipeline (24 in. dia., 3.9 miles)	$8,281,000	$8,281,000	--	--
Transmission Pipeline (16 in. dia., 5.2 miles)	$6,351,000	$6,351,000	--	--
Transmission Pipeline (12 in. dia., 1.1 miles)	$544,000	$544,000	--	--
Well Fields (wells, pumps, and piping)	$21,240,000	$11,006,000	$10,234,000	--
Elevated Storage Tanks (other than at booster pump stations)	$9,147,000	$8,004,000	$1,143,000	--
San Marcos WTP High Service Pump Station Expansion and Ground Storage Tank	$6,077,000	$589,000	$3,714,000	$1,774,000
Water Treatment Plant (33.6 mgd)	$10,208,000	$6,125,000	$4,083,000	--

ITEM	TOTAL ESTIMATED COST FOR ALL FACILITIES	ESTIMATED COSTS FOR ARWA	ESTIMATED COSTS FOR GBRA	ESTIMATED COSTS FOR SAN MARCOS
GBRA Purchase of Groundwater	$31,000,000	--	$31,000,000	--
TOTAL COST OF FACILITIES	**$252,928,000**	**$156,367,000**	**$94,787,000**	**$1,774,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$70,075,000	$48,987,000	$20,466,000	$621,000
Environmental and Archaeology Studies and Mitigation	$3,733,000	$2,235,000	$1,268,000	$230,000
Land Acquisition and Surveying (1,201 acres)	$8,062,000	$6,073,000	$1,989,000	--
Interest During Construction (3% for 2.5 years with a 0.5% return on investment)	$20,887,000	$14,703,000	$6,002,000	$181,000
TOTAL COST OF PROJECT	**$355,685,000**	**$228,365,000**	**$124,512,000**	**$2,806,000**
ANNUAL COST				
Debt Service (3.5 percent, 20 years)	$22,845,000	$16,083,000	$6,566,000	$197,000
Operation and Maintenance				
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$1,862,000	$1,346,000	$498,000	$18,000
Intakes and Pump Stations (2.5% of cost of facilities)	$664,000	$395,000	$242,000	$27,000
Water Treatment Plant	$4,960,000	$2,180,000	$2,319,000	$461,000
Pumping Energy Costs (22,869,023 kW-h @ 0.08 $/kW-h)	$2,634,000	$1,450,000	$1,184,000	--
TOTAL ANNUAL COST	**$32,965,000**	**$21,454,000**	**$10,809,000**	**$703,000**
Available Project Yield (acft/yr)	30,000	15,000	15,000	--
Annual Cost of Water ($ per acft)	$1,099	$1,430	$721	--
Annual Cost of Water After Debt Service ($ per acft)	$337	$358	$283	--
Annual Cost of Water ($ per 1,000 gallons)	$3.37	$4.39	$2.21	--
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$1.04	$1.10	$0.87	--
Based on a peaking factor of 1.5 for ARWA; no peaking factor for GBRA.				

5.2.12.5 Implementation Considerations

Information presented in this WMS was provided by ARWA and GBRA and represents the current plan, which is based on the sponsor's current understanding of the system. The actual well capacities and water quality may vary, depending on site-specific conditions. Implementation of the ARWA/GBRA Project (Phase 1) WMS includes the following considerations:

- Verification of available groundwater quantity and well productivity;
- Verification of water quality for concentrations of constituents, such as TDS, chloride, sulfate, iron, manganese, and hydrogen sulfide;
- Verification of minimal impacts to Carrizo-Wilcox Aquifer, particularly as it relates to applicable Desired Future Conditions;
- Regulations by TCEQ; and
- Regulations by the Gonzales County Underground Water Conservation District.

Reliability

Supply is considered to be medium based on the need to verify well productivity and water quality, potential impacts to Carrizo-Wilcox Aquifer and regulations by the Gonzales County Underground Water Conservation District (reliability score = 4).

5.2.13 ARWA Project (Phase 2)

5.2.13.1 Description of Water Management Strategy

ARWA plans to develop a new well field that would provide 20,999 acft/yr of water supply for ARWA. The ARWA Project (Phase 2) would expand upon a joint project with GBRA entitled the ARWA/GBRA Project (Phase 1) (refer to Section 5.2.12 for details of the WMS). Both Phase 1 and Phase 2 include development of raw groundwater supply from the Carrizo-Wilcox Aquifer in Caldwell County.

Planned facilities for Phase 2 include a new well field in Caldwell County for ARWA from the Carrizo-Wilcox Aquifer to increase groundwater supply, a 28 mgd expansion to the Phase 1 WTP, an expansion to increase the capacity of the booster pump station that was implemented in Phase 1, two 10 MG GSTs at the expanded booster pump station, and supplementary delivery volumes to the ARWA delivery points. An additional 48-inch diameter pipeline parallel to the Phase 1 pipeline to the booster station is also planned for Phase 2. The approximate location of the project is shown on Figure 5.2.13-1. The implementation is planned for 2040.

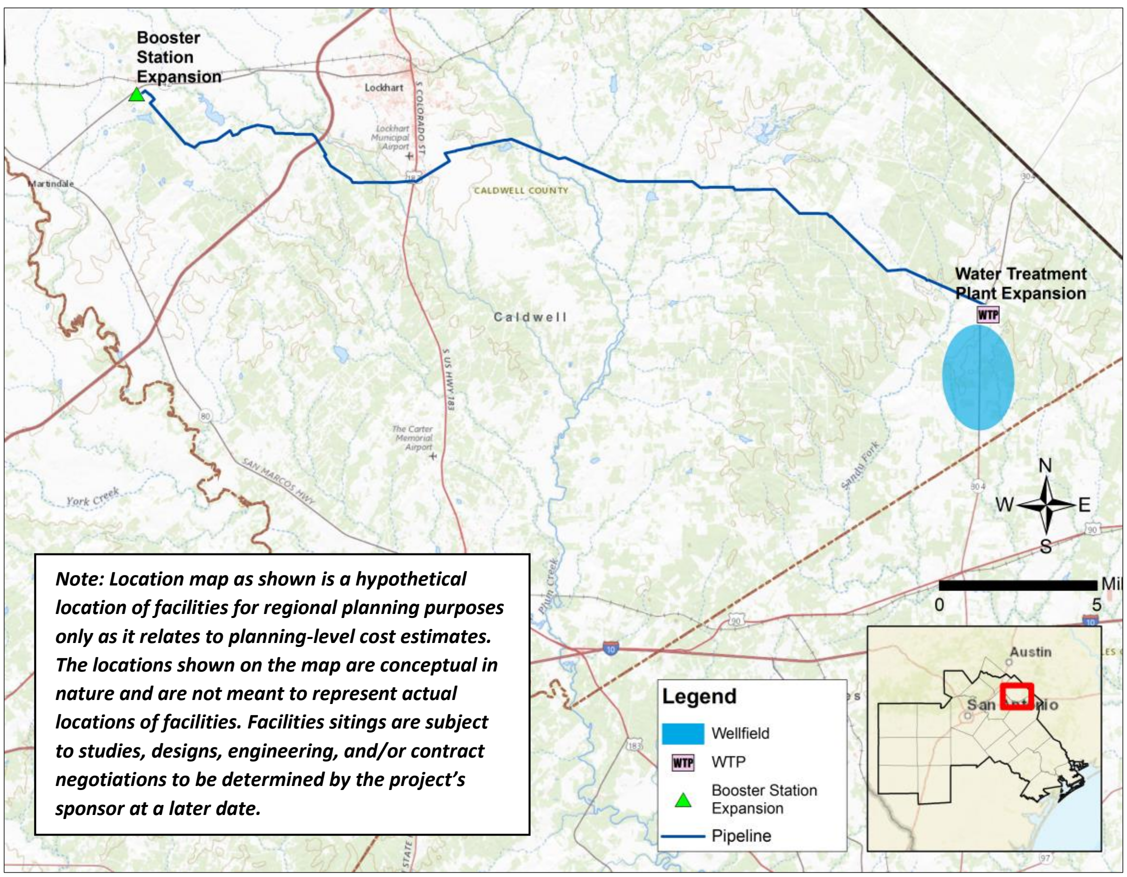

Figure 5.2.13-1 ARWA Project (Phase 2) Location

5.2.13.2 Available Yield

For the Phase 2 project, ARWA plans to develop a well field that would supply a total of 20,999 acft/yr from the Carrizo-Wilcox Aquifer. A total of 15 wells are proposed, with two of the 15 wells recommended as contingency for operational flexibility or backup raw water supply. These 15 wells are in addition to the 11 wells planned for a separate well field in Phase 1 of the ARWA project. Well field details and project yield for ARWA's Phase 1 and Phase 2 projects are provided in Table 5.2.13-1.

Table 5.2.13-1 ARWA Phase 1 and Phase 2 Projects Well Field Details and Project Yield

DESCRIPTION	PHASE 1*	PHASE 2
Project Yield (acft/yr)	15,000	20,999
Number of Wells	11	15
Average Well Production Capacity (gpm)	1,044	1,012
Well Depth (ft)	~300	~700
Total Dissolved Solids Concentration (mg/L)	200	200

* Refer to Subsection 5.2.12 for additional details on the ARWA/GBRA Phase 1 Project.

The Phase 2 Project will provide additional treated water volumes to all eight ARWA delivery locations. These additional volumes are detailed in Table 5.2.13-2.

Table 5.2.13-2 ARWA Delivery Points and Annual Volumes for Phase 1, Phase 2, and Phase 3 Projects

DELIVERY POINT	ANNUAL DELIVERY VOLUMES (ACFT/YR)			
	PHASE 1 [a]	PHASE 2	PHASE 3 [b]	TOTAL
Crystal Clear SUD (Delivery Point 1)	2,348	3,297	953	6,598
Crystal Clear SUD (Delivery Point 2)	212	288	0	500
Green Valley SUD	1,595	2,232	594	4,421
San Marcos (Delivery Point 1) [c]	2,519	3,523	937	6,979
San Marcos (Delivery Point 2) [c]	2,861	4,007	1,065	7,933
County Line SUD	478	669	178	1,325
Kyle Delivery Point	4,225	5,916	1,573	11,714
Buda Delivery Point [d]	762	1,067	178	2,007
Total	**15,000**	**20,999**	**5,494 [e]**	**41,493**

[a] Refer to Subsection 5.2.12 for more details on the ARWA/GBRA (Phase 1) Project.
[b] Refer to Subsection 5.2.14 for more details on the ARWA (Phase 3) Project.
[c] San Marcos plans to provide 2,786 acft/yr to Manufacturing, Comal in 2020. Starting in 2030 and continuing throughout the planning period, the San Marcos delivery volume will be 5,380 acft/yr.
[d] Buda is a split WUG between Region K and Region L. Volumes in this table are representative of the total volume for both regions. The Region L portion is described in Section 5.3.
[e] Phase 3 also includes 16 acft/yr of unassigned volumes to ARWA, for a total of 5,494 acft/yr.

5.2.13.3 Environmental Considerations

Environmental Considerations

Vegetation and Land Use

The project area is located in the Post Oak Savannah and Blackland Prairie ecoregions and crosses a variety of vegetation types, mostly open fields, pastures, and riparian zones along streams. As mapped by TPWD,[1] dominant vegetation types in the project area are disturbance/tame grassland, savanna grassland, and mesquite shrubland. The linear components of the project cross riparian vegetation zones along streams, mapped by TPWD as floodplain and riparian herbaceous vegetation, floodplain and riparian hardwood forest, floodplain and riparian deciduous shrubland, and riparian hardwood/evergreen forest. Riparian vegetation zones within the Phase 2 well field site are mapped by TPWD as floodplain and riparian herbaceous vegetation, hardwood/evergreen forest, deciduous and evergreen shrublands, and live oak and hardwood forests.

Based on TPWD vegetation mapping, the project may have the potential to impact 95 acres of agricultural resources, including 4 acres mapped as row crops, and 91 acres of disturbance or tame grassland which may include pasture areas used for grazing.

Project pipeline easements would require removal of woody vegetation and long-term maintenance (mowing and woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each water management strategy to determine the best course of action regarding revegetation. Pipeline easements may also continue to be used for agricultural purposes.

Aquatic Resources

The project pipeline alignment does not cross any major rivers but crosses several mapped streams and their floodplains, including the San Marcos River within the Guadalupe River basin. The NWI mapping shows 3.3 acres of ponds and riverine wetlands in the project area. The well field site contains approximately 52.1 acres of mapped ponds and riverine wetlands.

The pipeline does not cross any stream segment that has been designated as an impaired water body in the Texas Integrated Report of 303(d) listed water bodies[2]. This list identifies the water bodies or segments in Texas that do not meet assigned water quality standards. The project pipeline does not cross any ecologically significant stream segments designated by TPWD.

The project will require an on-site delineation of streams, ponds, and wetlands. Stream crossings for pipeline construction would result in temporary stream impacts that would require USACE permitting.

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[1] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

[2] Texas Commission on Environmental Quality. 2018. 2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf.

Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including cases where there would be permanent impacts to more than 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under streams (e.g., through horizontal directional drilling) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

Table 5.2.13-3 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Caldwell County[3] [4]. Suitable habitat for federally threatened or endangered species does not occur in the project region. However, three freshwater mussel species are under review for federal listing as threatened or endangered, and the project pipeline crosses streams that may provide suitable habitat for freshwater mussels.

Suitable habitat may occur for several state-listed threatened species, including the Texas horned lizard (*Phrynosoma cornutum*), timber rattlesnake (*Crotalus horridus*), and white-faced ibis (*Plegadis chihi*). Potentially suitable habitat may occur for numerous wildlife, plant, and insect species designated by TPWD as SGCN, particularly species associated with sandy soil habitats. These species do not have formal protected status but are being monitored by TPWD. Migratory birds may occur in the project area, particularly in riparian zones and wetland areas.

Streams in the project area may contain suitable habitat for federal candidate/state threatened freshwater mussel species. Suitable habitat may occur in perennial streams and perennial pools of intermittent streams. If any such habitat would be affected by construction, presence/absence surveys and relocation of native mussel species would be required. Handling and relocation of mussels and other aquatic species must be conducted by TPWD-permitted personnel and in accordance with an approved Aquatic Resources Relocation Plan. Furthermore, these candidate species may be listed as federally threatened or endangered during the project timeline, in which case any species impacts would require USFWS consultation.

Site-specific field surveys would be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain its recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat is present, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs from impacts unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct

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[3] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Caldwell County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.
[4] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Caldwell County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.

preconstruction nest surveys or to avoid vegetation clearing during the general bird nesting season from March 15 to September 15. Preconstruction surveys for active bird nests are recommended.

Table 5.2.13-3 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for ARWA Project (Phase 2); Caldwell County, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Houston toad	*Anaxyrus houstonensis*	E	E	Sandy soils near ephemeral pools and populations of loblolly pine.	Project is outside of the expected range of this species.
San Marcos salamander	*Eurycea nana*	T	T	Headwaters of the San Marcos River downstream to about 0.5 mile past IH 35.	Project is outside of the expected range of this species.
Strecker's chorus frog	*Pseudarcris streckeri*	N/A	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Suitable habitat may occur within project area.
Texas blind salamander	*Eurycea rathbuni*	E	E	Water-filled subterranean caverns along 6 miles of the San Marcos Spring Fault.	Project is outside of the expected range of this species.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur within project area.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	N/A	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat does not occur in project area; may fly over during migration.
Black rail	*Laterallus jamaicensis*	PT	SGCN	Salt, brackish, and freshwater marshes; pond borders; wet meadows; and grassy swamps. Nests in or along edge of marsh.	Low potential for suitable habitat to occur within project area; may fly over during migration.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur within project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also known to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Suitable habitat does not occur within project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie; feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat may occur within project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur in project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	T	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Suitable habitat does not occur in project area; may fly over during migration.
Red knot	*Calidris canutus rufa*	T	SGCN	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays.	Suitable habitat does not occur in project area; may fly over during migration.
Swallow-tailed kite	*Elanoides forficatus*	N/A	T	Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge.	Low potential for suitable habitat to occur within project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots; nests and roosts in abandoned burrows.	Suitable habitat may occur in project vicinity; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat may occur in project vicinity; may fly over during migration.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio Counties. Roost predominantly in palustrine or riverine wetland systems [during migration].	Suitable habitat does not occur in project area; may fly over during migration.
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Unlikely to occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat does not occur in project area; may fly over during migration.
Fish					
Fountain darter	*Etheostoma fonticola*	E	E	San Marcos and Comal Rivers; springs and spring-fed streams with dense beds of aquatic plants.	Project is outside of the expected range of this species.
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat may occur within project area.
Guadalupe darter	*Percina apristis*	N/A	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Suitable habitat may occur within project area.
Headwater catfish	*Ictalurus lupus*	N/A	SGCN	Limited to Rio Grande drainage; springs with sandy and rocky riffles, pools of clear creeks, runs, and small rivers.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas shiner	*Notropis amabilis*	N/A	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Project is outside of the expected range of this species.
Insects					
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in project area.
Comanche harvester ant	*Pogonomyrmex comanche*	N/A	SGCN	Barren or sparse vegetation.	Suitable habitat may occur in project area.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur within project area.
Aransas short-tailed shrew	*Blarina hylophaga plumbea*	N/A	SGCN	Excavates burrows in sandy soils underlying mottes of live oak trees or in areas with little to no ground cover.	Suitable habitat may occur within project area.
Big brown bat	*Eptesicus fuscus*	N/A	SGCN	Woodlands or wooded areas.	Suitable habitat may occur within project area.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls; will use buildings.	May use buildings within project area.
Cave myotis bat	*Myotis velifer*	N/A	SGCN	Cave-dwelling; also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	May use buildings/ structures within project area.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat may occur within project area.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields, prairies, croplands, fence rows, farmyards, and forest edges.	Suitable habitat may occur within project area.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Suitable habitat may occur within project area.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	Suitable habitat may occur within project area; may use buildings/ structures.
Mexican long-tongued bat	*Choeronycteris Mexicana*	N/A	SGCN	Riparian forest in Texas; roost in mines, large crevices, and caves.	Suitable habitat may occur within project area.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Low potential for suitable habitat to occur within project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Low potential for suitable habitat to occur within project area.
Southern short-tailed shrew	*Blarina carolinensis*	N/A	SGCN	Various upland and wetland habitats, including moist deciduous woods, brushy areas, pine woodland and forest, and mixed oak-pine-juniper woods.	Suitable habitat may occur within project area.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat may occur within project area.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Restricted to dry and sandy soils of open areas, such as grasslands, cultivated fields, meadows, roadsides, airfields, shrublands, and suburban lawns.	Suitable habitat may occur within project area.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat may occur within project area.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat may occur within project area.
Mollusks					
False spike	*Fusconaia mitchelli*	N/A	T	Medium to large rivers; present in Guadalupe, Colorado, and Brazos River basins.	Suitable habitat may occur in streams/rivers.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Golden orb	*Cyclonaias aurea*	N/A	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Potential to occur in perennial waterways along the pipeline alignments. This species was recently a federal candidate species but its listing as federally threatened or endangered was not warranted as it is not a valid species.
No accepted common name	*Millerelix gracilis*	N/A	SGCN	Terrestrial snail; Edwards Plateau.	Project area is outside the expected range of this species.
No accepted common name	*Cyclonaias necki*	N/A	SGCN	Guadalupe River basin; moderate to large streams with flowing water.	Potential to occur in perennial waterways along the pipeline alignment.
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	N/A	SGCN	Endemic to sandy regions of southern and south-central Texas.	Suitable habitat may occur within project area.
Engelmann's bladderpod	*Physaria engelmannii*	N/A	SGCN	Grasslands and calcareous rock outcrops in a band along the eastern edge of the Edwards Plateau.	Suitable habitat does not occur within project area.
Heller's marbleseed	*Omosmodium helleri*	N/A	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Suitable habitat does not occur within project area.
Hill Country wild-mercury	*Argythamnia aphoroides*	N/A	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands; also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Sandhill woolywhite	*Hymenopappus carrizoanus*	N/A	SGCN	Disturbed or open areas in grasslands and post oak woodlands on deep sands derived from the Carrizo Sand and similar Eocene formations.	Suitable habitat may occur within project area.
Shinner's sunflower	*Helianthus occidentalis* ssp. *plantagineus*	N/A	SGCN	Mostly in prairies on the Coastal Plain, with several slightly disjunct populations in the Pineywoods and South Texas Brush Country.	Suitable habitat may occur within project area.
Sycamore-leaf snowbell	*Styrax platanifolius* ssp. *platanifolius*	N/A	SGCN	Oak-juniper woodlands on steep rocky banks and ledges along intermittent or perennials streams.	Project area is outside the expected range of this species.
Texas beebalm	*Monarda viridissima*	N/A	SGCN	Endemic perennial herb of the Carrizo Sands; deep, well-drained sandy soils in openings of post oak woodlands.	Suitable habitat may occur within project area.
Texas sandmint	*Rhododon ciliatus*	N/A	SGCN	Open sandy areas in the Post Oak Belt of east-central Texas.	Suitable habitat may occur within project area.
Texas tauschia	*Tauschia texana*	N/A	SGCN	Occurs in loamy soils in deciduous forests or woodlands on river and stream terraces.	Suitable habitat may occur within project area.
Reptiles					
Cagle's map turtle	*Graptemys caglei*	N/A	SGCN	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River system.	Low potential for suitable habitat to occur within project area.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur within project area.
Slender glass lizard	*Ophisaurus attenuates*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannas, pine barrens, and oil fields.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur within project area.
Timber rattlesnake	*Crotalus horridus*	N/A	T	Swamps, floodplains, upland pine and deciduous woodland, riparian zones, and abandoned farmland. Limestone bluffs, sandy soil, or black clay.	Suitable habitat may occur within project area.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrows into soil or may use burrows made by other species.	Suitable habitat may occur within project area.
PT = Proposed Threatened T = Threatened E = Endangered C = Candidate DL = Delisted N/A = Not applicable SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC and the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the Project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[5] to assess whether it will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified three previously recorded archaeological sites intersecting or immediately adjacent (within 300 feet) to the project area (Table 5.2.13-4; THC 2019). Two sites consist of prehistoric campsites with undetermined NRHP eligibility. One site consists of a prehistoric lithic artifact scatter determined ineligible for listing in the NRHP. In addition, the review identified 19

[5] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to Texas Code § 2254.021.

potentially historic-age buildings intersecting or immediately adjacent to the project area. No cemeteries, historical markers, or NRHP properties are known to be near the project.

The model used assessed unrecorded archaeological site potential within the project area to include low to high potential zones, ranging from 4 to 77 percent likelihood for the landform crossed to contain unidentified archaeological resources. The areas with greatest archaeological probability are located near the three previously documented archaeological sites and the landforms adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 54.5 (further information regarding methodology for developing the assessment score is provided in Section 5.2). Based on the results of the background review, SWCA recommends that a structured cultural resources survey of the final design plan be performed to accurately assess the presence and significance of identified and unrecorded cultural resources within its boundaries.

Table 5.2.13-4 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Ineligible	Intersect
Archaeological Site	Campsite	Prehistoric	Undetermined	Intersect
Archaeological Site	Campsite	Prehistoric	Undetermined	Intersect
None	19 Buildings	Historic	–	–
			ASSESSMENT SCORE TOTAL:	54.5

5.2.13.4 Engineering and Costing

Preliminary engineering and costing analyses have been performed using the 2021 Regional Water Planning methods. For Region L, Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and unit costs. The engineering and costing analysis for ARWA for the Phase 2 project encompasses all the facilities required for the additional water production from the Carrizo-Wilcox Aquifer including wells, collector pipelines, a 28 mgd WTP expansion, parallel treated water pipeline that runs from the WTP to the booster station, booster station expansion, and two ground storage tanks. All facilities are located within Caldwell County.

Cost estimates were calculated for capital costs, annual debt service, operation and maintenance, power, land acquisition, and environmental mitigation for season and peak day demands. These costs are summarized in Table 5.2.13-5. The project costs, including capital, are estimated to be $130,526,000. The annual costs are estimated to be $13,391,000. This option produces potable water at an estimated annual cost of $635 per acft.

Table 5.2.13-5 Project Cost Estimate Summary

ITEM	ESTIMATED COSTS
Transmission Pipeline (48 in. dia., 27.7 miles)	$56,901,000
Well Fields (wells, pumps, and piping)	$15,700,000
Storage Tanks (other than at booster pump stations)	$10,753,000
Water Treatment Plant Expansion (28 mgd expansion)	$6,518,000
Booster Station Expansion (28 mgd expansion)	$2,579,000
TOTAL COST OF FACILITIES	**$92,451,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$29,513,000
Environmental and Archaeology Studies and Mitigation	$1,263,000
Land Acquisition and Surveying (64 acres)	$494,000
Interest During Construction (3% for 1 year with a 0.5% return on investment)	$6,805,000
TOTAL COST OF PROJECT	**$130,526,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$9,184,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$780,000
Water Treatment Plant Expansion	$2,151,000
Pumping Energy Costs (15,858,127 kWh @ 0.08 $/kWh)	$1,276,000
TOTAL ANNUAL COST	**$13,391,000**
Available Project Yield (acft/yr)	21,000
Annual Cost of Water ($ per acft)	$635
Annual Cost of Water After Debt Service ($ per acft)	$199
Annual Cost of Water ($ per 1,000 gallons)	$1.95
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.61
Based on a peaking factor of 1.5.	

5.2.13.5 Implementation Considerations

Information presented in this WMS was provided by ARWA and represents the current plan, which is based on the sponsor's current understanding of the system. The actual well capacities and water quality may vary, depending on site-specific conditions. Implementation of the ARWA Project (Phase 2) WMS includes the following considerations:

- Verification of available groundwater quantity and well productivity;
- Verification of water quality for concentrations of constituents, such as TDS, chloride, sulfate, iron, manganese, and hydrogen sulfide;
- Verification of minimal impacts to the Carrizo-Wilcox Aquifer;
- Regulations by TCEQ; and
- Regulations by the Gonzales County Underground Water Conservation District.

Reliability

Water from these sources is considered to be very reliable based on hydrogeologic information that will be obtained from Phase 1. Supply is considered to be medium based on the need to verify well productivity and water quality, potential impacts to Carrizo-Wilcox Aquifer and regulations by the Gonzales County Underground Water Conservation District (reliability score = 4).

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5.2.14 ARWA Project (Phase 3)

5.2.14.1 Description of Water Management Strategy

ARWA plans to develop a DPR WTP that would provide approximately 5,494 acft/yr of water supply for ARWA. The ARWA Project (Phase 3) would expand upon two prior projects: a joint project with the GBRA called the ARWA/GBRA Project (Phase 1) (refer to Section 5.2.12) and the ARWA Project (Phase 2) (refer to Section 5.2.13). The ARWA Phase 3 Project, evaluated in this WMS, would increase the total water supply from all three phases to 41,493 acft/yr (Table 5.2.14-1). The decade of implementation is planned for 2060.

Table 5.2.14-1 Capacity of Phase 1 and Phase 2 of the ARWA Project

ARWA PROJECT PHASE	PROJECT CAPACITY (ACFT/YR)
1*	15,000
2	20,999
3	5,494
Total	**41,493**

* Phase 1 is a shared project with GBRA. Total project capacity, including GBRA's portion is 30,000 acft/yr.

Phase 3 includes advanced treatment of wastewater effluent for direct potable reuse and construction of new pipelines for delivery of treated water and disposal of blended effluent concentrate. Planned facilities will be located within Caldwell and Hays Counties. The planned facilities and features for the ARWA Project (Phase 3) include the following:

- Construction of a 5.0 mgd DPR WTP near the San Marcos WWTP that would provide advanced treatment of the San Marcos WWTP effluent to DPR standards;
- A 5.0 mgd pump station at the DPR WTP;
- A 5.0 mgd expansion to an existing booster station;
- An 18-inch diameter pipeline to deliver the DPR treated drinking water to the existing booster station;
- A 16-inch pipeline for the blended effluent concentrate;
- A 1 MG ground storage tank; and
- Supplementary delivery volumes to the ARWA delivery points.

The approximate location of the project is shown on Figure 5.2.14-1.

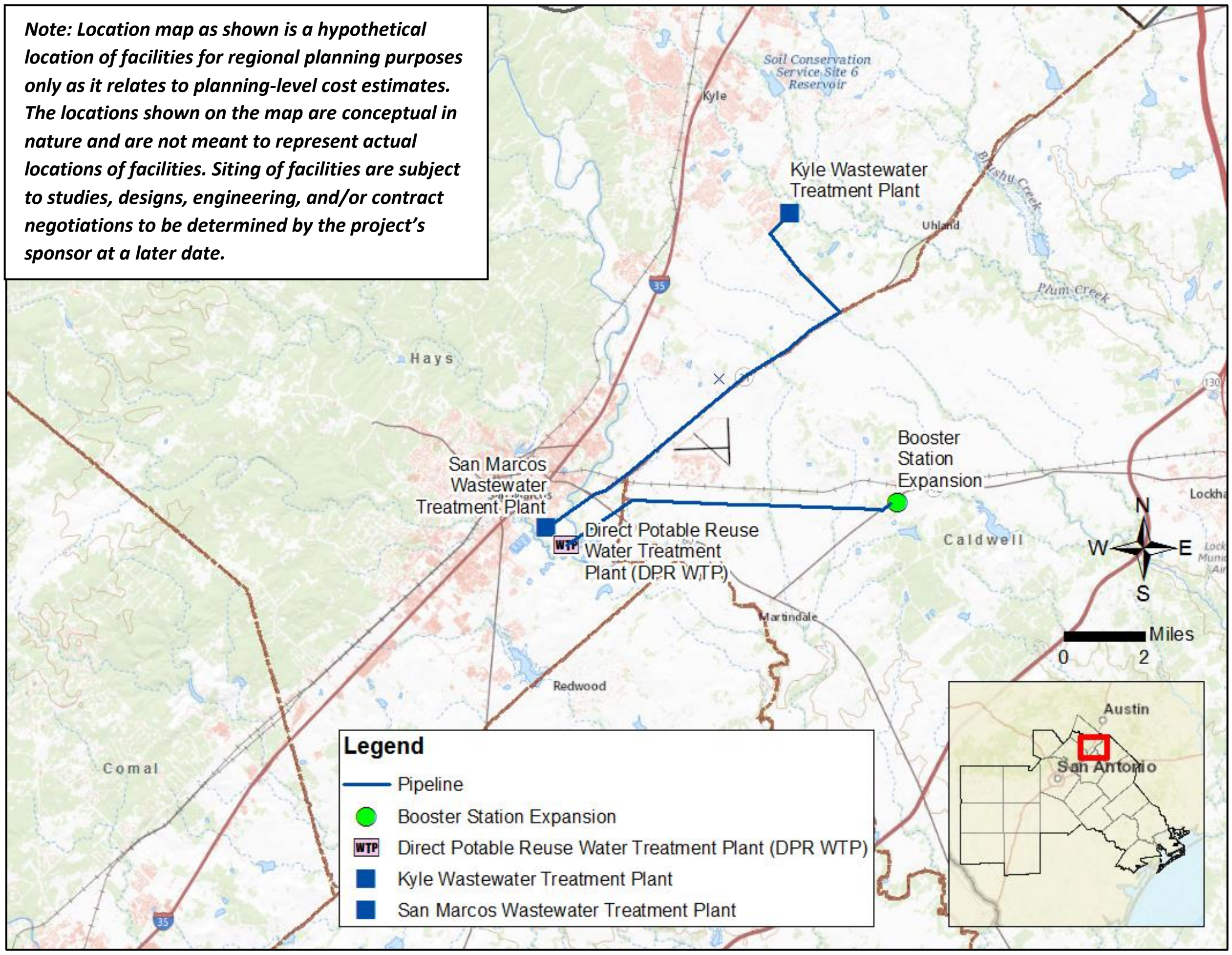

Figure 5.2.14-1 ARWA Project (Phase 3) Location

5.2.14.2 Available Yield

Phase 3 will provide an additional 5,494 acft/yr of water by treating effluent from the San Marcos WWTP and Kyle WWTP via reverse osmosis (RO) at a planned 5.0 mgd DPR WTP. Treated water will be conveyed through an 18-inch diameter pipeline to the booster station for blending with other ARWA water sources and then distributed to customers. Seven of the eight ARWA delivery locations are expected to receive additional treated water as detailed in Table 5.2.14-2. The concentrate waste stream from the DPR WTP will be blended with effluent from the San Marcos WWTP and pumped to via a 16-inch diameter pipeline and then blended with the Kyle WWTP prior to discharge. This WMS is considered for implementation beginning in the 2060 decade.

Table 5.2.14-2 ARWA Delivery Points and Annual Volumes for Phase 1, Phase 2, and Phase 3 Projects

DELIVERY POINT	ANNUAL DELIVERY VOLUMES (ACFT/YR)			
	PHASE 1[a]	PHASE 2[b]	PHASE 3	TOTAL
Crystal Clear SUD (Delivery Point 1)	2,348	3,297	953	6,598
Crystal Clear SUD (Delivery Point 2)	212	288	0	500
Green Valley SUD	1,595	2,232	594	4,421
San Marcos (Delivery Point 1) [c]	2,519	3,523	937	6,979
San Marcos (Delivery Point 2) [c]	2,861	4,007	1,065	7,933
County Line SUD	478	669	178	1,325
Kyle Delivery Point	4,225	5,916	1,573	11,714
Buda Delivery Point [d]	762	1,067	178	2,007
Total	**15,000**	**20,999**	**5,494[e]**	**41,493**

[a] Refer to Subsection 5.2.12 for more details on the ARWA/GBRA (Phase 1) Project.
[b] Refer to Subsection 5.2.13 for more details on the ARWA (Phase 2) Project.
[c] San Marcos plans to provide 2,786 acft/yr to Manufacturing, Comal in 2020. Starting in 2030 and continuing throughout the planning period, the San Marcos delivery volume will be 5,380 acft/yr.
[d] Buda is a split WUG between Region K and Region L. Volumes in this table are representative of the total volume for both regions. The Region L portion is described in Section 5.3.
[e] Phase 3 also includes 16 acft/yr of unassigned volumes to ARWA, for a total of 5,494 acft/yr.

5.2.14.3 Environmental Considerations

Environmental Considerations

Vegetation and Land Use

The project area is located in the Blackland Prairie ecoregion and crosses a variety of vegetation types, mostly open fields, pastures, and riparian zones along streams. As mapped by TPWD,[1] dominant vegetation types in the project area are disturbance/tame grassland, row crops, and herbaceous vegetation. The project crosses riparian vegetation zones along streams, mapped by TPWD as floodplain and riparian herbaceous vegetation, floodplain and riparian hardwood forest, and floodplain and riparian deciduous shrubland.

Based on TPWD vegetation mapping, the project may have the potential to impact 202 acres of agricultural resources, including 72 acres mapped as row crops, and 130 acres of disturbance or tame grassland which may include pasture areas used for grazing.

Project pipeline easements would require removal of woody vegetation and long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be

[1] TPWD. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each WMS to determine the best course of action regarding revegetation. Pipeline easements may continue to be used for agricultural purposes.

Aquatic Resources

The project pipeline alignment crosses the Blanco River and two mapped streams and their floodplains associated with the San Marcos River within the Guadalupe River basin. The NWI mapping shows 5.6 acres of ponds and riverine wetlands in the project area.

The project pipeline does not cross any streams designated as impaired stream segments in the Texas Integrated Report of 303(d)-listed water bodies[2]. This list identifies the water bodies or segments in Texas that do not meet assigned water quality standards. The project pipeline does not cross any ecologically significant stream segments designated by TPWD.

The project will require an on-site delineation of streams, ponds, and wetlands. Stream crossings for pipeline construction would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including if there would be permanent impacts to over 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under streams (e.g., through horizontal directional drilling) would not require a USACE permit.

Threatened, Endangered, and Species of Concern.

Table 5.2.14-3 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Caldwell and Hays counties. [3],[4],[5],[6] Suitable habitat for federally threatened or endangered species does not occur in the project region. However, two freshwater mussel species are under review for federal listing as threatened or endangered, and the project pipeline crosses streams that may provide suitable habitat for freshwater mussels.

Suitable habitat may occur for several state-listed threatened species including Texas horned lizard (*Phrynosoma cornutum*), timber rattlesnake (*Crotalus horridus*), and white-faced ibis (*Plegadis chihi*).

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[2] Texas Commission on Environmental Quality. 2018. 2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf
[3] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Caldwell County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.
[4] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Caldwell County. https://ecos.fws.gov/ipac/location/Q7YOOGZ4XFDYJH3XAH426PVLMU/resources.
[5] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Hays County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.
[6] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Hays County. https://ecos.fws.gov/ipac/location/XG4UGQLIY5HUFORG5ANNCL5T5I/resources.

Potentially suitable habitat may occur for numerous wildlife, plant, and insect species designated by TPWD as SGCN, particularly species associated with sandy soil habitats. These species do not have formal protected status but are being monitored by TPWD. Migratory birds may occur in the project area, particularly in riparian zones and wetland areas.

Streams in the project area may contain suitable habitat for federal candidate/state-threatened freshwater mussel species. Suitable habitat may occur in perennial streams and perennial pools of intermittent streams. If any such habitat would be affected by construction, presence/absence surveys and relocation of native mussel species would be required. Handling and relocation of mussels and other aquatic species must be conducted by TPWD-permitted personnel and in accordance with an approved Aquatic Resources Relocation Plan. Furthermore, these candidate species may be listed as federally threatened or endangered during the project timeline; in which case, any species impacts would require USFWS consultation.

Site-specific field surveys would be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain its recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs from impacts unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15. Preconstruction surveys for active bird nests are recommended.

Table 5.2.14-3 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for ARWA Project (Phase 3), Caldwell and Hays Counties, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Barton Springs salamander	*Eurycea sosorum*	E	E	Outlets of Barton Springs and subterranean water-filled caverns; found under rocks, in gravel, or among aquatic vascular plants and algae.	Project is outside of the expected range of this species.
Blanco blind salamander	*Eurycea robusta*	N/A	T	Water-filled subterranean caverns; may inhabit deep levels of the Balcones Aquifer to the north and east of the Blanco River.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Blanco River Springs salamander	*Eurycea pterophila*	N/A	SGCN	Springs and caves in the Blanco River drainage.	Project is outside of the expected range of this species.
Houston toad	*Anaxyrus houstonensis*	E	E	Sandy soils near ephemeral pools and populations of loblolly pine.	Project is outside of the expected range of this species.
San Marcos salamander	*Eurycea nana*	T	T	Headwaters of the San Marcos River downstream to about 0.5 mile past IH 35.	Project is outside of the expected range of this species.
Strecker's chorus frog	*Pseudarcris streckeri*	N/A	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Suitable habitat may occur within the project area.
Texas blind salamander	*Eurycea rathbuni*	E	E	Water-filled subterranean caverns along 6 miles of the San Marcos Spring Fault.	Project is outside of the expected range of this species.
Texas salamander	*Eurycea neotenes*	N/A	SGCN	Cave streams, seeps, springs, and creek headwaters; Helotes and Leon Creek drainages.	Project is outside of the expected range of this species.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur within the project area.
Arachnids					
No common accepted name	*Cicurina russelli*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Cicurina ubicki*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Texella mulaiki*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Texella renkesae*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Cicurina ezelli*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
No common accepted name	*Texella diplospina*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Texella grubbsi*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Tartarocreagris grubbsi*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	N/A	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat may occur along Blanco River; may fly over during migration.
Black-capped vireo	*Vireo atricapilla*	N/A	E	Oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces.	Project is outside of the expected range of this species.
Black rail	*Laterallus jamaicensis*	PT	SGCN	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh.	Suitable habitat unlikely to occur within the project area; may fly over during migration.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable does not occur within the project area; may fly over during migration.
Golden-cheeked warbler	*Setophaga chrysoparia*	E	E	Ashe juniper in mixed stands with various oaks (*Quercus* spp.). Edges of cedar brakes.	Project is outside of the expected range of this species.
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also known to nest on manmade structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Unlikely to occur within project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable wintering habitat may occur within the project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur in project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	T	Brackish marshes, shallow salt ponds and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Suitable habitat does not occur in project area; may fly over during migration.
Red knot	*Calidris canutus rufa*	T	SGCN	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays.	Suitable habitat does not occur in project area; may fly over during migration.
Swallow-tailed kite	*Elanoides forficatus*	N/A	T	Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge.	Unlikely to occur within project area; may fly over during migration.
Tropical parula	*Setophaga pitiayumi*	N/A	T	Semi-tropical evergreen woodland along rivers and resacas.	Project is outside of the expected range of this species; may fly over during migration or as a vagrant.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots; nests and roosts in abandoned burrows.	Suitable wintering habitat may occur in project vicinity; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat may occur in project vicinity; may fly over during migration.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems (during migration).	Suitable habitat does not occur in project area; may fly over during migration.
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Unlikely to occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat may occur within the project area; may fly over during migration.
Crustaceans					
Balcones Cave amphipod	*Stygobromus balconis*	N/A	SGCN	Subaquatic, subterranean obligate amphipod.	Project is outside of the expected range of this species.
Ezell's Cave amphipod	*Stygobromus flagellates*	N/A	SGCN	Known only from artesian wells.	Project is outside of the expected range of this species.
No accepted common name	*Texiweckelia texensis*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No accepted common name	*Palaemonetes texanus*	N/A	SGCN	River shrimp found in the Middle Guadalupe and San Marcos watersheds.	Suitable habitat may occur in the Blanco River.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
No accepted common name	*Cyclops cavernarum*	N/A	SGCN	Subaquatic.	Project is outside of the expected range of this species.
Texas troglobitic water slater	*Lirceolus smithii*	N/A	SGCN	Subaquatic, subterranean obligate, aquifer.	Project is outside of the expected range of this species.
Fishes					
American eel	*Anguilla rostrate*	N/A	SGCN	Coastal waterways below reservoirs.	Suitable habitat may occur within the Blanco River.
Fountain darter	*Etheostoma fonticola*	E	E	San Marcos and Comal Rivers; springs and spring-fed streams with dense beds of aquatic plants.	Project is outside of the expected range of this species.
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat may occur within the Blanco River.
Guadalupe darter	*Percina apristis*	N/A	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Low potential for suitable habitat to occur within the Blanco River.
Headwater catfish	*Ictalurus lupus*	N/A	SGCN	Limited to Rio Grande drainage; springs with sandy and rocky riffles, pools of clear creeks, runs, and small rivers.	Project is outside of the expected range of this species.
Ironcolor shiner	*Notropis chalybaeus*	N/A	SGCN	Often at the upstream ends of pools, with a moderate to sluggish current and sand, mud, silt, or detritus substrates.	Low potential for suitable habitat to occur within the Blanco River.
Texas shiner	*Notropis amabilis*	N/A	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Suitable habitat may occur within the Blanco River.
Insects					
A cave obligate beetle	*Rhadine austinica*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
A mayfly	*Procloeon distinctum*	N/A	SGCN	Found in shoreline vegetation.	Suitable habitat may occur in the project area.
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in the project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Comal Springs diving beetle	*Comaldessus stygius*	N/A	SGCN	Known only from the outflows at Comal Springs; generally, inhabit the water column.	Project is outside the expected range of this species.
Comal Springs dryopid beetle	*Stygoparnus comalensis*	E	E	Found crawling on stream bottoms or along shores.	Project is outside of the expected range of this species.
Comal Springs riffle beetle	*Heterelmis comalensis*	E	E	Comal and San Marcos Springs.	Project is outside the expected range of this species.
Comanche harvester ant	*Pogonomyrmex comanche*	N/A	SGCN	Barren, sparse vegetation.	Suitable habitat may occur in the project area.
Edwards Aquifer diving beetle	*Haideoporus texanus*	N/A	SGCN	Habitat poorly known; known from an artesian well in Hays County.	Project is outside the expected range of this species.
No accepted common name	*Rhadine insolita*	N/A	SGCN	Cave dwelling.	Project is outside the expected range of this species.
No accepted common name	*Batrisodes grubbsi*	N/A	SGCN	Cave dwelling.	Project is outside the expected range of this species.
No accepted common name	*Neotrichia juani*	N/A	SGCN	Riparian/riverine.	Suitable habitat may occur in the project area.
No accepted common name	*Oxyelophila callista*	N/A	SGCN	Woodlands.	Suitable habitat may occur in the project area.
No accepted common name	*Ochrotrichia capitana*	N/A	SGCN	Riparian/riverine.	Suitable habitat may occur in the project area.
No accepted common name	*Plauditus texanus*	N/A	SGCN	Riparian/riverine.	Suitable habitat may occur in the project area.
No accepted common name	*Xiphocentron messapus*	N/A	SGCN	Riparian/riverine.	Suitable habitat may occur in the project area.
San Marcos saddle-case caddisfly	*Protoptila arca*	N/A	SGCN	Known from an artesian well in Hays County.	Project is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas austrotinodes caddisfly	*Austrotinodes texensis*	N/A	SGCN	Ranges from cobble and gravel to limestone bedrock; many limestone outcroppings also found along streams.	Suitable habitat may occur in the project area.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur within project area.
Aransas short-tailed shrew	*Blarina hylophaga plumbea*	N/A	SGCN	Excavates burrows in sandy soils underlying mottes of live oak trees or in areas with little to no ground cover.	Suitable habitat may occur within project area.
Big brown bat	*Eptesicus fuscus*	N/A	SGCN	Woodlands or wooded areas.	Suitable habitat may occur within project area.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls, will use buildings.	Suitable habitat may occur within project area.
Cave myotis bat	*Myotis velifer*	N/A	SGCN	Cave-dwelling, also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau	Suitable habitat may occur within project area.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat may occur within project area.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges.	Suitable habitat may occur within project area.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur within project area.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	Suitable habitat may occur within project area; may use buildings/ structures.
Mexican long-tongued bat	*Choeronycteris Mexicana*	N/A	SGCN	Riparian forest in Texas; roost in mines, large crevices, and caves.	Suitable habitat may occur within project area.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Low potential for suitable habitat to occur within project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Wide range of habitats, especially rocky areas, canyons, riparian zones and dense brush.	Low potential for suitable habitat to occur within project area.
Southern short-tailed shrew	*Blarina carolinensis*	N/A	SGCN	Various upland and wetland habitats, including moist deciduous woods, brushy areas, pine woodland and forest, mixed oak-pine-juniper woods.	Suitable habitat may occur within project area.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat may occur within project area.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Restricted to dry and sandy soils of open areas, such as grasslands, cultivated fields, meadows, roadsides, airfields, shrublands, and suburb lawns.	Suitable habitat may occur within project area.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat may occur within project area.
Western spotted skunk	*Spilogale gracilis*	N/A	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur within project area.
Woodland vole	*Microtus pinetorum*	N/A	SGCN	Includes grassy marshes, swamp edges, old-field/pine woodland ecotones, tallgrass fields; generally sandy soils.	Unlikely to occur within project area.
Mollusks					
False spike	*Fusconaia mitchelli*	N/A	T	Medium to large rivers; present in Guadalupe, Colorado, and Brazos river basins.	Potential to occur in the Blanco River.
Glossy wolfsnail	*Euglandina texasiana*	N/A	SGCN	Terrestrial; south Texas, Rio Grande	Project area is outside the expected range of this species.
Golden orb	*Cyclonaias aurea*	N/A	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces river basins.	Potential to occur in the Blanco River. This species was recently a federal candidate species, but its listing as federally threatened or endangered was not warranted as it is not a valid species.
No accepted common name	*Holospira goldfussi*	N/A	SGCN	Terrestrial snail; Edwards Plateau.	Project area is outside the expected range of this species.
No accepted common name	*Millerelix gracilis*	N/A	SGCN	Terrestrial snail; Edwards Plateau.	Project area is outside the expected range of this species.
No accepted common name	*Cyclonaias necki*	N/A	SGCN	Guadalupe River basin; moderate to large streams with flowing water.	Potential to occur in the Blanco River.
No accepted common name	*Elimia comalensis*	N/A	SGCN	Aquatic; found in springs in Central Texas.	Project area is outside the expected range of this species.
No accepted common name	*Phreatodrobia conica*	N/A	SGCN	Subaquatic; subterranean obligate.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
No accepted common name	*Phreatodrobia micra*	N/A	SGCN	Subaquatic; subterranean obligate.	Project area is outside the expected range of this species.
No accepted common name	*Phreatodrobia plana*	N/A	SGCN	Subaquatic; subterranean obligate.	Project area is outside the expected range of this species.
No accepted common name	*Phreatodrobia punctata*	N/A	SGCN	Subaquatic; subterranean obligate.	Project area is outside the expected range of this species.
No accepted common name	*Phreatodrobia rotunda*	N/A	SGCN	Subaquatic; subterranean obligate.	Project area is outside the expected range of this species.
Texas fatmucket	*Lampsilis bracteata*	C	T	Colorado River basin; streams and rivers on sand, mud, and gravel substrates; mistakenly thought to occur in the Guadalupe River basin.	Project area is outside the expected range of this species.
Texas pimpleback	*Cyclonaias petrina*	C	T	Colorado River basin; mud, gravel, and sand substrates in areas with slow flow rates; mistakenly thought to occur in the Guadalupe River basin.	Project area is outside the expected range of this species.
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	N/A	SGCN	Endemic to sandy regions of southern and south-central Texas.	Low potential for suitable habitat to occur within project area.
Bigflower cornsalad	*Valerianella stenocarpa*	N/A	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms.	Suitable habitat unlikely to occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Bracted twistflower	*Streptanthus bracteatus*	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Project area is outside the expected range of this species.
Buckley tridens	*Tridens buckleyanus*	N/A	SGCN	Occurs in juniper-oak woodlands on rocky limestone slopes.	Project area is outside the expected range of this species.
Canyon mock-orange	*Philadelphus texensis* var. *ernestii*	N/A	SGCN	On outcrops of Cretaceous limestone exposed as rimrock along mesic canyons, usually in the shade of mixed evergreen-deciduous canyon woodland.	Project area is outside the expected range of this species.
Engelmann's bladderpod	*Physaria engelmannii*	N/A	SGCN	Grasslands and calcareous rock outcrops in a band along the eastern edge of the Edwards Plateau.	Suitable habitat may occur within project area.
Glass Mountains coral-root	*Hexalectris nitida*	N/A	SGCN	Under *Juniperus ashei* in woodlands over limestone on the Edwards Plateau, Callahan Divide, and Lampasas Cutplain.	Project area is outside the expected range of this species.
Gravelbar brickelbush	*Brickellia dentata*	N/A	SGCN	Frequently scoured gravelly alluvial beds in creek and river bottoms of Edwards Plateau.	Project area is outside the expected range of this species.
Hall's prairie clover	*Dalea hallii*	N/A	SGCN	In grasslands on eroded limestone or chalk and in oak scrub on rocky hillsides.	Project area is outside the expected range of this species.
Heller's beardtongue	*Penstemon triflorus* ssp. *integrifolius*	N/A	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Low potential for habitat to occur within the project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Heller's marbleseed	*Omosmodium helleri*	N/A	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Project area is outside the expected range of this species.
Hill Country wild-mercury	*Argythamnia aphoroides*	N/A	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands, also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Project area is outside the expected range of this species.
Narrowleaf brickelbush	*Brickellia eupatorioides* var. *gracillima*	N/A	SGCN	Occurs in a variety of vernally moist habitats in a number of natural regions.	Suitable habitat may occur within project area.
Net-leaf bundleflower	*Desmanthus reticulatus*	N/A	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat may occur within project area.
Osage Plains false foxglove	*Agalinis densiflora*	N/A	SGCN	Grasslands on shallow, gravelly, well drained, calcareous soils; prairies, dry limestone soils.	Suitable habitat may occur within project area.
Plateau loosestrife	*Lythrum ovalifolium*	N/A	SGCN	Banks and gravelly beds of perennial (or strong intermittent) streams on the Edwards Plateau, Llano Uplift, and Lampasas Cutplain.	Project area is outside the expected range of this species.
Plateau milkvine	*Matelea edwardsensis*	N/A	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Project area is outside the expected range of this species.
Sandhill woolywhite	*Hymenopappus carrizoanus*	N/A	SGCN	Disturbed or open areas in grasslands and post oak woodlands on deep sands derived from the Carrizo Sand and similar Eocene formations.	Unlikely to occur in the project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Scarlet leather-flower	*Clematis texensis*	N/A	SGCN	In oak-juniper woodlands in mesic rocky limestone canyons or along perennial streams.	Project area is outside the expected range of this species.
Shinner's sunflower	*Helianthus occidentalis* ssp. *plantagineus*	N/A	SGCN	Mostly in prairies on the Coastal Plain, with several slightly disjunct populations in the Pineywoods and South Texas Brush Country.	Suitable habitat may occur within project area.
Spreading leastdaisy	*Chaetopappa effusa*	N/A	SGCN	Limestone cliffs, ledges, bluffs, steep hillsides, sometimes in seepy areas, oak-juniper, oak, or mixed deciduous woods, 300-500 meter elevation.	Project area is outside the expected range of this species.
Sycamore-leaf snowbell	*Styrax platanifolius* ssp. *platanifolius*	N/A	SGCN	Oak-juniper woodlands on steep rocky banks and ledges along intermittent or perennials streams.	Project area is outside the expected range of this species.
Texas amorpha	*Amorpha roemeriana*	N/A	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes, sometimes on dry shelves above creeks.	Project area is outside the expected range of this species.
Texas barberry	*Berberis swaseyi*	N/A	SGCN	Shallow calcareous stony clay of upland grasslands/shrublands over limestone as well as in loamier soils in openly wooded canyons and on creek terraces.	Project area is outside the expected range of this species.
Texas beebalm	*Monarda viridissima*	N/A	SGCN	Endemic perennial herb of the Carrizo Sands; deep, well-drained sandy soils in openings of post oak woodlands.	Unlikely to occur within the project area.
Texas claret-cup cactus	*Echinocereus coccineus* var. *paucispinus*	N/A	SGCN	Occurs in rocky outcroppings, often in the partial-shade of oak and pine-oak woodlands and mixed conifer forest.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas fescue	*Festuca versuta*	N/A	SGCN	Occurs in mesic woodlands on limestone-derived soils on stream terraces and canyon slopes.	Project area is outside the expected range of this species.
Texas seymeria	*Seymeria texana*	N/A	SGCN	Found primarily in grassy openings in juniper-oak woodlands on dry rocky slopes but sometimes on rock outcrops in shaded canyons.	Project area is outside the expected range of this species.
Texas sandmint	*Rhododon ciliatus*	N/A	SGCN	Open sandy areas in the Post Oak Belt of east-central Texas.	Low potential for suitable habitat to occur in the project area.
Texas tauschia	*Tauschia texana*	N/A	SGCN	Occurs in loamy soils in deciduous forests or woodlands on river and stream terraces.	Suitable habitat may occur within project area.
Texas wild-rice	*Zizania texana*	E	E	Spring-fed river, in clear, cool, swift water mostly less than 1 meter deep, with coarse sandy soils.	Project area is outside the expected range of this species.
Threeflower penstemon	*Penstemon triflorus* ssp. *triflorus*	N/A	SGCN	Occurs sparingly on rock outcrops and in grasslands associated with juniper-oak woodlands.	Project area is outside the expected range of this species.
Tree dodder	*Cuscuta exaltata*	N/A	SGCN	Parasitic on various *Quercus*, *Juglans*, *Rhus*, *Vitis*, *Ulmus*, and *Diospyros* species as well as *Acacia berlandieri*.	Suitable habitat may occur within project area.
Turnip-root scurfpea	*Pediomelum cyphocalyx*	N/A	SGCN	Grasslands and openings in juniper-oak woodlands on limestone substrates on the Edwards Plateau and in north-central Texas.	Project area is outside the expected range of this species.
Warnock's coral-root	*Hexalectris warnockii*	N/A	SGCN	In leaf litter and humus in oak-juniper woodlands on shaded slopes and intermittent, rocky creekbeds in canyons.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Reptiles					
Cagle's map turtle	*Graptemys caglei*	N/A	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River System.	Suitable habitat may occur within the Blanco River.
Common garter snake	*Thamnophis sirtalis*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur within project area.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur within project area.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat may occur within project area.
Northern spot-tailed earless lizard	*Holbrookia lacerata lacerata*	N/A	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edwards Plateau.	Suitable habitat may occur within project area.
Slender glass lizard	*Ophisaurus attenuatus*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannas, pine barrens, and oil fields.	Suitable habitat may occur within project area.
Spot-tailed earless lizard	*Holbrookia lacerata*	N/A	SGCN	Moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas.	Suitable habitat may occur within project area.
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	N/A	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas garter snake	*Thamnophis sirtalis annectens*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur within project area.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees.	Suitable habitat may occur within project area.
Texas map turtle	*Graptemys versa*	N/A	SGCN	Colorado River drainage; rivers with moderate current, abundant aquatic vegetation, and basking logs; also associated oxbows and lakes.	Project area is outside the expected range of this species.
Timber rattlesnake	*Crotalus horridus*	N/A	T	Swamps, floodplains, upland pine and deciduous woodland, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay.	Low potential for suitable habitat to occur within project area.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland, prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrows into soil or may use burrows made by other species.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Western hognose snake	*Heterodon nasicus*	N/A	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas, and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets. Seems to prefer sandy and loamy soils.	Suitable habitat may occur within project area.
PT = Proposed Threatened T = Threatened E = Endangered C = Candidate DL = Delisted N/A = Not applicable SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC, the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[7] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified ten previously recorded archaeological sites intersecting or immediately adjacent (within 300 feet) to the project area (Table 5.2.14-4; THC 2019). Two archaeological sites are prehistoric lithic artifact scatters with undetermined NRHP eligibility. Two archaeological sites are prehistoric campsites, one with a historic artifact scatter within it, with undetermined NRHP eligibility. One additional archaeological site is a historic farmstead with undetermined NRHP eligibility. The other five archaeological sites were all determined to be ineligible for listing in the NRHP. They include two prehistoric lithic artifact scatters; two historic artifact scatters, one site with both historic and prehistoric artifacts; and one prehistoric campsite. In addition, the review identified up to 114 potentially historic-age buildings and one cemetery intersecting or immediately adjacent to the project area (Table 5.2.14-4; THC 2019). No historical markers or NRHP-listed properties are known to be near the project.

The model used assessed unrecorded archaeological site potential within the project area to include low to high potential zones, ranging from 18 percent to 90 percent likelihood for the landform crossed to

[7] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

contain unidentified archaeological resources. The areas with greatest archaeological probability are located near the ten previously documented archaeological sites and the landforms adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As previously discussed, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 187.0 (a higher score indicates higher probability of cultural resources; further information regarding methodology for developing the assessment score is provided in Section 5.2). Based on results of the background review, SWCA recommends that a structured cultural resources survey of the final design plan be performed to accurately assess the presence and significance of identified and unrecorded cultural resources within project boundaries.

Table 5.2.14-4 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological Site	Artifact Scatter	Prehistoric/Historic	Ineligible	Intersect
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Ineligible	Intersect
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Undetermined	Adjacent
Archaeological Site	Farmstead	Historic	Undetermined	Adjacent
Archaeological Site	Campsite and Artifact Scatter	Prehistoric/Historic	Undetermined	Intersect
Archaeological Site	Artifact Scatter	Historic	Ineligible	Intersect
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Undetermined	Intersect
Archaeological Site	Campsite	Prehistoric	Ineligible	Adjacent
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Ineligible	Intersect
Archaeological Site	Campsite	Prehistoric	Undetermined	Adjacent
Santa Maria Aida	Cemetery	–	–	Adjacent
None	99 Buildings	Historic	–	Adjacent
None	15 Buildings	Historic	–	Intersect
			ASSESSMENT SCORE TOTAL:	187.0

5.2.14.4 Engineering and Costing

Preliminary engineering and costing analyses have been performed using the 2021 Regional Water Planning methods. For Region L, Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and unit costs. The engineering and costing analysis for the ARWA Project (Phase 3) includes all facilities required for the advanced water treatment for direct potable reuse, delivery of treated water, and disposal of blended concentrate, including construction of a 5.0 mgd DPR WTP near the San Marcos WWTP to provide advanced treatment of the San Marcos WWTP effluent to DPR standards, a 5.0 mgd pump station at the DPR WTP, a 5.0 mgd expansion to the existing booster station, an 18-inch diameter pipeline to transfer DPR treated water to the booster station for delivery to customers, a 16-inch diameter pipeline for the blended concentrate effluent from the DPR WTP to Kyle WWTP for disposal, a 1 MG ground storage tank, and supplementary delivery volumes to the ARWA delivery points.

Cost estimates were calculated for capital costs, annual debt service, operation and maintenance, power, land acquisition, and environmental mitigation for season and peak day demands. These costs are summarized in Table 5.2.14-5. The overall project costs, including capital costs, are estimated to be $73,558,000. Accounting for debt service, operations and maintenance, and pumping energy, the annual cost is estimated to be $11,171,000 per year. This option produces potable water at an estimated annual unit cost of $2,001 per acft per year.

Table 5.2.14-5 Project Cost Estimate Summary

ITEM	ESTIMATED COSTS
Direct Potable Reuse Water Treatment Plant (DPR WTP; 5.0 mgd)	$35,705,000
Booster Station Expansion (5.0 mgd expansion)	$1,660,000
Treated Water Transmission Pipeline (18 in. dia., 4 miles)	$5,229,000
Blended Concentrate Transmission Pipeline (16 in. dia., 11 miles)	$4,869,000
Treated Water Transmission Pump Station(s) and Storage Tank(s)	$1,498,000
Blended Concentrate Transmission Pump Station(s) and Storage Tank(s)	$2,171,000
Clearwell (5.0 MG)	$3,308,000
TOTAL COST OF FACILITIES	**$54,440,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$16,833,000
Environmental and Archaeology Studies and Mitigation	$397,000
Land Acquisition and Surveying (0 acres)	$31,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$1,857,000
TOTAL COST OF PROJECT	**$73,558,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$4,881,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$95,000
Advanced Water Treatment Facility	$4,610,000
Pumping Energy Costs (19,809,819 kW-h @ 0.08 $/kW-h)	$1,585,000
TOTAL ANNUAL COST	**$11,171,000**

ITEM	ESTIMATED COSTS
Available Project Yield (acft/yr)	5,494
Annual Cost of Water ($ per acft)	$2,001
Annual Cost of Water After Debt Service ($ per acft)	$1,126
Annual Cost of Water ($ per 1,000 gallons)	$6.14
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$3.46
No Peaking Factor	

5.2.14.5 Implementation Considerations

Information presented in this WMS was provided by ARWA and represents the current plan, which is based on the sponsor's current understanding of the system. The actual well capacities and water quality may vary, depending on site-specific conditions. Implementation of the ARWA Project (Phase 3) WMS will require permits and approvals from the TCEQ. Additional implementation considerations include the following:

- Adequate treatment of WWTP effluent to direct potable reuse water quality standards;
- Verification of water quality for concentrations of constituents, such as TDS, chloride, sulfate, iron, manganese, and hydrogen sulfide;
- The TCEQ has not previously approved potable reuse projects that combine effluent from multiple WWTPs; additional effluent source water characterization studies may be required; and
- Uncertain TCEQ regulatory requirements for DPR WTPs and for blending DPR treated water with other water sources.

Reliability

Supply amounts for this strategy were developed based on estimates of water use and related return flows to specific wastewater treatment plants. Where applicable, consideration was given for specific minimum by-pass flow requirements where required by water rights. This strategy is considered highly reliable (reliability score = 5). There is the potential for the reuse supplies to develop at a faster or slower rate, depending on the volume of return flows.

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5.2.15 GBRA Mid-Basin Project (Phase 2)

5.2.15.1 Description of Water Management Strategy

The GBRA Mid-Basin Project (Phase 2) WMS would divert surface water from the Guadalupe River near the City of Gonzales to a new WTP for delivery to GBRA customers, with excess treated water injected into a new ASR well field. The WTP and ASR well field will be located northwest of the City of Gonzales, and pipelines would be constructed to deliver treated water to customers. The project is expected to have a firm yield of 27,000 acft/yr. A map of the approximate project location is shown on Figure 5.2.15-1. The map shown is for conceptual purposes, as the exact pipeline route and configuration have not yet been determined. The application for the required permits is currently pending at the TCEQ.

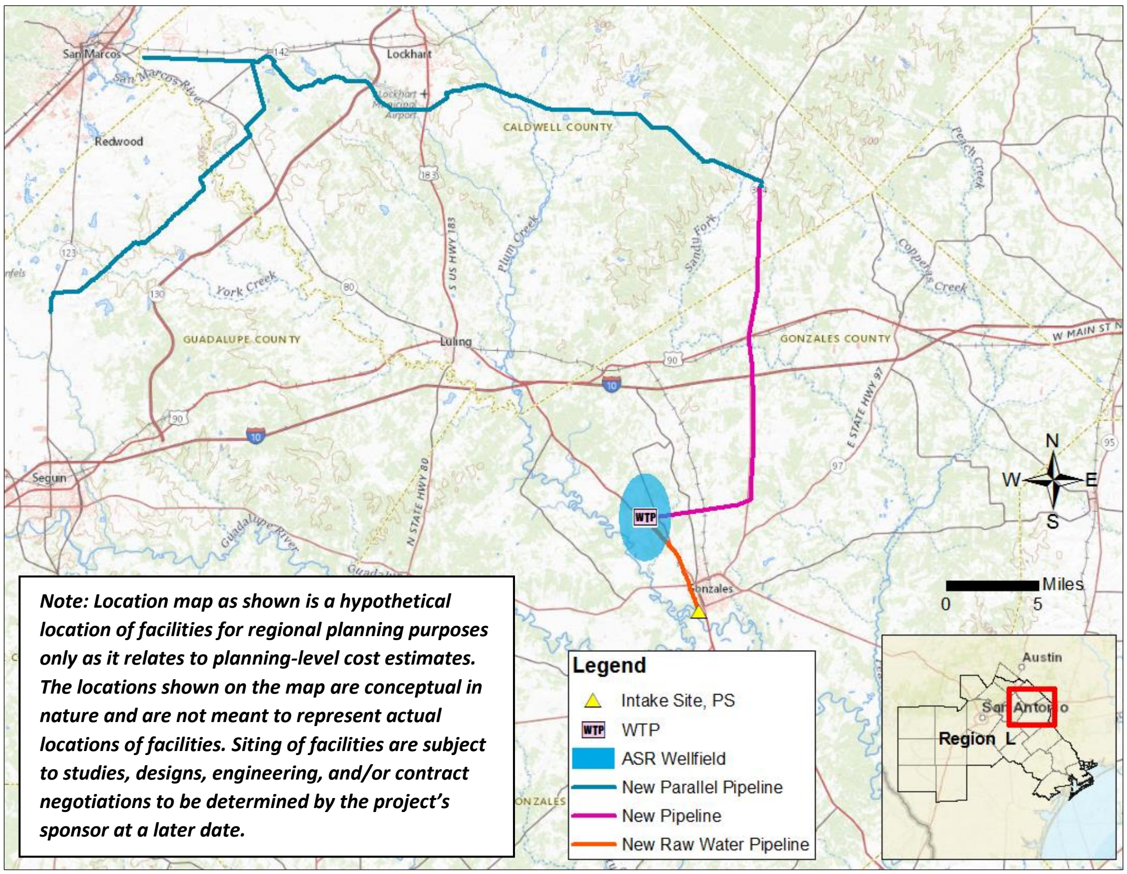

Figure 5.2.15-1 GBRA Mid-Basin (Phase 2) Project Approximate Location

Surface water from the river diversion/intake point near Gonzales will be pumped 5.3 miles to a WTP located northwest of Gonzales. Treated surface water will generally be delivered to meet daily needs; however, when WTP capacity exceeds daily needs, excess treated water will be injected into the Carrizo-Wilcox Aquifer using ASR injection wells.

Potable water supplies are conveyed to two delivery points in Lockhart and New Braunfels, which will include a meter and two storage tanks with capacity for 15 percent of average daily demand. Customers will be responsible for construction of any facilities required to connect to the delivery locations. Additionally, some treated supply could be made available to customers along the transmission line.

The total finished water pipeline route length is 75 miles, paralleling existing right-of-way for nearly 55 miles. The transmission line is sized to deliver baseline supply with a 1.0 peaking factor. Two pump stations are required to deliver supplies along the finished transmission main. A high service pump station (HSPS) will pump from the clear well located at the WTP and will provide sufficient head to deliver supplies to the first booster pump station. This pump station will boost pressures to convey supplies to the delivery points.

5.2.15.2 Available Yield

The operational concept for the GBRA Mid-Basin Project with ASR water management strategy is summarized as follows: (1) when demands can be met with water rights in the Guadalupe River at Gonzales, the water is treated and delivered directly to participants, (2) when surface water supplies available from the Guadalupe River exceed demands and there is unused capacity in the water treatment plant and delivery system, the excess surface water is treated and stored in the Carrizo-Wilcox Aquifer through ASR wells, and (3) when available surface water supplies cannot meet participant demands, native groundwater or surface water previously stored in the aquifer is produced or recovered to meet the balance of the participant demands. The loss of ASR water is assumed to be zero for the purpose of this WMS modeling, but further study is recommended. The introduction of ASR water adds to the volume of water in storage and increases what can be withdrawn from the aquifer without exceeding the GCUWCD drawdown limits. This WMS is planned for implementation in the 2030 decade.

Surface Water Modeling

Estimates of surface water available for diversion under a new appropriation from the Guadalupe River at Gonzales were computed subject to senior water rights and environmental flow standards adopted by the TCEQ. Surface water availability was estimated in conformance with GBRA's Application No. 12378, which includes a maximum annual diversion of 75,000 acft/yr from the Guadalupe River at Gonzales and maximum instantaneous diversion rate of 500 cfs. The models used to determine availability and yield include the Guadalupe-San Antonio River Basin Water Availability Model (GSA WAM) and the FRAT.

Major modeling assumptions in applications of the GSA WAM and FRAT include the following:

- Estimated water availability subject to full use of senior water rights for consumptive uses and environmental flow standards adopted by TCEQ on August 8, 2012.

- Treated effluent discharges were excluded throughout the river basin (similar to TCEQ Run 3), except when specifically addressed in a water right (e.g., INVISTA, Kate O'Connor Trust, etc.).
- Springflows from the Edwards Aquifer were based on aquifer management in accordance with full implementation of the EAHCP, approved by the USFWS.

To calculate surface water available from the Guadalupe River at Gonzales for the GBRA Mid-Basin Project (Phase 2), a new water right (junior to all existing water rights) was modeled in the GSA WAM to obtain monthly unappropriated and regulated flows for the Guadalupe River at Gonzales. The portion of streamflow allocated to downstream senior water rights was calculated by subtracting the unappropriated flow from the regulated flow. Monthly regulated flows were then disaggregated to daily values using gaged or estimated daily streamflows for the Guadalupe River at Gonzales. Monthly amounts allocated to downstream senior water rights were then taken uniformly out of the base of the daily hydrograph so that the sum of daily pass-through amounts in each month equaled the total monthly amount allocated to downstream senior water rights.

Daily senior water right pass-throughs and daily regulated flows are incorporated into the FRAT model, along with the TCEQ environmental flow standards for the Guadalupe River at Gonzales. These environmental flow standards consist of seasonal subsistence and base flows, two tiers of seasonal pulses, and a pulse exemption provision under which pulses may be excluded if the magnitude of the maximum diversion rate of the water right is less than or equal to 20 percent of the pulse peak. For example, if the maximum diversion rate for the GBRA Mid-Basin Project is 116 cfs, all small and large seasonal pulse diversion restrictions would be excluded and the project would not be required to honor those pulses. Additionally, the environmental flow standard for the Guadalupe River at Gonzales includes a provision for diversions that are made between the base flow and the subsistence flow, so that when streamflow is between the base and subsistence flows, only 50 percent of the difference between the streamflow and the subsistence flow can be diverted.

Surface Water, Groundwater, and ASR

Using the monthly water availability and daily disaggregation procedures described above, an accounting model was used to simulate surface water diversions to a WTP and ASR well field from which a firm supply of treated water could be delivered to project participants. Simulations indicate that a firm yield of 27,000 acft/yr can be obtained, assuming a maximum instantaneous river diversion rate and ASR WTP capacity of 97 cfs (63 mgd) and maximum long-term drawdown in the Carrizo-Wilcox Aquifer near the well field on the order of 100 feet.

5.2.15.3 Environmental Considerations

Environmental Considerations

Vegetation and Land Use

The project area is located in the Post Oak Savannah and Blackland Prairie ecoregions and crosses a variety of vegetation types, mostly open fields, pastures, and riparian zones along streams. As mapped by TPWD,[1] dominant vegetation types in the project area are savannah grassland, mesquite shrubland, floodplain herbaceous vegetation, and post oak motte and woodland. The linear components of the project cross riparian vegetation zones along streams, mapped by TPWD as floodplain and riparian herbaceous vegetation, floodplain and riparian hardwood forest, floodplain and riparian deciduous shrubland, and floodplain live oak forest.

Based on TPWD vegetation mapping, the project may have the potential to impact 57 acres of agricultural resources, including 8 acres mapped as row crops, and 49 acres of disturbance or tame grassland which may include pasture areas used for grazing. Construction of well fields would result in conversion of woody and herbaceous vegetation and agricultural uses to industrial land use for facilities. Project pipeline easements would require removal of woody vegetation and long-term maintenance (mowing and woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each water management strategy to determine the best course of action regarding revegetation. Pipeline easements may continue to be used for agricultural purposes.

Aquatic Resources

The project pipeline alignment crosses several mapped streams and their associated floodplains, including the San Marcos River, Plum Creek, and Sandy Fork, and includes a raw water intake in the Guadalupe River. The NWI mapping shows 86.3 acres of ponds and riverine wetlands in the project area. The project pipeline crosses Segment 1804A of Geronimo Creek, a tributary of the Guadalupe River. This stream segment has been designated as impaired in the Texas Integrated Report of 303(d) listed water bodies.[2] This list identifies the water bodies or segments in Texas that do not meet assigned water quality standards. The project pipeline crosses the headwaters of Geronimo Creek, an ecologically significant stream segment designated by TPWD.

The project will require an on-site delineation of streams, ponds, and wetlands. Stream crossings for pipeline construction would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including cases where there would be permanent impacts to more than 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under a stream (e.g., through horizontal directional drilling) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

[1] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.
[2] Texas Commission on Environmental Quality. 2018. 2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf.

Table 5.2.15-1 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Caldwell, Gonzales, Guadalupe, and Hays Counties. .[3],[4],[5],[6],[7],[8],[9],[10] Suitable habitat for the federally endangered golden-cheeked warbler may occur in woodlands within the project area. The project will require an on-site habitat assessment to determine if suitable habitat is present within this area. Suitable habitat does not occur for any other federally endangered species with the potential to occur in the project region. However, several freshwater mussel species are under review for federal listing as threatened or endangered, and the project pipeline crosses streams that may provide suitable habitat for freshwater mussels.

Suitable habitat may occur for several state-listed threatened species, including the Texas horned lizard (*Phrynosoma cornutum*), Texas tortoise (*Gopherus berlandieri*), and Cagle's map turtle (*Graptemys caglei*). Potentially suitable habitat may occur for numerous state wildlife, plant, and insect species designated by TPWD as SGCN. These species do not have formal protected status but are being monitored by TPWD. Migratory birds may occur in the project area, particularly in riparian zones and wetland areas.

Streams in the project area may contain suitable habitat for federal candidate/state threatened freshwater mussel species. Suitable habitat may occur in perennial rivers/streams and perennial pools of intermittent streams. If any such habitat would be affected by construction, presence/absence surveys and relocation of native mussel species would be required. Handling and relocation of mussels and other aquatic species must be conducted by TPWD-permitted personnel and in accordance with an approved Aquatic Resources Relocation Plan. Furthermore, these candidate species may be listed as federally threatened or endangered during the project timeline, in which case any species impacts would require USFWS consultation.

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[3] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Caldwell County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[4] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Caldwell County. https://ecos.fws.gov/ipac/location/Q7YOOGZ4XFDYJH3XAH426PVLMU/resources.

[5] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Gonzales County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[6] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Gonzales County. https://ecos.fws.gov/ipac/location/THAN4LUF6JGQ3FAWPQMXZQPATA/resources.

[7] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Guadalupe County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[8] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Guadalupe County. https://ecos.fws.gov/ipac/location/QVIBPJWUHBAAFNOCI4UCN5RVEI/resources.

[9] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Hays County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[10] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Hays County. https://ecos.fws.gov/ipac/location/XG4UGQLIY5HUFORG5ANNCL5T5I/resources.

Site-specific field surveys would be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain its recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or to avoid vegetation clearing during the general bird nesting season from March 15 to September 15. Preconstruction surveys for active bird nests are recommended.

Table 5.2.15-1 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for GBRA Mid-Basin Project (Phase 2), Caldwell, Gonzales, Guadalupe, and Hays Counties, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Barton Springs salamander	*Eurycea sosorum*	E	E	Outlets of Barton Springs and subterranean water-filled caverns; found under rocks, in gravel, or among aquatic vascular plants and algae.	Project is outside of the expected range of this species.
Blanco blind salamander	*Eurycea robusta*	N/A	T	Water-filled subterranean caverns; may inhabit deep levels of the Balcones Aquifer to the north and east of the Blanco River.	Suitable habitat unlikely to occur within project area.
Blanco River Springs salamander	*Eurycea pterophila*	N/A	SGCN	Springs and caves in the Blanco River drainage.	Project is outside of the expected range of this species.
Houston toad	*Anaxyrus houstonensis*	E	E	Sandy soils near ephemeral pools and populations of Loblolly pine.	Project is outside of the expected range of this species.
Pedernales River Springs salamander	*Eurycea sp. 6*	N/A	N/A	Known only from springs.	Project is outside of the expected range of this species.
San Marcos salamander	*Eurycea nana*	T	T	Headwaters of the San Marcos River downstream to about 0.5 mile past IH 35.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Strecker's chorus frog	*Pseudarcris streckeri*	N/A	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Suitable habitat may occur within project area.
Texas blind salamander	*Eurycea rathbuni*	E	E	Water-filled subterranean caverns along 6 miles of the San Marcos Spring Fault.	Project is outside of the expected range of this species.
Texas salamander	*Eurycea neotenes*	N/A	SGCN	Cave streams, seeps, springs, and creek headwaters; Helotes and Leon Creek drainages.	Project is outside of the expected range of this species.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur within project area.
Arachnids					
No common accepted name	*Cicurina russelli*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Cicurina ubicki*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Texella mulaiki*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Texella renkesae*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Cicurina ezelli*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Texella diplospina*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Texella grubbsi*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No common accepted name	*Tartarocreagris grubbsi*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
Birds					

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Bald eagle	*Haliaeetus leucocephalus*	N/A	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat may occur along the San Marcos and Guadalupe Rivers; may fly over during migration.
Black-capped vireo	*Vireo atricapilla*	N/A	E	Oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces.	Suitable habitat does not occur in project area; may fly over during migration.
Black rail	*Laterallus jamaicensis*	PT	SGCN	Salt, brackish, and freshwater marshes; pond borders; wet meadows; and grassy swamps. Nests in or along edge of marsh.	Suitable habitat may occur within project area; may fly over during migration.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur within project area; may fly over during migration.
Golden-cheeked warbler	*Setophaga chrysoparia*	E	E	Ashe juniper in mixed stands with various oaks (*Quercus* spp.). Edges of cedar brakes.	Suitable habitat may occur in parts of project area; may fly over during migration.
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also known to nest on manmade structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Unlikely to occur within project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie; feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat may occur within project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur in project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	T	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Suitable habitat does not occur in project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Red knot	*Calidris canutus rufa*	T	SGCN	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays.	Suitable habitat does not occur in project area; may fly over during migration.
Swallow-tailed kite	*Elanoides forficatus*	N/A	T	Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge.	Unlikely to occur within project area; may fly over during migration.
Tropical parula	*Setophaga pitiayumi*	N/A	T	Semi-tropical evergreen woodland along rivers and resacas.	Unlikely to occur within project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots; nests and roosts in abandoned burrows.	Suitable wintering habitat may occur in project vicinity; may fly over during migration.
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat may occur in project vicinity; may fly over during migration.
White-tailed hawk	*Buteo albicaudatus*	N/A	T	Near coast on prairies, cordgrass flats, and scrub live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral.	Suitable habitat may occur in project vicinity; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems [during migration].	Suitable habitat does not occur in project area; may fly over during migration.
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Unlikely to occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat may occur along the San Marcos and Guadalupe Rivers; may fly over during migration.
Crustaceans					
Balcones Cave amphipod	*Stygobromus balconis*	N/A	SGCN	Subaquatic, subterranean obligate amphipod.	Project is outside of the expected range of this species.
Ezell's Cave amphipod	*Stygobromus flagellates*	N/A	SGCN	Known only from artesian wells.	Project is outside of the expected range of this species.
No accepted common name	*Texiweckelia texensis*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
No accepted common name	*Palaemonetes texanus*	N/A	SGCN	River shrimp found in the Middle Guadalupe and San Marcos watersheds.	May occur in the Guadalupe and San Marcos Rivers.
Texas troglobitic water slater	*Lirceolus smithii*	N/A	SGCN	Subaquatic, subterranean obligate, aquifer.	Project is outside of the expected range of this species.
Fishes					
American eel	*Anguilla rostrate*	N/A	SGCN	Coastal waterways below reservoirs.	May occur in the Guadalupe and San Marcos Rivers.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Fountain darter	*Etheostoma fonticola*	E	E	San Marcos and Comal Rivers; springs and spring-fed streams with dense beds of aquatic plants.	Project is outside of the expected range of this species.
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat may occur within the San Marcos and Guadalupe Rivers.
Guadalupe darter	*Percina apristis*	N/A	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Suitable habitat may occur within the Guadalupe River within project area.
Headwater catfish	*Ictalurus lupus*	N/A	SGCN	Limited to Rio Grande drainage; springs with sandy and rocky riffles, pools of clear creeks, runs, and small rivers.	Project is outside of the expected range of this species.
Ironcolor shiner	*Notropis chalybaeus*	N/A	SGCN	Often at the upstream ends of pools, with a moderate to sluggish current and sand, mud, silt, or detritus substrates.	Suitable habitat may occur within project area.
Plateau shiner	*Cyprinella lepida*	N/A	SGCN	Edwards Plateau portion of the Nueces basin; cool, clear, spring-fed headwater creeks.	Project is outside of the expected range of this species.
Texas shiner	*Notropis amabilis*	N/A	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Suitable habitat may occur within project area.
Insects					
Cave obligate beetle	*Rhadine austinica*	N/A	SGCN	Cave dwelling.	Project is outside of the expected range of this species.
A mayfly	*Procloeon distinctum*	N/A	SGCN	Found in shoreline vegetation.	Suitable habitat may occur in project area.
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in project area.
Comal Springs diving beetle	*Comaldessus stygius*	N/A	SGCN	Known only from the outflows at Comal Springs; generally inhabit the water column.	Project is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Comal Springs dryopid beetle	*Stygoparnus comalensis*	E	E	Found crawling on stream bottoms or along shores.	Project is outside of the expected range of this species.
Comal Springs riffle beetle	*Heterelmis comalensis*	E	E	Comal and San Marcos Springs.	Project is outside the expected range of this species.
Comanche harvester ant	*Pogonomyrmex comanche*	N/A	SGCN	Barren, sparse vegetation.	Suitable habitat may occur in project area, particularly in areas of sandy soils.
Edwards Aquifer diving beetle	*Haideoporus texanus*	N/A	SGCN	Habitat poorly known; known from an artesian well in Hays County.	Project is outside the expected range of this species.
No accepted common name	*Rhadine insolita*	N/A	SGCN	Cave dwelling.	Project is outside the expected range of this species.
No accepted common name	*Batrisodes grubbsi*	N/A	SGCN	Cave dwelling.	Project is outside the expected range of this species.
No accepted common name	*Neotrichia juani*	N/A	SGCN	Riparian/riverine.	Suitable habitat may occur in project area.
No accepted common name	*Oxyelophila callista*	N/A	SGCN	Woodlands.	Suitable habitat may occur in project area.
No accepted common name	*Ochrotrichia capitana*	N/A	SGCN	Riparian/riverine.	Suitable habitat may occur in project area.
No accepted common name	*Plauditus texanus*	N/A	SGCN	Riparian/riverine.	Suitable habitat may occur in project area.
No accepted common name	*Xiphocentron messapus*	N/A	SGCN	Riparian/riverine.	Suitable habitat may occur in project area.
No accepted common name	*Bombus variabilis*	N/A	SGCN	Grasslands and croplands.	Suitable habitat may occur in project area.
No accepted common name	*Melanoplus alexanderi*	N/A	SGCN	Open oak savannahs.	Suitable habitat may occur in project area.
San Marcos saddle-case caddisfly	*Protoptila arca*	N/A	SGCN	Known from an artesian well in Hays County.	Project is outside the expected range of this species.
Texas austrotinodes caddisfly	*Austrotinodes texensis*	N/A	SGCN	Ranges from cobble and gravel to limestone bedrock; many limestone outcroppings also found along streams.	Suitable habitat may occur in project area.
Mammals					

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur within project area.
Aransas short-tailed shrew	*Blarina hylophaga plumbea*	N/A	SGCN	Sandy soils underlying mottes of live oak trees or in areas with little to no ground cover.	Suitable habitat may occur within project area.
Big brown bat	*Eptesicus fuscus*	N/A	SGCN	Woodlands or wooded areas.	Suitable habitat may occur within project area.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls; will use buildings.	Suitable habitat may occur within project area.
Cave myotis bat	*Myotis velifer*	N/A	SGCN	Cave-dwelling; also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	Suitable habitat may occur within project area.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat may occur within project area.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields, prairies, croplands, fence rows, farmyards, and forest edges.	Suitable habitat may occur within project area.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Suitable habitat may occur within project area.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur within project area.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	Suitable habitat may occur within project area; may use buildings/ structures.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Mexican long-tongued bat	*Choeronycteris Mexicana*	N/A	SGCN	Riparian forest in Texas; roost in mines, large crevices, and caves.	Suitable habitat may occur within project area.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Suitable habitat may occur within project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Low potential for suitable habitat to occur within project area.
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	N/A	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur within project area.
Southern short-tailed shrew	*Blarina carolinensis*	N/A	SGCN	Various upland and wetland habitats, including moist deciduous woods, brushy areas, pine woodland and forest, and mixed oak-pine-juniper woods.	Suitable habitat may occur within project area.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat may occur within project area.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Restricted to dry and sandy soils of open areas, such as grasslands, cultivated fields, meadows, roadsides, airfields, shrublands, and suburb lawns.	Suitable habitat may occur within project area.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat may occur within project area.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat may occur within project area.
Western spotted skunk	*Spilogale gracilis*	N/A	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
White-nosed coati	*Nasua narica*	N/A	T	Canyons, riparian corridors, and woodlands.	Project area is outside the expected range of this species.
Woodland vole	*Microtus pinetorum*	N/A	SGCN	Includes grassy marshes, swamp edges, old-field/pine woodland ecotones, tallgrass fields; generally sandy soils.	Unlikely to occur within project area.
Mollusks					
False spike	*Fusconaia mitchelli*	N/A	T	Medium to large rivers; present in Guadalupe, Colorado, and Brazos River basins.	Potential to occur in waterways in project area.
Glossy wolfsnail	*Euglandina texasiana*	N/A	SGCN	Terrestrial; south Texas, Rio Grande	Project area is outside the expected range of this species.
Golden orb	*Cyclonaias aurea*	N/A	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Potential to occur in waterways in project area. This species was recently a federal candidate species but its listing as federally threatened or endangered was not warranted as it is not a valid species.
No accepted common name	*Holospira goldfussi*	N/A	SGCN	Terrestrial snail; Edwards Plateau.	Project area is outside the expected range of this species.
No accepted common name	*Millerelix gracilis*	N/A	SGCN	Terrestrial snail; Edwards Plateau.	Project area is outside the expected range of this species.
No accepted common name	*Cyclonaias necki*	N/A	SGCN	Guadalupe River basin; moderate to large streams with flowing water.	Potential to occur in waterways in project area.
No accepted common name	*Elimia comalensis*	N/A	SGCN	Aquatic; found in springs in Central Texas.	Project area is outside the expected range of this species.
No accepted common name	*Phreatodrobia conica*	N/A	SGCN	Subaquatic; subterranean obligate.	Project area is outside the expected range of this species.
No accepted common name	*Phreatodrobia micra*	N/A	SGCN	Subaquatic; subterranean obligate.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
No accepted common name	*Phreatodrobia plana*	N/A	SGCN	Subaquatic; subterranean obligate.	Project area is outside the expected range of this species.
No accepted common name	*Phreatodrobia punctata*	N/A	SGCN	Subaquatic; subterranean obligate.	Project area is outside the expected range of this species.
No accepted common name	*Phreatodrobia rotunda*	N/A	SGCN	Subaquatic; subterranean obligate.	Project area is outside the expected range of this species.
Texas fatmucket	*Lampsilis bracteata*	C	T	Colorado River basin; streams and rivers on sand, mud, and gravel substrates; previously thought to occur in the Guadalupe River basin.	Project area is outside the expected range of this species.
Texas pimpleback	*Cyclonaias petrina*	C	T	Colorado River basin; mud, gravel, and sand substrates in areas with slow flow rates; previously thought to occur in the Guadalupe River basin.	Project area is outside the expected range of this species.
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	N/A	SGCN	Endemic to sandy regions of southern and south-central Texas.	Suitable habitat may occur within project area.
Bigflower cornsalad	*Valerianella stenocarpa*	N/A	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings; on steep to moderate slopes and in canyon bottoms.	Suitable habitat may occur within project area.
Big red sage	*Salvia pentstemonoides*	N/A	SGCN	Steep limestone outcrops on seeps within canyons or along creek banks; occasionally on clayey to silty soils of creek banks and terraces, in partial shade to full sun.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Bracted twistflower	*Streptanthus bracteatus*	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings; on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Project area is outside the expected range of this species.
Bristle nailwort	*Paronychia setacea*	N/A	SGCN	Flowering vascular plant endemic to eastern south-central Texas; occurs in sandy soils.	Suitable habitat may occur within project area.
Buckley tridens	*Tridens buckleyanus*	N/A	SGCN	Occurs in juniper-oak woodlands on rocky limestone slopes.	Project area is outside the expected range of this species.
Buckley's spiderwort	*Tradescantia buckleyi*	N/A	SGCN	Occurs on sandy loam or clay soils in grasslands or shrublands underlain by the Beaumount Formation.	Project area is outside the expected range of this species.
Canyon mock-orange	*Philadelphus texensis* var. *ernestii*	N/A	SGCN	On outcrops of Cretaceous limestone exposed as rimrock along mesic canyons, usually in the shade of mixed evergreen-deciduous canyon woodland.	Project area is outside the expected range of this species.
Crestless onion	*Allium canadense var. ecristatum*	N/A	SGCN	Occurs on poorly drained sites on sandy substrates within coastal prairies of the Coastal Bend area.	Project area is outside the expected range of this species.
Drummond's rushpea	*Caesalpinia drummondii*	N/A	SGCN	Open areas on sandy clay.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Elmendorf's onion	*Allium elmendorfii*	N/A	SGCN	Grassland openings in oak woodlands on deep, loose, well-drained sands; to the north it occurs in post oak-black hickory-live oak woodlands over Queen City and similar Eocene formations.	Project area is outside the expected range of this species.
Engelmann's bladderpod	*Physaria engelmannii*	N/A	SGCN	Grasslands and calcareous rock outcrops in a band along the eastern edge of the Edwards Plateau.	Suitable habitat may occur within project area.
Florida pinkroot	*Spigelia texana*	N/A	SGCN	Woodlands on loamy soils along rivers in south Texas.	Suitable habitat may occur within project area.
Glass Mountains coral-root	*Hexalectris nitida*	N/A	SGCN	Under *Juniperus ashei* in woodlands over limestone on the Edwards Plateau, Callahan Divide, and Lampasas Cutplain.	Project area is outside the expected range of this species.
Gravelbar brickelbush	*Brickellia dentata*	N/A	SGCN	Frequently-scoured gravelly alluvial beds in creek and river bottoms of Edwards Plateau.	Project area is outside the expected range of this species.
Hall's prairie clover	*Dalea hallii*	N/A	SGCN	In grasslands on eroded limestone or chalk and in oak scrub on rocky hillsides.	Project area is outside the expected range of this species.
Heartleaf evening-primrose	*Oenothera cordata*	N/A	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Suitable habitat may occur within project area.
Heller's beardtongue	*Penstemon triflorus* ssp. *integrifolius*	N/A	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Suitable habitat may occur within project area.
Heller's marbleseed	*Omosmodium helleri*	N/A	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Hill Country wild-mercury	*Argythamnia aphoroides*	N/A	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands; also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Project area is outside the expected range of this species.
Low spurge	*Euphorbia peplidion*	N/A	SGCN	Occurs in a variety of vernally moist situations in a number of natural regions.	Suitable habitat may occur within project area.
Lundell's whitlow wort	*Paronychia lundellorum*	N/A	SGCN	The Sand Sheet of eastern South Texas, in tight sandy soils over saline clay on microhighs within salty prairie grasslands, and in upper portions of saline flats surrounding short drainages and brackish basins typical of the South Texas Sand Sheet.	Project area is outside the expected range of this species.
Narrowleaf brickelbush	*Brickellia eupatorioides* var. *gracillima*	N/A	SGCN	Occurs in a variety of vernally moist habitats in a number of natural regions.	Suitable habitat may occur within project area.
Net-leaf bundleflower	*Desmanthus reticulatus*	N/A	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat may occur within project area.
Osage Plains false foxglove	*Agalinis densiflora*	N/A	SGCN	Grasslands on shallow, gravelly, well drained, calcareous soils; prairies, dry limestone soils.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Parks jointweed	*Polygonella parksii*	N/A	SGCN	Mostly on deep, loose, whitish sand blowouts (unstable, deep, xeric, sandhill barrens) in Post Oak Savanna landscapes over the Carrizo and Sparta formations; also occurs in early successional grasslands, along rights-of-way, and on mechanically disturbed areas.	Suitable habitat may occur within project area.
Plateau loosestrife	*Lythrum ovalifolium*	N/A	SGCN	Banks and gravelly beds of perennial (or strong intermittent) streams on the Edwards Plateau, Llano Uplift, and Lampasas Cutplain.	Project area is outside the expected range of this species.
Plateau milkvine	*Matelea edwardsensis*	N/A	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Suitable habitat may occur within project area.
Sandhill woolywhite	*Hymenopappus carrizoanus*	N/A	SGCN	Disturbed or open areas in grasslands and post oak woodlands on deep sands derived from the Carrizo Sand and similar Eocene formations.	Suitable habitat may occur within project area.
Sayersville blue eyes	*Nemophila sayersensis*	N/A	SGCN	Very sandy soils near stream edges.	Suitable habitat may occur within project area.
Scarlet leather-flower	*Clematis texensis*	N/A	SGCN	In oak-juniper woodlands in mesic rocky limestone canyons or along perennial streams.	Project area is outside the expected range of this species.
Shinner's sunflower	*Helianthus occidentalis* ssp. *plantagineus*	N/A	SGCN	Mostly in prairies on the Coastal Plain, with several slightly disjunct populations in the Pineywoods and South Texas Brush Country.	Suitable habitat may occur within project area.
South Texas spikesedge	*Eleocharis austrotexana*	N/A	SGCN	Wetlands on the coastal plain.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Spreading leastdaisy	*Chaetopappa effusa*	N/A	SGCN	Limestone cliffs, ledges, bluffs, steep hillsides; sometimes in seepy areas, oak-juniper, oak, or mixed deciduous woods; 300-500 meter elevation.	Project area is outside the expected range of this species.
Sycamore-leaf snowbell	*Styrax platanifolius* ssp. *platanifolius*	N/A	SGCN	Oak-juniper woodlands on steep rocky banks and ledges along intermittent or perennials streams.	Project area is outside the expected range of this species.
Texas amorpha	*Amorpha roemeriana*	N/A	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes; sometimes on dry shelves above creeks.	Project area is outside the expected range of this species.
Texas barberry	*Berberis swaseyi*	N/A	SGCN	Shallow calcareous stony clay of upland grasslands/shrublands over limestone as well as in loamier soils in openly wooded canyons and on creek terraces.	Project area is outside the expected range of this species.
Texas beebalm	*Monarda viridissima*	N/A	SGCN	Endemic perennial herb of the Carrizo Sands; deep, well-drained sandy soils in openings of post oak woodlands.	Suitable habitat may occur within project area.
Texas claret-cup cactus	*Echinocereus coccineus* var. *paucispinus*	N/A	SGCN	Occurs in rocky outcroppings, often in the partial shade of oak and pine-oak woodlands and mixed conifer forest.	Project area is outside the expected range of this species.
Texas fescue	*Festuca versuta*	N/A	SGCN	Occurs in mesic woodlands on limestone-derived soils on stream terraces and canyon slopes.	Project area is outside the expected range of this species.
Texas milk vetch	*Astragalus reflexus*	N/A	SGCN	Grasslands, prairies, and roadsides on calcareous and clay substrates.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas peachbush	*Primus texana*	N/A	SGCN	Occurs at scattered sites in various well drained sandy situations; deep sand, plains and sand hills, grasslands, and oak woods; 0-200 meter elevation.	Suitable habitat may occur within project area.
Texas seymeria	*Seymeria texana*	N/A	SGCN	Found primarily in grassy openings in juniper-oak woodlands on dry rocky slopes but sometimes on rock outcrops in shaded canyons.	Project area is outside the expected range of this species.
Texas sandmint	*Rhododon ciliatus*	N/A	SGCN	Open sandy areas in the Post Oak Belt of east-central Texas.	Suitable habitat may occur within project area.
Texas tauschia	*Tauschia texana*	N/A	SGCN	Occurs in loamy soils in deciduous forests or woodlands on river and stream terraces.	Suitable habitat may occur within project area.
Texas wild-rice	*Zizania texana*	E	E	Spring-fed river, in clear, cool, swift water mostly less than 1 meter deep, with coarse sandy soils.	Project area is outside the expected range of this species.
Threeflower penstemon	*Penstemon triflorus* ssp. *triflorus*	N/A	SGCN	Occurs sparingly on rock outcrops and in grasslands associated with juniper-oak woodlands.	Project area is outside the expected range of this species.
Topeka purple-coneflower	*Echinacea atrorubens*	N/A	SGCN	Occurring mostly in tallgrass prairie of the southern Great Plains, in blackland prairies, but also in a variety of other sites like limestone hillsides.	Suitable habitat may occur within project area.
Tree dodder	*Cuscuta exaltata*	N/A	SGCN	Parasitic on various *Quercus*, *Juglans*, *Rhus*, *Vitis*, *Ulmus*, and *Diospyros* species as well as *Acacia berlandieri*.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Turnip-root scurf	*Pediomelum cyphocalyx*	N/A	SGCN	Grasslands and openings in juniper-oak woodlands on limestone substrates on the Edwards Plateau and in north-central Texas.	Project area is outside the expected range of this species.
Warnock's coral-root	*Hexalectris warnockii*	N/A	SGCN	In leaf litter and humus in oak-juniper woodlands on shaded slopes and intermittent, rocky creekbeds in canyons.	Project area is outside the expected range of this species.
Woolly butterflyweed	*Gaura villosa* ssp. *parksii*	N/A	SGCN	Sandy soils of Rio Grande plains.	Project area is outside the expected range of this species.
Wright's trichocoronis	*Trichocoronis wrightii* var. *wrightii*	N/A	SGCN	Riparian zones, wetlands, pond margins, and wet meadows.	Suitable habitat may occur within project area.
Reptiles					
Cagle's map turtle	*Graptemys caglei*	N/A	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River System.	Suitable habitat may occur within project area.
Common garter snake	*Thamnophis sirtalis*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland, grassy, or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur within project area.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur within project area.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat may occur within project area.
Northern spot-tailed earless lizard	*Holbrookia lacerata*	N/A	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edwards Plateau.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Slender glass lizard	*Ophisaurus attenuatus*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannas, pine barrens, and oil fields.	Suitable habitat may occur within project area.
Spot-tailed earless lizard	*Holbrookia lacerata*	N/A	SGCN	Moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas.	Suitable habitat may occur within project area.
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	N/A	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat may occur within project area.
Texas garter snake	*Thamnophis sirtalis annectens*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland; grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur within project area.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur within project area.
Texas map turtle	*Graptemys versa*	N/A	SGCN	Rivers with moderate current, abundant aquatic vegetation, and basking logs; also associated oxbows and lakes.	Project area is outside the expected range of this species.
Texas tortoise	*Gopherus berlandieri*	N/A	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive, occupies shallow depressions at base of bush or cactus.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Timber rattlesnake	*Crotalus horridus*	N/A	T	Swamps, floodplains, upland pine and deciduous woodland, riparian zones, and abandoned farmland. Limestone bluffs, sandy soil, or black clay.	Low potential for suitable habitat to occur within project area.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrows into soil or may use burrows made by other species.	Suitable habitat may occur within project area.
Western hognose snake	*Heterodon nasicus*	N/A	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas, and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets. Seems to prefer sandy and loamy soils.	Suitable habitat may occur within project area.
PT = Proposed Threatened T = Threatened E = Endangered C = Candidate DL = Delisted SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC and the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[11] to assess whether it will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified 11 previously recorded archaeological sites intersecting or immediately adjacent (within 300 feet) to the project area (Table 5.2.15-2; THC 2019). In addition, the review identified up to 37 potentially historic-age buildings and six cemeteries intersecting or immediately adjacent to the project area (Table 5.2.15-2; THC 2019). No historical markers or NRHP-listed properties are known to be near the project.

The model used assessed unrecorded archaeological site potential within the project area to include low to high potential zones, ranging from 4 percent to 87 percent likelihood for the landform crossed to contain unidentified archaeological resources. The areas with greatest archaeological probability are located near the 11 previously documented archaeological sites and the landforms adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 109.5. A high cultural resources assessment score equates to a greater likelihood that the project may potentially impact cultural resources as currently defined (further information regarding methodology for developing the assessment score is provided in Section 5.2). Based on results of the background review, the project will require a structured cultural resources survey of the final design plan to accurately assess the presence and significance of identified and unrecorded cultural resources within project boundaries.

Table 5.2.15-2 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological Site	Lithic Artifact Scatter & Artifact Scatter	Prehistoric & Historic	Ineligible	Intersect
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Ineligible	Intersect
Archaeological Site	Campsite	Prehistoric	Undetermined	Intersect
Archaeological Site	Campsite	Prehistoric	Undetermined	Intersect
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Ineligible	Adjacent
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Ineligible	Adjacent
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Ineligible	Intersect
Archaeological Site	Artifact Scatter	Historic	Undetermined	Adjacent
Archaeological Site	Artifact Scatter	Historic	Ineligible	Adjacent
Archaeological Site	Campsite	Prehistoric	Ineligible	Adjacent

[11] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological Site	Campsite	Prehistoric	Ineligible	Adjacent
Santa Maria Aida	Cemetery	Historic	Unknown	Adjacent
Salge Family	Cemetery	Historic	Unknown	Adjacent
Mc Keller	Cemetery	Historic	Unknown	Adjacent
Masonic	Cemetery	Historic	Unknown	Adjacent
Odd Fellows	Cemetery	Historic	Unknown	Adjacent
Jewish Cemetery	Cemetery	Historic	Unknown	Adjacent
None	37 Buildings	Historic	Unknown	Adjacent or Intersect
			ASSESSMENT SCORE TOTAL:	109.5

5.2.15.4 Engineering and Costing

Preliminary engineering and costing analyses have been performed using the 2021 Regional Water Planning methods. Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and method for calculating unit costs. These costs are for all facilities including the raw water intake and pump station, raw water delivery pipelines, well field facilities, treatment plant, and potable water facilities up to the customer delivery points. A cost estimate summary for the GBRA Mid-Basin (Phase 2) WMS has been prepared and is provided in Table 5.2.15-3.

Cost estimates were calculated for capital costs, annual debt service, operation and maintenance, power, land acquisition, and environmental mitigation for season and peak day demands. The overall project costs are estimated to be $403,046,000. The annual cost is estimated to be $40,281,000 per year, and the annual unit cost of additional firm supply is approximately $1,492/acft per year.

Table 5.2.15-3 Summary of Cost Estimate

ITEM	ESTIMATED COSTS
Intake Pump Stations (90.4 mgd)	$61,465,000
Transmission Pipeline (80.3 miles)	$166,707,000
Well Fields (wells, pumps, and piping)	$35,859,000
Storage Tanks (other than at booster pump stations)	$4,878,000
Water Treatment Plant (63 mgd)	$17,222,000
TOTAL COST OF FACILITIES	**$286,131,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$87,797,000
Environmental & Archaeology Studies and Mitigation	$3,890,000
Land Acquisition and Surveying (1,224 acres)	$4,216,000
Interest During Construction (3% for 1 year with a 0.5% return on investment)	$21,012,000
TOTAL COST OF PROJECT	**$403,046,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$28,359,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$1,941,000
Intakes and Pump Stations (2.5% of cost of facilities)	$1,537,000
Water Treatment Plant	$5,683,000
Pumping Energy Costs (34,513,489 kWh @ 0.08 $/kWh)	$2,761,000
TOTAL ANNUAL COST	**$40,281,000**
Available Project Yield (acft/yr)	27,000
Annual Cost of Water ($ per acft)	$1,492
Annual Cost of Water After Debt Service ($ per acft)	$442
Annual Cost of Water ($ per 1,000 gallons)	$4.58
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$1.35
Based on a Peaking Factor of 2.0	

5.2.15.5 Implementation Considerations

Information presented in this WMS was provided by GBRA and represents the current plan, which is based on the sponsor's current understanding of the system. At the time of writing, GBRA's permit application for this WMS is pending at the TCEQ. Implementation of the GBRA Mid-Basin (Phase 2) Project WMS includes the following considerations:

- TCEQ approval of GBRA's surface water diversion permit application and modifications of or variances to rules from the GCUWCD including granting recharge credit for injected water through ASR operations; these credits would be used to increase the allowable groundwater production from given leases.
- It may be necessary to obtain the following permits or authorizations:
  - USACE Sections 10 and 404 dredge and fill permits for the pipelines;
  - General Land Office (GLO) sand and gravel removal permits;
  - GLO easement for use of state-owned land; and
  - TPWD sand, gravel, and marl permit.
- Acquisition of private land for construction of facilities through either negotiations or condemnation.
- Permitting will likely require the following additional studies:
  - Habitat mitigation plan;
  - Environmental studies; and
  - Cultural resources survey.

Reliability

The reliability of the water supplies is projected to be high (reliability score = 5). Successful ASR development is highly reliable. It is normally possible to achieve 90-95% recovery efficiency. Challenges to reliability include natural groundwater flow away from the ASR site and the associated drift of the storage bubble, thus reducing available supplies. Flat hydraulic gradients are not typical in Texas, especially in shallow aquifers. This migration of stored water is an important consideration in determining the reliability and viability of an ASR project. Also, since withdrawal of groundwater is a property right, competition with other nearby users could reduce the reliability of this water. One way to address the issue of other competing wells is to own the property rights over the storage bubble but that will drive up the strategy costs. If the water is recharged and recovered over a relatively short period (e.g., one year), the likelihood of reduced reliability is low. However, short-term ASR operations are highly dependent on the local aquifer hydrogeological features and that may impact reliability as well.

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5.2.16 GBRA Lower Basin Storage Project

5.2.16.1 Description of Water Management Strategy

The GBRA and Dow, individually and collectively, own surface water rights in the lower Guadalupe-San Antonio River Basin (the GBRA/Dow Water Rights) authorizing diversions from the run-of-river flow of the Guadalupe River totaling 172,501 acft/yr. Table 5.2.16-1 lists the GBRA/Dow Water Rights and provides their individual permit number, certificate of adjudication number, priority date, annual diversion amount, authorized uses, and ownership.

Water available for diversion under these rights for use by GBRA and Dow is governed by the complex interactions of natural, anthropogenic, and legal factors including rainfall, runoff, springflow, evaporation, aquifer recharge, diversions by other water right owners, reservoir operations, off-channel storage, terms and conditions of contracts between GBRA and Dow, terms and conditions of water rights, and the prior appropriation doctrine as enforced by the South Texas Watermaster of the TCEQ. Because the point of diversion for the GBRA/Dow Water Rights near Tivoli is below the confluence of the San Antonio and Guadalupe Rivers, and the water rights have senior priority dates to most upstream water rights in both the Guadalupe and San Antonio River Basins, the water rights are considered quite reliable but not firm.

To firm up the run-of-river supplies of water available under the GBRA/Dow Water Rights, an OCR near the GBRA Main Canal and Dow Seadrift Operations facilities is considered for implementation in the 2020 decade. Although a final site has yet to be selected, the approximate area of the OCR is shown on Figure 5.2.16-1, approximately 3 miles east of Green Lake. The OCR is assumed to be a ring dike structure with an approximate water depth of 25 feet, capable of impounding approximately 12,763 acft of water. A pressure pipeline would transport water diverted from the GBRA Main Canal to the OCR site, and a gravity outlet pipeline would return stored water to the GBRA Main Canal. GBRA has obtained water rights permits for this project.

Table 5.2.16-1 GBRA/Dow Water Rights in the Lower Guadalupe River Basin

PERMIT NUMBER	CERTIFICATE OF ADJUDICATION	PRIORITY DATE	AUTHORIZED USES	OWNERSHIP	ANNUAL DIVERSION (ACFT/YR)
1319	18-5173	2/3/1941	Irrigation/Industrial	GBRA/Dow	2,500
1362	18-5174	6/15/1944	Irrigation/Industrial	GBRA/Dow	1,870
1564	18-5175	2/13/1951	Irrigation/Industrial/ Mining/Livestock	GBRA/Dow	940
1592	18-5176	6/21/1951	Irrigation/Industrial/ Municipal	GBRA/Dow	9,944
1375	18-5177	1/3/1944	Irrigation/Industrial/ Municipal	Dow	10,000
		1/3/1944	Irrigation/Industrial/ Municipal	GBRA/Dow	32,615

PERMIT NUMBER	CERTIFICATE OF ADJUDICATION	PRIORITY DATE	AUTHORIZED USES	OWNERSHIP	ANNUAL DIVERSION (ACFT/YR)
		1/26/1948	Irrigation/Industrial	GBRA/Dow	8,632
1614	18-5178	1/7/1952	Irrigation/Industrial/ Municipal	GBRA/Dow	106,000
				TOTAL ANNUAL DIVERSION (ACFT/YR)	172,501

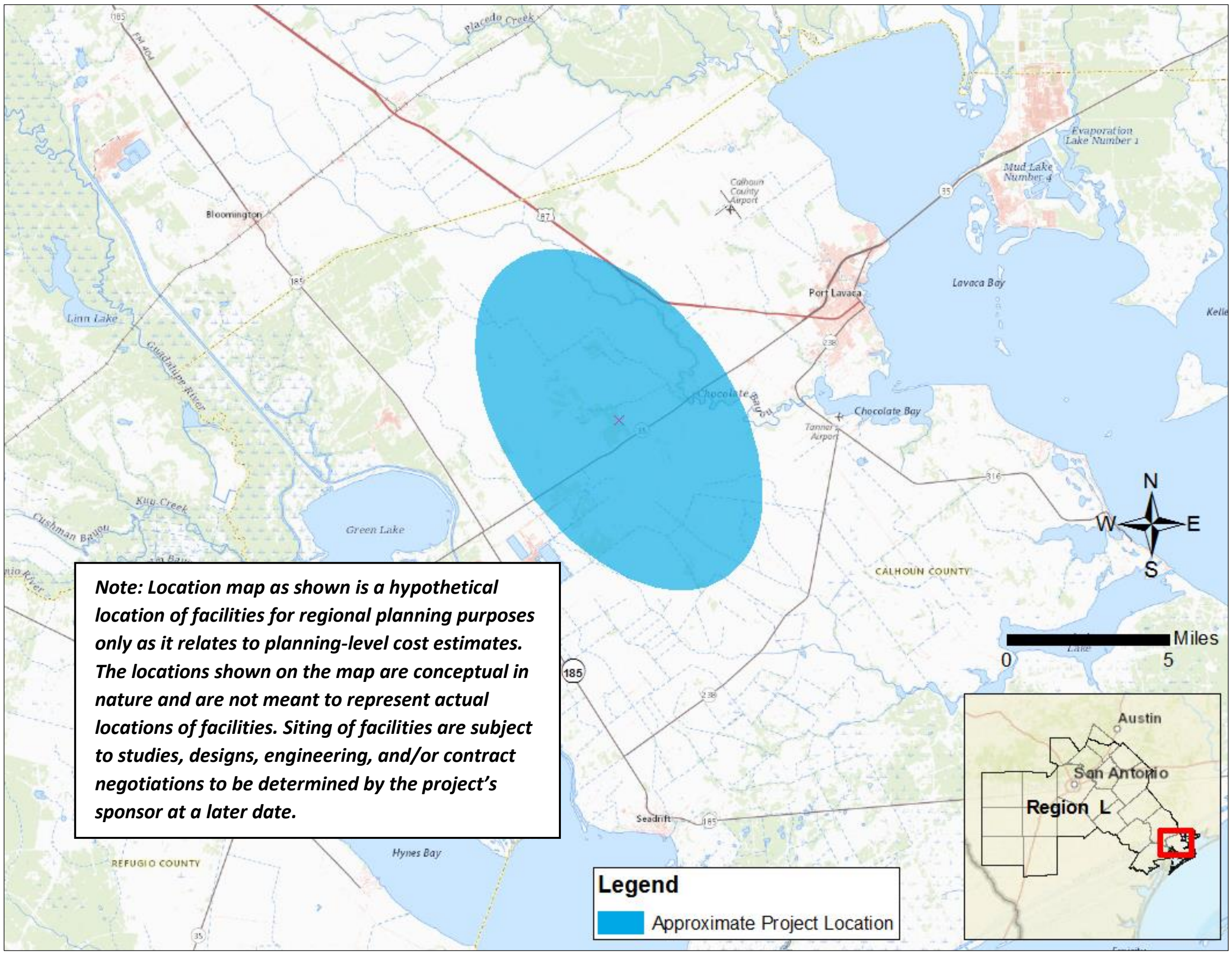

Figure 5.2.16-1 GBRA Lower Basin Storage Site Location

5.2.16.2 Available Yield

Initial water availability calculations were performed using TCEQ's GSA WAM Run 3. The GSA WAM is a monthly time-step computer model used to estimate regulated streamflow and water available for diversion under existing water rights on a priority basis subject to technical assumptions regarding natural, anthropogenic, and legal factors. General technical assumptions used for the applications of the GSA WAM include the following:

- Surface water rights were modeled at full consumptive amounts per certificates of adjudication and permits with no treated effluent discharges (TCEQ WAM Run 3).
- Edwards Aquifer withdrawals, critical period management, and resulting springflows consistent with the approved Habitat Conservation Plan (Phase I) were developed through the Edwards Aquifer Recovery Implementation Program.
- All senior Guadalupe River hydropower water rights were subordinated to Canyon Reservoir.
- For firm water supply modeling purposes, the total run-of-river supply of water available under the GBRA/Dow Water Rights at any time is assumed to be allocated first to satisfy projected demands for firm water at that time among all present and future GBRA customers and then, to the extent additional run-of-river water is available, to storage in the proposed OCR.
- For firm water supply modeling purposes, projected demands for firm water by all present and future GBRA customers are assumed to be in accordance with current GBRA planning.

Monthly regulated streamflow values from the GSA WAM were disaggregated to daily values using historical daily streamflow patterns to obtain estimates of firm water supply available under the GBRA/Dow Water Rights on a daily basis. The firm supply available from the GBRA/Dow Water Rights without the proposed OCR is approximately 8,870 acft/yr. This analysis is limited to a shorter historical period of record because of data availability and does not include on-site storage capacity that Dow or other end users may have, which could impact firm yield.

Firm water supplies available on a daily basis under the GBRA/Dow Water Rights can be enhanced with development and integration of off-channel storage. Analyses of the proposed OCR are based on the following:

- OCR capacity of approximately 12,763 acft;
- Simplified OCR operations simulations assuming maximum and minimum water depths of 25 feet and approximately 3 feet, respectively;
- Delivery of water into OCR at a maximum rate of 100 cfs; and
- Historical net evaporation from the GSA WAM.

Under the above assumptions, firm water supply could be increased from 8,870 acft/yr to 68,650 acft/yr (59,780 acft/yr increase, which is the firm yield of the WMS) with the addition of a 12,763 acft OCR storage. Additionally, the firm supply would also be increased by increasing the rate of delivery of water into the OCR above the assumed maximum rate of 100 cfs. This WMS is planned for implementation in the 2020 decade.

5.2.16.3 Environmental Considerations

Environmental Considerations

Vegetation and Land Use

The project area is located in the Western Gulf Coastal Plain ecoregion and lies within a variety of vegetation types, predominantly croplands, pastures, shrublands, and wetlands. A large chemical plant and associated water basins and railway lie within the project area. As mapped by TPWD,[1] dominant vegetation types in the project area are coastal prairie, row crops, open water, and invasive evergreen shrubland. The project contains riparian vegetation zones, mapped by TPWD as riparian grassland, riparian evergreen and deciduous shrublands, riparian hardwood forest, riparian live oak forest, and riparian live oak/hardwood forest.

Based on TPWD vegetation mapping, the project may have the potential to impact 11,901 acres of agricultural resources mapped as row crops. The project area also contains 8,003 acres mapped as coastal prairie may include pasture areas used for grazing or hay production.

Construction of the project reservoir would result in permanent conversion of terrestrial vegetation, including agricultural lands, to reservoir use. The project pipeline easements would require the removal of woody vegetation and long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each water management strategy to determine the best course of action regarding revegetation.

Aquatic Resources

The project is located between San Antonio Bay and Matagorda Bay. A network of irrigation ditches and East and West Coloma creeks traverse the project area. These two creeks appear to be channelized and eventually flow into Matagorda Bay. Operational water basins associated with a chemical plant occur on the western side of the project region. NWI mapping shows 1,257 acres of emergent and forested/shrub wetlands and ponds, lakes, and riverine wetlands in the project area.

No streams designated as impaired stream segments in the Texas Integrated Report of 303(d)-listed **w**ater bodies occur in the project area.[2] This list identifies the water bodies or segments in Texas that do not meet assigned water quality standards. No ecologically significant stream segments designated by TPWD occur in the project area.

The project will require an on-site delineation of streams, ponds, and wetlands. Stream crossings for pipeline construction would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including if there would be permanent impacts to over 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in pre-construction contours of waters of the United States. Utility crossings under streams (e.g., through horizontal directional drilling) would not require a USACE permit. Although

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[1] TPWD. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

[2] Texas Commission on Environmental Quality. 2018. 2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf.

the proposed project is an off-channel reservoir, streams/wetlands affected by reservoir development, if applicable, would require appropriate USACE permitting depending on impacts.

Threatened, Endangered, and Species of Concern

Table 5.2.16-2 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Calhoun County [3] [4]. Suitable foraging habitat for the federally endangered whooping crane (*Grus americana*) may occur in or fly over the project area. The only natural flock of whooping cranes winters mainly in and adjacent to Aransas National Wildlife Refuge (ANWR) along the central Texas coast in Aransas, Calhoun, and Refugio Counties.[5] The project area occurs approximately 12 miles north of the ANWR. Furthermore, the project area occurs approximately 8.5 miles north of federally designated critical habitat for the whooping crane. Habitat for the black rail (*Laterallus jamaicensis*), a species proposed to be listed as federally threatened, may occur within wetlands in the project area. This species is not currently listed as federally threatened but may be listed in the future. Habitat for other federally threatened or endangered species does not occur in the project region.

Suitable habitat may occur for state-listed threatened species including wood stork (*Mycteria americana*), bald eagle (*Haliaeetus leucocephalus*), and Texas horned lizard (*Phrynosoma cornutum*). The wood stork and bald eagle would only be expected to forage within the project area. Potentially suitable habitat may occur for numerous wildlife, plant, and insect species designated by TPWD as SGCN. These species do not have formal protected status but are being monitored by TPWD. Migratory birds may occur in the project area, particularly in riparian zones and wetland areas.

A site-specific assessment of the potential for whooping cranes to utilize the project area would be required. Additionally, site-specific field surveys would be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs from impacts unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15. Preconstruction surveys for active bird nests are recommended.

[3] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Calhoun County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.[3]

[4] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Calhoun County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.

[5] Canadian Wildlife Service and U.S. Fish and Wildlife Service 2007. International Recovery Plan for the Whooping Crane. Ottawa: Recovery of Nationally Endangered Wildlife, and USFWS, Albuquerque, New Mexico.

Table 5.2.16-2 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for GBRA Lower Basin Project, Calhoun County, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Black-spotted newt	*Notophthalmus meridionalis*	N/A	T	May be found in resacas and bodies of water with firm bottoms and little or no vegetation. Wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; the absence of predatory fish is probably important. Aestivates in the ground during dry periods; Gulf Coastal Plain south of the San Antonio River.	Suitable habitat may occur within the project area.
Sheep frog	*Hypopachus variolosus*	N/A	T	Predominantly grassland and savannah; largely fossorial in areas with moist microclimates.	Suitable habitat may occur within the project area.
Southern crawfish frog	*Lithobates areolatus*	N/A	SGCN	Found in abandoned crawfish holes and small mammal burrows, shallow water, herbaceous wetland, riparian, temporary pools, cropland/hedgerow, grassland/herbaceous, suburban/orchard, woodland – conifer.	Suitable habitat may occur within the project area.
Strecker's chorus frog	*Pseudacris streckeri*	N/A	SGCN	Wooded floodplains and flats, prairies, cultivated fields, and marshes. Likes sandy substrates.	Suitable habitat may occur within the project area.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur within the project area.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	N/A	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable nesting habitat does not occur in project area; may fly over and forage within the project area during migration and in the winter.
Black rail	*Laterallus jamaicensis*	PT	SGCN	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh.	Suitable habitat may occur within the project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur in project area; may fly over during migration.
Northern aplomado falcon	*Falco femoralis septentrionalis*	E	E	Open country, especially savannah and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus; nests in old stick nests of other bird species.	Suitable habitat does not occur in project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur in project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	T	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Suitable habitat does not occur in project area; may fly over during migration.
Red knot	*Calidris canutus rufa*	T	SGCN	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays.	Suitable habitat does not occur in project area; may fly over during migration.
Swallow-tailed kite	*Elanoides forficatus*	N/A	T	Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall trees in clearing or on forest woodland edge.	Suitable habitat does not occur in project area; may fly over during migration.
Tropical kingbird	*Tyrannus melancholicus*	N/A	SGCN	Open to semi-open habitat from savannahs to agricultural fields, also parks and neighborhoods.	Suitable habitat may occur in project area.
Tropical parula	*Setophaga pitiayumi*	N/A	T	Semi-tropical evergreen woodland along rivers and resacas.	Suitable habitat does not occur in project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots, nests and roosts in abandoned burrows.	Suitable habitat may occur in project area; may occur in the project area in the winter.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat may occur in project area.
White-tailed hawk	*Buteo albicaudatus*	N/A	T	Near coast on prairies, cordgrass flats, and scrub live oak; further inland on prairies, mesquite and oak savannahs, and mixed savannah-chaparral.	Suitable habitat may occur in project area.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems (during migration).	Suitable foraging habitat may occur in the project area; may fly over during migration.
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Suitable foraging habitat may occur in project area.
Fishes					
Alligator gar	*Atractosteus spatula*	N/A	SGCN	Found in rivers, streams, lakes, swamps, bayous, bays, and estuaries typically in pools and backwater habitats. Floodplains inundated with flood waters provide spawning and nursery habitats.	Suitable habitat does not occur in project area.
Opossum pipefish	*Microphis brachyurus*	N/A	T	Brooding adults found in fresh or low salinity waters and young move or are carried into more saline waters after birth; southern coastal areas.	Suitable habitat does not occur in project area.
Saltmarsh topminnow	*Fundulus jenkinsi*	N/A	SGCN	Salt marsh, tidal meanders.	Suitable habitat does not occur in project area.
Southern flounder	*Paralichthys lethostigma*	N/A	SGCN	Brackish bays, estuaries and coastal waters to about 40 meter depth; move to deeper waters in winter.	Suitable habitat does not occur in project area.
Insects					
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
No accepted common name	*Trimerotropis schaefferi*	N/A	SGCN	Gulf dune grasshopper – grassland.	Suitable habitat may occur in project area.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur in project area.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls; will use buildings.	Suitable habitat does not occur in project area.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat does not occur in project area.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, and forest edges.	Suitable habitat may occur in project area.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Project area is outside the expected range of this species.
Humpback whale	*Megaptera novaeangliae*	E	E	Open ocean and coastal waters, sometimes including inshore areas such as bays; summer distribution is in temperate and subpolar waters; in winter, most are in tropical/subtropical waters near islands or coasts.	Suitable habitat does not occur in project area.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur in project area.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	Suitable habitat may occur in project area.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Suitable habitat may occur in project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Suitable habitat does not occur in project area.
Padre Island kangaroo rat	*Dipodomys compactus*	N/A	SGCN	Coastal barren sparse vegetation.	Suitable habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	SGCN	Open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie.	Suitable habitat may occur in project area.
Southern short-tailed shrew	*Blarina carolinensis*	N/A	SGCN	Various upland and wetland habitats, including moist deciduous woods, brushy areas, pine woodland and forest, mixed oak-pine-juniper woods, grassy situations, and densely wooded floodplains. Nest sites are probably under logs, stumps, and other debris.	Suitable habitat may occur in project area.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat may occur in project area.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Restricted to dry and sandy soils of open areas, such as grasslands, cultivated fields, meadows, roadsides, airfields, shrublands, and suburb lawns.	Low potential for habitat to occur in project area.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat does not occur in project area.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat does not occur in project area.
White-nosed coati	*Nasua narica*	N/A	T	Canyons, riparian corridors, and woodlands.	Suitable habitat does not occur in project area.
Mollusks					
No accepted common name	*Nesovitrea suzannae*	N/A	SGCN	Land snail – coastal southern Texas woodland.	Suitable habitat does not occur in project area.
Plants					
Awnless bluestem	*Bothriochloa exaristata*	N/A	SGCN	Coastal prairies on black clay.	Suitable habitat may occur in project area.
Coastal gay-feather	*Liatris bracteate*	N/A	SGCN	Coastal prairie grasslands of various types, from salty prairie on low-lying somewhat saline clay loams to upland prairie on nonsaline clayey to sandy loams.	Suitable habitat may occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Indianola beakrush	*Rhynchospora indianolensis*	N/A	SGCN	Locally abundant in cattle pastures in some areas (at least during wet years), possibly becoming a management problem in such sites.	Suitable habitat may occur in project area.
Marsh-elder dodder	*Cuscuta attenuate*	N/A	SGCN	Parasitizes a particular sumpweed (*Iva annua*) almost exclusively as well as ragweed and heath aster. Host plants typically found in open, disturbed habitats like fallow fields and creek bottomlands.	Suitable habitat may occur in project area.
Sand Brazos mint	*Brazoria arenaria*	N/A	SGCN	Sandy areas in South Texas.	Suitable habitat may occur in project area.
Texas peachbush	*Prunus texana*	N/A	SGCN	Occurs at scattered sites in various well drained sandy situations; deep sand, plains and sand hills, grasslands, oak woods, 0-200 meter elevation.	Suitable habitat may occur in project area.
Texas willkommia	*Willkommia texana var. texana*	N/A	SGCN	Mostly in sparsely vegetated shortgrass patches within taller prairies on alkaline or saline soils on the Coastal Plain.	Suitable habitat may occur in project area.
Tharp's dropseed	*Sporobolus tharpii*	N/A	SGCN	Occurs on barrier islands, shores of lagoons and bays protected by the barrier islands, and on shores of a few near-coastal ponds. Plants occur at the bases of dunes, in interdune swales and sandflats, and on upper beaches. The substrate is of Holocene age.	Suitable dune habitat does not occur in project area.
Threeflower broomweed	*Thurovia trifloral*	N/A	SGCN	Near coast in sparse, low vegetation on a veneer of light-colored silt or fine sand over saline clay along drier upper margins of ecotone between salty prairies and tidal flats; further inland associated with vegetated slick spots on prairie mima mounds.	Suitable habitat does not occur in project area.
Velvet spurge	*Euphorbia innocua*	N/A	SGCN	Open or brushy areas on coastal sands and the South Texas Sand Sheet.	Suitable habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Reptiles					
Atlantic hawksbill sea turtle	*Eretmochelys imbricate*	E	E	Gulf and bay system, warm shallow waters especially in rocky marine environments, such as coral reefs and jetties, juveniles found in floating mats of sea plants; feed on sponges, jellyfish, sea urchins, mollusks, and crustaceans.	Suitable aquatic habitat does not occur in project area.
Common garter snake	*Thamnophis sirtalis*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur in project area.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Low likelihood of suitable habitat in project area.
Green sea turtle	*Chelonia mydas*	T	T	Gulf and bay system; shallow water seagrass beds, open water between feeding and nesting areas, barrier island beaches; adults are herbivorous feeding on sea grass and seaweed; juveniles are omnivorous feeding initially on marine invertebrates, then increasingly on sea grasses and seaweeds.	Suitable aquatic habitat does not occur in project area.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable dune habitat does not occur in project area.
Kemp's Ridley sea turtle	*Lepidochelys kempii*	E	E	Gulf and bay system, adults stay within the shallow waters of the Gulf of Mexico; feed primarily on crabs, but also snails, clams, other crustaceans, and plants; juveniles feed on sargassum and its associated fauna.	Suitable aquatic habitat does not occur in project area.
Loggerhead sea turtle	*Caretta caretta*	T	T	Gulf and bay system primarily for juveniles, adults are most pelagic of the sea turtles; omnivorous, shows a preference for mollusks, crustaceans, and coral.	Suitable aquatic habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Massasauga	*Sistrurus tergeminus*	N/A	SGCN	Quite common in gently rolling prairie occasionally broken by creek valley or rocky hillside.	Low likelihood of suitable habitat in project area.
Slender glass lizard	*Ophisaurus attenuatus*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannas, pine barrens, and oil fields.	Low likelihood of suitable habitat in project area.
Texas diamondback terrapin	*Malaclemys terrapin littoralis*	N/A	SGCN	Coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches; brackish and salt water; burrows into mud when inactive; may venture into lowlands at high tide.	Suitable aquatic habitat does not occur in project area.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur in project area.
Texas scarlet snake	*Cemophora coccinea lineri*	T	SGCN	Along Gulf Coast, known from mixed hardwood scrub on sandy soils. Mixed hardwood scrub on sandy soils; feeds on reptile eggs; semifossorial.	Low likelihood of suitable habitat in project area.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland, prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrows into soil or may use burrows made by other species.	Suitable habitat may occur in project area.

PT = Proposed Threatened
T = Threatened
E = Endangered
C = Candidate
DL = Delisted
N/A = Not applicable
SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC and the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[6] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

No previously recorded archaeological sites intersect or are located immediately adjacent (within 300 feet) to the project area (THC 2019). The background literature review identified one historic linear feature intersecting the project area (Table 5.2.16-3). No cemeteries, historical markers, or National Register of Historic Places listed properties are known to be near the project.

The model used assessed the overall archaeological site potential to include low to high potential zones, ranging from 2 percent to 65 percent likelihood for the project area to contain significant unidentified archaeological resources. The areas with greatest archaeological probability are located near the historic feature and landforms adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As previously discussed, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 19.0 (higher scores indicate a higher probability of cultural resources; further information regarding methodology for developing the assessment score is provided in Section 5.2). On the basis of the results of the background review, SWCA recommends that a structured cultural resources survey of the final design plan be performed to accurately assess the presence and significance of identified and unrecorded cultural resources within project boundaries.

Table 5.2.16-3 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/HISTORIC	NRHP ELIGIBILITY	LOCATION
Levee	Linear Feature	Historic	Unknown	Intersect
			ASSESSMENT SCORE TOTAL:	19.0

[6] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

5.2.16.4 Engineering and Costing

Preliminary engineering and costing analyses have been performed using the 2021 Regional Water Planning methods. Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and methods for calculating unit costs. Relying in part on an available feasibility study and integrating current TWDB guidance for regional water planning, a cost estimate summary for the GBRA Lower Basin Storage project was prepared and is provided in Table 5.2.16-4. The engineering and costing analysis for the GBRA Lower Basin Storage Project includes the embankment and appurtenant facilities for the OCR, a 100 cfs raw water intake and pump station, and a 66-inch transmission pipeline, estimated to be 1 mile long. Depending on the location(s) and type(s) of use for water supplies associated with the strategy, additional facilities and costs could include transmission and treatment facilities for service to project participants and customers.

Cost estimates were calculated for capital costs, annual debt service, operation and maintenance, power, land acquisition, and environmental mitigation for season and peak day demands. The overall project costs are estimated to be $65,470,000. The annual cost is estimated to be $6,603,000, and the annual unit cost of additional firm supply is estimated to be $110 per acft. Per section 8.2.4 of the UCM User Guide, dated November 2018, for all project components except pipelines, the UCM assumes the Environmental/Mitigation Costs are 100 percent of land costs. The recommended value for environmental studies and mitigation costs for pipelines is $25,000/mile of pipeline. This cost estimate is representative of 600 acres for the Reservoir foot-print and conservation pool, 12.1 acres for the pipeline facilities, and 5 acres for a pump station. Some participants or customers may incur additional costs for purchase of water, transmission facilities, treatment, and/or integration.

Table 5.2.16-4 Project Cost Estimate Summary

ITEM	ESTIMATED COSTS
Off-Channel Storage/Ring Dike (Conservation Pool 12,763 acft, 600 acres)	$25,992,000
Primary Pump Station (68 MGD)	$15,791,000
Transmission Pipeline (66 in dia., 1 miles)	$2,206,000
TOTAL COST OF FACILITIES	**$43,989,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$15,286,000
Environmental & Archaeology Studies and Mitigation	$2,193,000
Land Acquisition and Surveying (617 acres @ $3,584/acre)	$2,248,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$1,754,000
TOTAL COST OF PROJECT	**$65,470,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,757,000
Reservoir Debt Service (3.5 percent, 40 years)	$1,897,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$22,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$395,000
Dam and Reservoir (1.5% of Cost of Facilities)	$390,000
Pumping Energy Costs (4,865,404 kW-hr @ 0.08 $/kW-hr)	$389,000
Purchase of Water (59,780 acft/yr @ 29.33 $/acft)	$1,753,000
TOTAL ANNUAL COST	**$6,603,000**
Available Project Yield (acft/yr)	59,780
Annual Cost of Water ($ per acft)	$110
Annual Cost of Water After 20-year Debt Service ($ per acft)	$81
Annual Cost of Water After 40-year Debt Service ($ per acft)	$49
Annual Cost of Water ($ per 1,000 gallons)	$0.34

ITEM	ESTIMATED COSTS
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.15
Based on a peaking factor of 1.0.	

5.2.16.5 Implementation Considerations

Information presented in this WMS was provided by GBRA and represents the current plan, which is based on the sponsor's current understanding of the system. GBRA has obtained the necessary water rights permits for this project from the TCEQ. Implementation of the GBRA Lower Basin Storage WMS includes the following considerations:

- An institutional arrangement may be needed to implement this project, including financing on a regional basis.
- It may be necessary to obtain the following permits or authorizations:
  - TCEQ interbasin transfer, depending upon location(s) of use;
  - USACE Sections 10 and 404 dredge and fill permits for the reservoir and pipelines;
  - GLO sand and gravel removal permits; and
  - TPWD sand, gravel, and marl permit.
- Permitting, at a minimum, will require the following additional studies:
  - Habitat mitigation plan;
  - Environmental studies; and
  - Cultural resources survey.
- Land will need to be acquired through either negotiations or condemnation.

Reliability

The reliability of the water supplies is projected to be high (reliability score = 5).

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5.2.17 GBRA Lower Basin New Appropriation

5.2.17.1 Description of Water Management Strategy

The GBRA is in the planning and permitting stages of a new appropriation for diversion of up to 189,484 acft/yr from the Guadalupe River in Calhoun County. The project would use existing gravity-flow diversion facilities located immediately upstream of GBRA's Saltwater Barrier and Diversion Dam at a rate of diversion not to exceed 500 cfs (within the existing 622 cfs maximum authorized diversion rate) and authorization to impound up to 200,000 acft in Calhoun County (Figure 5.2.17-1). The diversion and storage will serve municipal and industrial water users in GBRA's 10-county statutory district and are the subject of Application No. 12482 for surface water rights pending before the TCEQ. Implementation of this WMS will help to meet projected demands for current and future GBRA customers over the next 50 years and beyond. Based on WAM results (discussed below) that incorporate a proposed 150,000 acft OCR, the firm yield is estimated to be 40,500 acft/yr. A portion of this supply will be allocated to Victoria County Steam-Electric Power (23,925 acft/yr), which is discussed as a separate WMS in Section 5.2.18 – GBRA Victoria County Steam-Electric Project. This WMS is planned for implementation in the 2030 decade.

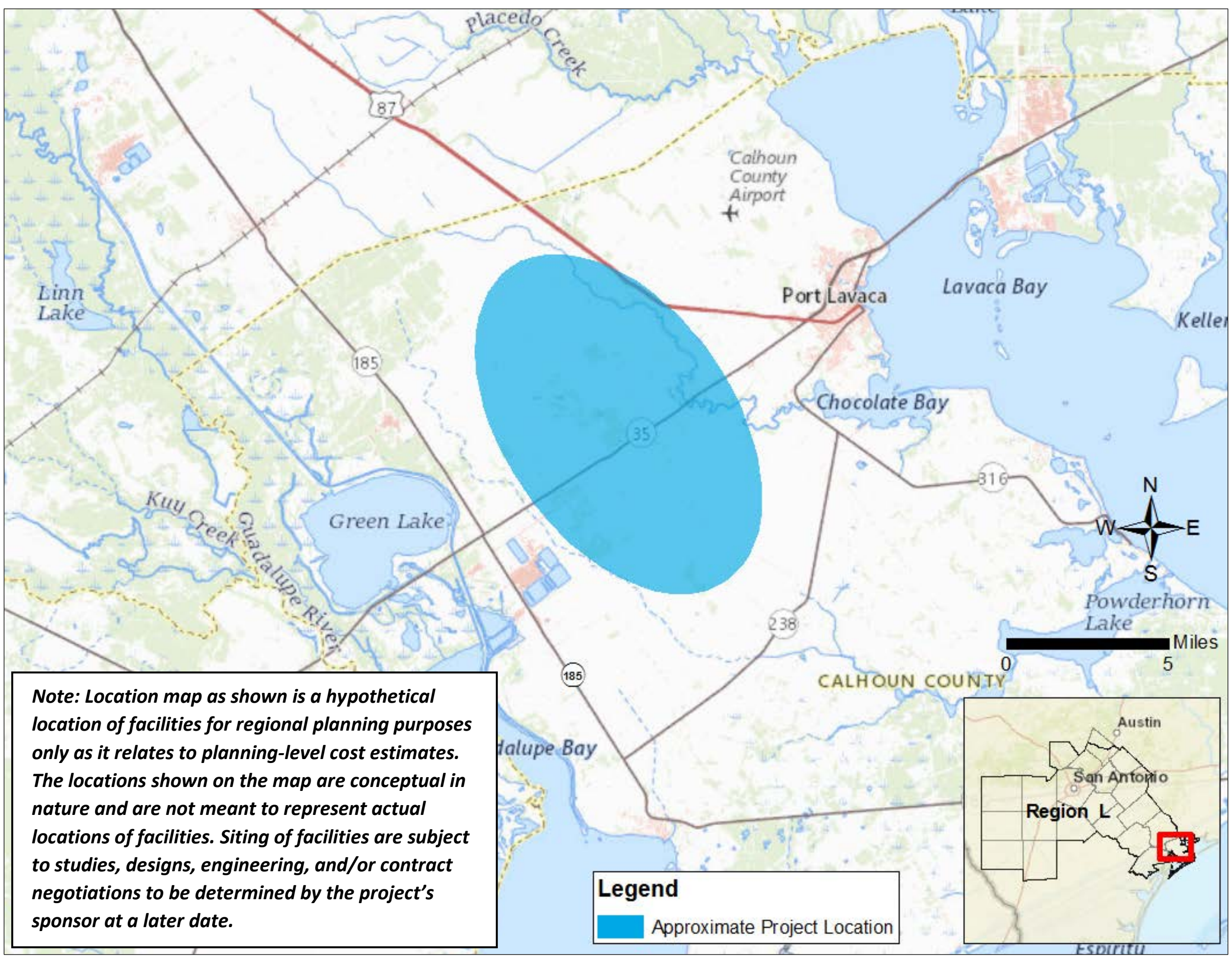

Figure 5.2.17-1 Approximate Lower Basin New Appropriation Project Location

5.2.17.2 Available Yield

Water Availability Modeling

The GBRA Lower Basin New Appropriation WMS is evaluated using the TCEQ GSA WAM. This WMS is subject to full application of environmental flow standards adopted pursuant to TWC §11.1471. The GSA WAM is a monthly time-step model; however, a series of spreadsheet models, including the FRAT, were used to quantify water availability for a new water right subject to daily flow variations, senior water rights, instantaneous instream flow restrictions, and an instantaneous maximum diversion rate.

Specifically, the GSA WAM was used to determine the regulated flow and unappropriated flow for the San Antonio and Guadalupe Rivers, separately, just upstream of the confluence of the two rivers. For each river, the regulated and unappropriated flows were disaggregated to daily values, and the daily senior water rights passage volume was determined. Results were imported into separate FRAT models, and the appropriate instream flow standard was incorporated. For the Guadalupe River, the environmental flow standard associated with the Guadalupe River at Victoria was used, adjusted for the additional incremental drainage area to the confluence. For the San Antonio River, the environmental flow standard associated with the San Antonio River at Goliad was used, adjusted for the additional incremental drainage area to the confluence. The FRAT models were then used to determine the amounts of water available to the GBRA Lower Basin New Appropriation WMS from each river. Finally, a daily spreadsheet model was used to determine the amount of water used from each river in conjunction with daily reservoir operations and to calculate firm yield.

Modeling Results

Firm yield calculations were performed for off-channel reservoir sizes of 25,000 acft, 50,000 acft, 100,000 acft, 150,000 acft, and 200,000 acft. Table 5.2.17-1 shows the results of these calculations for five off-channel reservoir sizes. With approval from the sponsor, the 150,000 acft OCR has been selected for consistency with the 2016 RWP, and would enable a firm yield of 40,500 acft/yr.

Table 5.2.17-1 Lower Basin New Appropriation Firm Yield for Various Off-Channel Reservoir Sizes

RESERVOIR SIZE (ACFT)	FIRM YIELD (ACFT/YR)
25,000	18,500
50,000	25,500
100,000	33,500
150,000	40,500
200,000	47,500

With any new project in the Guadalupe-San Antonio River Basin, there is concern regarding the project's impacts on freshwater inflows to the Guadalupe Estuary. Figure 5.2.17-2 and Figure 5.2.17-3 illustrate simulated freshwater inflows to the Guadalupe Estuary with and without implementation of this WMS. The data labeled as "With GBRA Lower Basin New Application" on Figure 5.2.17-2 and Figure 5.2.17-3 are from simulations including a 150,000 acft OCR and annual diversion of the firm yield as reported in Table 5.2.17-1.

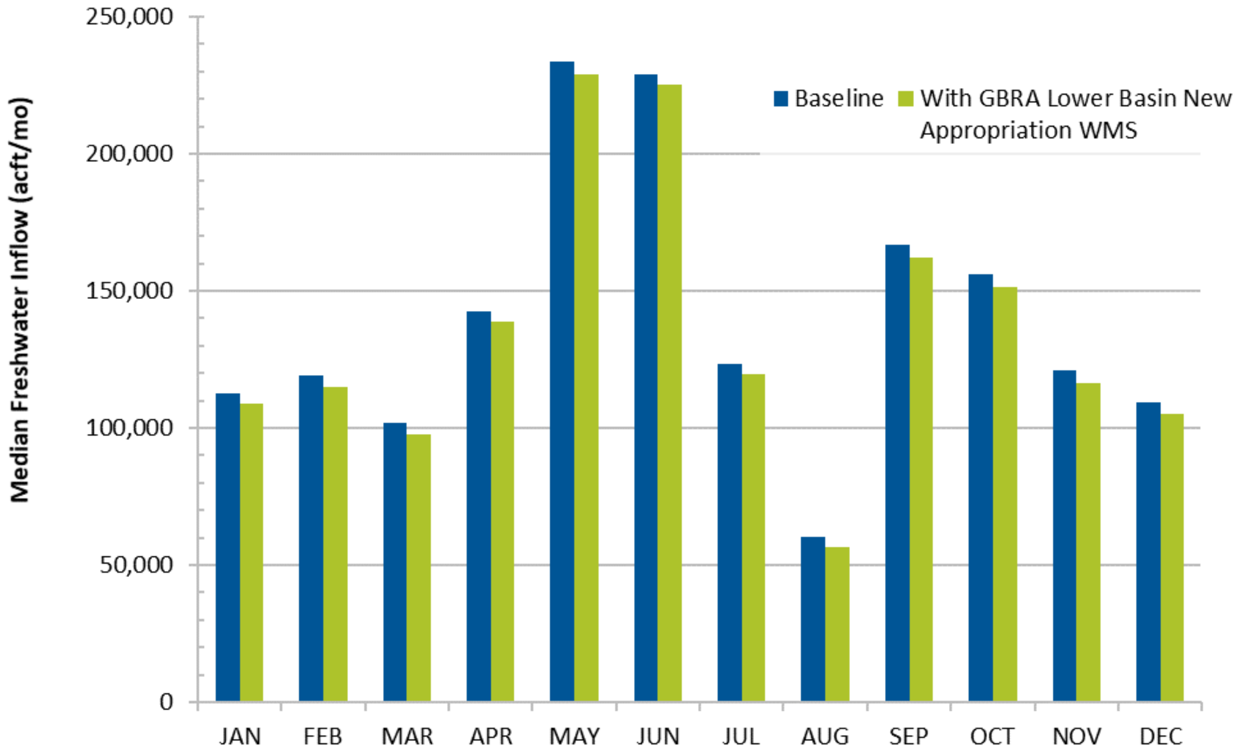

Figure 5.2.17-2 Monthly Median Freshwater Inflows

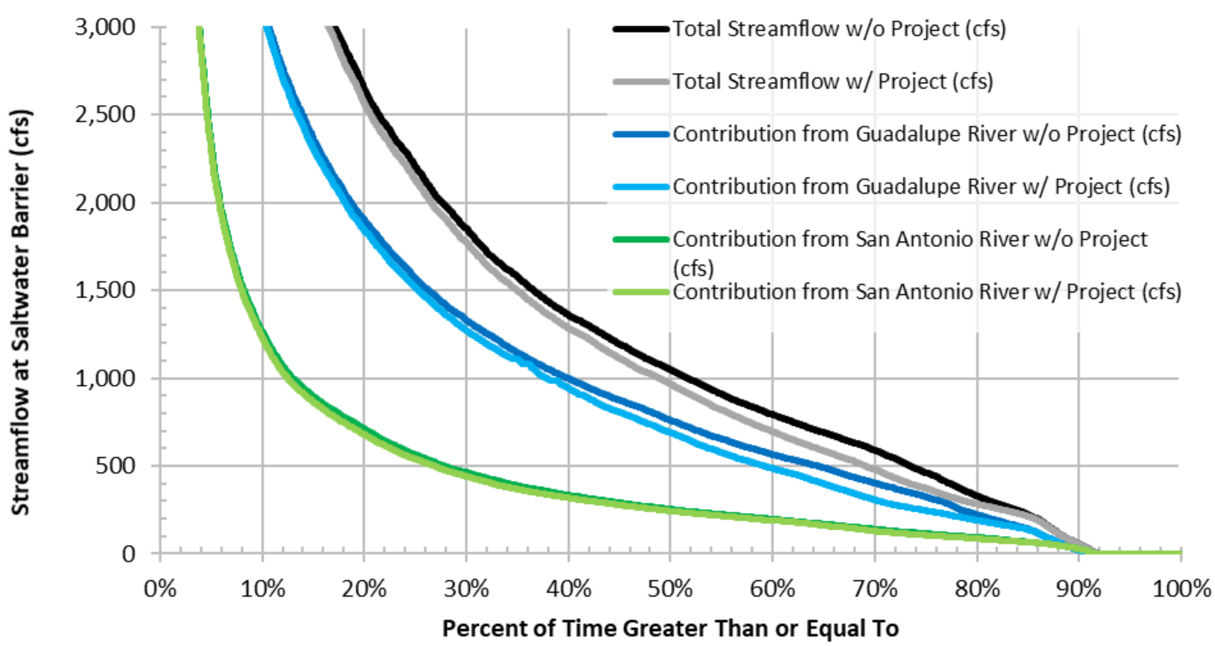

Figure 5.2.17-3 Freshwater Inflow Frequency

5.2.17.3 Environmental and Cultural Considerations

Environmental Considerations

Vegetation and Land Use

The project area is located in the Western Gulf Coastal Plain ecoregion, and occurs within a variety of vegetation types, mostly croplands, pastures, shrublands, and wetlands. A railway associated with a large chemical facility occurs within the project area. As mapped by TPWD[1], dominant vegetation types in the project area are row crops, coastal prairie, open water, and invasive evergreen shrubland. The project contains riparian vegetation zones, mapped by TPWD as riparian grassland, riparian evergreen and deciduous shrublands, riparian live oak/hardwood forest, riparian hardwood forest, and riparian herbaceous wetland.

Based on TPWD vegetation mapping, the project would not affect agricultural resources mapped as row crops, or areas mapped as tame/disturbance grassland that may be used as pasture areas used for grazing or hay production.

Construction of project storage and mechanical facilities would result in conversion of native vegetation and/or croplands to industrial and reservoir use. Project pipeline easements would require the removal of woody vegetation and long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each WMS to determine the best course of action regarding revegetation.

Aquatic Resources

The project occurs between San Antonio Bay and Matagorda Bay. A network of irrigation ditches and East and West Coloma Creeks traverse the project area. These two creeks appear to be channelized and eventually flow into Matagorda Bay. NWI mapping shows 488 acres of emergent and forested/shrub wetlands and ponds, and riverine wetlands in the project area.

There are no water bodies in the project area that are designated as impaired in the Texas Integrated Report of 303(d) listed water bodies[2]. This list identifies the water bodies or segments in Texas that do not meet assigned water quality standards. No ecologically significant stream segments designated by TPWD occur in the project area.

The project will require an on-site delineation of streams, ponds, and wetlands. Stream crossings for pipeline construction would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities.

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[1] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

[2] Texas Commission on Environmental Quality. 2018. 2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf.

A preconstruction notification to the USACE is required under certain conditions, including if there would be permanent impacts to over 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under streams (e.g., through horizontal directional drilling) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

Table 5.2.17-2 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Calhoun County [3] [4]. Suitable foraging habitat for the federally endangered whooping crane (*Grus americana*) may occur in the project area. The only natural flock of whooping cranes winter mainly in and adjacent to ANWR along the central Texas coast in Aransas, Calhoun, and Refugio counties[5] (Canadian Wildlife Service and USFWS 2007). The project area occurs approximately 6.8 miles north of the ANWR. Furthermore, the project area occurs approximately 8.7 miles north of federally designated critical habitat for the whooping crane. Habitat for the black rail (*Laterallus jamaicensis*), a species proposed for listing as federally threatened, may occur within wetlands in the project area. This species is not currently listed as federally threatened but may be listed in the future. Habitat for other federally threatened or endangered species does not occur in the project region.

Suitable habitat may occur for state listed threatened species including the wood stork (*Mycteria americana*), bald eagle (*Haliaeetus leucocephalus*), and Texas horned lizard (*Phrynosoma cornutum*). The wood stork and bald eagle would only be expected to forage within the project area. Potentially suitable habitat may occur for numerous wildlife, plant, and insect species designated by TPWD as SGCN. These species do not have formal protected status but are being monitored by TPWD. Migratory birds may occur in the project area, particularly in riparian zones and wetland areas.

A site-specific assessment for the potential for whooping cranes to utilize the project area would be required. Additionally, site-specific field surveys would be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain their recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs from impacts unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15. Preconstruction surveys for active bird nests are recommended.

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[3] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Calhoun County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[4] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation (IPaC) Resource List – Calhoun County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.

[5] Canadian Wildlife Service and USFWS 2007. *International Recovery Plan for the Whooping Crane*. Ottawa: Recovery of Nationally Endangered Wildlife, and USFWS, Albuquerque, New Mexico.

Table 5.2.17-2 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for GBRA Lower Basin New Appropriation Project; Calhoun County, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Black-spotted newt	*Notophthalmus meridionalis*	N/A	T	May be found in resacas and bodies of water with firm bottoms and little or no vegetation. Wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; the absence of predatory fish is probably important. Aestivates in the ground during dry periods; Gulf Coastal Plain south of the San Antonio River.	Suitable habitat may occur within the project area.
Sheep frog	*Hypopachus variolosus*	N/A	T	Predominantly grassland and savannah; largely fossorial in areas with moist microclimates.	Suitable habitat may occur within the project area.
Southern crawfish frog	*Lithobates areolatus areolatus*	N/A	SGCN	Found in abandoned crawfish holes and small mammal burrows, shallow water, herbaceous wetland, riparian, temporary pools, cropland/hedgerow, grassland/herbaceous, suburban/orchard, woodland – conifer.	Suitable habitat may occur within the project area.
Strecker's chorus frog	*Pseudacris streckeri*	N/A	SGCN	Wooded floodplains and flats, prairies, cultivated fields and marshes. Likes sandy substrates.	Suitable habitat may occur within the project area.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur within the project area.
Birds					

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Bald eagle	*Haliaeetus leucocephalus*	N/A	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable nesting habitat does not occur in project area, may fly over and forage within the project area during migration and in the winter.
Black rail	*Laterallus jamaicensis*	PT	SGCN	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps. Nests in or along edge of marsh.	Suitable habitat may occur within the project area.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes, may use fields and beaches during migration.	Suitable habitat does not occur in project area, may fly over during migration.
Northern aplomado falcon	*Falco femoralis septentrionalis*	E	E	Open country, especially savannah and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus; nests in old stick nests of other bird species.	Suitable habitat does not occur in project area, may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur in project area, may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	T	Brackish marshes, shallow salt ponds and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Suitable habitat does not occur in project area, may fly over during migration.
Red knot	*Calidris canutus rufa*	T	SGCN	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays.	Suitable habitat does not occur in project area, may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Swallow-tailed kite	*Elanoides forficatus*	N/A	T	Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge.	Suitable habitat does not occur in project area, may fly over during migration.
Tropical kingbird	*Tyrannus melancholicus*	N/A	SGCN	Open to semi-open habitat from savannahs to agricultural fields, also parks and neighborhoods.	Suitable habitat may occur in project area.
Tropical parula	*Setophaga pitiayumi*	N/A	T	Semi-tropical evergreen woodland along rivers and resacas.	Suitable habitat does not occur in project area, may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs, may use open areas such as vacant lots, nests and roosts in abandoned burrows.	Suitable habitat may occur in project area; may occur in the project area in the winter.
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat may occur in project area.
White-tailed hawk	*Buteo albicaudatus*	N/A	T	Near coast on prairies, cordgrass flats, and scrub live oak; further inland on prairies, mesquite and oak savannahs, and mixed savannah-chaparral.	Suitable habitat may occur in project area.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems (during migration).	Suitable foraging habitat may occur in the project area, may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Suitable foraging habitat may occur in project area.
Fishes					
Alligator gar	*Atractosteus spatula*	N/A	SGCN	Found in rivers, streams, lakes, swamps, bayous, bays and estuaries typically in pools and backwater habitats. Floodplains inundated with flood waters provide spawning and nursery habitats.	Suitable habitat does not occur in project area.
Opossum pipefish	*Microphis brachyurus*	N/A	T	Brooding adults found in fresh or low salinity waters and young move or are carried into more saline waters after birth; southern coastal areas.	Suitable habitat does not occur in project area.
Saltmarsh topminnow	*Fundulus jenkinsi*	N/A	SGCN	Salt marsh, tidal meanders.	Suitable habitat does not occur in project area.
Southern flounder	*Paralichthys lethostigma*	N/A	SGCN	Brackish bays, estuaries and coastal waters to about 40 meter depth; move to deeper waters in winter.	Suitable habitat does not occur in project area.
Insects					
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in project area.
No accepted common name	*Trimerotropis schaefferi*	N/A	SGCN	Gulf dune grasshopper – grassland.	Suitable habitat may occur in project area.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur in project area.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls, will use buildings.	Suitable habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat does not occur in project area.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges.	Suitable habitat may occur in project area.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Project area is outside the expected range of this species.
Humpback whale	*Megaptera novaeangliae*	E	E	Open ocean and coastal waters, sometimes including inshore areas such as bays; summer distribution is in temperate and subpolar waters; in winter, most are in tropical/subtropical waters near islands or coasts.	Suitable habitat does not occur in project area.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur in project area.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	Suitable habitat may occur in project area.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps and marshes.	Suitable habitat may occur in project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Wide range of habitats, especially rocky areas, canyons, riparian zones and dense brush.	Suitable habitat does not occur in project area.
Padre Island kangaroo rat	*Dipodomys compactus compactus*	N/A	SGCN	Coastal barren sparse vegetation.	Suitable habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	SGCN	Open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie.	Suitable habitat may occur in project area.
Southern short-tailed shrew	*Blarina carolinensis*	N/A	SGCN	Various upland and wetland habitats, including moist deciduous woods, brushy areas, pine woodland and forest, mixed oak-pine-juniper woods, grassy situations, densely wooded floodplains. Nest sites are probably under logs, stumps and other debris.	Suitable habitat may occur in project area.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat may occur in project area.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Restricted to dry and sandy soils of open areas, such as grasslands, cultivated fields, meadows, roadsides, airfields, shrublands, and suburb lawns.	Low potential for habitat to occur in project area.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat does not occur in project area.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat does not occur in project area.
White-nosed coati	*Nasua narica*	N/A	T	Canyons, riparian corridors, and woodlands.	Suitable habitat does not occur in project area.
Mollusks					
No accepted common name	*Nesovitrea suzannae*	N/A	SGCN	Land snail – coastal southern Texas woodland.	Suitable habitat does not occur in project area.
Plants					
Awnless bluestem	*Bothriochloa exaristata*	N/A	SGCN	Coastal prairies on black clay.	Suitable habitat may occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Coastal gay-feather	*Liatris bracteate*	N/A	SGCN	Coastal prairie grasslands of various types, from salty prairie on low- lying somewhat saline clay loams to upland prairie on nonsaline clayey to sandy loams.	Suitable habitat may occur in project area.
Indianola beakrush	*Rhynchospora indianolensis*	N/A	SGCN	Locally abundant in cattle pastures in some areas (at least during wet years), possibly becoming a management problem in such sites.	Suitable habitat may occur in project area.
Marsh-elder dodder	*Cuscuta attenuate*	N/A	SGCN	Parasitizes a particular sumpweed (*Iva annua*) almost exclusively as well as ragweed and heath aster. Host plants typically found in open, disturbed habitats like fallow fields and creek bottomlands.	Suitable habitat may occur in project area.
Sand Brazos mint	*Brazoria arenaria*	N/A	SGCN	Sandy areas in South Texas.	Suitable habitat may occur in project area.
Texas peachbush	*Prunus texana*	N/A	SGCN	Occurs at scattered sites in various well drained sandy situations; deep sand, plains and sand hills, grasslands, oak woods, 0-200 meter elevation.	Suitable habitat may occur in project area.
Texas willkommia	*Willkommia texana var. texana*	N/A	SGCN	Mostly in sparsely vegetated shortgrass patches within taller prairies on alkaline or saline soils on the Coastal Plain.	Suitable habitat may occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Tharp's dropseed	*Sporobolus tharpii*	N/A	SGCN	Occurs on barrier islands, shores of lagoons and bays protected by the barrier islands, and on shores of a few near-coastal ponds. Plants occur at the bases of dunes, in interdune swales and sandflats, and on upper beaches. The substrate is of Holocene age.	Suitable dune habitat does not occur in project area.
Threeflower broomweed	*Thurovia trifloral*	N/A	SGCN	Near coast in sparse, low vegetation on a veneer of light-colored silt or fine sand over saline clay along drier upper margins of ecotone between between salty prairies and tidal flats; further inland associated with vegetated slick spots on prairie mima mounds.	Suitable habitat does not occur in project area.
Velvet spurge	*Euphorbia innocua*	N/A	SGCN	Open or brushy areas on coastal sands and the South Texas Sand Sheet.	Suitable habitat does not occur in project area.
Reptiles					
Atlantic hawksbill sea turtle	*Eretmochelys imbricate*	E	E	Gulf and bay system, warm shallow waters especially in rocky marine environments, such as coral reefs and jetties, juveniles found in floating mats of sea plants; feed on sponges, jellyfish, sea urchins, mollusks, and crustaceans.	Suitable aquatic habitat does not occur in project area.
Common garter snake	*Thamnophis sirtalis*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Low likelihood of suitable habitat in project area.
Green sea turtle	*Chelonia mydas*	T	T	Gulf and bay system; shallow water seagrass beds, open water between feeding and nesting areas, barrier island beaches; adults are herbivorous feeding on sea grass and seaweed; juveniles are omnivorous feeding initially on marine invertebrates, then increasingly on sea grasses and seaweeds.	Suitable aquatic habitat does not occur in project area.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable dune habitat does not occur in project area.
Kemp's Ridley sea turtle	*Lepidochelys kempii*	E	E	Gulf and bay system, adults stay within the shallow waters of the Gulf of Mexico; feed primarily on crabs, but also snails, clams, other crustaceans and plants, juveniles feed on sargassum and its associated fauna.	Suitable aquatic habitat does not occur in project area.
Loggerhead sea turtle	*Caretta caretta*	T	T	Gulf and bay system primarily for juveniles, adults are most pelagic of the sea turtles; omnivorous, shows a preference for mollusks, crustaceans, and coral.	Suitable aquatic habitat does not occur in project area.
Massasauga	*Sistrurus tergeminus*	N/A	SGCN	Quite common in gently rolling prairie occasionally broken by creek valley or rocky hillside.	Low likelihood of suitable habitat in project area.
Slender glass lizard	*Ophisaurus attenuatus*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannahs, pine barrens, and oil fields.	Low likelihood of suitable habitat in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas diamondback terrapin	*Malaclemys terrapin littoralis*	N/A	SGCN	Coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches; brackish and salt water; burrows into mud when inactive; may venture into lowlands at high tide.	Suitable aquatic habitat does not occur in project area.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees.	Suitable habitat may occur in project area.
Texas scarlet snake	*Cemophora coccinea lineri*	T	SGCN	Along Gulf Coast, known from mixed hardwood scrub on sandy soils. Mixed hardwood scrub on sandy soils; feeds on reptile eggs; semifossorial.	Low likelihood of suitable habitat in project area.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland, prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrows into soil or may use burrows made by other species.	Suitable habitat may occur in project area.
PT = Proposed Threatened T = Threatened E = Endangered C = Candidate DL = Delisted N/A = Not applicable SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC and the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the Project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[6] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

One previously recorded archaeological site is located immediately adjacent (within 300 feet) to the project area (Table 5.2.17-3; THC 2019). There is no data provided in the state records on its NRHP eligibility determination or the resource type. The review also identified one historic linear feature intersecting the project area, one cemetery, and 150 potentially historic-age structures intersecting or immediately adjacent to the project area. No historical markers or NRHP-listed properties are known to be near the project.

The model used assessed the overall archaeological site potential to include low to high potential zones, ranging from 2 to 65 percent likelihood for the landform crossed to contain unidentified archaeological resources. The areas with greatest archaeological probability are located near the previously documented archaeological site, the historic linear feature and landforms adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 174.0. A high cultural resources assessment score equates to a greater likelihood that the project may potentially impact cultural resources as currently defined (further information regarding methodology for developing the assessment score is provided in Section 5.2). Based on the results of the background review, a structured cultural resources survey of the final design plan will be required to accurately assess the presence and significance of identified and unrecorded cultural resources within its boundaries.

Table 5.2.17-3 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological Site	Unknown	Unknown	Unknown	Adjacent
Levee	Linear Feature	Historic	Unknown	Intersect
None	150 Structures	Historic	Unknown	Intersect or Adjacent
Long Mott Mexican	Cemetery	Historic	Unknown	Intersect
			ASSESSMENT SCORE TOTAL:	**174.0**

5.2.17.4 Engineering and Costing

Preliminary engineering and costing analyses have been performed using the 2021 Regional Water Planning methods. For Region L, Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and unit costs. The engineering and costing analysis for the GBRA Lower

[6] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

Basin New Appropriation project includes all facilities required to implement the river diversion option, including the following:

- Main pump station and canal upgrades (from 355 cfs to 500 cfs);
- New intake and pump station from Main Canal (approximately 250 cfs);
- 10-mile, 96-inch diameter diversion pipeline;
- OCR between 25,000 acft and 200,000 acft; and
- Integration.

Cost estimates for each of the five off-channel reservoir sizes are summarized in Table 5.2.17-4.

Table 5.2.17-4 Cost Estimates for Off-Channel Reservoir Sizes

ITEM	OFF-CHANNEL RESERVOIR SIZE (ACFT)				
	25,000	50,000	100,000	150,000	200,000
Cost of Facilities	$152,451,000	$178,777,000	$211,657,000	$244,538,000	$277,419,000
Total Project Cost	$269,057,000	$217,142,000	$321,517,000	$381,960,000	$442,403,000
Annual Cost ($/yr)	$16,708,000	$19,604,000	$23,127,000	$26,648,000	$30,143,000
Firm Yield (acft/yr)	18,500	25,500	33,500	40,500	47,500
Unit Cost ($/acft/yr)	$903	$769	$690	$658	$635

The cost evaluations for a range of reservoir sizes indicate a decreasing unit cost with increasing storage capacity. However, with the approval of the sponsor, the 150,000 acft off-channel reservoir has been selected for consistency with the 2016 RWP.

Cost estimates were calculated for capital costs, annual debt service, operation and maintenance, power, land acquisition, and environmental mitigation. These cost estimate assumptions and line items are summarized in Table 5.2.17-5. Total project costs for the GBRA Lower Basin New Appropriation WMS are estimated to be $381,960,000. Including debt service, operations and maintenance, and pumping energy, the annual cost is estimated to be $26,648,000, and annual unit costs are estimated to be $658/acft/yr). Per section 8.2.4 of the UCM User Guide, dated November 2018, for all project components except pipelines, the UCM assumes the Environmental/Mitigation Costs are 100 percent of land costs. The recommended value for environmental studies and mitigation costs for pipelines is $25,000/mile of pipeline. This cost estimate is representative of 6,000 acres for the reservoir foot-print and conservation pool, 121.2 acres for the pipeline facilities, and 4.8 acres for a pump station.

Table 5.2.17-5 Project Cost Estimate Summary

ITEM	ESTIMATED COST FOR FACILITIES
Off-Channel Storage/Ring Dike (Conservation Pool 150,000 acft, 6,000 acres)	$114,223,000
Primary Pump Station	$41,724,000
Diversion Pipeline (96 in. dia., 10 miles)	$49,284,000
Integration, Relocations, and Other	$39,307,000
TOTAL COST OF FACILITIES	**$244,538,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$83,124,000
Environmental and Archaeology Studies and Mitigation	$21,772,000
Land Acquisition and Surveying (6,126 acres)	$22,302,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$10,224,000
TOTAL COST OF PROJECT	**$381,960,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$12,596,000
Reservoir Debt Service (3.5%, 40 years)	$9,503,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$886,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$1,043,000
Dam and Reservoir (1.5% of Cost of Facilities)	$1,713,000
Pumping Energy Costs (35,425,007 kW-hr @ 0.08 $/kW-hr)	$907,000
TOTAL ANNUAL COST	**$26,648,000**
Available Project Yield (acft/yr)	40,500
Annual Cost of Water ($ per acft)	$658
Annual Cost of Water After 20-year Debt Service ($ per acft)	$347
Annual Cost of Water After 40-year Debt Service ($ per acft)	$112
Annual Cost of Water($ per 1,000 gallons)	$2.02
Annual Cost of Water After Debt Service* ($ per 1,000 gallons)	$0.34
Based on a Peaking Factor of 1.0	

5.2.17.5 Implementation Considerations

Information presented in this WMS was provided by GBRA and represents the current plan which is based on the sponsor's current understanding of the system. At the time of writing, the Water Rights Permit Application Pending at TCEQ. Implementation of the GBRA Lower Basin New Appropriation WMS includes the following considerations:

- Institutional arrangements may be needed to implement the project.
- It may be necessary to obtain the following:
  - TCEQ Diversion and Storage Permits (Application No. 12482, pending);
  - USACE Sections 10 and 404 Dredge and Fill Permits for the reservoir and pipelines;
  - GLO Sand and Gravel Removal permits;
  - GLO Easement for use of state-owned land; and
  - TPWD Sand, Gravel, and Marl permit.
- Permitting may require the following studies:
  - Habitat mitigation plan;
  - Environmental studies; and
  - Cultural resource studies and mitigation.
- Land will need to be acquired through either negotiations or condemnation.
- Relocations for the off-channel storage facilities may include the following:
  - County roads;
  - Other utilities;
  - Product transmission pipelines; and
  - Power transmission lines.

Reliability

The reliability of the water supplies is projected to be high (reliability score = 5).

5.2.18 GBRA Victoria County Steam-Electric Project

5.2.18.1 Description of Water Management Strategy

In order to meet steam-electric needs in Victoria County, a reliable supply of raw water is proposed to be developed via a canal diversion from the GBRA Calhoun Canal System. A firm yield of 23,925 acft/yr from the GBRA Lower Basin New Appropriation Project (evaluated in Section 5.2.17) would be supplied to Victoria County steam-electric uses.

Facilities that would be constructed for the canal diversion include conveyance improvements to existing canals and pumping capabilities. The GBRA Calhoun Canal System currently supplies water from the Guadalupe River to a Dow facility (formerly owned by Union Carbide Corporation), the GBRA Port Lavaca WTP, and various GBRA municipal, industrial, and irrigation customers. For this project, the existing GBRA Calhoun Canal System will be improved and used to convey raw water from the Guadalupe River at the GBRA Saltwater Barrier to a proposed 121 mgd pump station located on the Main Canal adjacent to the existing GBRA Relift No. 1 Pump Station (Figure 5.2.18-1). After water is diverted from the Main Canal at the proposed pump station, raw water will be delivered via a 36-inch, 22-mile transmission pipeline within Victoria County. Conventional direct-bury/lay construction techniques are suitable for the installation of most of the pipeline along the route; however, horizontal directional drilling (HDD) is likely necessary at the Victoria Barge Canal and the Guadalupe River. The pipeline terminus is located south-southwest of Linn Lake (Figure 5.2.18-1).

The Gravity Conveyance System (GCS) refers to the gravity flow components of the GBRA Calhoun Canal System. More specifically, the GCS comprises two gravity subsystems: one for conveyance of water diverted from the Guadalupe River to the Goff Bayou Siphon intake adjacent to the Victoria Barge Canal and the other for conveyance of water from the Main Pump Station discharge structure to the Relift No. 1 Pump Station site via a canal and conduits on Dow property and the Main Canal. The GCS will be improved to provide the increased capacity necessary to supply water to steam-electric facilities in addition to existing customers. The associated work will include the following:

- Modification of the existing diversion structure at the Guadalupe River to increase its capacity;
- Construction of two bridges providing access to the north side of the existing diversion canal running between the Guadalupe River and Hog Bayou to allow access for enhanced maintenance (clearing) of the north canal bank;
- Modification to the Green Lake spillway;
- Increasing the height of the levees on the Dow Canal, which is located between the Main Pump Station and the Main Canal;
- Adding capacity to the Main Canal, including excavating a new channel parallel to the existing canal, associated land acquisition, levee construction, and construction of a maintenance access bridge; and
- Upgrading the existing dirt access road to the Relift No. 1 Pump Station.

In addition to the new pump station, new pipeline, and GCS improvements, the canal diversion option will also require modifications to the existing Main Pump Station to increase its capacity.

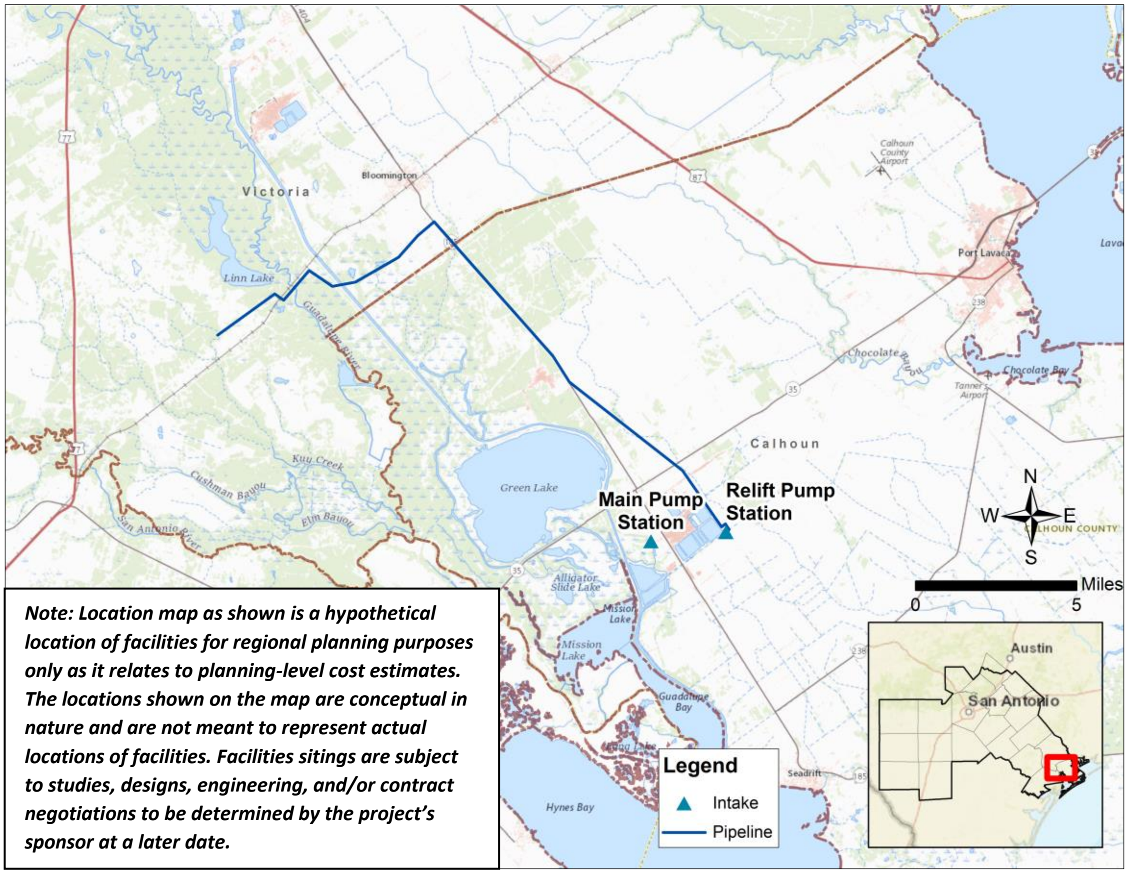

Figure 5.2.18-1 GBRA Victoria County Steam-Electric Project Location

5.2.18.2 Available Yield

The Guadalupe River Saltwater Barrier was constructed in the early 1960s at a location immediately downstream of the confluence of the Guadalupe and San Antonio Rivers; the barrier creates a reservoir pool extending some distance up both rivers. Diversions from this reservoir pool, under existing rights, flow into GBRA's Calhoun Canal System and are dependent on waters originating in both the Guadalupe and San Antonio Rivers and their respective tributaries. This WMS is planned for implementation in the 2030 decade.

The newly evaluated Lower Basin New Appropriation Project (pending TCEQ application No. 12482; Section 5.2.17) is for 189,484 acft/yr, with up to a 500 cfs diversion rate (within the existing 622 cfs) and off-channel storage of up to 200,000 acft in Calhoun County. GBRA estimates that up to 23,925 acft/yr of the estimated firm yield associated with this water right will be used to meet the steam-electric and manufacturing needs in Victoria County.

5.2.18.3 Environmental Considerations

Environmental Considerations

Vegetation and Land Use

The project area occurs in the Western Gulf Coastal Plain ecoregion and is within a variety of vegetation types, predominantly croplands, pastures, shrublands, and wetlands. As mapped by TPWD,[1] dominant vegetation types in the project area are coastal prairie, row crops, herbaceous wetland, and mesquite shrubland. The project area contains riparian vegetation zones, mapped by TPWD as riparian grassland, riparian deciduous shrubland, floodplain hardwood forest, and floodplain grassland.

Based on TPWD vegetation mapping, the project may have the potential to impact 75 acres of agricultural resources mapped as row crops. The area of potential impacts also includes 429 acres mapped as coastal prairie which may include pasture areas used for grazing or hay production.

Project pipeline easements would require the removal of woody vegetation and long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each water management strategy to determine the best course of action regarding revegetation. Pipeline easements may continue to be used for agricultural purposes.

Aquatic Resources

The project alignment lies north of the San Antonio Bay and crosses the Guadalupe River and associated floodplain. Surface waters within the project area appear to eventually flow into San Antonio Bay or Matagorda Bay, located to the east of the project area. Operational water basins associated with a chemical plant occur to the immediate west of the project area. NWI mapping shows approximately 104 acres of emergent and forested/shrub wetlands and ponds, lakes, and riverine wetlands in the project area.

No streams designated as impaired stream segments in the Texas Integrated Report of 303(d)-listed water bodies occur in the project area.[2] This list identifies the water bodies or segments in Texas that do not meet assigned water quality standards. The Lower Guadalupe River, which crosses the project alignment in southern Victoria County, is listed as an ecologically significant stream segment by TPWD.

The project will require an on-site delineation of streams, ponds, and wetlands. Stream crossings for pipeline construction would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities. A

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[1] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

[2] Texas Commission on Environmental Quality. 2018. 2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf.

preconstruction notification to the USACE is required under certain conditions, including if there would be permanent impacts to over 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under streams (e.g., through HDD) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

Table 5.2.18-1 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Calhoun and Victoria Counties[3] [4] [5] [6]. Suitable foraging habitat for the federally endangered whooping crane (*Grus americana*) may occur in the project area. The only natural flock of whooping cranes winter mainly in and adjacent to ANWR along the central Texas coast in Aransas, Calhoun, and Refugio counties (Canadian Wildlife Service and USFWS 2007). The project area lies approximately 13.9 miles north of the ANWR. Furthermore, the project area is approximately 11.2 miles north of federally designated critical habitat for the whooping crane. Suitable habitat for the federally endangered Attwater's greater prairie-chicken (*Tympanuchus cupido attwateri*) may occur in open prairies within the project area; however, this species known range has been reduced to two small pockets in Galveston and Colorado counties. Habitat for the black rail (*Laterallus jamaicensis*), a species proposed to be listed as federally threatened, may occur within wetlands in the project area. This species is not currently listed as federally threatened but be may be listed in the future. Habitat for other federally threatened or endangered species does not occur in the project region.

Suitable habitat may occur for state listed threatened species including sheep frog (*Hypopachus variolosus*), wood stork (*Mycteria americana*), bald eagle (*Haliaeetus leucocephalus*), white-facied ibis (*Plegadis chihi*), white-tailed hawk (*Buteo albicaudatus*), white-nosed coati (*Nasua narica*), Cagle's map turtle (*Graptemys caglei*), timber rattlesnake (*Crotalus horridus*), and Texas horned lizard (*Phrynosoma cornutum*). The wood stork and bald eagle would only be expected to forage within the project area. Potentially suitable habitat may occur for numerous wildlife, plant, and insect species designated by TPWD as SGCN. These species do not have formal protected status but are being monitored by TPWD. Migratory birds may occur in the project area, particularly in riparian zones and wetland areas.

Streams in the project area may contain suitable habitat for federal candidate/state-threatened freshwater mussel species. Suitable habitat may occur in perennial rivers/streams and perennial pools of intermittent streams. If any such habitat would be affected by construction, presence/absence surveys and relocation of native mussel species would be required. Handling and relocation of mussels and other aquatic species must be conducted by TPWD-permitted personnel and in accordance with an approved Aquatic Resources Relocation Plan. Furthermore, these candidate species may be listed as federally threatened or endangered during the project timeline; in which case, any species impacts would require USFWS consultation.

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[3] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Calhoun County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[4] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Victoria County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[5] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Calhoun County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.

[6] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Victoria County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.

An assessment for the potential for whooping cranes to utilize the project area would be required. This assessment would entail a site visit and desktop analysis. Additionally, site-specific field surveys would be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain its recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs from impacts unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15. Preconstruction surveys for active bird nests are recommended.

Table 5.2.18-1 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for GBRA Victoria County Steam-Electric Project, Calhoun and Victoria Counties, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Black-spotted newt	*Notophthalmus meridionalis*	N/A	T	May be found in resacas and bodies of water with firm bottoms and little or no vegetation. Wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; the absence of predatory fish is probably important. Aestivates in the ground during dry periods; Gulf Coastal Plain south of the San Antonio River.	Suitable habitat may occur within the project area.
Sheep frog	*Hypopachus variolosus*	N/A	T	Predominantly grassland and savannah; largely fossorial in areas with moist microclimates.	Suitable habitat may occur within the project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Southern crawfish frog	*Lithobates areolatus areolatus*	N/A	SGCN	Found in abandoned crawfish holes and small mammal burrows, shallow water, herbaceous wetland, riparian, temporary pools, cropland/hedgerow, grassland/herbaceous, suburban/orchard, and woodland – conifer.	Suitable habitat may occur within the project area.
Strecker's chorus frog	*Pseudacris streckeri*	N/A	SGCN	Wooded floodplains and flats, prairies, cultivated fields and marshes. Likes sandy substrates.	Suitable habitat may occur within the project area.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur within the project area.
Birds					
Attwater's greater prairie-chicken	*Tympanuchus cupido attwateri*	E	E	Open prairies of mostly thick grass one to three feet tall; sandhill country with bunch grass, sage, and shinnery oak. From near sea level to 200 feet along coastal plain on upper two-thirds of Texas coast.	Suitable habitat may occur within project area; however, species is not expected to occur.
Bald eagle	*Haliaeetus leucocephalus*	N/A	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable nesting habitat does not occur in project area; may fly over and forage within the project area during migration and in the winter.
Black rail	*Laterallus jamaicensis*	PT	SGCN	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh.	Suitable habitat may occur within the project area.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur in project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Interior least tern	*Sternula antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also known to nest on manmade structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Suitable habitat does not occur in project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat does not occur in project area; may fly over during migration.
Northern aplomado falcon	*Falco femoralis septentrionalis*	E	E	Open country, especially savanna and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus; nests in old stick nests of other bird species.	Suitable habitat does not occur in project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur in project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	T	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Suitable habitat does not occur in project area; may fly over during migration.
Red knot	*Calidris canutus rufa*	T	SGCN	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays.	Suitable habitat does not occur in project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Swallow-tailed kite	*Elanoides forficatus*	N/A	T	Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall trees in clearing or on forest woodland edge.	Suitable habitat does not occur in project area; may fly over during migration.
Tropical kingbird	*Tyrannus melancholicus*	N/A	SGCN	Open to semi-open habitat from savannahs to agricultural fields, also parks and neighborhoods.	Suitable habitat may occur in project area.
Tropical parula	*Setophaga pitiayumi*	N/A	T	Semi-tropical evergreen woodland along rivers and resacas.	Suitable habitat does not occur in project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs, may use open areas such as vacant lots, nests, and roosts in abandoned burrows.	Suitable habitat may occur in project area; may occur in the project area in the winter.
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat may occur in project area.
White-tailed hawk	*Buteo albicaudatus*	N/A	T	Near coast on prairies, cordgrass flats, and scrub live oak; further inland on prairies, mesquite and oak savannahs, and mixed savannah-chaparral.	Suitable habitat may occur in project area.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems (during migration).	Suitable foraging habitat may occur in the project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Suitable foraging habitat may occur in project area.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat does not occur in project area; may fly over during migration.
Fishes					
Alligator gar	*Atractosteus spatula*	N/A	SGCN	Found in rivers, streams, lakes, swamps, bayous, bays, and estuaries typically in pools and backwater habitats. Floodplains inundated with flood waters provide spawning and nursery habitats.	Suitable habitat does not occur in project area.
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat may occur in project area.
Guadalupe darter	*Percina apristis*	N/A	SGCN	Endemic to the Guadalupe River Basin; found in riffles; most common under or around 25 to 30 centimeters boulders in the main current; seems to prefer moderately turbid water.	Suitable habitat may occur in project area.
Opossum pipefish	*Microphis brachyurus*	N/A	T	Brooding adults found in fresh or low salinity waters and young move or are carried into more saline waters after birth; southern coastal areas.	Suitable habitat does not occur in project area.
Saltmarsh topminnow	*Fundulus jenkinsi*	N/A	SGCN	Salt marsh, tidal meanders.	Suitable habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Southern flounder	*Paralichthys lethostigma*	N/A	SGCN	Brackish bays, estuaries and coastal waters to about 40-meter depth; move to deeper waters in winter.	Suitable habitat does not occur in project area.
Texas shiner	*Notropis amabilis*	N/A	SGCN	In Texas, it is found primarily in Edwards Plateau streams from the San Gabriel River in the east to the Pecos River in the west. Typical habitat includes rocky or sandy runs, as well as pools.	Suitable habitat may occur in project area.
Insects					
A mayfly	*Tortopus circumfluus*	N/A	SGCN	Mayflies distinguished by aquatic larval stage; adult stage generally found in shoreline vegetation.	Suitable habitat may occur in project area.
A mayfly	*Tricorythodes curvatus*	N/A	SGCN	Mayflies distinguished by aquatic larval stage; adult stage generally found in bankside vegetation.	Suitable habitat may occur in project area.
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in project area.
Comanche harvester ant	*Pogonomyrmex comanche*	N/A	SGCN	Barren or sparsely vegetation areas.	Suitable habitat may occur in the project area, particularly in areas of sandy soils.
No accepted common name	*Cotinis boylei*	N/A	SGCN	South Texas coastal plains.	Suitable habitat may occur in project area.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur in project area.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls, will use buildings.	Suitable habitat does not occur in project area.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, and forest edges.	Suitable habitat may occur in project area.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Project area is outside the expected range of this species.
Humpback whale	*Megaptera novaeangliae*	E	E	Open ocean and coastal waters, sometimes including inshore areas such as bays; summer distribution is in temperate and subpolar waters; in winter, most are in tropical/subtropical waters near islands or coasts.	Suitable habitat does not occur in project area.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur in project area.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	Suitable habitat may occur in project area.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Suitable habitat may occur in project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Suitable habitat does not occur in project area.
Padre Island kangaroo rat	*Dipodomys compactus compactus*	N/A	SGCN	Coastal barren sparse vegetation.	Suitable habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	SGCN	Open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie.	Suitable habitat may occur in project area.
Southern short-tailed shrew	*Blarina carolinensis*	N/A	SGCN	Various upland and wetland habitats, including moist deciduous woods, brushy areas, pine woodland and forest, mixed oak-pine-juniper woods, grassy situations, and densely wooded floodplains. Nest sites are probably under logs, stumps, and other debris.	Suitable habitat may occur in project area.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat may occur in project area.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Restricted to dry and sandy soils of open areas, such as grasslands, cultivated fields, meadows, roadsides, airfields, shrublands, and suburb lawns.	Low potential for habitat to occur in project area.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat does not occur in project area.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat does not occur in project area.
White-nosed coati	*Nasua narica*	N/A	T	Canyons, riparian corridors, and woodlands.	Suitable habitat may occur in project area.
Mollusks					
False spike	*Fusconaia mitchelli*	N/A	T	Medium to large rivers; present in Guadalupe, Colorado, and Brazos river basins.	Potential to occur in perennial waterways along the pipeline alignment.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Golden orb	*Quadrula aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces river basins.	Potential to occur in perennial waterways along the pipeline alignment. This species was recently a federal candidate species, but its listing as federally threatened or endangered was not warranted as it is not a valid species.
Plants					
Awnless bluestem	*Bothriochloa exaristata*	N/A	SGCN	Coastal prairies on black clay.	Suitable habitat may occur in project area.
Awnless leastdaisy	*Chaetopappa imberbis*	N/A	SGCN	Endemic to sandy regions of southern and south-central Texas.	Suitable habitat may occur in project area.
Coastal gay-feather	*Liatris bracteate*	N/A	SGCN	Coastal prairie grasslands of various types, from salty prairie on low-lying somewhat saline clay loams to upland prairie on nonsaline clayey to sandy loams.	Suitable habitat may occur in project area.
Crestless onion	*Allium canadense var. ecristatum*	N/A	SGCN	Occurs on poorly drained sites on sandy substrates within coastal prairies of the Coastal Bend area.	Suitable habitat may occur in project area.
Florida pinkroot	*Spigelia texana*	N/A	SGCN	Woodlands on loamy soils.	Suitable habitat may occur in project area.
Heartleaf evening-primrose	*Oenothera cordata*	N/A	SGCN	Occurs in post oak woodlands on sandy soils on the coastal plain.	Suitable habitat may occur in project area.
Indianola beakrush	*Rhynchospora indianolensis*	N/A	SGCN	Locally abundant in cattle pastures in some areas (at least during wet years), possibly becoming a management problem in such sites.	Suitable habitat may occur in project area.
Jones's rainlilly	*Cooperia jonesii*	N/A	SGCN	Habitat description is not available at this time.	Suitable habitat may occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Marsh-elder dodder	*Cuscuta attenuate*	N/A	SGCN	Parasitizes a particular sumpweed (*Iva annua*) almost exclusively as well as ragweed and heath aster. Host plants typically found in open, disturbed habitats like fallow fields and creek bottomlands.	Suitable habitat may occur in project area.
Sand Brazos mint	*Brazoria arenaria*	N/A	SGCN	Sandy areas in South Texas.	Suitable habitat may occur in project area.
Shinner's sunflower	*Helianthus occidentalis ssp. plantagineus*	N/A	SGCN	Mostly in prairies on the Coastal Plain, with several slightly disjunct populations in the Pineywoods and South Texas Brush Country.	Suitable habitat may occur in project area.
Texas peachbush	*Prunus texana*	N/A	SGCN	Occurs at scattered sites in various well drained sandy situations; deep sand, plains and sand hills, grasslands, oak woods, 0-200 meter elevation.	Suitable habitat may occur in project area.
Texas tauschia	*Tauschia texana*	N/A	SGCN	Occurs in loamy soils in deciduous forests or woodlands on river and stream terraces.	Suitable habitat may occur in project area.
Texas willkommia	*Willkommia texana var. texana*	N/A	SGCN	Mostly in sparsely vegetated shortgrass patches within taller prairies on alkaline or saline soils on the Coastal Plain.	Suitable habitat may occur in project area.
Tharp's dropseed	*Sporobolus tharpii*	N/A	SGCN	Occurs on barrier islands, shores of lagoons and bays protected by the barrier islands, and on shores of a few near-coastal ponds. Plants occur at the bases of dunes, in interdune swales and sandflats, and on upper beaches. The substrate is of Holocene age.	Suitable dune habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Threeflower broomweed	*Thurovia trifloral*	N/A	SGCN	Near coast in sparse, low vegetation on a veneer of light-colored silt or fine sand over saline clay along drier upper margins of ecotone between between salty prairies and tidal flats; further inland associated with vegetated slick spots on prairie mima mounds.	Suitable habitat does not occur in project area.
Two-flower stick-pea	*Calliandra biflora*	N/A	SGCN	Primarily in open areas on caliche outcrops or in shallow sandy soils over caliche.	Suitable habitat may occur in project area.
Velvet spurge	*Euphorbia innocua*	N/A	SGCN	Open or brushy areas on coastal sands and the South Texas Sand Sheet.	Suitable habitat does not occur in project area.
Welder machaeranthera	*Psilactis heterocarpa*	N/A	SGCN	Grasslands, varying from midgrass coastal prairies, and open mesquite-huisache woodlands on nearly level, gray to dark gray clayey to silty soils; known locations mapped on Victoria clay, Edroy clay, Dacosta sandy clay loam over Beaumont and Lissie formations.	Suitable habitat may occur in project area.
Wright's trichocoronis	*Trichocoronis wrightii var. wrightii*	N/A	SGCN	Most records from Texas are historical, perhaps indicating a decline as a result of alteration of wetland habitats.	Suitable habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Reptiles					
Atlantic hawksbill sea turtle	*Eretmochelys imbricate*	E	E	Gulf and bay system, warm shallow waters especially in rocky marine environments, such as coral reefs and jetties, juveniles found in floating mats of sea plants; feed on sponges, jellyfish, sea urchins, mollusks, and crustaceans.	Suitable aquatic habitat does not occur in project area.
Cagle's map turtle	*Graptemys caglei*	N/A	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River system.	Suitable habitat may occur in project area.
Common garter snake	*Thamnophis sirtalis*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland, grassy, or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur in project area.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Low likelihood of suitable habitat in project area.
Green sea turtle	*Chelonia mydas*	T	T	Gulf and bay system; shallow water seagrass beds, open water between feeding and nesting areas, barrier island beaches; adults are herbivorous feeding on sea grass and seaweed; juveniles are omnivorous feeding initially on marine invertebrates, then increasingly on sea grasses and seaweeds.	Suitable aquatic habitat does not occur in project area.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable dune habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Kemp's Ridley sea turtle	*Lepidochelys kempii*	E	E	Gulf and bay system, adults stay within the shallow waters of the Gulf of Mexico; feed primarily on crabs, but also snails, clams, other crustaceans and plants, juveniles feed on sargassum and its associated fauna.	Suitable aquatic habitat does not occur in project area.
Loggerhead sea turtle	*Caretta caretta*	T	T	Gulf and bay system primarily for juveniles, adults are most pelagic of the sea turtles; omnivorous, shows a preference for mollusks, crustaceans, and coral.	Suitable aquatic habitat does not occur in project area.
Massasauga	*Sistrurus tergeminus*	N/A	SGCN	Quite common in gently rolling prairie occasionally broken by creek valley or rocky hillside.	Low likelihood of suitable habitat in project area.
Slender glass lizard	*Ophisaurus attenuatus*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannahs, pine barrens, and oil fields.	Low likelihood of suitable habitat in project area.
Texas diamondback terrapin	*Malaclemys terrapin littoralis*	N/A	SGCN	Coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches; brackish and salt water; burrows into mud when inactive; may venture into lowlands at high tide.	Suitable aquatic habitat does not occur in project area.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees.	Suitable habitat may occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas scarlet snake	*Cemophora coccinea lineri*	T	SGCN	Along Gulf Coast, known from mixed hardwood scrub on sandy soils. Mixed hardwood scrub on sandy soils; feeds on reptile eggs; semifossorial.	Low likelihood of suitable habitat in project area.
Texas tortoise	*Gopherus berlandieri*	N/A	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus.	Low likelihood of suitable habitat in project area.
Timber rattlesnake	*Crotalus horridus*	N/A	T	Swamps, floodplains, upland pine and deciduous woodland, riparian zones, abandoned farmland. Limestone bluffs, sandy soil, or black clay.	Suitable habitat may occur in project area.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland, prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrows into soil or may use burrows made by other species.	Suitable habitat may occur in project area.

PT = Proposed Threatened
T = Threatened
E = Endangered
C = Candidate
DL = Delisted
N/A = Not applicable
SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC, the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[7] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified no previously recorded archaeological sites intersecting or immediately adjacent (within 300 feet) to the project area (THC 2019). The review identified 25 potentially historic-age buildings and two historic linear features intersecting or immediately adjacent to the project area (Table 5.2.18-2). No cemeteries, historic markers, or National Register of Historic Places-listed properties are known to be near the project.

The model used assessed unrecorded archaeological site potential within the project area to include low to high potential zones, ranging from 1 percent to 99 percent likelihood for the landform crossed to contain unidentified archaeological resources. The areas with greatest archaeological probability are located near the landforms adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 46.0. A high cultural resources assessment score equates to a greater likelihood that the project may potentially impact cultural resources as currently defined. Based on the results of the background review, SWCA recommends that a structured cultural resources survey of the final design plan be performed to accurately assess the presence and significance of identified and unrecorded cultural resources within project boundaries.

Table 5.2.18-2 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/HISTORIC	NRHP ELIGIBILITY	LOCATION
Missouri Pacific Railroad	Linear Feature	Historic	Unknown	Intersect
Levee	Linear Feature	Historic	Unknown	Intersect
None	24 Buildings	Historic	Unknown	Adjacent or Intersect
			ASSESSMENT SCORE TOTAL:	**43.0**

[7] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

5.2.18.4 Engineering and Costing

The planned facilities for this WMS include GCS improvements, expansion of the Main Pump Station, a new 121 MGD pump station on the Main Canal adjacent to the existing GBRA Relift No. 1 Pump Station, and a 36-inch diameter transmission pipeline, including two borings. Preliminary engineering and costing analyses were performed for construction of the planned facilities using the 2021 Regional Water Planning methods and information provided by GBRA. For Region L, Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and unit costs.

Cost estimates were computed for capital costs, annual debt service, operation and maintenance, power, land acquisition, and environmental mitigation for season and peak day demands. These costs are summarized in Table 5.2.18-3. The project costs, including capital, are estimated to be $117,260,000. The annual costs, including debt service, operation and maintenance, power, are estimated to be $13,196,000. This option produces potable water at an estimated annual cost of $552 per acft.

It is noted that the supplies for this GBRA Victoria County Steam Electric Project WMS are from the GBRA Lower Basin New Appropriation Project (Refer to Section 5.2.17). The GBRA Victoria County Steam Electric Project includes costs associated with the intake pump station, transmission line, canal upgrades, and the purchase of water ($112/acft/yr after debt services) associated with the implementation of the GBRA Lower Basin New Appropriation Project. The GBRA Lower Basin New Appropriation Project is included in the 2021 SCTRWP (Refer to Section 5.2.17).

Table 5.2.18-3 Project Cost Estimate Summary

ITEM	ESTIMATED COSTS
Intake Pump Stations (22.5 mgd)	$35,850,000
Transmission Pipeline (36 in dia., 22.4 miles)	$30,405,000
Main Pump Station and Canal Upgrades	$18,061,000
TOTAL COST OF FACILITIES	**$84,316,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$27,990,000
Environmental & Archaeology Studies and Mitigation	$579,000
Land Acquisition and Surveying (276 acres)	$1,236,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$3,139,000
TOTAL COST OF PROJECT	**$117,260,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$8,250,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$485,000
Intakes and Pump Stations (2.5% of cost of facilities)	$896,000

ITEM	ESTIMATED COSTS
Pumping Energy Costs (11,061,803 kWh @ 0.08 $/kWh)	$885,000
Purchase of Water for GBRA LBNA Project (23,925 acft/yr @ 112 $/acft)	$2,680,000
TOTAL ANNUAL COST	**$13,196,000**
Available Project Yield (acft/yr)	23,925
Annual Cost of Water ($ per acft)	$552
Annual Cost of Water After Debt Service ($ per acft)	$207
Annual Cost of Water ($ per 1,000 gallons)	$1.69
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.63
Based on a Peaking Factor of 1.0	

5.2.18.5 Implementation Considerations

Implementation of the GBRA Victoria County SE Project includes the considerations:

- It will be necessary to obtain the following:
  - Combined Operating License from the Nuclear Regulatory Commission;
  - Final Water Supply Agreement;
  - USACE Sections 10 and 404 Dredge and Fill Permits for the pipelines;
  - GLO Sand and Gravel Removal permits;
  - GLO Easement for use of state-owned land;
  - Coastal Coordination Council review; and
  - TPWD Marl, Sand, Gravel, Shell or Mudshell permit.
- Permitting may require the following studies:
  - Assessment of changes in freshwater inflows to bays and estuaries;
  - Habitat mitigation plan;
  - Environmental studies; and
  - Cultural resource studies and mitigation.
- Land will need to be acquired through either negotiations or condemnation.

Reliability

The reliability of the water supplies is projected to be high (reliability score = 5).

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5.2.19 CRWA Wells Ranch Phase 3 Project

5.2.19.1 Description of Water Management Strategy

CRWA is planning to expand their existing Wells Ranch Project to provide an additional 7,000 acft/yr of water supply. The project includes 6 to 11 new wells made up of a combination of Carrizo Aquifer wells and Wilcox Aquifer wells. Raw water from the wells would be delivered to the CRWA Wells Ranch WTP, which will require expansion, for treatment and disinfection before the water is delivered to the CRWA distribution system. The proposed wells are to be constructed in a new well field in Guadalupe County, southwest of the existing Wells Ranch WTP off of HWY 123 (Figure 5.2.19-1). The project is expected to be implemented in the 2020 decade at 3,500 acft/yr, with the full project capacity (7,000 acft/yr) being utilized in the 2030 decade.

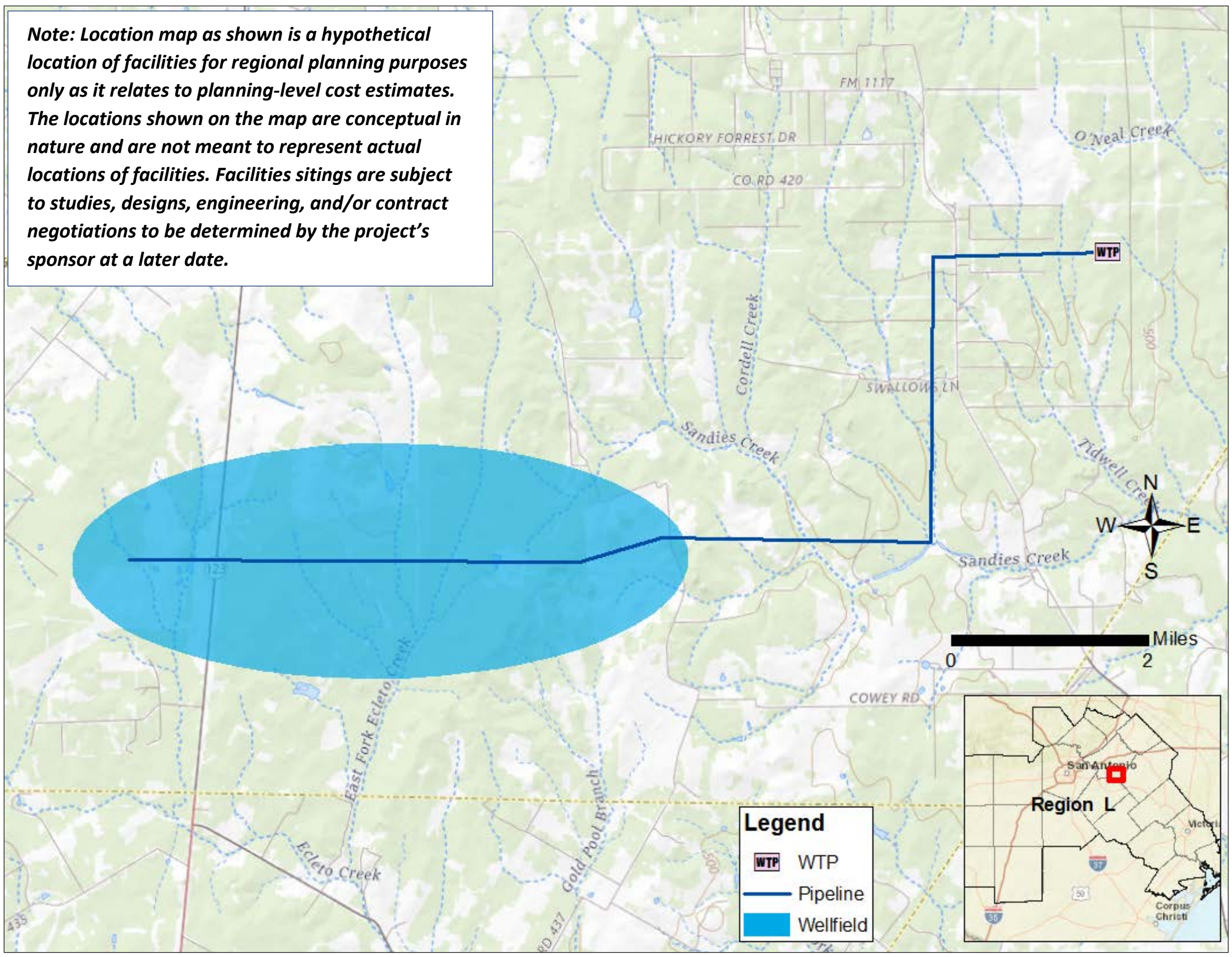

Figure 5.2.19-1 Wells Ranch Phase 3 SAWS Project Location

5.2.19.2 Available Yield

The CRWA Wells Ranch Phase 3 Project wells are to be designed to each produce between 290 to 910 gpm. Wells in the Carrizo Aquifer are expected to have a depth ranging from 400 to 600 feet, while wells in the Wilcox Aquifer are expected to have a depth ranging from 1,000 to 1,500 feet.

The Carrizo-Wilcox Aquifer is one of four major aquifers in the South Central Texas Water Planning Region. Overall, the water quality of the Carrizo-Wilcox Aquifer is suitable for use as a water supply, as this area is low in total dissolved solids, but often is high concentrations of iron and manganese.

For Wells Ranch Phase 3 Project, groundwater production and well spacing in the Carrizo-Wilcox aquifer are regulated by the Guadalupe County Groundwater Conservation District. In November 2016, GMA-13 established the DFC for the Carrizo-Wilcox, Queen City Sparta Aquifer[1]. Based on the approved DFC, TWDB has determined that the MAG for 2070 in the Carrizo-Wilcox Aquifer is 47,833 acft/yr for Guadalupe County[2].

5.2.19.3 Environmental and Cultural Resources

Environmental Considerations

Vegetation and Land Use

The project area occurs in the Post Oak Savannah ecoregion. As mapped by TPWD;[3] the project area crosses a mix of grassland, shrubland, and wooded areas. The predominant vegetation communities are post oak motte and woodland, and savannah grassland. The project area also includes some mesquite shrubland, and the proposed pipelines cross several riparian vegetation zones mapped by TPWD as riparian deciduous hardwood forest, riparian deciduous shrubland, and riparian herbaceous vegetation.

Based on TPWD vegetation mapping, the project does not affect agricultural resources mapped as row crops or tame grassland that may be used for pasture. The project impact area does contain 2 acres mapped as sandyland grassland that may include pasture areas used for grazing or hay production

The proposed well pads would result in conversion of land use from undeveloped vegetation or pasture (mostly open fields) to small areas of industrial use. Project pipeline easements would require removal of woody vegetation and long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each WMS to determine the best course of action regarding revegetation.

Aquatic Resources

The project area contains several mapped intermittent streams and their associated floodplains, including Tidwell Creek, East Fork Ecleto Creek, multiple crossings of Sandies Creek, and several unnamed tributaries. The NWI mapping shows two freshwater ponds in the project area.

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[1] http://www.twdb.texas.gov/groundwater/dfc/docs/summary/GMA13_DFC_2016.pdf?d=52712.51999999731

[2] Texas Water Development Board report, GR 17-027 MAG; http://www.twdb.texas.gov/groundwater/dfc/docs/summary/GMA13_MAG_2016b.pdf?d=52712.51999999731

[3] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/

Segment 1803B of Sandies Creek in the project area has been designated as an impaired stream segment in the Texas Integrated Report of 303(d) listed water bodies.[4] This list identifies the water bodies or segments in Texas that do not meet assigned water quality standards. The project area does not contain ecologically significant stream segments as designated by TPWD.

The project will require an on-site delineation of streams, ponds, and wetlands. Well field facilities can typically be sited to avoid impacts to waters of the United States, including wetlands. Stream crossing for pipeline construction would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including if there would be permanent impacts to more than 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under stream (e.g., through horizontal directional drilling) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

Table 5.2.19-1 provides a summary of threatened, endangered, and candidate species and species of concern that have potential to occur in Guadalupe County.[5][6] It should be noted that the county species lists are current as of August 9, 2019, but may be updated as new species information becomes available. Suitable habitat does not occur for any of the federally-listed species. However, several freshwater mussel species are under review for federal listing as threatened or endangered, and the project pipeline crosses streams that have low potential to provide suitable habitat for freshwater mussels.

Suitable habitat may occur for the state-listed threatened species: white-faced ibis (*Plegadis chihi*), Texas horned lizard (*Phrynosoma cornutum*), and Texas tortoise (*Gopherus berlandieri*).

There is potential for suitable habitat for numerous wildlife species designated by TPWD as SGCN, including American bumblebee (*Bombus pensylvanicus*), Strecker's chorus frog (*Pseudacris streckeri*), Woodhouse's toad (*Anaxyrus woodhousii*), western burrowing owl (*Athene cunicularia hypugaea*), American badger (*Taxidea taxus*), thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*), eastern spotted skunk (*Spilogale putorius*), and plains spotted skunk (*Spilogale putorius interrupta*). In addition, SGCN bat species may utilize structures and could therefore occur in developed areas. The SGCN list also includes numerous plant species. SGCN species do not have formal protected status but are being monitored by TPWD.

Site-specific field surveys would be required to determine the quality of habitat for freshwater mussels, should they be added to the federal list of threatened/endangered species. Consultation with the USFWS would be required if suitable mussel habitat may be affected by pipeline and well sites

[4] Texas Commission on Environmental Quality. 2015. 2014 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/waterquality/assessment/14twqi/14txir.
[5] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Guadalupe County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.
[6] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Guadalupe County. https://ecos.fws.gov/ipac/location/C2VXOUKYDFDHXMRWX2HITU6E3I/resources .

construction activities. Site-specific field surveys would also be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain their recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15.

Table 5.2.19-1 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for Wells Ranch Phase 3 Project, Guadalupe County, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Strecker's chorus frog	*Pseudarcris streckeri*	NA	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Suitable habitat may occur in wetland areas along pipeline alignment and well pad sites.
Texas blind salamander	*Eurycea rathbuni*	E	SGCN	Water-filled subterranean caverns along 6 miles of the San Marcos Spring Fault.	Project is outside of the expected range of this species.
Woodhouse's toad	*Anaxyrus woodhousii*	NA	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur in wetland areas along pipeline alignment and well pad sites.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat does not occur within project area; may fly over during migration.
Black rail	*Laterallus jamaicensis*	NA	SGCN	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh.	Low probability of occurring in emergent wetland areas along the pipeline alignment and well pad site.
Franklin's gull	*Leucophaeus pipixcan*	NA	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur within project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also known to nest on manmade structures (inland beaches, WWTPs, gravel mines, etc.).	Suitable habitat does not occur within project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	NA	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat does not occur within project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur within project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	NA	SGCN	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Project is outside of the expected range of this species.
Swallow-tailed kite	*Elanoides forficatus*	NA	SGCN	Lowland forest, especially swampy areas, ranges to open woodland; marshes, along rivers, lakes, and ponds. Nests high in tall trees in clearing or on forest woodland edge, usually pine, cypress, or deciduous trees.	Suitable habitat does not occur within project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	NA	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots, nests, and roosts in abandoned burrows.	Suitable open habitats may occur in the project area along the pipeline and well field site.
White-faced ibis	*Plegadis chihi*	NA	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat may occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems [during migration].	Suitable habitat does not occur within project area; may fly over during migration.
Wood stork	*Mycteria americana*	NA	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Unlikely to occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	NA	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat does not occur within project area; may fly over during migration.
Fishes					
American eel	*Anguila rostrata*	NA	SGCN	Coastal waterways below reservoirs.	Unlikely to occur in project area.
Fountain darter	*Etheostoma fonticola*	E	E	San Marcos and Comal Rivers; springs and spring-fed streams with dense beds of aquatic plants.	Project is outside of the expected range of this species
Guadalupe bass	*Micropterus treculii*	NA	SGCN	Perennial streams of the Edwards Plateau region.	Low potential to occur in project area.
Guadalupe darter	*Percina apristis*	NA	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Suitable habitat does not occur within project area
Plateau shiner	*Cyprinella lepida*	NA	SGCN	Edwards Plateau portion of the Nueces basin; cool, clear, spring-fed headwater creeks.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
River darter	*Percina shumardi*	NA	SGCN	Confined to large rivers and lower parts of major tributaries; almost invariably found in deep chutes and riffles where current is swift and bottom composed of coarse gravel or rock.	Suitable habitat does not occur within project area.
Texas shiner	*Notropis amabilis*	NA	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Suitable habitat does not occur within project area.
Insects					
American bumblebee	*Bombus pensylvanicus*	NA	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in the project area along the pipeline alignment and well field site.
Mammals					
American badger	*Taxidea taxus*	NA	SGCN	Prefer grasslands and open areas.	May occur along pipeline alignment and well field site.
Big brown bat	*Eptesicus fuscus*	NA	SGCN	Woodlands or wooded areas.	May possibly occur within woodlands along the pipeline alignment and well field site.
Big free-tailed bat	*Nyctinomops macrotis*	NA	SGCN	Roost in high canyon walls but will use buildings.	Suitable habitat does not occur within project area.
Black-tailed prairie dog	*Cynomys ludovicianus*	NA	SGCN	Short, flat, dry grasslands with sparse vegetation.	Not expected to occur within the project area.
Cave myotis bat	*Myotis velifer*	NA	SGCN	Cave-dwelling, also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	Suitable habitat does not occur within project area.
Eastern red bat	*Lasiurus borealis*	NA	SGCN	Often associated with wooded areas; found in urban areas during migration.	May possibly occur within woodlands along the pipeline alignment and well field site.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Eastern spotted skunk	*Spilogale putorius*	NA	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges, and woodlands. Prefer wooded, brushy areas; tallgrass prairies.	May occur within woodlands along the pipeline alignment and well field site.
Hoary bat	*Lasiurus cinereus*	NA	SGCN	Forests and woods in east and central Texas.	May possibly occur within woodlands along the pipeline alignment and well field site.
Long-tailed weasel	*Mustela frenata*	NA	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	May possibly occur within along the pipeline alignment and well field site.
Mexican free-tailed bat	*Tadarida brasiliensis*	NA	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	May forage along portions of the pipeline alignment and well field site.
Mexican long-tongued bat	*Choeronycteris mexicana*	NA	SGCN	Riparian forest in Texas; roost in mines, large crevices, and caves.	Not expected to occur in project area.
Mink	*Neovison vison*	NA	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Not expected to occur in project area.
Mountain lion	*Puma concolor*	NA	SGCN	Use wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Very low potential to occur as a vagrant along pipeline alignment and wells sites.
Plains spotted skunk	*Spilogale putorius interrupta*	NA	SGCN	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur along pipeline alignment and well field site.
Swamp rabbit	*Sylvilagus aquaticus*	NA	SGCN	Found near water in fallen trees, thickets, and stumps.	Very low potential to occur in wetland/riparian areas along the pipeline alignment and well field site.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	NA	SGCN	Prefer short-grass prairies, also occur in pastures and along fencerows. Excavate burrows or use abandoned pocket gopher or prairie dog burrows.	Suitable habitat may occur along pipeline alignment and well field site.
Tricolored bat	*Perimyotis subflavus*	NA	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat may occur along pipeline alignment and well field site.
Western hog-nosed skunk	*Conepatus leuconotus*	NA	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat may occur along pipeline alignment and well field site.
Western spotted skunk	*Spilogale gracilis*	NA	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur along pipeline alignment and well field site.
White-nosed coati	*Nasua narica*	NA	T	Canyons, riparian corridors, and woodlands.	Project area is outside the expected range of this species.
Mollusks					
False spike	*Fusconaia mitchelli*	NA	T	Medium to large rivers; present in Guadalupe, Colorado, Brazos river basins.	Very low potential to occur in waterways along the pipeline alignment. Not expected in well field sites.
Golden orb	*Cyclonaias aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Very low potential to occur in waterways along the pipeline alignment. Not expected in well field sites. This species is expected to be removed the federal candidate list in the future.
No accepted common name	*Cyclonaias necki*	NA	NA	Guadalupe River basin; moderate to large streams with flowing water.	Very low potential to occur in perennial waterways along the pipeline alignment. Not expected in well field sites. This species is expected to be state listed in the near future.
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	NA	SGCN	Endemic to sandy regions of southern and south-central Texas.	Suitable sandy habitats may occur along pipeline alignment and well field site.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Big red sage	*Salvia pentstemonoides*	NA	SGCN	Moist to seasonally wet, steep limestone outcrops on seeps within canyons or along creek banks; occasionally on clayey to silty soils of creek banks and terraces, in partial shade to full sun.	Not expected to occur in project area.
Bracted twistflower	Streptanthus bracteatus	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Suitable habitat does not occur within project area.
Buckley tridens	*Tridens buckleyanus*	NA	SGCN	Juniper-oak woodlands on rocky limestone slopes.	Suitable habitat does not occur within project area.
Elmendorf's onion	*Allium elmendorfii*	NA	SGCN	Grassland openings in oak woodlands on deep, loose, well-drained sands; to the north it occurs in post oak-black hickory-live oak woodlands over Queen City and similar Eocene formations.	Suitable habitat likely occurs along pipeline alignment and well field site.
Engelmann's bladdpod	*Physaria engelmannii*	NA	SGCN	Grasslands and calcareous rock outcrops along the eastern edge of the Edwards Plateau, ranging as far north as the Red River.	Suitable habitat does not occur within project area.
Heartleaf evening primrose	*Oenothera cordata*	NA	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Suitable habitat may occur along pipeline alignment and well field site.
Heller's marbleseed	*Omosmodium helleri*	NA	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Hill Country wild-mercury	*Argythamnia aphoroides*	NA	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands, also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Suitable habitat does not occur within project area.
Low spurge	*Euphorbia peplidion*	NA	SGCN	Occurs in a variety of vernally moist situations in a number of natural regions.	Suitable habitat may occur along pipeline alignment and well field site.
Net-leaf bundleflower	*Desmanthus reticulatus*	NA	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat may occur along pipeline alignment and well field site.
Parks jointweed	*Polygonella parksii*	NA	SGCN	Mostly on deep, loose, whitish sand blowouts (unstable, deep, xeric, sandhill barrens) in Post Oak Savannah landscapes over the Carrizo and Sparta formations; also occurs in early successional grasslands, along rights-of-way, and on mechanically disturbed areas.	Suitable habitat may occur along pipeline alignment and well field site.
Plateau milkvine	*Matelea edwardsensis*	NA	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Suitable habitat does not occur within project area.
Sandhill woolywhite	*Hymenopappus carrizoanus*	NA	SGCN	Disturbed or open areas in grasslands and post oak woodlands on deep sands derived from the Carrizo Sand and similar Eocene formations.	Suitable habitat may occur along pipeline alignment and well field site.
South Texas spikesedge	*Eleocharis austrotexana*	NA	SGCN	Wetlands on the coastal plain.	Suitable habitat may occur along pipeline alignment and well field site.
Texas amorpha	*Amorpha roemeriana*	NA	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes, sometimes on dry shelves above creeks.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas beebalm	*Monarda viridissima*	NA	SGCN	Endemic perennial herb of the Carrizo Sands; deep, well-drained sandy soils in openings of post oak woodlands.	Suitable habitat may occur along pipeline alignment and well field site.
Woolly butterflyweed	*Gaura villosa ssp. parksii*	NA	SGCN	Sandy soils of Rio Grande plains.	Suitable habitat does not occur within project area.
Wright's trichocoronis	*Trichocoronis wrightii* var. *wrightii*	NA	SGCN	Riparian zones, wetlands, pond margins, wet meadows.	Suitable habitat may occur along pipeline alignment and well field site.
Reptiles					
American alligator	*Alligator mississippiensis*	NA	NA	Inland natural rivers, swamps, marshes, coastal marshes, and manmade impoundments.	Unlikely to occur in project area.
Cagle's map turtle	*Graptemys caglei*	NA	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River System.	Suitable habitat does not occur within project area.
Eastern box turtle	*Terrapene carolina*	NA	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur along pipeline alignment and well field site.
Keeled earless lizard	*Holbrookia propinqua*	NA	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat may occur along pipeline alignment and well field site.
Northern spot-tailed earless lizard	*Holbrookia lacerata lacerata*	NA	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edward's Plateau.	Suitable habitat may occur along pipeline alignment and well field site.
Slender glass lizard	*Ophisaurus attenuatus*	NA	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannahs, pine barrens, and oil fields.	Suitable sandy habitats likely occur along pipeline alignment and well field site.
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	NA	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat may occur along pipeline alignment and well field site.
Texas horned lizard	*Phrynosoma cornutum*	NA	T	Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur along pipeline alignment and well field site.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas tortoise	*Gopherus berlandieri*	NA	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus.	Suitable habitat may occur along pipeline alignment and well field site.
Western box turtle	*Terrapene ornata*	NA	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrow into soil or may use burrows made by other species.	Suitable habitat may occur along pipeline alignment and well field site.
Western hognose snake	*Heterodon nasicus*	NA	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas, and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets. Seems to prefer sandy and loamy soils.	Suitable habitat may occur along pipeline alignment and well field site.
T = Threatened E = Endangered C = Candidate DL = Delisted SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC, the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the Project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[7] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified no previously recorded archaeological site intersecting or adjacent (within 300 feet) to the project area. The review did identify two potential historic buildings

[7] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

and two linear historic features that intersect the project area. No potential cemeteries, historical markers, or NRHP properties are in or adjacent to the project area.

The model used assessed overall archaeological potential within the project area to be low, ranging from 5 percent to 17 percent likelihood that the project area contains significant unidentified archaeological resources. The greatest probability areas were designated adjacent to existing drainages and near the historic buildings and features.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 15. Based on the results of the background review, a structured cultural resources survey of the final design plan is recommended to assess the presence and significance of cultural resources within its boundaries.

Table 5.2.19-2 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
None	Two Structures	Historic	None	Intersect
Nockenut Seguin Road	Linear Feature	Historic	None	Intersect
Union Seguin Road	Linear Feature	Historic	None	Intersect

5.2.19.4 Engineering and Costing

The preliminary engineering analyses have groundwater being developed for baseload operations (uniform rate). Black & Veatch used the Uniform Costing Tool, which includes standard costing procedures and method for calculating unit costs. The costing procedures include all facilities required for water production, collection, transmission, and treatment. Water treatment consists of iron and manganese removal.

The major facilities required for this strategy (Phase 3) include the following:

- Production wells (nine wells) at approximately 650 gpm;
- Well collection pipelines; and
- Water treatment plant expansion.

Cost estimates developed using regional planning procedures are summarized in Table 5.2.19-3. The costs also include an annual groundwater lease fee of $62.50 per acft/yr and a groundwater district export fee of $8.71 per acft/yr (for a total of $71.21 per acft/yr). The cost of water is estimated to be $1,330 per acft/yr ($4.08 per 1,000 gallons) for treated water.

Table 5.2.19-3 Project Cost Estimate Summary

ITEM	ESTIMATED COSTS
Well Fields (wells, pumps, and piping)	$26,245,000

ITEM	ESTIMATED COSTS
Two Water Treatment Plants (5 mgd)	$7,945,000
TOTAL COST OF FACILITIES	**$94,190,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$11,966,000
Environmental and Archaeology Studies and Mitigation	$333,000
Land Acquisition and Surveying (181 acres)	$62,000
Interest During Construction (3% for 1 year with a 0.5% return on interest)	$1,281,000
TOTAL COST OF PROJECT	**$47,832,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,366,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$262,000
Water Treatment Plant	$4,246,000
Pumping Energy Costs (11,705,881 kWh at 0.08 $/kWh)	$936,000
Groundwater Leases and Export Fees (7,000 acft/yr at $71.21/acft)	$498,000
TOTAL ANNUAL COST	**$9,308,000**
Available Project Yield (acft/yr)	7,000
Annual Cost of Water ($ per acft)	$1,330
Annual Cost of Water After Debt Service ($ per acft)	$849
Annual Cost of Water ($ per 1,000 gallons)	$4.08
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$2.60
Based on a Peaking Factor of 1.	

5.2.19.5 Implementation Considerations

As part of the initial planning for this strategy, existing rules of the GCUWCD with regard to well yield, spacing, and acreage have been considered. An assessment has not been conducted of the maximum drawdown criteria, which will be performed in the cumulative effects section of the plan.

Part or all of the water needed by this WMS is anticipated to be supplied from locations within the jurisdiction of a groundwater conservation district (District).

The development of groundwater in the Carrizo-Wilcox Aquifer in the South Texas Water Planning Region must address several issues. Major issues include the following:

- Verification of available groundwater quantity and well productivity;
- Verification of water quality for concentrations of dissolved constituents, such as TDS, chloride, sulfate, iron, manganese, and hydrogen sulfide;
- Verification of the potential for deep well injection of concentrate;
- Potential for differing water qualities/chemical constituents in the water;
- Iron and manganese content in the water;
- Potential adverse impacts on other aquifers, including potential interaction between the Wilcox and Carrizo formations (additional research regarding potential interaction between the Wilcox and Carrizo formations has been suggested);
- Permitting Class 1 disposal wells for deep well injection of desalination concentrate through TCEQ General Permit;
- Regulations by TCEQ;
- Regulations by and securing permits from the Evergreen Underground Water Conservation District; and
- Experience in operating and maintaining a desalination water treatment plant.

Additional considerations may include the following:

- Impacts on the following:
  - Endangered and threatened species;
  - Water levels in the aquifer, including potential dewatering of the current artesian part of the aquifer;
  - Baseflow in streams; and
  - Wetlands.
- Competition with others in the area for groundwater in the Carrizo Aquifer to include the following:
  - Private water purveyors;
  - Public water purveyors in the area; and/or
  - Future oil and gas drilling operations.

Reliability

Water from these sources is considered to be very reliable based on available hydrogeologic information from the existing nearby wells. Supply is considered to be medium because of the potential of differing well productivity and water quality, potential impacts to natural resources and Carrizo-Wilcox Aquifer user competition (reliability score = 4).

5.2.20 CRWA Siesta Project

5.2.20.1 Description of Water Management Strategy

The CRWA Siesta Project includes diversions from Cibolo Creek in Wilson County under existing and amended water rights along with treated effluent from treatment facilities operated by SARA, CCMA, the City of Marion, and/or GVSUD. Should treated effluent from wastewater treatment facilities not be available, the project could include brackish groundwater as an alternate backup source. The CRWA Siesta Project involves the acquisition/lease of additional water rights and the amendment of surface water right CA #19-1155 presently held by CRWA to increase authorized diversions from Cibolo Creek by CRWA from 42 acft/yr to 5,042 acft/yr. The firm yield of the CRWA Siesta Project at the Siesta Cattle Company site is to be available to the CRWA members via the existing CRWA Mid-Cities Pipeline (Figure 5.2.20-1).

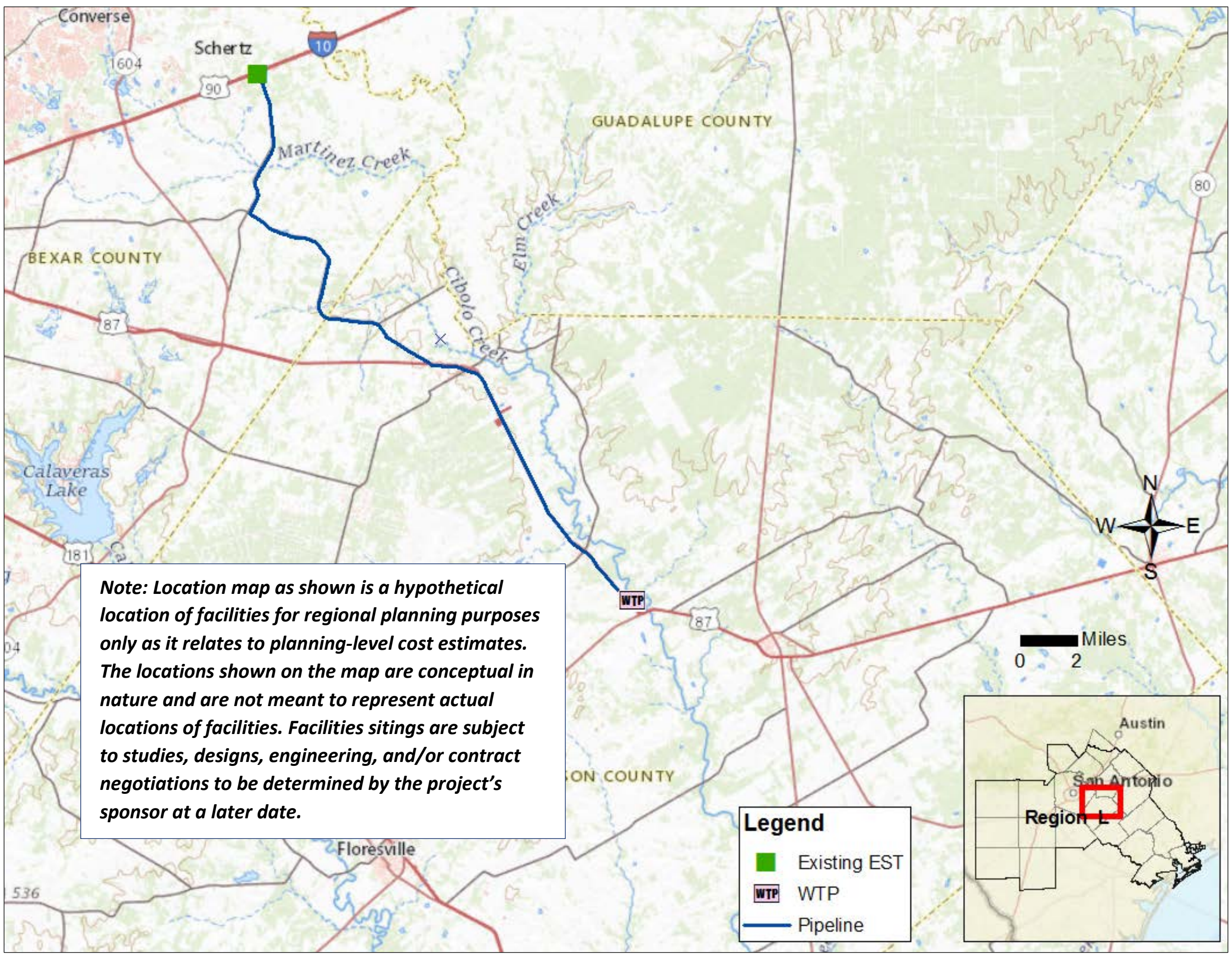

Figure 5.2.20-1 CRWA Siesta Project Location

5.2.20.2 Available Yield

CRWA has acquired two water rights on Cibolo Creek – Certificate of Adjudication (CA) #19-1155 for 42 acft/yr (formerly held by the Siesta Cattle Company) and CA #19-1151 for 86 acft/yr (formerly held by Raymond D. Hegwer et ux). CRWA has entered into agreements to lease water from two water rights holders on Cibolo Creek – CA #19-1152 for 35 acft/yr and CA #19-1157 for 117 acft/yr. CRWA will be seeking to amend these water rights so that a common diversion point can be utilized at the Siesta Cattle Company site and to increase total authorized diversions at that point to 5,042 acft/yr, which is the firm yield for this WMS.

The Guadalupe-San Antonio River Basin Water Availability Model was used to quantify water available for diversion under the existing water rights CRWA has either already acquired/leased or is seeking to acquire/lease. Hydrologic simulations and calculations were performed subject to the Hydrologic Assumptions for approval by TWDB for regional planning.

The GSAWAM was also used to quantify the water available under a proposed amendment to the Siesta water right (CA #19-1155), thereby increasing authorized diversion by 4,762 acft/yr. The proposed amendment to CA #19-1155 was modeled as a new appropriation subject to TCEQ Environmental Flow Standards.

The volumetric and monthly reliability of the water diverted for the CRWA Siesta Project under the various water rights acquisitions, leases, and amendments is shown in Table 5.2.20-1. In addition, Figure 5.2.20-2 shows the makeup water necessary from SARA and/or CCMA WWTPs on Martinez Creek to obtain a firm yield of 5,042 acft/yr. The long-term average (1934 to 1989) diversion from Cibolo Creek under the various water rights is 3,370 acft/yr. The corresponding long-term average makeup water requirement is 1,572 acft/yr. This WMS project is planned for implementation in the 2060 decade.

Table 5.2.20-1 Volumetric and Monthly Reliability for CRWA Siesta Project

WATER RIGHT	VOLUMETRIC RELIABILITY	MONTHLY RELIABILITY
CA #19-1155_1	98.86%	99.11%
CA #19-1151_1	98.86%	99.11%
CA #19-1152_1	94.15%	95.24%
CA #19-1157_2	93.34%	94.49%
CA #19-1155_2*	29.48%	15.48%
*New surface water amendment/permit to be obtained by CRWA.		

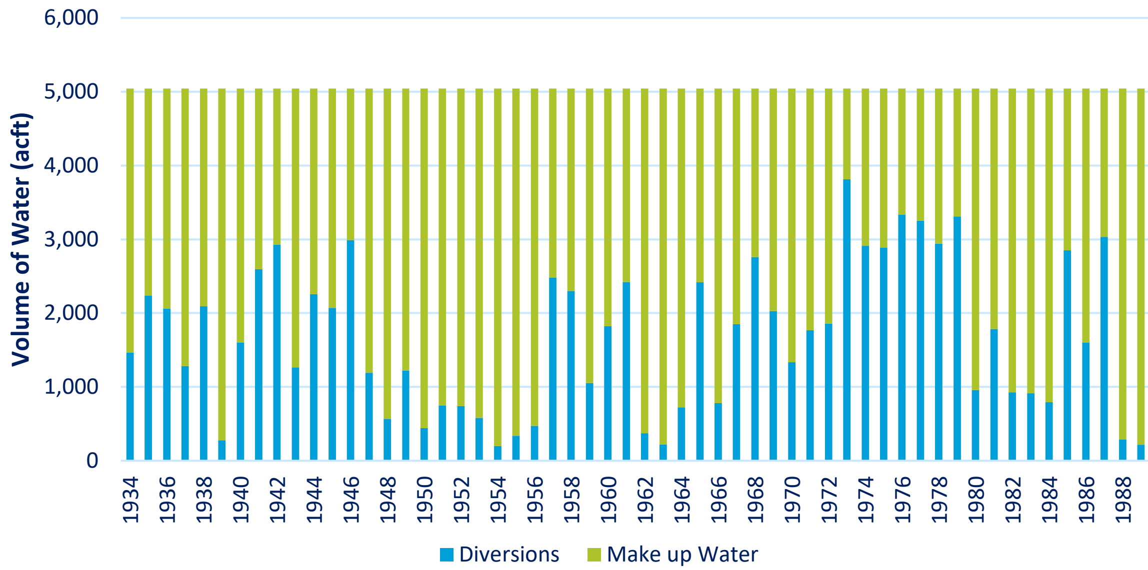

Figure 5.2.20-2 Annual Surface Water Diversion and Makeup Water for Siesta Project

5.2.20.3 Environmental Considerations

Environmental Considerations

Vegetation and Land Use

The project area occurs in the Post Oak Savannah and Blackland Prairie ecoregions, and crosses a variety of vegetation types, mostly open fields, pastures, and riparian zones along streams. As mapped by TPWD[1], dominant vegetation types in the project area are post oak savannah, disturbance/tame grassland, floodplain herbaceous vegetation, mesquite shrubland, and urban. The linear components of the project cross riparian vegetation zones along streams, mapped by TPWD as floodplain and riparian herbaceous vegetation, floodplain and riparian hardwood forest, and floodplain live oak forest.

Based on TPWD vegetation mapping, the project may have the potential to impact 35 acres of agricultural resources, including 2 acres mapped as row crops, and 33 acres of disturbance or tame grassland which may include pasture areas used for grazing or hay production.

The FM 1518 elevated storage tank would result in conversion of land use from undeveloped or agricultural land to small areas of industrial use. Project pipeline easements would require removal of woody vegetation and long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Pipeline easements may continue to be used for agricultural purposes.

[1] TPWD. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

Aquatic Resources

The project pipeline alignment crosses several mapped streams and their associated floodplains, including the Martinez Creek and several tributaries of Cibolo Creek. The NWI mapping displays 2.1 acres of freshwater pond/riverine wetlands in the project area.

The project pipeline alignment generally runs along Segment 1902 of Lower Cibolo Creek; this stream segment has been designated as an impaired stream segment in the Texas Integrated Report of 303(d) listed water bodies[2]. This list identifies the water bodies or segments in Texas that do not meet assigned water quality standards. Martinez Creek in the project area is not listed as impaired. The project area does not contain ecologically significant stream segments as designated by TPWD.

The project will require an on-site delineation of streams, ponds, and wetlands. Stream crossings for pipeline construction would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12 – Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including if there would be permanent impacts to over 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under stream (e.g., through horizontal directional drilling) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

Table 5.2.20-2 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Bexar and Wilson Counties. [3],[4],[5],[6] Suitable habitat does not occur for any of the federally-listed threatened or endangered species; however, several freshwater mussel species are under review for federal listing as threatened or endangered, and the project pipeline crosses streams that may provide suitable habitat for freshwater mussels.

Suitable habitat may occur for several state-listed threatened species, including Texas horned lizard (*Phrynosoma cornutum*), Texas tortoise (*Gopherus berlandieri*), and timber rattlesnake (*Crotalus horridus*). Potentially suitable habitat may occur for numerous state wildlife, plant, and insect species designated by TPWD as SGCN. These species do not have formal protected status but are being monitored by TPWD. Migratory birds may occur in the project area, particularly in riparian zones and wetland areas.

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[2] Texas Commission on Environmental Quality. 2015. 2014 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/waterquality/assessment/14twqi/14txir

[3] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Bexar County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[4] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Bexar County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.

[5] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Wilson County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[6] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Wilson County. https://ecos.fws.gov/ipac/location/FX45LGWSGVBZLJHV4APLVP7LU4/resources.

Streams in the project area may contain suitable habitat for federal candidate/state-threatened freshwater mussel species. Suitable habitat may occur in perennial rivers/streams and perennial pools of intermittent streams. If any such habitat would be affected by construction, presence/absence surveys and relocation of native mussel species would be required. Handling and relocation of aquatic species must be conducted by TPWD-permitted personnel and in accordance with an approved Aquatic Resources Relocation Plan. Furthermore, these candidate species may be listed as threatened or endangered during the project timeline, in which case any species impacts would require USFWS consultation.

Site-specific field surveys would be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain their recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15. Preconstruction surveys for active bird nests are recommended.

Table 5.2.20-2 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for CRWA Siesta Project, Bexar and Wilson Counties, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Black-spotted newt	*Notophthalmus meridionalis*	NA	T	Gulf Coastal Plain south of the San Antonio River; in resacas and bodies of water with firm bottoms and little or no vegetation. Also, in wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions, the absence of predatory fish is probably important.	Project area is outside the expected range of this species.
Cascade Caverns salamander	*Eurycea latitans*	NA	T	Springs and caves in Guadalupe River, Medina River, and Cibolo Creek watersheds, all within the Edwards Aquifer.	Suitable karst habitat does not occur within the project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Comal Blind salamander	*Eurycea tridentifera*	NA	T	Within aphotic zones of shallow limestone caves; found in springs and waters of caves.	Suitable karst habitat does not occur within the project area.
Mexican treefrog	*Smilisca baudinii*	NA	SGCN	The subtropical Rio Grande embayment around Brownsville. May do well in association with human development and may tolerate relatively dry situations provided moist microclimates are available.	Project area is outside the expected range of this species.
Strecker's chorus frog	*Pseudarcris streckeri*	NA	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Suitable habitat may occur in project area.
Texas salamander	*Eurycea neotenes*	NA	SGCN	Cave streams, seeps, springs, and creek headwaters; Helotes and Leon Creek drainages.	Project is outside of the expected range of this species.
Valdina Farms sinkhole salamander	*Eurycea troglodytes*	NA	SGCN	Isolated, intermittent pools of subterranean streams and sinkholes in Nueces, Frio, Guadalupe, and Pedernales watersheds within Edwards Aquifer area.	Project is outside of the expected range of this species.
Woodhouse's toad	*Anaxyrus woodhousii*	NA	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur in project area.
Arachnids					
Braken Bat Cave meshweaver	*Cicurina venii*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Cokendolpher Cave harvestman	*Texella cokendolpheri*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Government Canyon Bat Cave meshweaver	*Cicurina vespera*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Government Canyon Bat Cave spider	*Neoleptoneta microps*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Madla Cave meshweaver	*Cicurina madla*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
No accepted common name	*Speodesmus reddelli*	NA	SGCN	Karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Tartarocreagris amblyopa*	NA	SGCN	Karst features.	Suitable karst habitat does not occur in project area.
Robber Baron Cave meshweaver	*Cicurina baronia*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Arthropods					
No accepted common name	*Speodesmus falcatus*	NA	SGCN	Karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Speodesmus ivyi*	NA	SGCN	Subterranean obligate.	Suitable karst habitat does not occur in project area.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat does not occur in project area; may fly over or forage in wetlands during migration.
Black-capped vireo	*Vireo articapilla*	DL	E	Patches of oak-juniper woodland with open grassy spaces; foliage must reach ground level for nesting cover.	Suitable habitat does not occur in project area; may fly over during migration.
Black rail	*Laterallus jamaicensis*	NA	SGCN	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh.	Low probability of occurring in emergent wetland areas along the pipeline alignment and well pad site.
Franklin's gull	*Leucophaeus pipixcan*	NA	SGCN	Nests around lakes and marshes, may use fields and beaches during migration.	Suitable habitat does not occur within project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Golden-cheeked warbler	*Dendroica chrysoparia*	E	E	Mixed stands of Ashe juniper and various oaks; edges of cedar brakes.	Suitable habitat does not occur in project area; may fly over during migration.
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also known to nest on manmade structures (inland beaches, WWTPs, gravel mines, etc.).	Suitable habitat does not occur in project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	NA	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat may occur within project area; may fly over or feed in area during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur within project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	NA	SGCN	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Project is outside of the expected range of this species.
Tropical parula	*Setophaga pitiayumi*	NA	T	Dense or open woods, brush, trees, and undergrowth along edges of river and resacas.	Suitable habitat does not occur within project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	NA	SGCN	Open grasslands and savannahs may use open areas such as vacant lots, nests, and roosts in abandoned burrows.	Suitable habitat may occur in project area.
White-faced ibis	*Plegadis chihi*	NA	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Low likelihood of suitable habitat in project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems [during migration].	Suitable habitat does not occur within project area; may fly over during migration.
Wood stork	*Mycteria americana*	NA	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Unlikely to occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	NA	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat does not occur within project area; may fly over during migration.
Crustaceans					
A cave obligate isopod	*Speocirolana hardeni*	NA	SGCN	Cave obligate.	Suitable karst habitat does not occur in project area.
Cascade Cave amphipod	*Stygobromus dejectus*	NA	SGCN	Subaquatic, subterranean pools.	Suitable karst habitat does not occur in project area.
Ezell's Cave amphipod	*Stygobromus flagellates*	NA	SGCN	Artesian wells.	Suitable karst habitat does not occur in project area.
No accepted common name	*Mexiweckelia hardeni*	NA	SGCN	Cave obligate amphipod.	Suitable karst habitat does not occur in project area.
Fishes					
Guadalupe bass	*Micropterus treculii*	NA	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat may occur in streams in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
River darter	*Percina shumardi*	NA	SGCN	Confined to large rivers and lower parts of major tributaries; almost invariably found in deep chutes and riffles where current is swift and bottom composed of coarse gravel or rock.	Suitable habitat does not occur in project area.
Texas shiner	*Notropis amabilis*	NA	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Suitable habitat may occur in streams in project area.
Toothless blindcat	*Trogloglanis pattersoni*	NA	SGCN	Known from five artesian wells penetrating the San Antonio Pool of the Edwards Aquifer; found at depths of 305 to 582 meters.	Project would not affect groundwater.
Widemouth blindcat	*Satan eurystomus*	NA	SGCN	Known from five artesian wells penetrating the San Antonio Pool of the Edwards Aquifer; found at depths of 305 to 582 meters.	Project would not affect groundwater.
Insects					
A cave obligate beetle	*Batrisodes shadeae*	NA	SGCN	Cave obligates.	Suitable karst habitat does not occur in project area.
A ground beetle	*Rhadine exilis*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
A ground beetle	*Rhadine infernalis*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
American bumblebee	*Bombus pensylvanicus*	NA	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in the project area.
No accepted common name	*Bombus variabilis*	NA	SGCN	Parasite on other bumblebee species.	Suitable habitat may occur in the project area.
Comanche harvester ant	*Pogonomyrmex comanche*	NA	SGCN	Sandy soils and post oak.	Suitable habitat may occur in the project area along the pipeline and well field site.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Helotes mold beetle	*Batrisodes venyivi*	E	SGCN	Karst features in total darkness with constant temperature and humidity.	Suitable karst habitat does not occur in project area.
Manfreda giant skipper	*Stallingsia maculosus*	NA	SGCN	Subtropical mesquite scrub with an abundance of Manfreda, on sandy or clay soils, either dry or moist. Apparently occasionally pine woodland.	Suitable habitat may occur in the project area.
No accepted common name	*Arethaea phantasma*	NA	SGCN	Shrubland, woodland.	May possibly occur within woodlands along the pipeline alignment and well field site.
No accepted common name	*Cotinis boylei*	NA	SGCN	South Texas coastal plains.	Suitable habitat unlikely to occur in the project area.
No accepted common name	*Cotalpa conclamara*	NA	SGCN	Sandy soils and post oak.	Suitable habitat may occur in the project area.
No accepted common name	*Dichopetala catinata*	NA	SGCN	Grassland, shrubland.	Suitable habitat may occur in the project area.
No accepted common name	*Dichopetala seeversi*	NA	SGCN	Grassland, shrubland.	Suitable habitat may occur in the project area.
No accepted common name	*Lymantes nadineae*	NA	SGCN	Caves/karst features.	Suitable karst habitat does not occur in the project area.
No accepted common name	*Megachile parksi*	NA	SGCN	Grassland, shrubland.	Suitable habitat may occur in the project area.
No accepted common name	*Nectopsyche texana*	NA	SGCN	Riparian/riverine habitats.	Suitable unlikely to occur in the project area.
No accepted common name	*Rhadine bullis*	NA	SGCN	Cave obligates.	Suitable karst habitat does not occur in the project area.
No accepted common name	*Pygarctia lorula*	NA	SGCN	Savannah, open woodland.	Suitable habitat may occur in the project area.
Mammals					
American badger	*Taxidea taxus*	NA	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur in the project area.
Big brown bat	*Eptesicus fuscus*	NA	SGCN	Woodlands or wooded areas.	Suitable habitat may occur in the project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Big free-tailed bat	*Nyctinomops macrotis*	NA	SGCN	Roost in high canyon walls but will use buildings.	May use buildings/ structures in the project area.
Black bear	*Ursus americanus*	NA	T	Juniper-oak habitat, bottomland hardwoods, floodplain forests, upland hardwoods with mixed pine.	Project is outside the expected range of this species.
Black-tailed prairie dog	*Cynomys ludovicianus*	NA	SGCN	Short, flat, dry grasslands with sparse vegetation.	Low potential of suitable habitat within the project area.
Cave myotis bat	*Myotis velifer*	NA	SGCN	Cave-dwelling, roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	May use buildings/ structures in the project area.
Eastern red bat	*Lasiurus borealis*	NA	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat may occur in the project area.
Eastern spotted skunk	*Spilogale putorius*	NA	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges and woodlands. Prefer wooded, brushy areas; tallgrass prairies.	Suitable habitat may occur in the project area.
Hoary bat	*Lasiurus cinereus*	NA	SGCN	Forests and woods in east and central Texas.	Suitable habitat may occur in the project area.
Long-tailed weasel	*Mustela frenata*	NA	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur in the project area.
Mexican free-tailed bat	*Tadarida brasiliensis*	NA	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	May use buildings/ structures in the project area.
Mink	*Neovison vison*	NA	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps and marshes.	Low potential of suitable habitat within the project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Mountain lion	*Puma concolor*	NA	SGCN	Use wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Low potential of suitable habitat within the project area.
Plains spotted skunk	*Spilogale putorius interrupta*	NA	SGCN	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur in project area.
Swamp rabbit	*Sylvilagus aquaticus*	NA	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat may occur in project area.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	NA	SGCN	Prefer short-grass prairies, also occur in pastures and along fencerows. Excavate burrows or use abandoned pocket gopher or prairie dog burrows.	Suitable habitat may occur in project area.
Tricolored bat	*Perimyotis subflavus*	NA	SGCN	Caves; riparian areas, woodland, and forest.	Low potential to occur in project area.
Western hog-nosed skunk	*Conepatus leuconotus*	NA	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat may occur in project area.
Western spotted skunk	*Spilogale gracilis*	NA	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur in project area.
White-nosed coati	*Nasua narica*	NA	T	Canyons, riparian corridors, and woodlands.	Low potential to occur in project area.
Mollusks					
Golden orb	*Cyclonaias aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Suitable habitat may occur in streams along pipeline alignment.
Mimic cavesnail	*Phreatodrobia imitata*	NA	SGCN	Subaquatic, only known from two wells penetrating the Edwards Aquifer.	Project would not affect groundwater.
No accepted common name	*Phreatodrobia conica*	NA	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
No accepted common name	*Cyclonaias necki*	NA	SGCN	Guadalupe River basin; moderate to large streams with flowing water.	Suitable habitat may occur in streams along pipeline alignment.
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	NA	SGCN	Endemic to sandy regions of southern and south-central Texas.	Suitable habitat may occur in project area.
Big red sage	*Salvia pentstemonoides*	NA	SGCN	Moist to seasonally wet, steep limestone outcrops on seeps within canyons or along creek banks; occasionally on clayey to silty soils of creek banks and terraces, in partial shade to full sun.	Suitable habitat does not occur within project area.
Bigflower cornsalad	*Valerianella stenocarpa*	NA	SGCN	Usually along creek beds or in vernally moist grassy open areas.	Suitable habitat may occur in project area.
Bracted twistflower	Streptanthus bracteatus	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Suitable habitat does not occur within project area.
Bristle nailwort	*Paronychia setacea*	NA	SGCN	Eastern south-central Texas, occurring in sandy soils.	Suitable habitat may occur in project area.
Buckley tridens	*Tridens buckleyanus*	NA	SGCN	Juniper-oak woodlands on rocky limestone slopes.	Suitable habitat does not occur within project area.
Burridge greenthread	*Thelesperma burridgeanum*	NA	SGCN	Sandy open areas.	Suitable habitat may occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Corell's false dragon-head	*Physostegia correllii*	NA	SGCN	Wet, silty clay loams on streamsides, in creek beds, irrigation channels, and roadside drainage ditches; or underlain by Austin Chalk limestone along gently flowing spring-fed creek in central Texas.	Low potential for suitable habitat in project area.
Drummond's rushpea	*Caesalpinia drummondii*	NA	SGCN	Open areas on sandy clay.	Suitable sandy habitats may occur along pipeline alignment and well field site.
Elmendorf's onion	*Allium elmendorfii*	NA	SGCN	Grassland openings in oak woodlands on deep, loose, well-drained sands; to the north it occurs in post oak-black hickory-live oak woodlands over Queen City and similar Eocene formations.	Suitable habitat may occur in project area.
Glass Mountains coral-root	*Hexalectris nitida*	NA	SGCN	Ashe juniper woodlands over limestone in Edwards Plateau.	Suitable habitat unlikely to occur within project area.
Gravelbar brickellbush	*Brickellia dentata*	NA	SGCN	Frequently scoured gravelly alluvial beds in creek and river bottoms.	Suitable habitat unlikely to occur within project area.
Hairy sycamore-leaf snowbell	*Styrax platanifolius ssp. stellatus*	NA	SGCN	Usually in oak-juniper woodlands on steep rocky banks and ledges along intermittent or perennial streams, rarely far from some reliable source of moisture.	Suitable habitat does not occur within project area.
Heller's beardtongue	*Penstemon triflorus ssp. integrifolius*	NA	SGCN	Rock outcrops and in grasslands associated with juniper-oak woodlands	Suitable habitat may occur within project area.
Heller's marbleseed	*Omosmodium helleri*	NA	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Hill Country wild-mercury	*Argythamnia aphoroides*	NA	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands, also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Suitable habitat does not occur within project area.
Low spurge	*Euphorbia peplidion*	NA	SGCN	Occurs in a variety of vernally-moist situations in a number of natural regions.	Suitable habitat may occur within project area.
Lundell's whitlow-wort	*Paronychia lundellorum*	NA	SGCN	The Sand Sheet of eastern South Texas, in tight sandy soils over saline clay on microhighs within salty prairie grasslands, and in upper portions of saline flats surrounding short drainages and brackish basins typical of the South Texas Sand Sheet.	Project area is outside the expected range of this species.
Narrowleaf brickellbush	*Brickellia eupatorioides var. gracillima*	NA	SGCN	Moist to dry gravelly alluvial soils along riverbanks but also on limestone slopes.	Suitable habitat does not occur within project area.
Net-leaf bundleflower	*Desmanthus reticulatus*	NA	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat may occur within project area.
Osage Plains false foxglove	*Agalinis densiflora*	NA	SGCN	Grasslands on shallow, gravelly, well drained calcareous soils; prairies, dry limestone soils.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Parks jointweed	*Polygonella parksii*	NA	SGCN	Mostly on deep, loose, whitish sand blowouts (unstable, deep, xeric, sandhill barrens) in Post Oak Savannah landscapes over the Carrizo and Sparta formations; also occurs in early successional grasslands, along rights-of-way, and on mechanically disturbed areas.	Suitable habitat may occur within project area.
Plateau loosestrife	*Lythrum ovalifolium*	NA	SGCN	Banks and gravelly beds of perennial or strong intermittent streams on Edwards Plateau.	Suitable habitat does not occur within project area.
Plateau milkvine	*Matelea edwardsensis*	NA	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Suitable habitat does not occur within project area.
Sandhill woolywhite	*Hymenopappus carrizoanus*	NA	SGCN	Disturbed or open areas in grasslands and post oak woodlands on deep sands derived from the Carrizo Sand and similar Eocene formations.	Suitable habitat may occur within project area.
Siler's huaco	*Manfreda sileri*	NA	SGCN	Rare in a variety of grasslands and shrublands on dry sites.	Suitable habitat may occur within project area.
South Texas rushpea	*Caesalpinia phyllanthoides*	NA	SGCN	Tamaulipan thorn shrublands or grasslands on very shallow sandy to clayey soils over calcareous sandstone and caliche.	Low likelihood of suitable habitat within project area.
Spreading leastdaisy	*Chaetopappa effusa*	NA	SGCN	Limestone cliffs, ledges, bluffs, steep hillsides, sometimes in seepy areas, oak-juniper, oak, or mixed deciduous woods, 300 to 500 meter elevation.	Low likelihood of suitable habitat within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Sycamore-leaf snowbell	*Styrax platanifolius ssp. platanifolius*	NA	SGCN	Rare throughout range, usually in oak-juniper woodlands on steep rocky banks and ledges along intermittent or perennial streams, rarely far from some reliable source of moisture.	Suitable habitat does not occur within project area.
Texas almond	*Prunus minutiflora*	NA	SGCN	Variety of grassland and shrubland habitats, mostly on calcareous soils underlain by limestone.	Low likelihood of suitable habitat in project area.
Texas amorpha	*Amorpha roemeriana*	NA	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes, sometimes on dry shelves above creeks.	Suitable habitat does not occur within project area.
Texas beebalm	*Monarda viridissima*	NA	SGCN	Endemic perennial herb of the Carrizo Sands; deep, well-drained sandy soils in openings of post oak woodlands.	Suitable habitat may occur along pipeline alignment and well field site.
Texas fescue	*Festuca versuta*	NA	SGCN	Mesic woodlands on limestone-derived soils on stream terraces and canyon slopes.	Suitable habitat does not occur within project area.
Texas peachbush	*Prunus texana*	NA	SGCN	Occurs at scattered sites in various well drained sandy situations; deep sand, plains and sand hills, grasslands, oak woods, 0 to 200 meter elevation.	Suitable habitat may occur within project area.
Texas seymeria	*Seymeria texana*	NA	SGCN	Grassy openings in juniper-oak woodlands on dry rocky slopes or rock outcrops in shaded canyons.	Suitable habitat does not occur within project area.
Threeflower penstemon	*Penstemon triflorus ssp. triflorus*	NA	SGCN	Occurs sparingly on rock outcrops and in grasslands associated with juniper-oak woodlands.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Tree dodder	*Cuscuta exaltata*	NA	SGCN	Parasitic on numerous woody plant species, including oak, walnut, sumac, grape, elm, and persimmon.	Suitable host species may occur in project vicinity.
Turnip-root scurfpea	*Pediomelum cyphocalyx*	NA	SGCN	Grasslands and openings in juniper-oak woodlands on limestone substrates on the Edwards Plateau and in north-central Texas.	Low likelihood of suitable habitat in project area.
Woolly butterflyweed	*Gaura villosa ssp. parksii*	NA	SGCN	Sandy soils of Rio Grande plains.	Low likelihood of suitable habitat in project area.
Wright’s milkvetch	*Astralagus wrightii*	NA	SGCN	Edwards Plateau.	Low likelihood of suitable habitat in project area.
Reptiles					
American alligator	*Alligator mississippiensis*	NA	NA	Inland natural rivers, swamps, marshes, coastal marshes, and manmade impoundments.	Low likelihood to occur in project area.
Cagle’s map turtle	*Graptemys caglei*	NA	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River System.	Suitable habitat unlikely to occur within project area.
Common garter snake	*Thamnophis sirtalis*	NA	SGCN	Marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur within project area.
Eastern box turtle	*Terrapene carolina*	NA	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur within project area.
Keeled earless lizard	*Holbrookia propinqua*	NA	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat may occur within project area.
Northern spot-tailed earless lizard	*Holbrookia lacerata*	NA	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edward’s Plateau.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Slender glass lizard	*Ophisaurus attenuatus*	NA	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannahs, pine barrens, and oil fields.	Suitable habitat may occur within project area.
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	NA	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat may occur within project area.
Texas garter snake	*Thamnophis sirtalis annectens*	NA	SGCN	Marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur within project area.
Texas horned lizard	*Phrynosoma cornutum*	NA	T	Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees.	Suitable habitat may occur within project area.
Texas indigo snake	*Drymarchon melanurus erebennus*	NA	T	South of the Guadalupe River and Balcones Escarpment, thornbrush chaparral woodland, particularly dense riparian corridors.	Project area is outside the expected range of this species.
Texas tortoise	*Gopherus berlandieri*	NA	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus.	Suitable habitat may occur within project area.
Timber rattlesnake	*Crotalus horridus*	NA	T	Swamps, floodplains, upland pine and deciduous woodland, riparian zones, abandoned farmland. Limestone bluffs, sandy soil or black clay. Prefers dense ground cover (i.e., grapevines, palmetto).	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Western box turtle	*Terrapene ornata*	NA	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrow into soil or may use burrows made by other species.	Suitable habitat may occur within project area.
Western hognose snake	*Heterodon nasicus*	NA	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas (but not intensively cultivated), and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets. Seems to prefer sandy and loamy soils.	Suitable habitat may occur within project area.
Western rattlesnake	*Crotalis viridis*	NA	SGCN	Desert and prairie grassland; shrub desert rocky hillsides; edges of arid and semi-arid river breaks.	Project area is outside the expected range of this species.
T = Threatened E = Endangered C = Candidate DL = Delisted SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC, the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the Project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[7] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified one previously recorded archaeological site adjacent (within 300 feet) to the project area. The site consists of a prehistoric lithic and ceramic artifact scatter with

[7] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. See TX Code § 2254.021.

undetermined NRHP eligibility (THC 2019). A total of 40 potential historic buildings intersect the project area. The review also identified three Official Texas Historic Markers and two cemeteries adjacent to the project area (Table 5.2.20-3). No known NRHP-listed properties are in or adjacent to the project area.

The model used assessed unrecorded archaeological site potential within the project area to include low to high potential zones, ranging from 5 percent to 91 percent likelihood that the landform crossed contains significant unidentified archaeological resources. The greatest probability areas were designated adjacent to existing streams, the known archaeological site, and cemeteries.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 91.5. Based on the results of the background review, SWCA recommends that the design avoid the cemeteries and a structured cultural resources survey of the final design plan be performed to accurately assess the presence and significance of identified and unrecorded cultural resources within its boundaries.

Table 5.2.20-3 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological Site	Artifact scatter	Prehistoric	Undetermined	Adjacent
Cemetery	Annunciation of the Blessed Virgin Mary Roman Catholic	Historic	Historic Texas Cemetery	Adjacent
Historic Marker #13574	Annunciation of the Blessed Virgin Mary Roman Catholic	Historic	None	Adjacent
Cemetery	Immanuel Lutheran	Historic	Historic Texas Cemetery	Adjacent
Historic Marker #13555	Immanuel Lutheran	Historic	None	Adjacent
Historic Marker #13047	Suttles Pottery	Historic	None	Adjacent
Historic Building	40 Historic Buildings	Historic	Undetermined	Intersect
			ASSESSMENT SCORE TOTAL:	**91.5**

5.2.20.4 Engineering and Costing

Facilities for the CRWA Siesta Project include a raw water intake and pump station and a water treatment plant at the Siesta Cattle Company site as well as a 23-mile, 20-inch treated water transmission pipeline to the existing FM 1518 elevated tank, part of the existing CRWA Mid-Cities Pipeline. Facilities have been sized with a 1.5 peaking factor to meet peak month demands. For costing purposes only, it is assumed that the entire 5,042 acft/yr would be delivered to the FM 1518 elevated tank. Preliminary engineering and costing analyses have been performed using the 2021 Regional Water Planning methods. For Region L, Black & Veatch utilized the standard costing procedures and unit costs.

As suggested by CRWA, water rights acquisition costs are based on a one-time cost of $500/acft and lease costs are based on an annual cost of $75/acft/yr. Table 5.2.20-4 contains the cost estimate for the CRWA Siesta Project. The capital cost for the facilities of the CRWA Siesta Project, including the acquisition of 583 acft/yr in water rights, is $75,582,000. With the inclusion of other project costs (contingencies, environmental, land acquisition, etc.), the total project cost is $107,161,000. The annual cost for the CRWA Siesta Project, including amortization and O&M, is $12,456,000, yielding a unit cost of water of $2,470 per acft/yr.

Table 5.2.20-4 Cost Estimate Summary

ITEM	ESTIMATED COSTS
Channel Dam	$585,000
Intake Pump Stations (6.8 mgd)	$18,993,000
Transmission Pipeline (20 in. diameter, 23 miles)	$20,024,000
Transmission Pump Station(s) and Storage Tank(s)	$6,625,000
Water Treatment Plant (6.8 mgd)	$29,355,000
TOTAL COST OF FACILITIES	**$75,582,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$25,452,000
Environmental and Archaeology Studies and Mitigation	$659,000
Land Acquisition and Surveying (296 acres)	$1,844,000
Interest During Construction (4% for 1 years with a 1% ROI)	$3,624,000
TOTAL COST OF PROJECT	**$107,161,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$8,967,000
O&M	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$212,000
Intakes and Pump Stations (2.5% of cost of facilities)	$612,000
Dam and Reservoir (1.5% of cost of facilities)	$9,000
Water Treatment Plant	$2,122,000
Pumping Energy Costs (5,813,397 kW-h at 0.09 $/kW-h)	$523,000

ITEM	ESTIMATED COSTS
Purchase of Water (152 acft/yr at 75 $/acft)	$11,000
TOTAL ANNUAL COST	**$12,456,000**
Available Project Yield (acft/yr)	5,042
Annual Cost of Water ($ per acft)	$2,470
Annual Cost of Water After Debt Service ($ per acft)	$692
Annual Cost of Water ($ per 1,000 gallons)	$7.58
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$2.12
Based on a Peaking Factor of 1.5.	

5.2.20.5 Implementation Considerations

Potential issues or challenges associated with implementation of the CRWA Siesta Project could include the following:

- Purchase or lease agreements with water rights holders on Cibolo Creek;
- Permit amendments for each of the water rights to be purchased or leased to allow diversion from a common point at the Siesta Cattle Company site;
- Permit amendment for the Siesta water right (CA #19-1155) to authorize increased diversions;
- Agreement between CRWA and SARA, the City of Marion, Green Valley, and/or CCMA for the purchase and use of treated effluent from the SARA WWTPs on Martinez Creek; and
- SARA, the City of Marion, Green Valley, and/or CCMA to obtain an authorization for the bed and banks transfer of treated effluent from the discharge points along Martinez Creek to the Siesta Cattle Company site.

Reliability

The reliability of this supply is considered medium (reliability score = 3) because of uncertainty involved in negotiations between buyers and sellers of existing water rights.

5.2.21 CRWA Brackish Carrizo-Wilcox Project

5.2.21.1 Description of Water Management Strategy

The CRWA Brackish Carrizo-Wilcox Project includes developing a brackish groundwater supply from the Carrizo-Wilcox Aquifer in Guadalupe and Wilson counties for members of CRWA with service areas in Bexar, Guadalupe, and Wilson counties. The project is designed to produce an annual water supply of 14,700 acft/yr (13.1 mgd) with a peak demand of 17.1 mgd. The well fields are planned for northern Wilson County and southern Guadalupe County, along Highway 123. The WTP and site of concentrate disposal will be in the vicinity of the well fields. Treated water will be transferred to the existing Liessner Booster Station for distribution to participating water utilities.

This strategy builds on a preliminary assessment of potential brackish groundwater supplies from the Carrizo-Wilcox Aquifer in a target area that is generally a 10 to 20 mile wide band that is south of Interstate 10 and between Loop 410 and Seguin[1]. The study and a summary of the findings are briefly discussed in Subsection 5.2.21.2.

Planned facilities for the CRWA Brackish Carrizo-Wilcox Project include two new well fields from the Carrizo-Wilcox Aquifer in Wilson and Guadalupe counties; wells, pumps, and collector pipelines; a 17.1 mgd WTP with desalination; a 12 mile treated water transmission pipeline, pump stations, and one ground storage tank; and five injection wells for disposal of desalination concentrate. The approximate location of the project is shown on Figure 5.2.21-1.

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[1] HDR Engineering, Inc. February 2008. *Preliminary assessment of potential water supplies from the Carrizo-Wilcox Aquifer in Parts of Bexar, Guadalupe, and Wilson Counties*. Prepared for San Antonio River Authority.

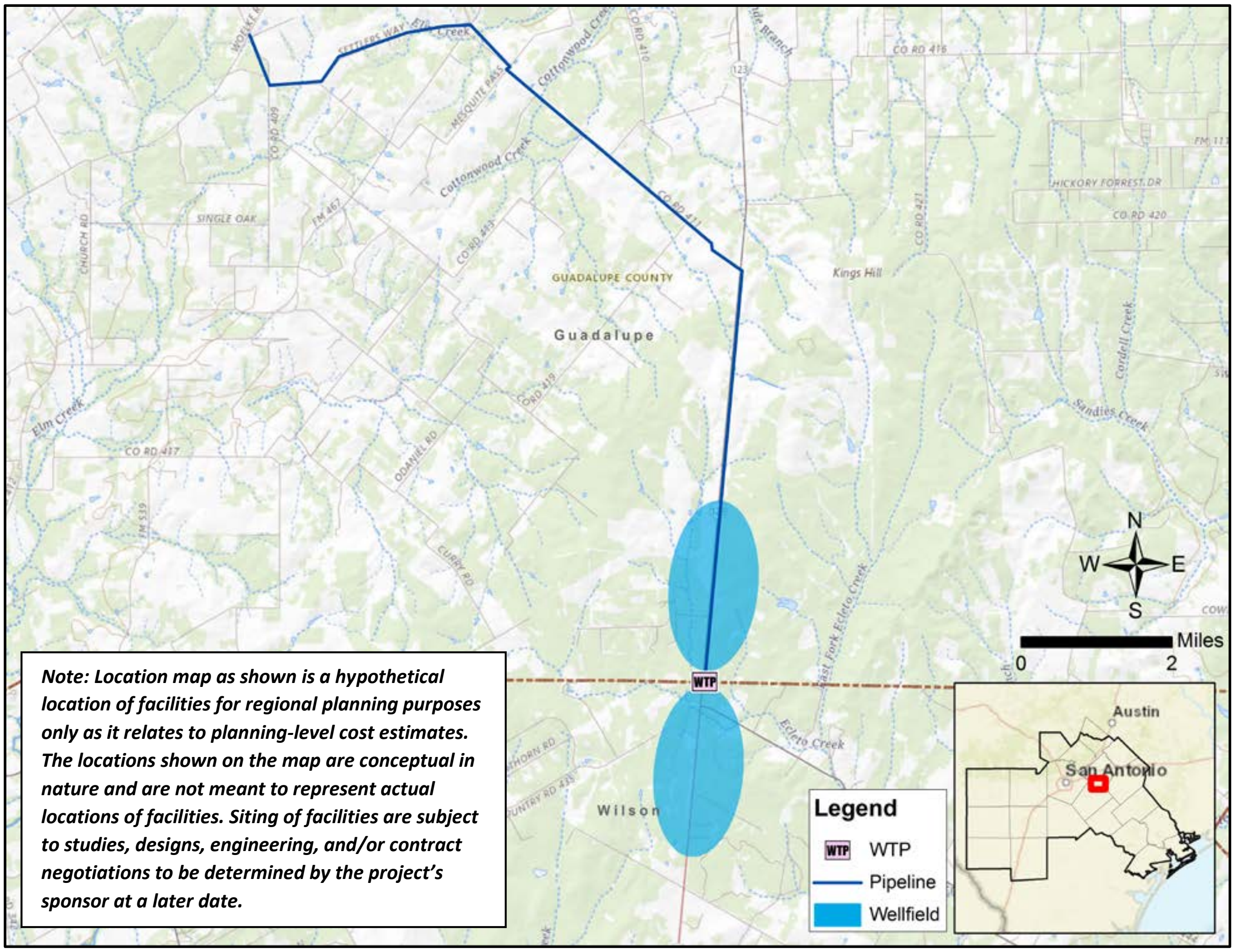

Figure 5.2.21-1 CRWA Brackish Carrizo-Wilcox Project Location

5.2.21.2 Available Yield

According to the previous study performed for the San Antonio River Authority, "favorable" and "most favorable" areas for brackish water wells in the Carrizo-Wilcox Aquifer were identified (Figure 5.2.21-2). The study identified trends and patterns of well depths, well yields, and concentrations of TDS, chlorides, and sulfates in the target area. The study relied on well data from the TWDB and oil and gas well logs from the TCEQ. Using information from the previous study, the CRWA Brackish Carrizo-Wilcox Project was sited to provide a reliable, safe yield for CRWA.

Wells for this project will be located in the vicinity of the Guadalupe-Wilson County line and Hwy 123, which was identified as the "most favorable" area in the previous study (Figure 5.2.21-2). According to TWDB well data and sand thicknesses included in the previous study, potential well yields in the "favorable" and "most favorable" areas are expected to be 500 to 800 gpm and 700 to 1,000 gpm, respectively. Concentrations of TDS are expected to range between 1,000 and 1,500 mg/L in the "favorable" area and 800 and 1,200 mg/L for the "most favorable" area. The Carrizo-Wilcox wells are expected to be between 1,200 and 1,700 feet deep. Well field details and project yield for the CRWA Brackish Carrizo-Wilcox Project are provided in Table 5.2.21-1. This WMS project is planned for implementation beginning in the 2030 decade, with an available yield of 14,700 acft/yr[2]. The strategy water loss for this WMS is estimated to be 14 percent; more information is available in Section 5.2.21.4.

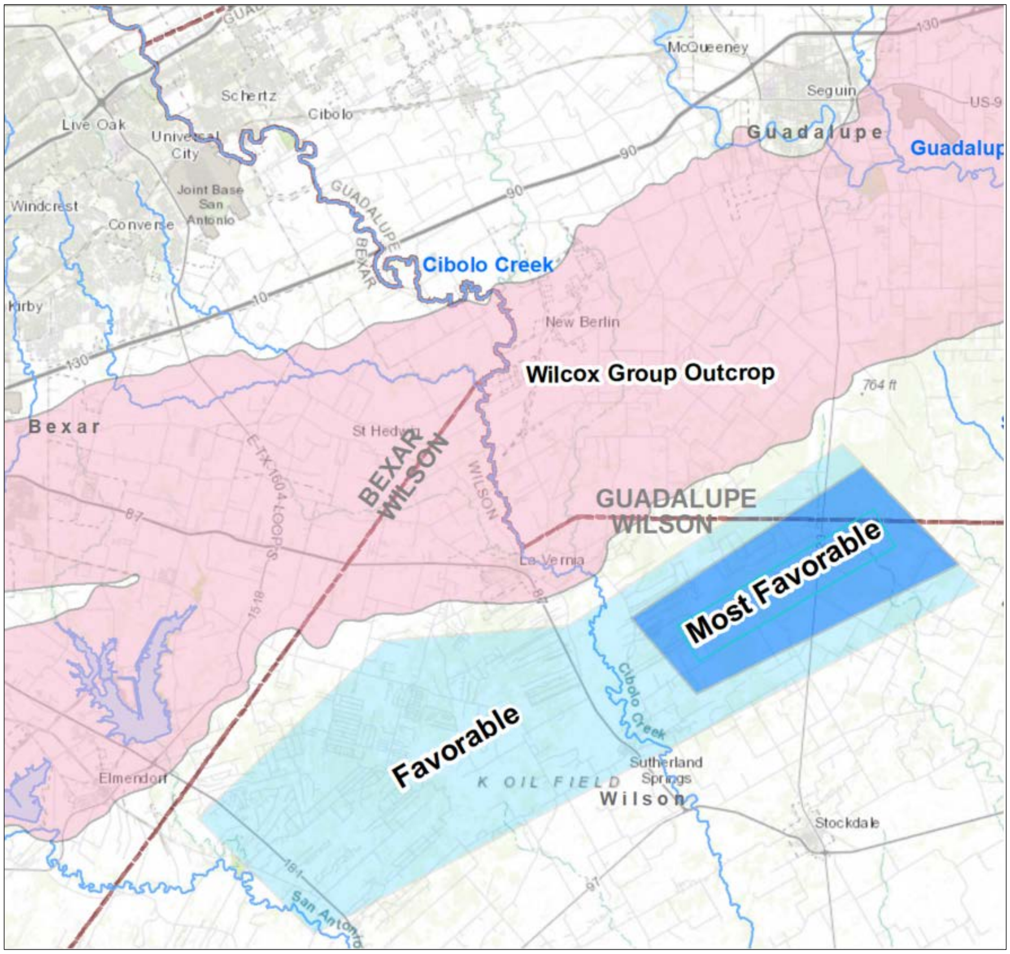

Figure 5.2.21-2 Location of Favorable and Most Favorable Areas for Groundwater Development in Carrizo-Wilcox Aquifer, as identified by HDR Engineering, Inc. (2008)

Table 5.2.21-1 CRWA Brackish Carrizo-Wilcox Project Well Field Details and Project Yield

DESCRIPTION	SOUTHERN GUADALUPE COUNTY WELL FIELD	NORTHERN WILSON COUNTY WELL FIELD
Project Yield (acft/yr)	14,700	
Number of Wells	9	8
Average Well Production Capacity (gpm)	800	800

[2] This project is limited by the MAG. For purposes of this plan and DB22, it is assumed that SAWS will utilize the "CRWA Brackish Wilcox Groundwater (GW Conversion)" WMS Project to secure the remaining supplies for the project.

DESCRIPTION	SOUTHERN GUADALUPE COUNTY WELL FIELD	NORTHERN WILSON COUNTY WELL FIELD
Well Depth (ft)	1,200 – 1,700	1,200 – 1,700
TDS Concentration (mg/L)	1,000 – 1,500	1,000 – 1,500

5.2.21.3 Environmental Considerations

Environmental Considerations

Vegetation and Land Use

The project area is located in the Post Oak Savannah ecoregion and crosses mostly pastures and post oak woodlands. As mapped by TPWD,[3] the project pipeline crosses primarily savannah grassland and post oak motte and woodland. Vegetation within the well field sites consists mostly of post oak motte and woodland and grassland.

Based on TPWD vegetation mapping, the project would not affect agricultural resources mapped as row crops. The project impact area does contain 2 acres mapped as tame/disturbance grassland which may include pasture areas used for grazing or hay production.

Construction of well fields would result in conversion of woody and herbaceous vegetation and agricultural areas to industrial land use for facilities. Project pipeline easements would require removal of woody vegetation and long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each water management strategy to determine the best course of action regarding revegetation. Pipeline easements may continue to be used for agricultural purposes.

Aquatic Resources

The project area includes several intermittent streams, and the NWI shows approximately 1.4 acres of freshwater and riverine wetlands in the project area. Project well field locations are traversed by TCEQ Segment No. 1901F of Ecleto Creek, a tributary of the San Marcos River. This creek is listed as impaired for depressed dissolved oxygen in the Texas Integrated Report of 303(d) listed water bodies.[4] The 303(d) list identifies the water bodies or segments in Texas that do not meet designated water quality standards. The project pipeline does not cross any streams identified as impaired stream segments. The project area does not include any ecologically significant stream segments designated by TPWD.

[3] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

[4] Texas Commission on Environmental Quality. 2018. *2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d).* https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf.

The project will require an on-site delineation of streams, ponds, and wetlands. Stream crossings for pipeline construction would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including if there would be permanent impacts to over 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under stream (e.g., through HDD) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

Table 5.2.21-2 provides a summary of threatened, endangered, and candidate species and species of concern that have the potential to occur in Guadalupe and Wilson counties. .[5],[6],[7],[8] Suitable habitat does not occur for any of the federally listed species.

Suitable habitat may occur for the state listed threatened Texas horned lizard (*Phrynosoma cornutum*) and Texas tortoise (*Gopherus berlandieri*). Potentially suitable habitat may occur for numerous wildlife, plant and insect species designated by TPWD as SGCN, particularly species associated with sandy soil habitats. These species do not have formal protected status but are being monitored by TPWD. Migratory birds may occur in the project area, particularly in riparian zones and wetland areas.

Since the project would not affect federally listed threatened or endangered species, consultation with the USFWS would not be required. Site-specific field surveys would be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain its recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15.

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[5] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Guadalupe County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[6] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Guadalupe County. https://ecos.fws.gov/ipac/location/QVIBPJWUHBAAFNOCI4UCN5RVEI/resources.

[7] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Wilson County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[8] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Wilson County. https://ecos.fws.gov/ipac/location/FX45LGWSGVBZLJHV4APLVP7LU4/resources.

Table 5.2.21-2 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for CRWA Brackish-Wilcox Project, Guadalupe and Wilson Counties, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Strecker's chorus frog	*Pseudarcris streckeri*	N/A	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Suitable habitat may occur in project area.
Texas blind salamander	*Eurycea rathbuni*	E	SGCN	Water-filled subterranean caverns along 6 miles of the San Marcos Spring Fault.	Project is outside of the expected range of this species.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur in project area.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat does not occur within project area; may fly over during migration.
Black rail	*Laterallus jamaicensis*	N/A	SGCN	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh.	Suitable habitat does not occur within project area; may fly over during migration.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur within project area; may fly over during migration.
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also know to nest on manmade structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Suitable habitat does not occur within project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Low potential for species to occur in the project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur within project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	SGCN	Brackish marshes, shallow salt ponds and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Project is outside of the expected range of this species.
Swallow-tailed kite	*Elanoides forficatus*	N/A	SGCN	Lowland forest, especially swampy areas, ranges to open woodland; marshes, along rivers, lakes, and ponds. Nests high in tall trees in clearing or on forest woodland edge, usually pine, cypress, or deciduous trees.	Suitable habitat does not occur in project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots; nests and roosts in abandoned burrows.	Low potential for species to occur in the project area.
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat does not occur in project area; may fly over during migration.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems (during migration).	Suitable habitat does not occur within project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Suitable habitat does not occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat does not occur within project area; may fly over during migration.
Fishes					
American eel	*Anguila rostrata*	N/A	SGCN	Coastal waterways below reservoirs.	Suitable habitat does not occur within project area.
Fountain darter	*Etheostoma fonticola*	E	E	San Marcos and Comal Rivers; springs and spring-fed streams with dense beds of aquatic plants.	Project is outside of the expected range of this species.
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat does not occur within project area.
Guadalupe darter	*Percina apristis*	N/A	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Suitable habitat does not occur within project area.
Plateau shiner	*Cyprinella lepida*	N/A	SGCN	Edwards Plateau portion of the Nueces basin; cool, clear, spring-fed headwater creeks.	Suitable habitat does not occur within project area.
Texas shiner	*Notropis amabilis*	N/A	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Project is outside the expected range of this species.
Insects					
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in the project area.
Comanche harvester ant	*Pogonomyrmex comanche*	N/A	SGCN	Barren or sparsely vegetated areas.	Suitable habitat may occur in the project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Manfreda giant skipper	*Stallingsia maculosus*	N/A	SGCN	Subtropical mesquite scrub with a lot of Manfreda (*Manfreda maculosa*), on sandy or clay soils, either dry or moist.	Suitable habitat may occur in the project area.
No accepted common name	*Cotalpa conclamara*	N/A	SGCN	Occurs in post oak (*Quercus stell*ata) woodlands.	Suitable habitat may occur in the project area.
No accepted common name	*Arethaea phantasma*	N/A	SGCN	Found in southern Texas shrubland, woodland.	Suitable habitat may occur in the project area.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur within project area.
Big brown bat	*Eptesicus fuscus*	N/A	SGCN	Woodlands or wooded areas.	Suitable habitat may occur within project area.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls, but will use buildings.	Suitable canyon habitat does not occur within project area; may use buildings.
Black-tailed prairie dog	*Cynomys ludovicianus*	N/A	SGCN	Short, flat, dry grasslands with sparse vegetation.	Project is outside the expected range of this species.
Cave myotis bat	*Myotis velifer*	N/A	SGCN	Cave-dwelling, also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	Suitable cave habitat does not occur within project area; may use buildings/structures.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat may occur within project area.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges, and woodlands. Prefer wooded, brushy areas; tallgrass prairies.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Suitable habitat may occur within project area.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur within project area.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	Suitable cave habitat does not occur within project area; may use buildings/structures.
Mexican long-tongued bat	*Choeronycteris mexicana*	N/A	SGCN	Riparian forest in Texas; roost in mines, large crevices, and caves.	Suitable habitat does not occur in project area.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps and marshes.	Suitable habitat may occur within project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Use wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Low potential to occur within project area.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat may occur within project area.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Prefer short-grass prairies, also occur in pastures and along fencerows. Excavate burrows or use abandoned pocket gopher or prairie dog burrows.	Suitable habitat may occur within project area.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat does not occur within project area.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat unlikely to occur within project area.
Western spotted skunk	*Spilogale gracilis*	N/A	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
White-nosed coati	*Nasua narica*	N/A	T	Canyons, riparian corridors, and woodlands.	Project area is outside the expected range of this species.
Mollusks					
False spike	*Fusconaia mitchelli*	N/A	T	Medium to large rivers; present in Guadalupe, Colorado, and Brazos river basins.	Low potential for suitable habitat to occur in the project area; project area does not contain perennial streams.
Golden orb	*Cyclonaias aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces river basins.	Low potential for suitable habitat to occur in the project area; project area does not contain perennial streams. Species was recently a federal candidate, but its listing as federally threatened or endangered was not warranted as it is not a valid species.
No accepted common name	*Cyclonaias necki*	N/A	N/A	Guadalupe River basin; moderate to large streams with flowing water.	Low potential for suitable habitat to occur in the project area; project area does not contain perennial streams.
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	N/A	SGCN	Endemic to sandy regions of southern and south-central Texas.	Suitable habitat may occur within project area.
Bigflower cornsalad	*Valerianella stenocarpa*	N/A	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms.	Suitable habitat does not occur in the project area.
Big red sage	*Salvia penstemonoides*	N/A	SGCN	Moist or seasonally wet, steep limestone outcrops on seep within canyons or along creek banks; occasional on clayey to silty creek bank and terrace soils.	Suitable habitat does not occur in the project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Bracted twistflower	Streptanthus bracteatus	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Project is outside of the expected range of this species.
Bristle nailwort	*Paronychia setacea*	N/A	SGCN	Endemic to eastern southcentral Texas, occurring in sandy soils.	Suitable habitat may occur within project area.
Buckley tridens	*Tridens buckleyanus*	N/A	SGCN	Juniper-oak woodlands on rocky limestone slopes.	Suitable habitat does not occur within project area.
Burridge greenthread	*Thelesperma burridgeamum*	N/A	SGCN	Sandy open areas.	Suitable habitat may occur within project area.
Drummond's rushpea	*Caesalpinia drummondii*	N/A	SGCN	Open areas on sandy clay.	Suitable habitat may occur within project area.
Elmendorf's onion	*Allium elmendorfii*	N/A	SGCN	Grassland openings in oak woodlands on deep, loose, well-drained sands; to the north, it occurs in post oak-black hickory-live oak woodlands over Queen City and similar Eocene formations.	Suitable habitat may occur within project area.
Engelmann's bladdpod	*Physaria engelmannii*	N/A	SGCN	Grasslands and calcareous rock outcrops along the eastern edge of the Edwards Plateau, ranging as far north as the Red River.	Suitable habitat may occur within project area.
Heartleaf evening primrose	*Oenothera cordata*	N/A	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Heller’s marbleseed	*Omosmodium helleri*	N/A	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Suitable habitat does not occur within project area.
Hill Country wild-mercury	*Argythamnia aphoroides*	N/A	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands, also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Suitable habitat does not occur within project area.
Low spurge	*Euphorbia peplidion*	N/A	SGCN	Occurs in a variety of vernally-moist situations in a number of natural regions.	Suitable habitat may occur within project area.
Net-leaf bundleflower	*Desmanthus reticulatus*	N/A	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat may occur within project area.
Parks jointweed	*Polygonella parksii*	N/A	SGCN	Mostly on deep, loose, whitish sand blowouts (unstable, deep, xeric, sandhill barrens) in post oak savannah landscapes over the Carrizo and Sparta formations; also occurs in early successional grasslands, along rights-of-way, and on mechanically disturbed areas.	Suitable habitat may occur within project area.
Plateau milkvine	*Matelea edwardsensis*	N/A	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Suitable habitat does not occur within project area.
Sandhill woolywhite	*Hymenopappus carrizoanus*	N/A	SGCN	Disturbed or open areas in grasslands and post oak woodlands on deep sands derived from the Carrizo Sand and similar Eocene formations.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
South Texas spikesedge	*Eleocharis austrotexana*	N/A	SGCN	Wetlands on the coastal plain.	Suitable habitat unlikely to occur within project area.
Texas amorpha	*Amorpha roemeriana*	N/A	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes, sometimes on dry shelves above creeks.	Project is outside of the expected range of this species.
Texas beebalm	*Monarda viridissima*	N/A	SGCN	Endemic perennial herb of the Carrizo Sands; deep, well-drained sandy soils in openings of post oak woodlands.	Suitable habitat may occur within project area.
Texas peachbush	*Prunus texana*	N/A	SGCN	Occurs at scattered sites in various well drained sandy situations; deep sand, plains and sand hills, grasslands, oak woods, 0-200 meter elevation.	Suitable habitat may occur within project area.
Woolly butterflyweed	*Gaura villosa* ssp. *parksii*	N/A	SGCN	Sandy soils of Rio Grande plains.	Low likelihood of suitable within project area.
Wright's trichocoronis	*Trichocoronis wrightii* var. *wrightii*	N/A	SGCN	Riparian zones, wetlands, pond margins, and wet meadows.	Suitable habitat may occur within project area.
Reptiles					
Cagle's map turtle	*Graptemys caglei*	N/A	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River system.	Suitable habitat does not occur within project area.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur within project area.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat may occur within project area.
Northern spot-tailed earless lizard	*Holbrookia lacerata lacerate*	N/A	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edwards Plateau	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Slender glass lizard	*Ophisaurus attenuatus*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannahs, pine barrens, and oil fields.	Suitable habitat may occur within project area.
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	N/A	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat may occur within project area.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur within project area.
Texas tortoise	*Gopherus berlandieri*	N/A	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus.	Suitable habitat may occur within project area.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland, prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrow into soil or may use burrows made by other species.	Suitable habitat may occur within project area.
Western hognose snake	*Heterodon nasicus*	N/A	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas (but not intensively cultivated), and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets. Seems to prefer sandy and loamy soils.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
T = Threatened E = Endangered PT = Proposed Threatened C = Candidate DL = Delisted SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC and the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[9] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified 11 previously-recorded archaeological sites intersecting or immediately adjacent (within 300 feet) to the project area (Table 5.2.21-3; THC 2019). In addition, the review identified up to 37 potentially historic-age buildings and six cemeteries intersecting or immediately adjacent to the project area (Table 5.2.21-3; THC 2019). No historical markers or NRHP-listed properties are known to be near the project.

The model used assessed unrecorded archaeological site potential within the project area to include low to high potential zones, ranging from 4 percent to 87 percent likelihood for the landform crossed to contain unidentified archaeological resources. The areas with greatest archaeological probability are located near the 11 previously documented archaeological sites and the landforms adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As previously discussed, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 109.5. A high cultural resources assessment score equates to a greater likelihood that the project may potentially impact cultural resources as currently defined (further information regarding methodology for developing the assessment score is provided in Section 5.2). On the basis of the results of the background review, SWCA recommends that a structured cultural resources survey of the final design plan be performed to accurately assess the presence and significance of identified and unrecorded cultural resources within its boundaries.

[9] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

Table 5.2.21-3 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological Site	Lithic Artifact Scatter and Artifact Scatter	Prehistoric and Historic	Ineligible	Intersect
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Ineligible	Intersect
Archaeological Site	Campsite	Prehistoric	Undetermined	Intersect
Archaeological Site	Campsite	Prehistoric	Undetermined	Intersect
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Ineligible	Adjacent
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Ineligible	Adjacent
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Ineligible	Intersect
Archaeological Site	Artifact Scatter	Historic	Undetermined	Adjacent
Archaeological Site	Artifact Scatter	Historic	Ineligible	Adjacent
Archaeological Site	Campsite	Prehistoric	Ineligible	Adjacent
Archaeological Site	Campsite	Prehistoric	Ineligible	Adjacent
Santa Maria Aida	Cemetery	Historic	Unknown	Adjacent
Salge Family	Cemetery	Historic	Unknown	Adjacent
Mc Keller	Cemetery	Historic	Unknown	Adjacent
Masonic	Cemetery	Historic	Unknown	Adjacent
Odd Fellows	Cemetery	Historic	Unknown	Adjacent
Jewish Cemetery	Cemetery	Historic	Unknown	Adjacent
None	37 Buildings	Historic	Unknown	Adjacent or Intersect
			ASSESSMENT SCORE TOTAL:	109.5

5.2.21.4 Engineering and Costing

Preliminary engineering and costing analyses were performed using the 2021 Regional Water Planning methods. Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and methods for calculating unit costs. A cost estimate summary for the CRWA Brackish Carrizo-Wilcox project was prepared and is provided in Table 5.2.21-4. The engineering and costing analysis for the CRWA Brackish Carrizo-Wilcox Project includes all facilities required for water production from the Carrizo-Wilcox Aquifer in Wilson and Guadalupe counties, including wells, collector pipelines, water treatment, treated water pipeline, pump stations, and disposal of concentrate.

The planned well field sites will be located along Texas Highway (TX Hwy) 123 and straddle the Guadalupe-Wilson county line. The wells are projected to be spaced approximately a mile apart. For planning purposes to estimate the cost of this WMS, a well in this portion of the Carrizo-Wilcox Aquifer will be 1,500 feet deep, yield 800 gpm, and produce water with a TDS concentration of approximately 1,200 mg/L. The planned well fields will consist of eight brackish water supply wells in Wilson County (7,000 acft/yr), nine brackish water supply wells in Guadalupe County (7,700 acft/yr), and collector pipelines with diameters ranging from 10 to 24 inches.

The desalination WTP, disposal well for the concentrate, and pump station will be located near the intersection of TX Hwy 123 and FM 1681. A raw water collector pipeline is planned to deliver brackish Carrizo-Wilcox water from the wells to the WTP, where it will undergo treatment and desalination.

Water treatment will consist of pretreatment and desalination. Pretreatment will include filtration and possibly other processes to remove particulates such as iron or manganese and to condition the water for optimal desalination. Desalination treatment is expected to be completed by RO. The required secondary Maximum Contaminant Level (MCL) for TDS is 1,000 mg/L. The design of the water treatment facilities is to produce potable water with a TDS concentration between 400 and 450 mg/L. Preliminary water treatment design includes (1) pretreatment of all raw water, (2) approximately 70 percent of the water will be sent to the desalination WTP, and (3) the remaining 30 percent of the water will be blended with the desalinated water. A desalination plant recovery rate of 80 percent is obtained by treating raw water with a TDS concentration of approximately 1,200 mg/L with conventional RO. Thus, 80 percent of the water entering the desalination plant becomes purified water and 20 percent of the water remains as concentrated brine. The desalinated water and the pretreated brackish water are blended to produce a treated water with a TDS concentration of approximately 420 mg/L, which is reasonably consistent with water currently being used by customers in the area. This process converts nearly 86 percent of the quantity of raw water produced from the well fields into potable water. The remaining 14 percent concentrate is discharged into the deep injection wells.

The treated water facilities consist of a transmission pipeline, which connects to an existing 30 inch pipeline, a pump station and booster station, and a GST at each station, and integration into the Liessner Booster Station. A 12 mile, 30 inch treated water pipeline is planned to deliver treated water to the Liessner Booster Station and will require a 17.1 mgd pump station at the WTP. The system is designed to provide treated water at an annual average of 13.1 mgd and a peak demand of 17.1 mgd.

A concentrate disposal well, GST, pipelines, and facilities are planned at or near the WTP. A concentrate water pipeline will deliver reject water to a GST. A small pump and a pipeline are planned to transport the concentrate to a new deep injection well field near the plant. The project will likely require five injection wells. The target disposal of the concentrate will be deep well injection into depleted or partially depleted oil and gas producing reservoirs (Austin Chalk or Edwards Limestone).

Cost estimates were calculated for capital costs, annual debt service, operation and maintenance, power, land acquisition, and environmental mitigation for seasonal and peak day demands. The overall project costs are estimated to be $177,944,000. The annual cost is estimated to be $23,451,000, and the annual unit cost is estimated to be $1,595 per acft. Treatment costs are determined on the basis of desalination and removal of iron and manganese.

Table 5.2.21-4 Project Cost Estimate Summary

ITEM	ESTIMATED COSTS
Primary Pump Station (17.1 mgd)	$7,601,000
Transmission Pipeline (30 in. dia., 12 miles)	$14,039,000
Well Fields (wells, pumps, and piping)	$48,382,000
Storage Tanks (Other Than at Booster Pump Stations)	$7,331,000
Water Treatment Plant (17.1 mgd)	$48,426,000
TOTAL COST OF FACILITIES	**$125,779,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$43,320,000
Environmental and Archaeology Studies and Mitigation	$1,862,000
Land Acquisition and Surveying (356 acres)	$2,220,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$4,763,000
TOTAL COST OF PROJECT	**$177,944,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$12,520,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$698,000
Intakes and Pump Stations (2.5% of cost of facilities)	$190,000
Water Treatment Plant	$9,026,000
Pumping Energy Costs (5,150,180 kWh @ 0.08 $/kWh)	$412,000
Purchase of Water (7,280 acft/yr @ 83.15 $/acft)	$605,000
TOTAL ANNUAL COST	**$23,451,000**
Available Project Yield (acft/yr)	14,700
Annual Cost of Water ($ per acft)	$1,595
Annual Cost of Water After Debt Service ($ per acft)	$744
Annual Cost of Water ($ per 1,000 gallons)	$4.90
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$2.28
Based on a peaking factor of 1.3.	

5.2.21.5 Implementation Considerations

Information presented in this WMS was provided by CRWA and previous reports and represents the current plan, which is based on the sponsor's current understanding of the system. Implementation of the CRWA Brackish Carrizo-Wilcox Project includes the following considerations:

- Verification of available groundwater quantity and well productivity;
- Verification of water quality for concentrations of dissolved constituents, such as TDS, chloride, sulfate, iron, manganese, and hydrogen sulfide;
- Verification of minimal impacts to Carrizo-Wilcox, particularly as it relates to applicable DFC;
- Verification of the potential for deep well injection of concentrate;
- Class I disposal well permit through the TCEQ for deep well injection of desalination concentrate;
- Regulations by TCEQ;
- Regulations by the Evergreen Underground Water Conservation District and Guadalupe County Groundwater Conservation District;
- Verification that desalinated Carrizo-Wilcox Aquifer water is compatible with other water sources being used by customers and will meet all water quality requirements in the end user's distribution system; and
- Experience in operating and maintaining a desalination WPT.

Reliability

Water from these sources is considered to be very reliable based on previous studies that relied on well data from the TWDB and oil and gas well logs from the TCEQ. Supply is considered to be medium because of the potential of differing well productivity and water quality, potential impacts to natural resources and Carrizo-Wilcox Aquifer user competition. Blending of Carrizo-Wilcox Aquifer water is considered to be as reliable as the fresh water source (reliability score = 4).

5.2.22 CVLGC Carrizo Project

5.2.22.1 Description of Water Management Strategy

The CVLGC comprises the cities of Schertz and Cibolo. CVLGC is considering a Carrizo-Wilcox Aquifer well field project in Wilson County. The general location of the planned well field is north of US 87 and east of Stockdale (Figure 5.2.22-1). Land use and groundwater availability were taken into consideration for selection of the well field. The project will supply 10,000 acft/yr of treated water to the partnering entities.

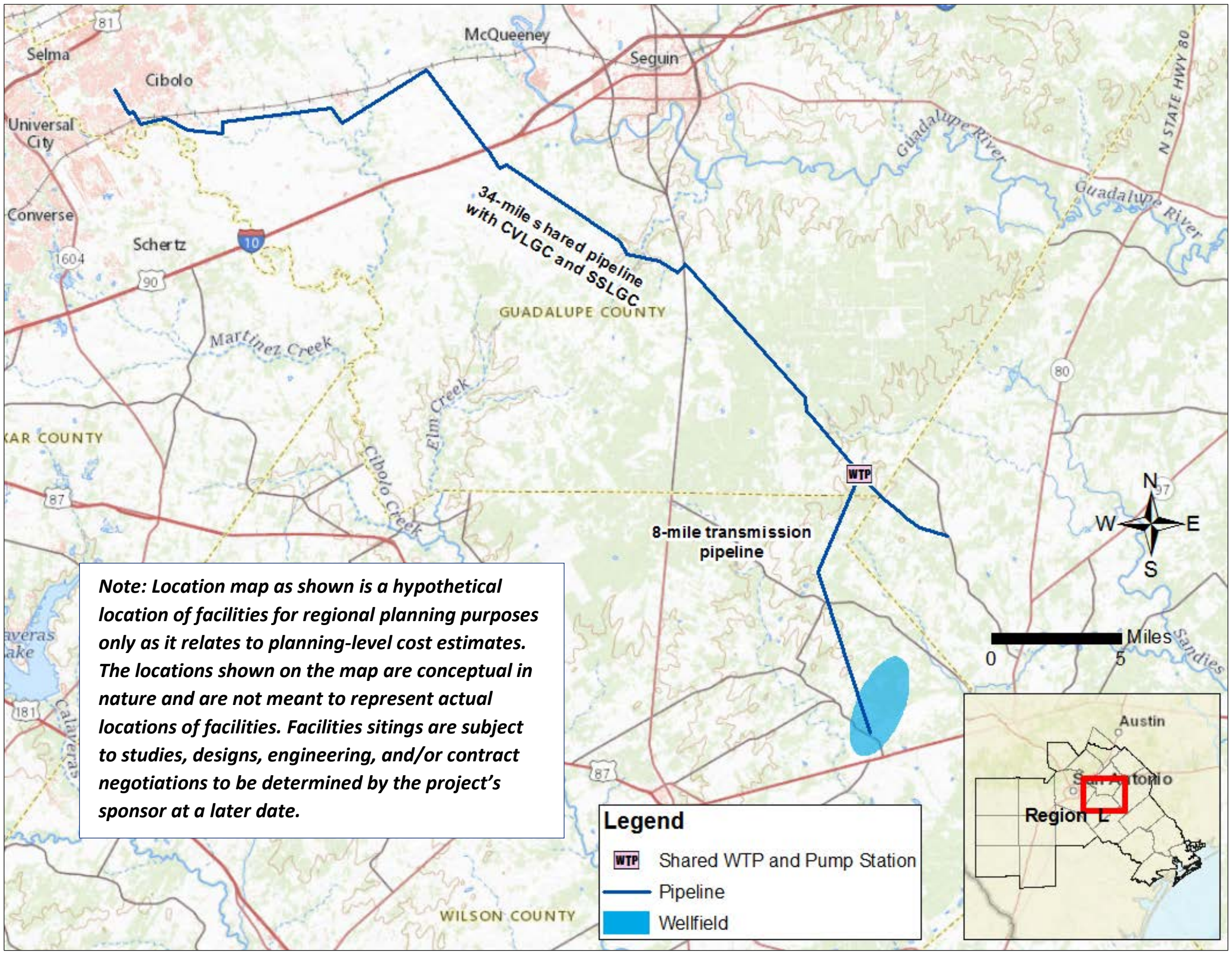

Figure 5.2.22-1 CVLGC Carrizo Project Location

5.2.22.2 Available Yield

The Carrizo-Wilcox Aquifer is one of four major aquifers in the South Central Texas Water Planning Region. Overall, the water quality of the Carrizo-Wilcox Aquifer is suitable for use as a water supply, except for elevated concentrations of iron and manganese in many areas.

The planned well field is in the confined part of the Carrizo-Wilcox Aquifer and is located approximately 7 miles downdip of the outcrop. Based on available hydrogeologic information, wells in this area would be capable of producing more than 2,000 gpm and would range in depth from 1,000 to 1,500 feet deep.

The target aquifer is the Carrizo Sand instead of the Wilcox Group for water quality and depth considerations. Groundwater quality in the area generally has a TDS concentration of less than 300 mg/L. However, the water typically has elevated concentrations of iron and manganese that requires treatment prior to public consumption.

Groundwater supply projects in Wilson County are subject to groundwater production, well spacing, and groundwater export rules of the Evergreen Underground Water Conservation District (EUWCD). The MAG for the Carrizo-Wilcox Aquifer in Wilson County varies between 104,918 and 111,093 acft/yr over the 50 year planning horizon[1]. Information on the amount of permitted groundwater production in the county by the EUWCD is not available. However, TWDB estimates of historic groundwater production from the Carrizo-Wilcox Aquifer are well below these MAG totals. TWDB estimates of historic municipal groundwater use from the Carrizo-Wilcox in the last 10 years has been between approximately 6,000 and 7,500 acft/yr. Irrigation is the only other significant source of groundwater use from the Carrizo-Wilcox Aquifer according to the TWDB surveys and has been between approximately 8,700 and 17,000 acft/yr in the last 10 years. Based on this information, it appears that the yield for this strategy is not limited by the MAG. This WMS project has a firm yield of 10,000 acft/yr[2] and is planned for implementation beginning in the 2030 decade.

5.2.22.3 Environmental Considerations

Environmental Considerations

Vegetation and Land Use

The project area is located in the Blackland Prairie and Post Oak Savannah ecoregions. As mapped by TPWD[3], the project area includes a variety of vegetation types, primarily grassland and savannah with more wooded areas toward the southeastern part of the project area and wooded riparian areas along streams. The predominant vegetation communities are grassland, disturbance/tame grassland, post oak motte/woodland, mesquite shrubland, and live oak motte and woodland.

Based on TPWD vegetation mapping, the project may have the potential to impact 961 acres of agricultural resources, including 65 acres mapped as row crops and 896 acres mapped as tame/disturbance grassland which may include pasture areas used for grazing or hay production.

Project pipeline easements would require removal of woody vegetation and long-term maintenance (mowing and woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each water management strategy to

[1] Wade, S.C. 2017. GAM Run 17-027 MAG: Modeled Available Groundwater for the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson Aquifers in Groundwater Management Area 13: Texas Water Development Board. https://www.twdb.texas.gov/groundwater/docs/GAMruns/GR17-027_MAG.pdf?d=19840.414999998757.

[2] This project is limited by the MAG. For purposes of this plan and DB22, it is assumed that CVLGC will utilize the "CVLGC Carrizo Project (GW Conversion)" WMS Project to secure the remaining supplies for the project.

[3] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

determine the best course of action regarding revegetation. Pipeline easements may continue to be used for agricultural purposes The proposed well field site would result in conversion of land use from undeveloped vegetation and agricultural areas (mostly open fields and shrubland) to small areas of industrial use.

Aquatic Resources

The proposed pipeline would cross Santa Clara Creek and several unnamed tributaries. Tally Branch and its tributaries occur within the general area of the proposed well field site. The NWI mapping identifies 40.3 acres of wetlands in the overall project area. The Texas Integrated Report of 303(d) listed water bodies[4] identifies the water bodies or segments in Texas that do not meet assigned water quality standards. Segment 1913 of Cibolo Creek, just south of the pipeline alignment, is listed as impaired. The well field project area does not contain listed impaired water bodies. The project area does not contain ecologically significant stream segments as designated by TPWD.

The project will require an on-site delineation of streams, ponds, and wetlands. Well field facilities can typically be sited to avoid impacts to waters of the United States, including wetlands. Stream crossings for pipeline construction would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including cases where there would be permanent impacts to more than 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under streams (e.g., through horizontal directional drilling) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

Table 5.2.22-1 provides a summary of threatened, endangered, and candidate species and species of concern that have potential to occur in Gonzales, Guadalupe, and Wilson Counties. [5],[6],[7],[8],[9],[10] Suitable habitat does not occur for any of the federally-listed species. However, several freshwater mussel

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[4] Texas Commission on Environmental Quality. 2015. 2014 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/waterquality/assessment/14twqi/14txir.

[5] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Gonzales County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[6] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Gonzales County. https://ecos.fws.gov/ipac/location/THAN4LUF6JGQ3FAWPQMXZQPATA/resources.

[7] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Guadalupe County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[8] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Guadalupe County. https://ecos.fws.gov/ipac/location/QVIBPJWUHBAAFNOCI4UCN5RVEI/resources.

[9] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Wilson County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[10] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Wilson County. https://ecos.fws.gov/ipac/location/FX45LGWSGVBZLJHV4APLVP7LU4/resources.

species are under review for federal listing as threatened or endangered, and the project pipeline crosses streams that may provide suitable habitat for freshwater mussels.

Suitable habitat may occur for state-listed threatened species, including the white-faced ibis (*Plegadis chihi*), white-tailed hawk (*Buteo albicaudatus*), Texas horned lizard (*Phrynosoma cornutum*), Texas tortoise (*Gopherus berlandieri*), and timber rattlesnake (*Croatlus horridus*).

There is potential for suitable habitat for numerous wildlife species designated by TPWD as SGCN, including American bumblebee (*Bombus pensylvanicus*), Strecker's chorus frog (*Pseudacris streckeri*), Woodhouse's toad (*Anaxyrus woodhousii*), western burrowing owl (*Athene cunicularia hypugaea*), American badger (*Taxidea taxus*), thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*), eastern spotted skunk (*Spilogale putorius*), and plains spotted skunk (*Spilogale putorius interrupta*). In addition, SGCN bat species may utilize structures and could, therefore, occur in developed areas. The SGCN list also includes numerous plant species, including many for which detailed habitat requirements have not been developed by TPWD. SGCN species do not have formal protected status but are being monitored by TPWD.

Site-specific field surveys would be required to determine the quality of habitat for freshwater mussels, should they be added to the federal list of threatened/endangered species. Consultation with the USFWS would be required if suitable mussel habitat may be affected by pipeline and well site construction activities. Site-specific field surveys would also be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain its recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or to avoid vegetation clearing during the general bird nesting season from March 15 to September 15.

Table 5.2.22-1 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for the CVLGC Carrizo Project; Gonzales, Guadalupe, and Wilson Counties, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Strecker's chorus frog	*Pseudarcris streckeri*	N/A	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Suitable habitat may occur in wetland areas along pipeline alignment and well pad sites.
Texas blind salamander	*Eurycea rathbuni*	E	SGCN	Water-filled subterranean caverns along 6 miles of the San Marcos Spring Fault.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur in wetland areas along pipeline alignment and well pad sites.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat does not occur within project area; may fly over during migration.
Black rail	*Laterallus jamaicensis*	N/A	SGCN	Salt, brackish, and freshwater marshes; pond borders; wet meadows; and grassy swamps. Nests in or along edge of marsh.	Low probability of occurring in emergent wetland areas along the pipeline alignment and well pad site.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes, may use fields and beaches during migration.	Suitable habitat does not occur within project area; may fly over during migration.
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also known to nest on manmade structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Suitable habitat does not occur within project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie; feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat does not occur within project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur within project area; may fly over during migration.
Red knot	*Calidris canutus rufa*	T	SGCN	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays.	Suitable habitat does not occur within project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	SGCN	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Swallow-tailed kite	*Elanoides forficatus*	N/A	SGCN	Lowland forest, especially swampy areas, ranges to open woodland; marshes, along rivers, lakes, and ponds. Nests high in tall trees in clearing or on forest woodland edge, usually pine, cypress, or deciduous trees.	Suitable habitat does not occur within project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots; nests, and roosts in abandoned burrows.	Suitable open habitats may occur in the project area along the pipeline and well field site.
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat may occur in project area.
White-tailed hawk	*Buteo albicaudatus*	N/a	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat may occur in project area.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio Counties. Roost predominantly in palustrine or riverine wetland systems (during migration).	Suitable habitat does not occur within project area; may fly over during migration.
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Unlikely to occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat does not occur within project area; may fly over during migration.
Fish					

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
American eel	*Anguila rostrata*	N/A	SGCN	Coastal waterways below reservoirs.	May occur in perennial streams that cross the pipeline alignment. Not expected in the well field sites.
Fountain darter	*Etheostoma fonticola*	E	E	San Marcos and Comal Rivers; springs and spring-fed streams with dense beds of aquatic plants.	Project is outside of the expected range of this species.
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams of the Edwards Plateau region.	May occur in perennial streams that cross the pipeline alignment. Not expected in the well field sites.
Guadalupe darter	*Percina apristis*	N/A	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Suitable habitat does not occur within project area.
Plateau shiner	*Cyprinella lepida*	N/A	SGCN	Edwards Plateau portion of the Nueces Basin; cool, clear, spring-fed headwater creeks.	Suitable habitat does not occur within project area.
River darter	*Percina shumardi*	N/A	SGCN	Confined to large rivers and lower parts of major tributaries; almost invariably found in deep chutes and riffles where current is swift and bottom is composed of coarse gravel or rock.	Suitable habitat does not occur within project area.
Texas shiner	*Notropis amabilis*	N/A	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Suitable habitat does not occur within project area.
Insects					
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in project area along the pipeline alignment and well field site.
No accepted common name	*Bombus variabilis*	N/A	SGCN	Parasite on other bumblebee species.	Suitable habitat may occur in project area along the pipeline alignment and well field site.
No accepted common name	*Melanoplus alexanderi*	N/A	SGCN	Primarily in open oak or pine/oak savannah type habitats with fine grain loamy sand to sandy loam soils.	Suitable sandy habitats may occur along the pipeline alignment and well field site.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Comanche harvester ant	*Pogonomyrmex comanche*	N/A	SGCN	Sandy soils and post oak.	Suitable habitat may occur in project area along the pipeline and well field site.
Manfreda giant-skipper	*Stallingsia maculosus*	N/A	SGCN	Subtropical mesquite scrub with a lot of Manfreda, on sandy or clay soils, either dry or moist. Apparently occasionally pine woodland.	Suitable habitat may occur in project area along the pipeline and well field site.
No accepted common name	*Cotalpa conclamara*	N/A	SGCN	Sandy soils and post oak.	Suitable sandy habitat may occur in project area along the pipeline alignment and well field site.
No accepted common name	*Arethaea phantasma*	N/A	SGCN	Grassland, shrubland.	May possibly occur within woodlands along the pipeline alignment and well field site.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Low potential to occur in sandy areas of the pipeline alignment and well field site.
Big brown bat	*Eptesicus fuscus*	N/A	SGCN	Woodlands or wooded areas.	May possibly occur within woodlands along the pipeline alignment and well field site.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls but will use buildings.	Suitable habitat does not occur within project area.
Black-tailed prairie dog	*Cynomys ludovicianus*	N/A	SGCN	Short, flat, dry grasslands with sparse vegetation.	Not expected to occur within project area.
Cave myotis bat	*Myotis velifer*	N/A	SGCN	Cave-dwelling; also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	Suitable habitat does not occur within project area.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	May possibly occur within woodlands along the pipeline alignment and well field site.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges, and woodlands. Prefer wooded, brushy areas; tallgrass prairies.	May occur within woodlands along the pipeline alignment and well field site.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	May possibly occur within woodlands along the pipeline alignment and well field site.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	May possibly occur within along the pipeline alignment and well field site.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	May forage along portions of the pipeline alignment and well field site.
Mexican long-tongued bat	*Choeronycteris mexicana*	N/A	SGCN	Riparian forest in Texas; roost in mines, large crevices, and caves.	Not expected to occur in project area.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Not expected to occur in project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Use wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Very low potential to occur as a vagrant along pipeline alignment and well field site.
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	SGCN	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur along pipeline alignment and well field site.
Southern short-tailed shrew	*Blarina carolinensis*	N/A	SGCN	Uses a variety of woodlands and grassy areas; burrowing in or using soil, fallen log/debris, and standing snag/hollow tree.	Suitable habitat may occur along pipeline alignment and well field site.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Very low potential to occur in wetland/riparian areas along the pipeline alignment and well field site.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Prefer short-grass prairies; also occur in pastures and along fencerows. Excavate burrows or use abandoned pocket gopher or prairie dog burrows.	Suitable habitat may occur along pipeline alignment and well field site.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat may occur along pipeline alignment and well field site.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat may occur along pipeline alignment and well field site.
Western spotted skunk	*Spilogale gracilis*	N/A	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur along pipeline alignment and well field site.
White-nosed coati	*Nasua narica*	N/A	T	Canyons, riparian corridors, and woodlands.	Project area is outside the expected range of this species.
Mollusks					
False spike	*Fusconaia mitchelli*	N/A	T	Medium to large rivers; present in Guadalupe, Colorado, and Brazos River basins.	Very low potential to occur in perennial waterways along the pipeline alignment. Not expected in well field site.
Golden orb	*Cyclonaias aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Very low potential to occur in perennial waterways along the pipeline alignment. Not expected in well field site.
No accepted common name	*Cyclonaias necki*	N/A	N/A	Guadalupe River basin; moderate to large streams with flowing water.	Very low potential to occur in perennial waterways along the pipeline alignment. Not expected in well field site.
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	N/A	SGCN	Endemic to sandy regions of southern and south-central Texas.	Suitable sandy habitats may occur along pipeline alignment and well field site.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Big red sage	*Salvia pentstemonoides*	N/A	SGCN	Moist to seasonally wet, steep limestone outcrops on seeps within canyons or along creek banks; occasionally on clayey to silty soils of creek banks and terraces, in partial shade to full sun.	Not expected to occur in project area.
Bigflower cornsalad	*Valerianella stenocarpa*	N/A	SGCN	Usually along creek beds or in vernally moist grassy open areas.	Suitable habitat may occur along pipeline alignment and well field site.
Bracted twistflower	Streptanthus bracteatus	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings; on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Suitable habitat does not occur within project area.
Bristle nailwort	*Paronychia setacea*	N/A	SGCN	Flowering vascular plant endemic to eastern south-central Texas, occurring in sandy soils.	Suitable sandy habitats may occur along pipeline alignment and well field site.
Burridge greenthread	*Thelesperma burridgeanum*	N/A	SGCN	Sandy open areas.	Suitable sandy habitats may occur along pipeline alignment and well field site.
Buckley's spiderwort	*Tradescantia buckleyi*	N/A	SGCN	Occurs on sandy loam or clay soils in grasslands or shrublands underlain by the Beaumont Formation.	Suitable habitat does not occur within project area.
Buckley tridens	*Tridens buckleyanus*	N/A	SGCN	Juniper-oak woodlands on rocky limestone slopes.	Suitable habitat does not occur within project area.
Crestless onion	*Allium canadense* var. *ecristatum*	N/A	SGCN	Occurs on poorly drained sites on sandy substrates within coastal prairies of the Coastal Bend area.	Suitable habitat does not occur within project area.
Drummond's rushpea	*Caesalpinia drummondii*	N/A	SGCN	Open areas on sandy clay.	Suitable sandy habitats may occur along pipeline alignment and well field site.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Elmendorf's onion	*Allium elmendorfii*	N/A	SGCN	Grassland openings in oak woodlands on deep, loose, well-drained sands; to the north it occurs in post oak-black hickory-live oak woodlands over Queen City and similar Eocene formations.	Suitable habitat likely occurs along pipeline alignment and well field site.
Engelmann's bladdpod	*Physaria engelmannii*	N/A	SGCN	Grasslands and calcareous rock outcrops along the eastern edge of the Edwards Plateau, ranging as far north as the Red River.	Suitable habitat does not occur within project area.
Florida pinkroot	*Spigelia texana*	N/A	SGCN	Woodlands on loamy soils.	Suitable habitat may occur along pipeline alignment and well field site.
Heartleaf evening primrose	*Oenothera cordata*	N/A	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Suitable habitat may occur along pipeline alignment and well field site.
Heller's marbleseed	*Omosmodium helleri*	N/A	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Suitable habitat does not occur within project area.
Hill Country wild-mercury	*Argythamnia aphoroides*	N/A	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands; also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Suitable habitat does not occur within project area.
Low spurge	*Euphorbia peplidion*	N/A	SGCN	Occurs in a variety of vernally-moist situations in a number of natural regions.	Suitable habitat may occur along pipeline alignment and well field site.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Lundell's whitlow-wort	*Paronychia lundellorum*	N/A	SGCN	The Sand Sheet of eastern South Texas, in tight sandy soils over saline clay on microhighs within salty prairie grasslands, and in upper portions of saline flats surrounding short drainages and brackish basins typical of the South Texas Sand Sheet.	Suitable habitat does not occur within project area.
Net-leaf bundleflower	*Desmanthus reticulatus*	N/A	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat may occur along pipeline alignment and well field site.
Parks jointweed	*Polygonella parksii*	N/A	SGCN	Mostly on deep, loose, whitish sand blowouts (unstable, deep, xeric, sandhill barrens) in Post Oak Savannah landscapes over the Carrizo and Sparta formations; also occurs in early successional grasslands, along rights-of-way, and on mechanically disturbed areas.	Suitable habitat may occur along pipeline alignment and well field site.
Plateau milkvine	*Matelea edwardsensis*	N/A	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Suitable habitat does not occur within project area.
Sandhill woolywhite	*Hymenopappus carrizoanus*	N/A	SGCN	Disturbed or open areas in grasslands and post oak woodlands on deep sands derived from the Carrizo Sand and similar Eocene formations.	Suitable habitat may occur along pipeline alignment and well field site.
Sayersville blue eyes	*Nemophila sayersensis*	N/A	SGCN	Forest/woodland, sand/dune, savannah, woodland – hardwood; sandy, nutrient poor soils; growing with willow, post oak, pecan, and elm in very sandy soil along a creek.	Suitable habitat may occur along pipeline alignment and well field site.
South Texas spikesedge	*Eleocharis austrotexana*	N/A	SGCN	Wetlands on the coastal plain.	Suitable habitat may occur along pipeline alignment and well field site.
Texas amorpha	*Amorpha roemeriana*	N/A	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes; sometimes on dry shelves above creeks.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas beebalm	*Monarda viridissima*	N/A	SGCN	Endemic perennial herb of the Carrizo Sands; deep, well-drained sandy soils in openings of post oak woodlands.	Suitable habitat may occur along pipeline alignment and well field site.
Texas milk vetch	*Astragalus reflexus*	N/A	SGCN	Grasslands, prairies, and roadsides on calcareous and clay substrates.	Suitable habitat may occur along pipeline alignment and well field site.
Texas peachbush	*Prunus texana*	N/A	SGCN	Occurs at scattered sites in various well drained sandy situations; deep sand, plains and sand hills, grasslands, and oak woods; 0 to 200 meter elevation.	Suitable habitat may occur along pipeline alignment and well field site.
Texas sandmint	*Rhododon ciliatus*	N/A	SGCN	Open sandy areas in the Post Oak Belt of east-central Texas.	Suitable habitat may occur along pipeline alignment and well field site.
Texas tauschia	*Tauschia texana*	N/A	SGCN	Occurs in loamy soils in deciduous forests or woodlands on river and stream terraces.	Unlikely to occur in project area.
Topeka purple-coneflower	*Echinacea atrorubens*	N/A	SGCN	Occurring mostly in tallgrass prairie of the southern Great Plains, in blackland prairies but also in a variety of other sites like limestone hillsides.	Suitable habitat may occur along pipeline alignment and well field site.
Woolly butterflyweed	*Gaura villosa ssp. parksii*	N/A	SGCN	Sandy soils of Rio Grande plains.	Suitable habitat does not occur within project area.
Wright's trichocoronis	*Trichocoronis wrightii* var. *wrightii*	N/A	SGCN	Riparian zones, wetlands, pond margins, and wet meadows.	Suitable habitat may occur along pipeline alignment and well field site.
Reptiles					
American alligator	*Alligator mississippiensis*	N/A	N/A	Inland natural rivers, swamps, marshes, coastal marshes, and manmade impoundments.	Unlikely to occur in project area.
Cagle's map turtle	*Graptemys caglei*	N/A	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River System.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur along pipeline alignment and well field site.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat may occur along pipeline alignment and well field site.
Northern spot-tailed earless lizard	*Holbrookia lacerata*	N/A	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edward's Plateau.	Suitable habitat may occur along pipeline alignment and well field site.
Slender glass lizard	*Ophisaurus attenuatus*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannahs, pine barrens, and oil fields.	Suitable sandy habitats likely occur along pipeline alignment and well field site.
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	N/A	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat may occur along pipeline alignment and well field site.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur along pipeline alignment and well field site.
Texas tortoise	*Gopherus berlandieri*	N/A	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive, occupies shallow depressions at base of bush or cactus.	Suitable habitat may occur along pipeline alignment and well field site.
Timber rattlesnake	*Crotalus horridus*	N/A	T	Swamps, floodplains, upland pine and deciduous woodland, riparian zones, and abandoned farmland. Limestone bluffs, sandy soil, or black clay. Prefers dense ground cover, i.e., grapevines, palmetto.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrow into soil or may use burrows made by other species.	Suitable habitat may occur along pipeline alignment and well field site.
Western hognose snake	*Heterodon nasicus*	N/A	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas, and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets. Seem to prefer sandy and loamy soils.	Suitable habitat may occur along pipeline alignment and well field site.
T = Threatened E = Endangered C = Candidate DL = Delisted SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC, and the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the Project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[11] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified nine previously recorded archaeological sites intersecting or immediately adjacent (within 300 feet) to the project area (Table 5.2.22-2). Three sites consist of prehistoric lithic artifact scatters of undetermined NRHP eligibility (THC 2019). Three sites consist of two prehistoric lithic scatters and one campsite, all determined ineligible for listing in the NRHP. Three historic sites of undetermined NRHP eligibility were identified intersecting or immediately adjacent to the project area (THC 2019). In addition, the review identified 52 potentially historic-age buildings intersecting or immediately adjacent to the project area. No cemeteries, historical markers, or NRHP properties are known to be near the project.

[11] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to Texas Code § 2254.021.

The model used assessed unrecorded archaeological site potential within the project area to include low to high potential zones, ranging from 5 to 85 percent likelihood for the landform crossed to contain significant unidentified archaeological resources. The areas with greatest archaeological probability are located near the nine previously documented archaeological sites, the 52 potential historic buildings, and landforms adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 97. Based on the results of the background review, a structured cultural resources survey of the final design plan is recommended to accurately assess the presence and significance of identified and unrecorded cultural resources within its boundaries.

Table 5.2.22-2 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological Site	Campsite	Prehistoric	Ineligible	Intersect
Archaeological Site	Lithic Scatter	Prehistoric	Ineligible	Intersect
Archaeological Site	Lithic Scatter	Prehistoric	Ineligible	Adjacent
Archaeological Site	Lithic Scatter	Prehistoric	Undetermined	Intersect
Archaeological Site	Lithic Scatter	Prehistoric	Undetermined	Intersect
Archaeological Site	Lithic Scatter	Prehistoric	Undetermined	Intersect
Archaeological Site	Farmstead	Historic	Undetermined	Intersect
Archaeological Site	Structural Feature	Historic	Undetermined	Adjacent
Archaeological Site	Artifact Scatter	Historic	Undetermined	Adjacent
Historic Structure	24 Buildings	Historic	None	Intersect
Historic Structure	28 Buildings	Historic	None	Adjacent
			ASSESSMENT SCORE TOTAL:	**97.0**

5.2.22.4 Engineering and Costing

The preliminary engineering analyses have groundwater being developed for a peaking factor of 1.25. For this water management strategy, it is assumed that all facilities would be included in a single phase. A final delivery point has not been selected at this time. For purposes of estimating cost, the delivery point is assumed to be near the City of Cibolo.

As shown on Figure 5.2.22-1, this project will share a planned SSLGC pipeline and pump station to deliver the water from the current SSLGC water treatment plant and pump station in southeast Guadalupe County.

The major facilities required for this strategy include the following:

- Six 1,100 gpm wells;
- Well field collection pipelines and pumps;
- 12 mgd water treatment plant expansion;
- 36 inch, 9 mile transmission pipeline; and
- Shared pipeline and pump station which runs parallel to an existing SSLGC pipeline, from SSLGC facilities in southeast Guadalupe County to the City of Cibolo.

Preliminary engineering and costing analyses have been performed using the 2021 Regional Water Planning methods. Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and methods for calculating unit costs. These costs are summarized in Table 5.2.22-3. Overall, project costs are estimated at $130,227,000. Accounting for debt service, operations and maintenance, and pumping energy, annual cost is estimated at $12,302,000, and the annual unit cost of additional firm supply is about $1,230/acft ($3.77/kgal).

Table 5.2.22-3 Project Cost Estimate Summary

ITEM	ESTIMATED COSTS
Primary Pump Station (11.2 mgd)	$9,413,000
Transmission Pipeline (36 in. dia., 9 miles)	$18,380,000
Shared Transmission Pipeline	$28,359,000
Transmission Pump Station(s) and Storage Tank(s)	$3,077,000
Well Fields (wells, pumps, and piping)	$10,764,000
Water Treatment Plant Expansion (12 mgd)	$22,494,000
TOTAL COST OF FACILITIES	**$92,487,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$30,034,000
Environmental and Archaeology Studies and Mitigation	$1,404,000
Land Acquisition and Surveying (604 acres)	$2,816,000

ITEM	ESTIMATED COSTS
Interest During Construction (3% for 1 year with a 0.5% return on investment)	$3,486,000
TOTAL COST OF PROJECT	**$130,227,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$9,163,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$575,000
Intakes and Pump Stations (2.5% of cost of facilities)	$312,000
Water Treatment Plant	$1,513,000
Pumping Energy Costs (8,217,767 kWh at 0.08 $/kWh)	$657,000
Purchase of Water (10,000 acft/yr at 8.15 $/acft)	$82,000
TOTAL ANNUAL COST	**$12,302,000**
Available Project Yield (acft/yr)	10,000
Annual Cost of Water ($ per acft)	$1,230
Annual Cost of Water After Debt Service ($ per acft)	$314
Annual Cost of Water ($ per 1,000 gallons)	$3.77
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.96
Based on a Peaking Factor of 1.25.	

5.2.22.5 Implementation Considerations

Implementation of the CVLGCC Project could create conflicts with other water supply plans as they will be competing for limited groundwater supplies within Wilson County and the EUWCD. Because the district's permitting process is independent of the regional planning process, potentially competing groundwater management strategies are not prioritized.

The development of groundwater in the Carrizo-Wilcox Aquifer in the South Texas Water Planning Region must address several issues. Major issues may include the following:

- EUWCD permits:
  - Analyses of pumping impacts on groundwater levels;
  - Mitigation of impacts on existing well owners;
  - Drought and Water Conservation Plans; and
  - Needs assessment of the receiving water utilities.

- Impacts on:
  - Endangered and threatened species;
  - Baseflow in streams; and
  - Wetlands.
- Competition with others in the area for groundwater.

Reliability

Water from these sources is considered to be reliable based on hydrogeologic information in the area and suitable for use as a water supply. Supply is considered to be medium because of conflicts with other water supply plans as they will be competing for limited groundwater supplies within Wilson County and the EUWCD (reliability score = 4).

5.2.23 SSLGC Expanded Carrizo Project

5.2.23.1 Description of Water Management Strategy

The Schertz-Seguin Water Supply Project, owned and operated by SSLGC, currently holds permits to pump 19,362 acft/yr of groundwater from the Carrizo Aquifer in western Gonzales County at their existing Carrizo Wellfield.

For this proposed WMS, SSLGC plans to expand into a new well field in Guadalupe County which will provide a supply of 6,000 acft/yr. SSLGC has obtained a permit for 4,035 acft/yr from the Carrizo Aquifer in southeastern Guadalupe County, and a permit for 1,290 acft/yr from the Wilcox Aquifer in southeastern Guadalupe County. SSLGC needs to obtain additional permits for 675 acft/yr.

The SSLGC Expanded Carrizo Project will be located in a new wellfield in southeastern Guadalupe County on lands owned or leased by SSLGC. After treatment at a new WTP, water will be transported via a shared pipeline between SSLGC and CVLGC, which will run parallel to SSLGC's existing transmission pipeline. Figure 5.2.23-1 illustrates the existing Schertz-Seguin Water Supply Project system and proposed new wellfield. The primary recipients of the water are the cities of Schertz and Seguin. SSLGC also provides some water to the cities of Selma, Universal City, Springs Hill WSC, and SAWS.

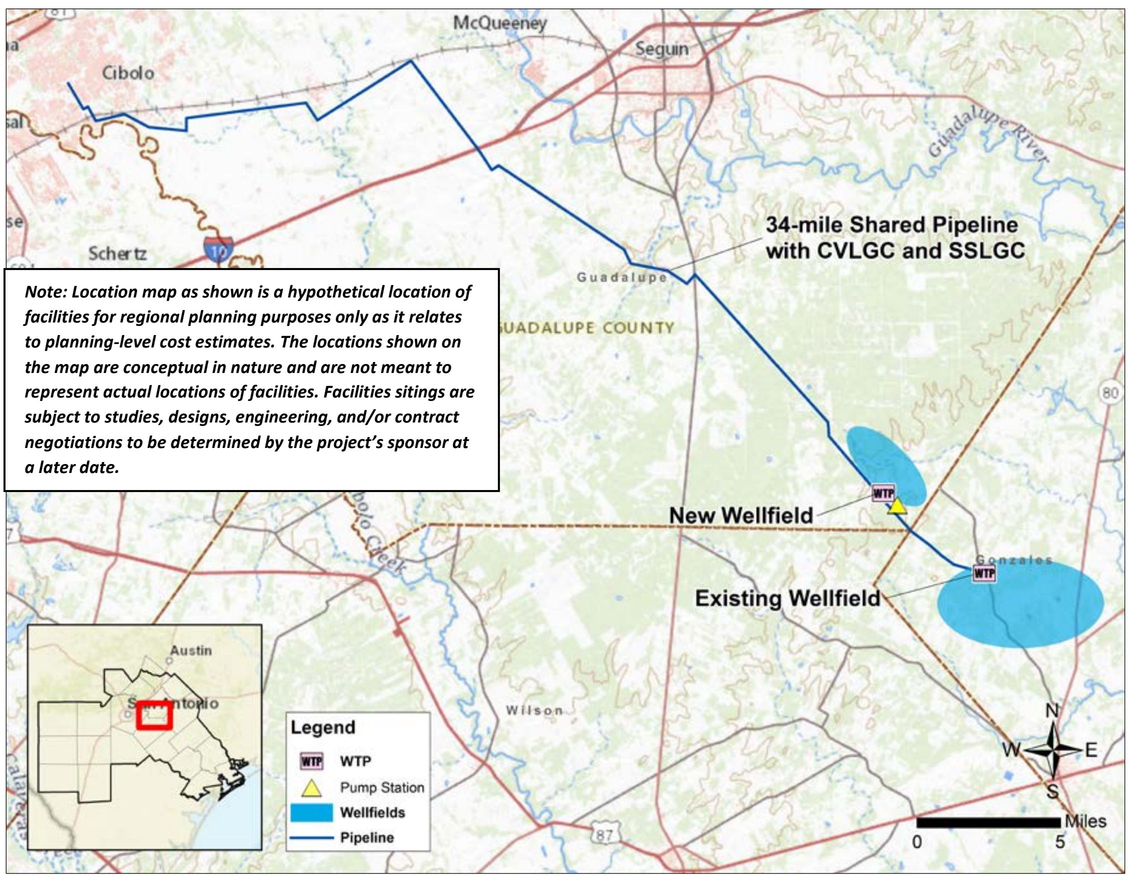

Figure 5.2.23-1 SSLGC Expanded Carrizo Project Location

5.2.23.2 Available Yield

The Carrizo Aquifer, near the planned well field, is in the confined part of the aquifer, and approximately 2 miles downdip of the outcrop. Hydrogeologic maps of the aquifer in this area suggest that wells would be capable of producing more than 500 gpm and up to 800 feet deep. The majority of the wells are planned to be screened in the Carrizo Sand instead of the Wilcox Group for water quality and depth considerations. Groundwater quality in the planned well field appears to have a concentration of TDS of less than 300 mg/L. However, the water quality of groundwater from the Carrizo Sand often has elevated concentrations of iron and manganese, which require removal before public use. The Wilcox Aquifer wells will be capable of producing approximately 400 gpm and be between 1,000 and 1,600 feet deep. The project will consist of eight wells in the Carrizo Aquifer and two wells in the Wilcox Aquifer.

Groundwater supply projects in Guadalupe County are subject to groundwater production and well spacing rules, and export of groundwater is subject to rules of the Guadalupe County Groundwater Conservation District (GCGCD). The MAG for the Carrizo-Wilcox Aquifer in Guadalupe County varies between 45,776 and 52,528 acft/yr over the 50 year planning horizon[1]. The GCGCD currently has 13,342 acft/yr permitted from the Carrizo-Wilcox Aquifer. In addition, TWDB estimates of historic groundwater production from the Carrizo-Wilcox Aquifer are even lower than the permitted totals provided by the Guadalupe County GCD. TWDB estimates of historic municipal groundwater use from the Carrizo-Wilcox in Guadalupe County in the last 10 years has been between approximately 700 and 3,500 acft/yr. Irrigation and livestock are the only other significant sources of groundwater use from the Carrizo-Wilcox according to the TWDB surveys but have been less than 1,000 acft/yr in the last 10 years for each of these uses. Based on this information, it appears that the yield for this strategy is not limited by the MAG. This WMS has a firm yield of 6,000 acft/yr and is planned for implementation beginning in the 2020 decade.

5.2.23.3 Environmental and Cultural Considerations

Environmental Considerations

Vegetation and Land Use

The project area occurs in the Blackland Prairie and Post Oak Savannah ecoregions. As mapped by TPWD[2]; the project area includes a variety of vegetation types – primarily grassland and savannah with more wooded areas toward the southeastern part of the project area and wooded riparian areas along streams. The predominant vegetation communities are disturbance/tame grassland, post oak savannah, post oak motte/woodland, mesquite shrubland, and agriculture.

Based on TPWD vegetation mapping, the project may have the potential to impact 153 acres of agricultural resources, including 41 acres mapped as row crops and 112 acres mapped as tame/disturbance grassland which may include pasture areas used for grazing or hay production.

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[1] Wade, S.C. 2017. GAM Run 17-027 MAG: Modeled Available Groundwater for the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson Aquifers in Groundwater Management Area 13: Texas Water Development Board. https://www.twdb.texas.gov/groundwater/docs/GAMruns/GR17-027_MAG.pdf?d=19840.414999998757.

[2] TPWD. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

Project pipeline easements would require removal of woody vegetation and long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each water management strategy to determine the best course of action regarding revegetation. Pipeline easements may continue to be used for agricultural purposes.

The proposed well field expansion would result in conversion of land use from undeveloped vegetation and agricultural areas (mostly open fields and shrubland) to small areas of industrial use.

Aquatic Resources

The proposed pipeline would cross Santa Clara Creek and several unnamed tributaries. The NWI mapping identifies 6.1 acres of wetlands in the overall project area. The Texas Integrated Report of 303(d)-listed water bodies[3] identifies the water bodies or segments in Texas that do not meet assigned water quality standards. Segment 1913 of Cibolo Creek, south of the pipeline alignment, is listed as impaired. The well field project area does not contain listed impaired water bodies. The project area does not contain ecologically significant stream segments as designated by TPWD.

The project will require an on-site delineation of streams, ponds, and wetlands. Well field facilities can typically be sited to avoid impacts to waters of the United States including wetlands. Stream crossings for pipeline construction would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including if there would be permanent impacts to more than 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under stream (e.g., through horizontal directional drilling) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

Table 5.2.23-1 provides a summary of threatened, endangered, and candidate species and species of concern that have potential to occur in Guadalupe and Gonzales Counties. [4],[5],[6],[7] Suitable habitat does not occur for any of the federally-listed species. However, several freshwater mussel species are under

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[3] Texas Commission on Environmental Quality. 2015. 2014 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/waterquality/assessment/14twqi/14txir.

[4] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Guadalupe County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[5] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Guadalupe County. https://ecos.fws.gov/ipac/location/QVIBPJWUHBAAFNOCI4UCN5RVEI/resources.

[6] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Gonzales County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[7] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Gonzales County. https://ecos.fws.gov/ipac/location/THAN4LUF6JGQ3FAWPQMXZQPATA/resources.

review for federal listing as threatened or endangered, and the project pipeline crosses streams that may provide suitable habitat for freshwater mussels.

Suitable habitat may occur for the state-listed threatened species white-faced ibis (*Plegadis chihi*), white-tailed hawk (*Buteo albicaudatus*), Texas horned lizard (*Phrynosoma cornutum*), Texas tortoise (*Gopherus berlandieri*), and timber rattlesnake (*Croatalus horridus*).

There is potential for suitable habitat for numerous wildlife species designated by TPWD as SGCN, including American bumblebee (*Bombus pensylvanicus*), Strecker's chorus frog (*Pseudacris streckeri*), Woodhouse's toad (*Anaxyrus woodhousii*), western burrowing owl (*Athene cunicularia hypugaea*), American badger (*Taxidea taxus*), thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*), eastern spotted skunk (*Spilogale putorius*), and plains spotted skunk (*Spilogale putorius interrupta*). In addition, SGCN bat species may utilize structures and could therefore occur in developed areas. The SGCN list also includes numerous plant species, including many for which detailed habitat requirements have not been developed by TPWD. SGCN species do not have formal protected status but are being monitored by TPWD.

Site-specific field surveys would be required to determine the quality of habitat for freshwater mussels, should they be added to the federal list of threatened/endangered species. Consultation with the USFWS would be required if mussel suitable habitat may be affected by pipeline construction activities. Site-specific field surveys would also be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain their recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15.

Table 5.2.23-1 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for SSLGC Expanded Carrizo Project, Guadalupe and Gonzales Counties, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Strecker's chorus frog	*Pseudacris streckeri*	NA	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Suitable habitat may occur in project area.
Texas blind salamander	Eurycea rathbuni	E	SGCN	Water-filled subterranean caverns along 6 miles of the San Marcos Spring Fault.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Woodhouse's toad	*Anaxyrus woodhousii*	NA	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur in project area.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat does not occur within project area; may fly over during migration.
Black rail	*Laterallus jamaicensis*	NA	SGCN	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh.	Unlikely to occur within project area; may fly over during migration.
Franklin's gull	*Leucophaeus pipixcan*	NA	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur within project area; may fly over during migration.
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also known to nest on manmade structures (inland beaches, WWTPs, gravel mines, etc.).	Unlikely to occur within project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	NA	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat may occur in project area.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur within project area; may fly over during migration.
Red knot	*Calidris canutus rufa*	T	SGCN	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays.	Suitable habitat does not occur within project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	NA	SGCN	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Swallow-tailed kite	*Elanoides forficatus*	NA	SGCN	Lowland forest, especially swampy areas, ranges to open woodland; marshes, along rivers, lakes, and ponds. Nests high in tall trees in clearing or on forest woodland edge, usually pine, cypress, or deciduous trees.	Suitable habitat unlikely to occur in project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	NA	SGCN	Open grasslands and savannahs may use open areas such as vacant lots, nests and roosts in abandoned burrows.	Suitable habitat may occur in project area.
White-faced ibis	*Plegadis chihi*	NA	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat may occur in project area.
White-tailed hawk	*Buteo albicaudatus*	NA	T	Near coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannahs, and mixed savannah-chaparral.	Suitable habitat may occur in project area.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems [during migration].	Suitable habitat does not occur within project area; may fly over during migration.
Wood stork	*Mycteria americana*	NA	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Unlikely to occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	NA	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat does not occur within project area; may fly over during migration.
Fish					

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
American eel	*Anguila rostrata*	NA	SGCN	Coastal waterways below reservoirs.	Suitable habitat does not occur within project area.
Fountain darter	*Etheostoma fonticola*	E	E	San Marcos and Comal Rivers; springs and spring-fed streams with dense beds of aquatic plants.	Project is outside of the expected range of this species.
Guadalupe bass	*Micropterus treculii*	NA	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat may occur within project area.
Guadalupe darter	*Percina apristis*	NA	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Suitable habitat does not occur within project area.
Plateau shiner	*Cyprinella lepida*	NA	SGCN	Edwards Plateau portion of the Nueces basin; cool, clear, spring-fed headwater creeks.	Suitable habitat does not occur within project area.
River darter	*Percina shumardi*	NA	SGCN	Eastern streams, including the Red southward to the Neches; a disjunct population in the Guadalupe and San Antonio River systems east of the Balcones Escarpment.	Suitable habitat does not occur within project area.
Texas shiner	*Notropis amabilis*	NA	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Project is outside the expected range of this species.
Insects					
American bumblebee	*Bombus pensylvanicus*	NA	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in the project area.
No accepted common name	*Bombus variabilis*	NA	SGCN	Parasite on other bumblebee species.	Suitable habitat may occur in the project area.
No accepted common name	*Melanoplus alexanderi*	NA	SGCN	Primarily in open oak or pine/oak savannah type habitats with fine grain loamy sand to sandy loam soils.	Suitable habitat may occur within project area.
Mammals					
American badger	*Taxidea taxus*	NA	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur within project area.
Big brown bat	*Eptesicus fuscus*	NA	SGCN	Woodlands or wooded areas.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Big free-tailed bat	*Nyctinomops macrotis*	NA	SGCN	Roost in high canyon walls but will use buildings.	Suitable canyon habitat does not occur within project area; may use buildings.
Black-tailed prairie dog	*Cynomys ludovicianus*	NA	SGCN	Short, flat, dry grasslands with sparse vegetation.	Project is outside the expected range of this species.
Cave myotis bat	*Myotis velifer*	NA	SGCN	Cave-dwelling, roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	Suitable habitat may occur within project area; may use buildings/structures.
Eastern red bat	*Lasiurus borealis*	NA	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat may occur within project area.
Eastern spotted skunk	*Spilogale putorius*	NA	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges, and woodlands. Prefer wooded, brushy areas; tallgrass prairies.	Suitable habitat may occur within project area.
Hoary bat	*Lasiurus cinereus*	NA	SGCN	Forests and woods in east and central Texas.	Suitable habitat may occur within project area.
Long-tailed weasel	*Mustela frenata*	NA	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur within project area.
Mexican free-tailed bat	*Tadarida brasiliensis*	NA	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	Suitable habitat may occur within project area; may use buildings/structures.
Mexican long-tongued bat	*Choeronycteris mexicana*	NA	SGCN	Riparian forest in Texas; roost in mines, large crevices, and caves.	Not expected to occur in project area.
Mink	*Neovison vison*	NA	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Low potential for suitable habitat to occur within project area.
Mountain lion	*Puma concolor*	NA	SGCN	Use wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Low potential for suitable habitat to occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Plains spotted skunk	*Spilogale putorius interrupta*	NA	NA	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur within project area.
Southern short-tailed shrew	*Blarina carolinensis*	NA	SGCN	Wooded and brushy areas; prefers fallen logs and abundant lead litter.	Suitable habitat may occur within project area.
Swamp rabbit	*Sylvilagus aquaticus*	NA	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat may occur within project area.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	NA	SGCN	Prefer short-grass prairies; also occur in pastures and along fencerows. Excavate burrows or use abandoned pocket gopher or prairie dog burrows.	Suitable habitat may occur within project area.
Tricolored bat	*Perimyotis subflavus*	NA	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat may occur within project area.
Western hog-nosed skunk	*Conepatus leuconotus*	NA	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat may occur within project area.
Western spotted skunk	*Spilogale gracilis*	NA	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur within project vicinity.
White-nosed coati	*Nasua narica*	NA	T	Canyons, riparian corridors, and woodlands.	Project area is outside the expected range of this species.
Mollusks					
False spike	*Fusconaia mitchelli*	NA	T	Medium to large rivers; present in Guadalupe, Colorado, Brazos river basins.	Suitable habitat may occur in streams; pipeline construction may result in temporary impacts.
Golden orb	*Cyclonaias aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Suitable habitat may occur in streams; pipeline construction may result in temporary impacts.
No accepted common name	*Cyclonaias necki*	NA	NA	Guadalupe River basin; moderate to large streams with flowing water.	Suitable habitat may occur in streams; pipeline construction may result in temporary impacts.
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	NA	SGCN	Endemic to sandy regions of southern and south-central Texas.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Bracted twistflower	Streptanthus bracteatus	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Suitable habitat does not occur within project area.
Bristle nailwort	*Paronychia setacea*	NA	SGCN	Flowering vascular plant endemic to eastern southcentral Texas, occurring in sandy soils.	Suitable habitat may occur within project area.
Buckley's spiderwort	*Tradescantia buckleyi*	NA	SGCN	Occurs on sandy loam or clay soils in grasslands or shrublands underlain by the Beaumont Formation.	The project area is outside the expected range of this species.
Buckley tridens	*Tridens buckleyanus*	NA	SGCN	Juniper-oak woodlands on rocky limestone slopes.	Suitable habitat does not occur within project area.
Crestless onion	*Allium canadense* var. *ecristatum*	NA	SGCN	Occurs on poorly drained sites on sandy substrates within coastal prairies of the Coastal Bend area.	The project area is outside the expected range of this species.
Drummond's rushpea	*Caesalpinia drummondii*	NA	SGCN	Open areas on sandy clay.	Suitable habitat may occur within project area.
Elmendorf's onion	*Allium elmendorfii*	NA	SGCN	Grassland openings in oak woodlands on deep, loose, well-drained sands; to the north it occurs in post oak-black hickory-live oak woodlands over Queen City and similar Eocene formations.	Suitable habitat may occur within project area.
Engelmann's bladderpod	*Physaria engelmannii*	NA	SGCN	Grasslands and calcareous rock outcrops along the eastern edge of the Edwards Plateau, ranging as far north as the Red River.	Suitable habitat does not occur within project area.
Florida pinkroot	*Spigelia texana*	NA	SGCN	Woodlands on loamy soils.	Suitable habitat may occur within project area.
Heartleaf evening primrose	*Oenothera cordata*	NA	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Heller's marbleseed	*Omosmodium helleri*	NA	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Suitable habitat does not occur within project area.
Hill Country wild-mercury	*Argythamnia aphoroides*	NA	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands, also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Suitable habitat does not occur within project area.
Low spurge	*Euphorbia peplidion*	NA	SGCN	Occurs in a variety of vernally-moist situations in a number of natural regions.	Suitable habitat may occur within project area.
Lundell's whitlow-wort	*Paronychia lundellorum*	NA	SGCN	The Sand Sheet of eastern South Texas, in tight sandy soils over saline clay on microhighs within salty prairie grasslands, and in upper portions of saline flats surrounding short drainages and brackish basins typical of the South Texas Sand Sheet.	The project area is outside the expected range of this species.
Net-leaf bundleflower	*Desmanthus reticulatus*	NA	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat may occur within project area.
Parks jointweed	*Polygonella parksii*	NA	SGCN	Mostly on deep, loose, whitish sand blowouts (unstable, deep, xeric, sandhill barrens) in Post Oak Savannah landscapes over the Carrizo and Sparta formations; also occurs in early successional grasslands, along rights-of-way, and on mechanically disturbed areas.	Suitable habitat may occur within project area.
Plateau milkvine	*Matelea edwardsensis*	NA	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Sandhill woolywhite	*Hymenopappus carrizoanus*	NA	SGCN	Disturbed or open areas in grasslands and post oak woodlands on deep sands derived from the Carrizo Sand and similar Eocene formations.	Suitable habitat may occur within project area.
Sayersville blue eyes	*Nemophila sayersensis*	NA	SGCN	Forest/woodland, sand/dune, savannah, woodland (hardwood; sandy), nutrient poor soils. With willow, post oak, pecan, and elm in very sandy soil along creeks.	Suitable habitat may occur within project area.
South Texas spikesedge	*Eleocharis austrotexana*	NA	SGCN	Wetlands on the coastal plain.	Suitable habitat does not occur within project area.
Texas amorpha	*Amorpha roemeriana*	NA	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes, sometimes on dry shelves above creeks.	Suitable habitat does not occur within project area.
Texas beebalm	*Monarda viridissima*	NA	SGCN	Endemic perennial herb of the Carrizo Sands; deep, well-drained sandy soils in openings of post oak woodlands.	Suitable habitat may occur within project area.
Texas milk vetch	*Astragalus reflexus*	NA	SGCN	Grasslands, prairies, and roadsides on calcareous and clay substrates.	Suitable habitat may occur within project area.
Texas peachbush	*Prunus texana*	NA	SGCN	Occurs at scattered sites in various well drained sandy situations; deep sand, plains and sand hills, grasslands, oak woods, 0 to 200 meter elevation.	Suitable habitat may occur within project area.
Texas sandmint	*Rhododon ciliatus*	NA	SGCN	Open sandy areas in the Post Oak Belt of east-central Texas.	Suitable habitat may occur within project area.
Texas tauschia	*Tauschia texana*	NA	SGCN	Occurs in loamy soils in deciduous forests or woodlands on river and stream terraces.	Suitable habitat may occur within project area.
Topeka purple-coneflower	*Echinacea atrorubens*	NA	SGCN	Occurring mostly in tallgrass prairie of the southern Great Plains, in blackland prairies, but also in a variety of other sites like limestone hillsides.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Woolly butterflyweed	*Gaura villosa ssp. parksii*	NA	SGCN	Sandy soils of Rio Grande plains.	Suitable habitat does not occur within project area.
Wright's trichocoronis	*Trichocoronis wrightii* var. *wrightii*	NA	SGCN	Riparian zones, wetlands, pond margins, wet meadows.	Suitable habitat may occur within project area.
Reptiles					
American alligator	*Alligator mississippiensis*	NA	NA	Inland natural rivers, swamps, marshes, coastal marshes, and manmade impoundments.	Suitable habitat may occur within project area.
Cagle's map turtle	*Graptemys caglei*	NA	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River System.	Suitable habitat unlikely to occur in project area.
Eastern box turtle	*Terrapene carolina*	NA	SGCN	Found in fields, forests, forest-brush, and forest-field	Suitable habitat may occur within project area.
Keeled earless lizard	*Holbrookia propinqua*	NA	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat does not occur within project area.
Northern spot-tailed earless lizard	*Holbrookia lacerata lacerate*	NA	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edwards Plateau.	Suitable habitat may occur within project area.
Slender glass lizard	*Ophisaurus attenuatus*	NA	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannahs, pine barrens, and oil fields.	Suitable habitat may occur within project area.
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	NA	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat may occur within project area.
Texas horned lizard	*Phrynosoma cornutum*	NA	T	Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur within project area.
Texas tortoise	*Gopherus berlandieri*	NA	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided when inactive occupies shallow depressions at base of bush or cactus.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Timber rattlesnake	*Crotalus horridus*	NA	T	Swamps, floodplains, upland pine and deciduous woodland, riparian zones, abandoned farmland. Limestone bluffs, sandy soil, or black clay. Prefers dense ground cover (i.e., grapevines, palmetto).	Suitable habitat may occur within project area.
Western box turtle	*Terrapene ornata*	NA	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland, prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrow into soil or may use burrows made by other species.	Suitable habitat may occur within project area.
Western hognose snake	*Heterodon nasicus*	NA	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas (but not intensively cultivated), and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets. Seems to prefer sandy and loamy soils. Periods of inactivity are spent burrowed in the soil or in existing burrows.	Suitable habitat may occur within project area.

T = Threatened
E = Endangered
PT = Proposed Threatened
C = Candidate
DL = Delisted
SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC, the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the Project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[8] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified nine previously recorded archaeological sites intersecting or immediately adjacent (within 300 feet) to the project area. Three sites consist of prehistoric lithic artifact scatters of undetermined NRHP eligibility (THC 2019). Three sites consist of two prehistoric lithic artifact scatters and one prehistoric campsite determined ineligible for listing in the NRHP. Three historic sites of undetermined NRHP eligibility intersect or are immediately adjacent to the project area (THC 2019). In addition, the review identified 55 potentially historic-age buildings intersecting or immediately adjacent to the project area. No cemeteries, historical markers, or NRHP properties are known to be near the project.

The model used assessed unrecorded archaeological site potential within the project area to include low to high potential zones, ranging from 5 percent to 85 percent likelihood for the landform crossed to contain significant unidentified archaeological resources. The areas with greatest archaeological probability are located near the nine previously documented archaeological sites and the landforms adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 103. Based on the results of the background review, SWCA recommends that a structured cultural resources survey of the final design plan be performed to accurately assess the presence and significance of identified and unrecorded cultural resources within its boundaries.

Table 5.2.23-2 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological Site	Campsite	Prehistoric	Ineligible	Intersect
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Ineligible	Intersect
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Ineligible	Adjacent
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Undetermined	Intersect
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Undetermined	Intersect
Archaeological Site	Lithic Artifact Scatter	Prehistoric	Undetermined	Intersect

[8] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological Site	Farmstead	Historic	Undetermined	Intersect
Archaeological Site	Structural Feature	Historic	Undetermined	Adjacent
Archaeological Site	Artifact Scatter	Historic	Undetermined	Adjacent
None	25 Buildings	Historic	None	Intersect
None	30 Buildings	Historic	None	Adjacent
			ASSESSMENT SCORE TOTAL:	103.0

5.2.23.4 Engineering and Costing

The groundwater project will be developed by constructing 10 new wells, installing a pipeline collection system, and a 6 mgd WTP at the new well field for chlorine disinfection and iron/manganese removal. The treated water will be conveyed with a new shared pipeline parallel to the existing SSLGC Pipeline. In addition to the treated groundwater from the proposed well field, the pipeline is sized to convey yield from the CVLGC. The costs are shared between the three projects.

The SSLGC Carrizo-Wilcox expansion is planned to provide an additional 6,000 acft/yr above the currently permitted 19,362 acft/yr. When completed, this Regional Carrizo project is to yield 25,362 acft/yr. The major facilities required for this strategy include the following:

- Wells;
- Well field collection pipeline(s);
- Water treatment plant; and
- SSLGC Parallel Pipeline/Pump Station.

The Guadalupe County wells in the Carrizo Aquifer were assumed to be 800 feet deep because they are located updip of the existing wells and have a rated capacity of 500 gpm. The wells in the Wilcox aquifer are assumed to have a depth of 1,600 feet for costing purposes. The WTP and pump station will be placed at the proposed intersection of the Cibolo Valley Carrizo project. Power costs for conveyance of the additional 6,000 acft/yr associated with the SSLGC Carrizo-Wilcox expansion were an equivalent portion of the total shared pipeline and pump station costs.

Preliminary engineering and costing analyses have been performed using the 2021 Regional Water Planning methods. Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and method for calculating unit costs. The overall project costs are estimated at $75,542,283,000. Accounting for debt service, O&M, and pumping energy, annual cost is estimated at $7,239,000 and the annual unit cost of additional firm supply is about $1,207/acft ($3.70/kgal; Table 5.2.23-3).

Table 5.2.23-3 Cost Estimate Summary

ITEM	ESTIMATED COSTS
Primary Pump Station (17.9 mgd)	$3,351,000
Shared Transmission Pipeline	$21,089,000
Transmission Pump Station(s) and Storage Tank(s)	$1,846,000
Well Fields (Wells, Pumps, and Piping)	$11,453,000
WTP (6 mgd)	$15,688,000
TOTAL COST OF FACILITIES	**$53,427,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$17,645,000
Environmental and Archaeology Studies and Mitigation	$1,420,000
Land Acquisition and Surveying (549 acres)	$1,028,000
Interest During Construction (3% for 1 year with a 0.5% return on investment)	$2,022,000
TOTAL COST OF PROJECT	**$75,542,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$5,315,000
O&M	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$325,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$130,000
WTP	$1,160,000
Pumping Energy Costs (3,861,179 kWh at 0.08 $/kWh)	$309,000
TOTAL ANNUAL COST	**$7,239,000**
Available Project Yield (acft/yr)	6,000
Annual Cost of Water ($ per acft)	$1,207
Annual Cost of Water After Debt Service ($ per acft)	$321
Annual Cost of Water ($ per 1,000 gallons)	$3.70
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.98
Based on a Peaking Factor of 1.25.	

5.2.23.5 Implementation Considerations

Implementation of the SSLGC Expanded Carrizo Project could involve limited conflicts with other Water Management Strategies under consideration, including the Wells Ranch Carrizo project, since both strategies would operate in common groundwater conservation districts.

Implementation of the SSLGC Expanded Carrizo Project may include the following considerations:

- Obtaining all required permits for the project; and
- Detailed feasibility evaluation, including test drilling and aquifer and water quality testing, followed with more detailed groundwater modeling to confirm results of this preliminary evaluation.
- Impact on the following:
    - Endangered and threatened wildlife species;
    - Water levels in the aquifer;
    - Baseflow in streams; and
    - Wetlands.
- Competition with others in the area for groundwater; and
- Regulations by the Guadalupe County GCD, including the renewal of pumping permits at 5 year intervals.

Reliability

Water from these sources is considered to be reliable based on available hydrogeologic information from the existing nearby wells. Supply is considered to be medium because of the potential of differing well productivity and water quality, potential impacts to natural resources and Carrizo Aquifer user competition (reliability score = 4).

5.2.24 SSLGC Expanded Brackish Wilcox Project

5.2.24.1 Description of Water Management Strategy

SSLGC is planning an expansion of their wellfield in the Brackish Wilcox Aquifer in Gonzales County. The expansion consists of seven new wells, each with a peak flow capacity of 800 gpm. The brackish Wilcox well field will provide a total of 5,000 acft/yr of supply.

Raw water from the Wilcox has a TDS of approximately 1,500 mg/L. Currently at the Gonzales wellfield, SSLGC has a permit for 19,363 acft/yr of water from the Carrizo, which has a TDS of approximately 300 mg/L. SSLGC will blend the raw Carrizo water with the raw brackish Wilcox water and treat the blended water at the existing WTP. The current WTP is to be expanded from 35 mgd to 40 mgd to handle the new capacity from the Gonzales well field. The treated yield will be transferred to the distribution system via the existing SSLGC pipeline. Figure 5.2.24-1 illustrates the existing Schertz-Seguin Water Supply Project system.

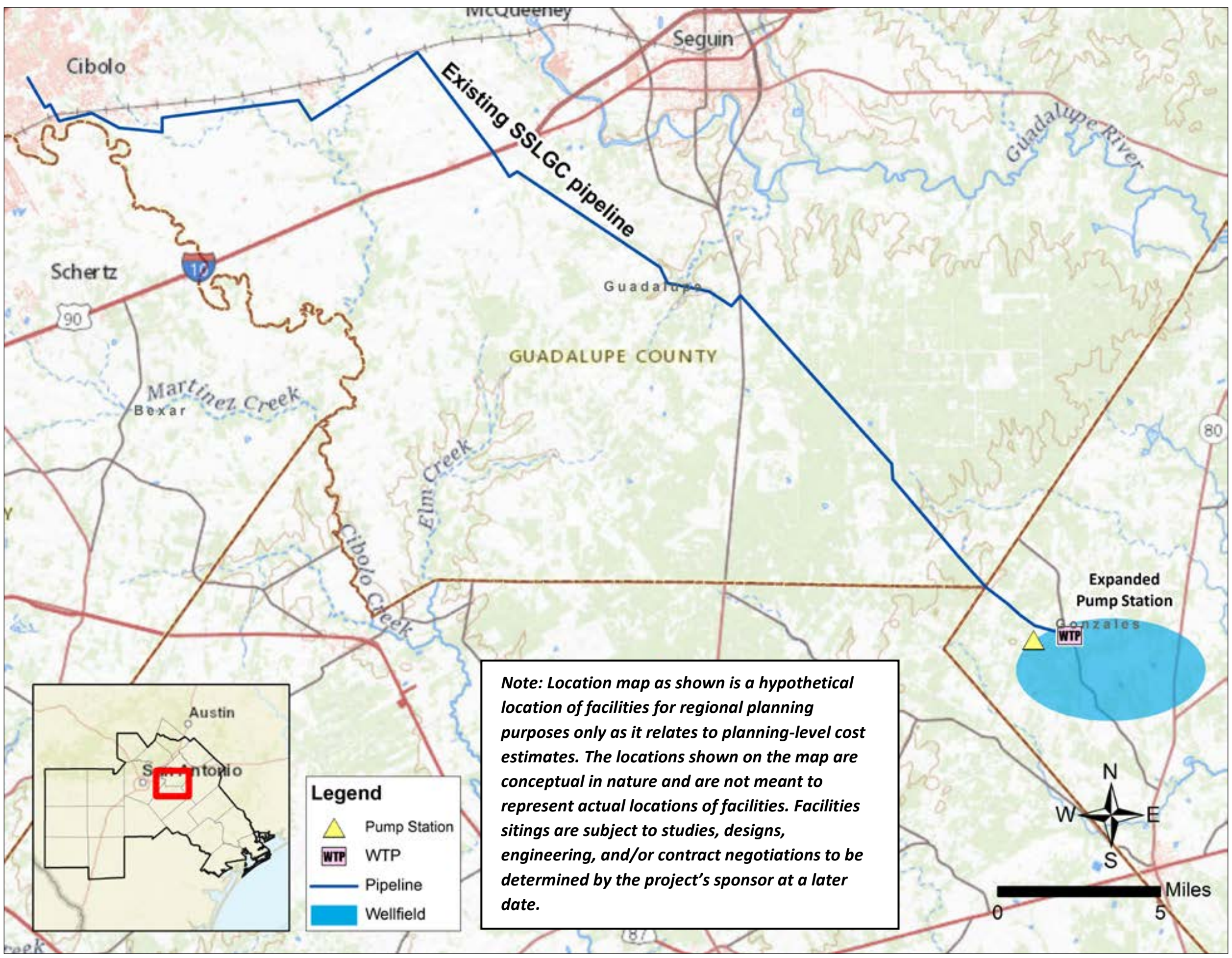

Figure 5.2.24-1 SSLGC Expanded Brackish Wilcox Project Location

5.2.24.2 Available Yield

The proposed wells are in the confined part of the Wilcox Aquifer and are approximately 12 miles downdip of the outcrop. Hydrogeologic maps of the aquifer in this area suggest that wells would be capable of producing in excess of 800 gpm and would range in depth from 1,800 to 2,400 feet.

Groundwater supply projects in Gonzales County are subject to groundwater production, well spacing, and groundwater export rules of the GCUWCD. The MAG for the Carrizo-Wilcox Aquifer in Gonzales County varies between 81,653 and 86,055 acft/yr over the 50-year planning horizon[1]. The GCUWCD currently has 104,486 acft/yr permitted from the Carrizo-Wilcox Aquifer[2], which may indicate a yield limitation by the MAG. However, recent legislation has been passed that addresses the permitting of brackish groundwater by groundwater districts. This legislation authorizes a groundwater conservation district over any part of a designated brackish groundwater production zone to adopt rules to govern the issuance of permits for the withdrawal of brackish groundwater. It is unknown at this time how the GCUWCD will address brackish groundwater permitting in the future. This WMS has a firm yield of 5,000 acft/yr and is planned for implementation beginning in the 2040 decade.

5.2.24.3 Environmental Considerations

Environmental Considerations

Vegetation and Land Use

The project area occurs in the Blackland Prairie and Post Oak Savannah ecoregions. As mapped by TPWD[3]; the project area is primarily grassland and savannah with some wooded areas along streams. The predominant vegetation communities are disturbance/tame grassland, savannah grassland, and agriculture.

Based on TPWD vegetation mapping, the project may have the potential to impact 164 acres of agricultural resources, including 41 acres mapped as row crops and 123 acres mapped as tame/disturbance grassland which may include pasture areas used for grazing or hay production.

The proposed well field expansion would result in conversion of land use from undeveloped vegetation or agricultural lands (mostly open fields) to small areas of industrial use.

[1] Wade, S.C. 2017. GAM Run 17-027 MAG: Modeled Available Groundwater for the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson Aquifers in Groundwater Management Area 13: Texas Water Development Board. https://www.twdb.texas.gov/groundwater/docs/GAMruns/GR17-027_MAG.pdf?d=19840.414999998757.

[2] Wade, S.C. 2017. GAM Run 17-027 MAG: Modeled Available Groundwater for the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson Aquifers in Groundwater Management Area 13: Texas Water Development Board.

[3] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/

Aquatic Resources

The project area contains mapped intermittent streams and several unnamed tributaries. The Texas Integrated Report of 303(d)-listed water bodies[4] identifies the water bodies or segments in Texas that do not meet assigned water quality standards. The well field project area does not contain listed water bodies. The project area does not contain ecologically significant stream segments as designated by TPWD.

The project will require an on-site delineation of streams, ponds, and wetlands. Well field facilities can typically be sited to avoid impacts to waters of the United States, including wetlands. Since the project would rely on existing pipeline, environmental impacts from the pipeline component should be limited to ongoing maintenance activities.

Threatened, Endangered, and Species of Concern

Table 5.2.24-1 provides a summary of threatened, endangered and candidate species and species of concern that have potential to occur in Guadalupe and Gonzales Counties. [5,6,7,8] Suitable habitat does not occur for any of the federally-listed species.

Suitable habitat may occur for the state-listed threatened species such as white-tailed hawk (*Buteo albicaudatus*), Texas horned lizard (*Phrynosoma cornutum*), Texas tortoise (*Gopherus berlandieri*), and timber rattlesnake (*Crotalus horridus*).

There is potential for suitable habitat for numerous wildlife species designated by TPWD as SGCN, including American bumblebee (*Bombus pensylvanicus*), Strecker's chorus frog (*Pseudacris streckeri*), Woodhouse's toad (*Anaxyrus woodhousii*), western burrowing owl (*Athene cunicularia hypugaea*), American badger (*Taxidea taxus*), thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*), eastern spotted skunk (*Spilogale putorius*), and plains spotted skunk (*Spilogale putorius interrupta*). In addition, SGCN bat species may utilize structures and could therefore occur in developed areas. The SGCN list also includes numerous plant species, including many for which detailed habitat requirements have not been developed by TPWD. SGCN species do not have formal protected status but are being monitored by TPWD.

Since the project would not affect federally listed threatened or endangered species, consultation with the USFWS would not be required. Site-specific field surveys would be required to determine the quality

[4] Texas Commission on Environmental Quality. 2015. 2014 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/waterquality/assessment/14twqi/14txir.

[5] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Guadalupe County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[6] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Guadalupe County. https://ecos.fws.gov/ipac/location/QVIBPJWUHBAAFNOCI4UCN5RVEI/resources.

[7] Texas Parks and Wildlife Department (TPWD). 2019. Annotated County Lists of Rare Species – Gonzales County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[8] U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation (IPaC) Resource List – Gonzales County. https://ecos.fws.gov/ipac/location/THAN4LUF6JGQ3FAWPQMXZQPATA/resources.

of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain their recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15.

Table 5.2.24-1 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for SSLGC Expanded Brackish Wilcox Project, Guadalupe and Gonzales Counties, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Strecker's chorus frog	*Pseudacris streckeri*	NA	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Suitable habitat may occur in project area.
Texas blind salamander	Eurycea rathbuni	E	SGCN	Water-filled subterranean caverns along 6 miles of the San Marcos Spring Fault.	Project is outside of the expected range of this species.
Woodhouse's toad	*Anaxyrus woodhousii*	NA	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur in project area.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat does not occur within project area; may fly over during migration.
Black rail	*Laterallus jamaicensis*	NA	SGCN	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh.	Suitable habitat does not occur within project area; may fly over during migration.
Franklin's gull	*Leucophaeus pipixcan*	NA	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur within project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also known to nest on manmade structures (inland beaches, WWTPs, gravel mines, etc.).	Suitable habitat does not occur within project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	NA	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat unlikely to occur within project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur within project area; may fly over during migration.
Red knot	*Calidris canutus rufa*	T	SGCN	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays.	Suitable habitat does not occur within project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	NA	SGCN	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Project is outside of the expected range of this species.
Swallow-tailed kite	*Elanoides forficatus*	NA	SGCN	Lowland forest, especially swampy areas, ranges to open woodland; marshes, along rivers, lakes, and ponds. Nests high in tall trees in clearing or on forest woodland edge, usually pine, cypress, or deciduous trees.	Suitable habitat does not occur in project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	NA	SGCN	Open grasslands and savannahs may use open areas such as vacant lots, nests, and roosts in abandoned burrows.	Suitable habitat may occur in project area.
White-faced ibis	*Plegadis chihi*	NA	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat does not occur in project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
White-tailed hawk	*Buteo albicaudatus*	NA	T	Near coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannahs, and mixed savannah-chaparral.	Suitable habitat may occur in project area.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems [during migration].	Suitable habitat does not occur within project area; may fly over during migration.
Wood stork	*Mycteria americana*	NA	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Suitable habitat does not occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	NA	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat does not occur within project area; may fly over during migration.
Fish					
American eel	*Anguila rostrata*	NA	SGCN	Coastal waterways below reservoirs.	Suitable habitat does not occur within project area.
Fountain darter	*Etheostoma fonticola*	E	E	San Marcos and Comal Rivers; springs and spring-fed streams with dense beds of aquatic plants.	Project is outside of the expected range of this species
Guadalupe bass	*Micropterus treculii*	NA	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat does not occur within project area.
Guadalupe darter	*Percina apristis*	NA	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Suitable habitat does not occur within project area.
Plateau shiner	*Cyprinella lepida*	NA	SGCN	Edwards Plateau portion of the Nueces basin; cool, clear, spring-fed headwater creeks.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
River darter	*Percina shumardi*	NA	SGCN	Eastern streams, including the Red southward to the Neches; a disjunct population in the Guadalupe and San Antonio River systems east of the Balcones Escarpment.	Suitable habitat does not occur within project area.
Texas shiner	*Notropis amabilis*	NA	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Project is outside the expected range of this species.
Insects					
American bumblebee	*Bombus pensylvanicus*	NA	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in the project area.
No accepted common name	*Bombus variabilis*	NA	SGCN	Parasite on other bumblebee species.	Suitable habitat may occur in the project area.
No accepted common name	*Melanoplus alexanderi*	NA	SGCN	Primarily in open oak or pine/oak savannah type habitats with fine grain loamy sand to sandy loam soils.	Suitable habitat may occur within project area.
Mammals					
American badger	*Taxidea taxus*	NA	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur within project area.
Big brown bat	*Eptesicus fuscus*	NA	SGCN	Woodlands or wooded areas.	Suitable habitat may occur within project area.
Big free-tailed bat	*Nyctinomops macrotis*	NA	SGCN	Roost in high canyon walls but will use buildings.	Suitable canyon habitat does not occur within project area; may use buildings.
Black-tailed prairie dog	*Cynomys ludovicianus*	NA	SGCN	Short, flat, dry grasslands with sparse vegetation.	Project is outside the expected range of this species.
Cave myotis bat	*Myotis velifer*	NA	SGCN	Cave-dwelling, roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	Suitable cave habitat does not occur within project area; may use buildings/structures.
Eastern red bat	*Lasiurus borealis*	NA	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Eastern spotted skunk	*Spilogale putorius*	NA	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges, and woodlands. Prefer wooded, brushy areas; tallgrass prairies.	Suitable habitat may occur within project area.
Hoary bat	*Lasiurus cinereus*	NA	SGCN	Forests and woods in east and central Texas.	Suitable habitat may occur within project area.
Long-tailed weasel	*Mustela frenata*	NA	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur within project area.
Mexican free-tailed bat	*Tadarida brasiliensis*	NA	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	Suitable cave habitat does not occur within project area; may use buildings/structures.
Mexican long-tongued bat	*Choeronycteris mexicana*	NA	SGCN	Riparian forest in Texas; roost in mines, large crevices, and caves.	Suitable habitat does not occur in project area.
Mink	*Neovison vison*	NA	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Low potential for suitable habitat to occur within project area.
Mountain lion	*Puma concolor*	NA	SGCN	Use wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Low potential to occur within project area.
Plains spotted skunk	*Spilogale putorius interrupta*	NA	NA	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur within project area.
Southern short-tailed shrew	*Blarina carolinensis*	NA	SGCN	Wooded and brushy areas; prefers fallen logs and abundant lead litter.	Suitable habitat may occur within project area.
Swamp rabbit	*Sylvilagus aquaticus*	NA	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat does not occur within project area.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	NA	SGCN	Prefer short-grass prairies; also occur in pastures and along fencerows. Excavate burrows or use abandoned pocket gopher or prairie dog burrows.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Tricolored bat	*Perimyotis subflavus*	NA	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat does not occur within project area.
Western hog-nosed skunk	*Conepatus leuconotus*	NA	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat unlikely to occur within project area.
Western spotted skunk	*Spilogale gracilis*	NA	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur within project area.
White-nosed coati	*Nasua narica*	NA	T	Canyons, riparian corridors, and woodlands.	Project area is outside the expected range of this species.
Mollusks					
False spike	*Fusconaia mitchelli*	NA	T	Medium to large rivers; present in Guadalupe, Colorado, Brazos river basins.	Suitable habitat may occur in streams; no impacts expected.
Golden orb	*Cyclonaias aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Suitable habitat may occur in streams; no impacts expected.
No accepted common name	*Cyclonaias necki*	NA	NA	Guadalupe River basin; moderate to large streams with flowing water.	Suitable habitat may occur in streams; no impacts expected.
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	NA	SGCN	Endemic to sandy regions of southern and south-central Texas.	Suitable habitat may occur within project area.
Bracted twistflower	Streptanthus bracteatus	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Suitable habitat does not occur within project area.
Bristle nailwort	*Paronychia setacea*	NA	SGCN	Endemic to eastern south central Texas, occurring in sandy soils.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Buckley's spiderwort	*Tradescantia buckleyi*	NA	SGCN	Occurs on sandy loam or clay soils in grasslands or shrublands underlain by the Beaumont Formation.	The project area is outside the expected range of this species.
Buckley tridens	*Tridens buckleyanus*	NA	SGCN	Juniper-oak woodlands on rocky limestone slopes.	Suitable habitat does not occur within project area.
Crestless onion	*Allium canadense* var. *ecristatum*	NA	SGCN	Occurs on poorly drained sites on sandy substrates within coastal prairies of the Coastal Bend area.	Suitable habitat does not occur within project area.
Drummond's rushpea	*Caesalpinia drummondii*	NA	SGCN	Open areas on sandy clay.	Suitable habitat may occur within project area.
Elmendorf's onion	*Allium elmendorfii*	NA	SGCN	Grassland openings in oak woodlands on deep, loose, well-drained sands; to the north it occurs in post oak-black hickory-live oak woodlands over Queen City and similar Eocene formations.	Suitable habitat may occur within project area.
Engelmann's bladderpod	*Physaria engelmannii*	NA	SGCN	Grasslands and calcareous rock outcrops along the eastern edge of the Edwards Plateau, ranging as far north as the Red River.	Suitable habitat does not occur within project area.
Florida pinkroot	*Spigelia texana*	NA	SGCN	Woodlands on loamy soils.	Suitable habitat may occur within project area.
Heartleaf evening primrose	*Oenothera cordata*	NA	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Suitable habitat does not occur within project area.
Heller's marbleseed	*Omosmodium helleri*	NA	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Suitable habitat does not occur within project area.
Hill Country wild-mercury	*Argythamnia aphoroides*	NA	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands, also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Low spurge	*Euphorbia peplidion*	NA	SGCN	Occurs in a variety of vernally-moist situations in a number of natural regions.	Suitable habitat may occur within project area.
Lundell's whitlow-wort	*Paronychia lundellorum*	NA	SGCN	The Sand Sheet of eastern South Texas, in tight sandy soils over saline clay on microhighs within salty prairie grasslands, and in upper portions of saline flats surrounding short drainages and brackish basins typical of the South Texas Sand Sheet.	The project area is outside the expected range of this species.
Net-leaf bundleflower	*Desmanthus reticulatus*	NA	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat may occur within project area.
Parks jointweed	*Polygonella parksii*	NA	SGCN	Mostly on deep, loose, whitish sand blowouts (unstable, deep, xeric, sandhill barrens) in Post Oak Savannah landscapes over the Carrizo and Sparta formations; also occurs in early successional grasslands, along rights-of-way, and on mechanically disturbed areas.	Suitable habitat may occur within project area.
Plateau milkvine	*Matelea edwardsensis*	NA	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Suitable habitat does not occur within project area.
Sandhill woolywhite	*Hymenopappus carrizoanus*	NA	SGCN	Disturbed or open areas in grasslands and post oak woodlands on deep sands derived from the Carrizo Sand and similar Eocene formations.	Suitable habitat may occur within project area.
Sayersville blue eyes	*Nemophila sayersensis*	NA	SGCN	Forest/woodland, sand/dune, savannah, woodland – hardwood; sandy, nutrient-poor soils; growing with willow, post oak, pecan, and elm in very sandy soil along a creek.	Suitable habitat may occur within project area.
South Texas spikesedge	*Eleocharis austrotexana*	NA	SGCN	Wetlands on the coastal plain.	Suitable habitat unlikely to occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas amorpha	*Amorpha roemeriana*	NA	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes, sometimes on dry shelves above creeks.	Suitable habitat does not occur within project area.
Texas beebalm	*Monarda viridissima*	NA	SGCN	Endemic perennial herb of the Carrizo Sands; deep, well-drained sandy soils in openings of post oak woodlands.	Suitable habitat may occur within project area.
Texas milk vetch	*Astragalus reflexus*	NA	SGCN	Grasslands, prairies, and roadsides on calcareous and clay substrates.	Suitable habitat may occur within project area.
Texas peachbush	*Prunus texana*	NA	SGCN	Occurs at scattered sites in various well drained sandy situations; deep sand, plains and sand hills, grasslands, oak woods, 0 to 200 meter elevation.	Suitable habitat may occur within project area.
Texas sandmint	*Rhododon ciliatus*	NA	SGCN	Open sandy areas in the Post Oak Belt of east-central Texas.	Suitable habitat may occur within project area.
Texas tauschia	*Tauschia texana*	NA	SGCN	Occurs in loamy soils in deciduous forests or woodlands on river and stream terraces.	Suitable habitat may occur within project area.
Topeka purple-coneflower	*Echinacea atrorubens*	NA	SGCN	Occurring mostly in tallgrass prairie of the southern Great Plains, in blackland prairies but also in a variety of other sites like limestone hillsides.	Suitable habitat may occur within project area.
Woolly butterflyweed	*Gaura villosa ssp. parksii*	NA	SGCN	Sandy soils of Rio Grande plains.	Low likelihood of suitable within project area.
Wright's trichocoronis	*Trichocoronis wrightii* var. *wrightii*	NA	SGCN	Riparian zones, wetlands, pond margins, wet meadows.	Low likelihood of suitable within project area.
Reptiles					
American alligator	*Alligator mississippiensis*	NA	NA	Inland natural rivers, swamps, marshes, coastal marshes, and manmade impoundments.	Suitable habitat does not occur within project area.
Cagle's map turtle	*Graptemys caglei*	NA	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River System.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Eastern box turtle	*Terrapene carolina*	NA	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur within project area.
Keeled earless lizard	*Holbrookia propinqua*	NA	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat does not occur within project area.
Northern spot-tailed earless lizard	*Holbrookia lacerata lacerate*	NA	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edwards Plateau	Suitable habitat may occur within project area.
Slender glass lizard	*Ophisaurus attenuatus*	NA	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannahs, pine barrens, and oil fields.	Suitable habitat may occur within project area.
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	NA	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat may occur within project area.
Texas horned lizard	*Phrynosoma cornutum*	NA	T	Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur within project area.
Texas tortoise	*Gopherus berlandieri*	NA	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus.	Suitable habitat may occur within project area.
Timber rattlesnake	*Crotalus horridus*	NA	T	Swamps, floodplains, upland pine and deciduous woodland, riparian zones, abandoned farmland. Limestone bluffs, sandy soil, or black clay. Prefers dense ground cover, i.e., grapevines, palmetto.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Western box turtle	*Terrapene ornata*	NA	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrow into soil or may use burrows made by other species.	Suitable habitat may occur within project area.
Western hognose snake	*Heterodon nasicus*	NA	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas (but not intensively cultivated), and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets. Seems to prefer sandy and loamy soils. Periods of inactivity are spent burrowed in the soil or in existing burrows.	Suitable habitat may occur within project area.
T = Threatened E = Endangered PT = Proposed Threatened C = Candidate DL = Delisted SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC, the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the Project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[9] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified one previously recorded archaeological site intersecting or immediately adjacent (within 300 feet) to the project area. The site consists of a historic farmstead of undetermined NRHP eligibility (THC 2019). In addition, the review identified two cemeteries and 114 potentially historic-age buildings intersecting or immediately adjacent to the project area. No historical markers or NRHP properties are known to be near the project.

[9] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

The model used assessed, unrecorded archaeological site potential within the project area to include low to high potential zones, ranging from 4 percent to 58 percent likelihood for the landform crossed to contain significant unidentified archaeological resources. The areas with greatest archaeological probability are located near the one previously documented archaeological site and landforms adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score for the project area as currently understood by SWCA is 138 (Table 5.2.24-2). Based on the results of the background review, a structured cultural resources survey of the final design plan is recommended to accurately assess the presence and significance of identified and unrecorded cultural resources within its boundaries.

Table 5.2.24-2 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological Site	Farmstead	Historic	Undetermined	Intersect
Cemetery	Sandy Chapel	Historic	None	Adjacent
Cemetery	Dewville	Historic	None	Adjacent
Historic Building	114 Buildings	Historic	None	Intersect
			ASSESSMENT SCORE TOTAL:	137.5

5.2.24.4 Engineering and Costing

Brackish Wilcox wells located at the existing well site in Gonzales County were assumed to be 2,400 feet deep, with a peak capacity of 800 gpm. The TDS of the pumped water is expected to be 1,500 mg/L. The Brackish Groundwater will be blended with Carrizo Groundwater that has a TDS of 300 mg/L. The resulting blended water is estimated to have a TDS level of 450 mg/L before entering the WTP. Brackish Groundwater will be developed by constructing new public supply wells, installing a pipeline collection system, and expanding existing treatment facilities to include an additional 5 mgd. The project will include seven new wells. The treated effluent will be transferred using an existing SSLGC pipeline.

The following major facilities for this strategy are:

- Public supply wells;
- Well field collection pipeline(s); and
- WTP expansion.

Preliminary engineering and costing analyses have been performed using the 2021 Regional Water Planning methods. Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and method for calculating unit costs. The overall project costs are estimated at $31,941,000. Accounting for debt service, O&M, and pumping energy, annual cost is estimated at $3,316,000 and the annual unit cost of additional firm supply is about $663/acft ($2.03/kgal; Table 5.2.24-3).

Table 5.2.24-3 Summary of Cost Estimate

ITEM	ESTIMATED COSTS
Well Fields (wells, pumps, and piping)	$13,995,000
WTP Expansion (5 mgd)	$8,535,000
TOTAL COST OF FACILITIES	**$22,530,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$7,886,000
Environmental and Archaeology Studies and Mitigation	$618,000
Land Acquisition and Surveying (91 acres)	$52,000
Interest During Construction (3% for 1 year with a 0.5% return on investment)	$855,000
TOTAL COST OF PROJECT	**$31,941,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,247,000
O&M	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$140,000
WTP	$597,000
Pumping Energy Costs (3,636,631 kWh at 0.08 $/kWh)	$291,000
Purchase of Water (5,000 acft/yr at 8.15 $/acft)	$41,000
TOTAL ANNUAL COST	**$3,316,000**
Available Project Yield (acft/yr)	5,000
Annual Cost of Water ($ per acft)	$663
Annual Cost of Water After Debt Service ($ per acft)	$214
Annual Cost of Water ($ per 1,000 gallons)	$2.03
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.66
Based on a Peaking Factor of 1.25.	

5.2.24.5 Implementation Considerations

This SSLGC Expanded Brackish Wilcox Project was evaluated in conformance with the existing rules of the GCUWCD.

The development of groundwater in the Carrizo-Wilcox Aquifer in the South Texas Water Planning Region must address several issues. Implementation considerations associated with the SSLGC Expanded Brackish Wilcox Project may include the following:

- Detailed feasibility evaluation, including test drilling and aquifer and water quality testing, followed with more detailed groundwater modeling to confirm results of this preliminary evaluation. This has been largely accomplished through the operation of the SSLGC well field since startup in October 2002;
- Impact on the following:
  - Endangered and threatened wildlife species;
  - Water levels in the aquifer;
  - Baseflow in streams; and
  - Wetlands.
- Competition with others in the area for groundwater; and
- Regulations by the GCUWCD, including the renewal of pumping permits at 5 year intervals and potential new rules related to brackish groundwater permitting.

Reliability

Water from these sources is considered to be reliable based on existing nearby wells. Supply is considered to be medium because of the potential of differing well productivity and water quality, potential impacts to natural resources and Carrizo Aquifer user competition. Blending of Carrizo-Wilcox aquifer water is as reliable as the fresh water source (reliability score = 4).

5.2.25 NBU ASR Project

5.2.25.1 Description of Water Management Strategy

NBU has plans to firm up its existing water supply with the addition of an ASR project (utilizing dual-purpose wells) to its water system[1]. NBU's ASR strategy is designed to accomplish the following:

- Provide a long-term supply during DOR,
- Provide an opportunity to increase utilization of existing permits, which postpones acquisition of new water supplies,
- Defer construction of a second WTP,
- Meet seasonal demands when restrictions are imposed,
- Meet demands at the ends of the distribution system,
- Provide an emergency supply,
- Minimize construction of new facilities,
- Provide for efficient use of existing distribution system, and
- Minimize environmental impacts.

Like any ASR project, the purpose is to store water during times of plenty and to recover the water during times of shortage. NBU's ASR project was designed to consider both the short-term and long-term timeframes. For the short-term or annual cycle, water is stored during winter and spring and recovered during the summer. For the long-term or multi-year cycle, water is stored over several years or even decades to provide emergency supply during a major drought.

The proposed ASR wells are located on property owned by NBU and the City of New Braunfels (City) in the saline potion of the Edwards Aquifer (Figure 5.2.25-1).

[1] New Braunfels Utilities, June 2018, 2018 Water Resources Plan, Executive Summary.

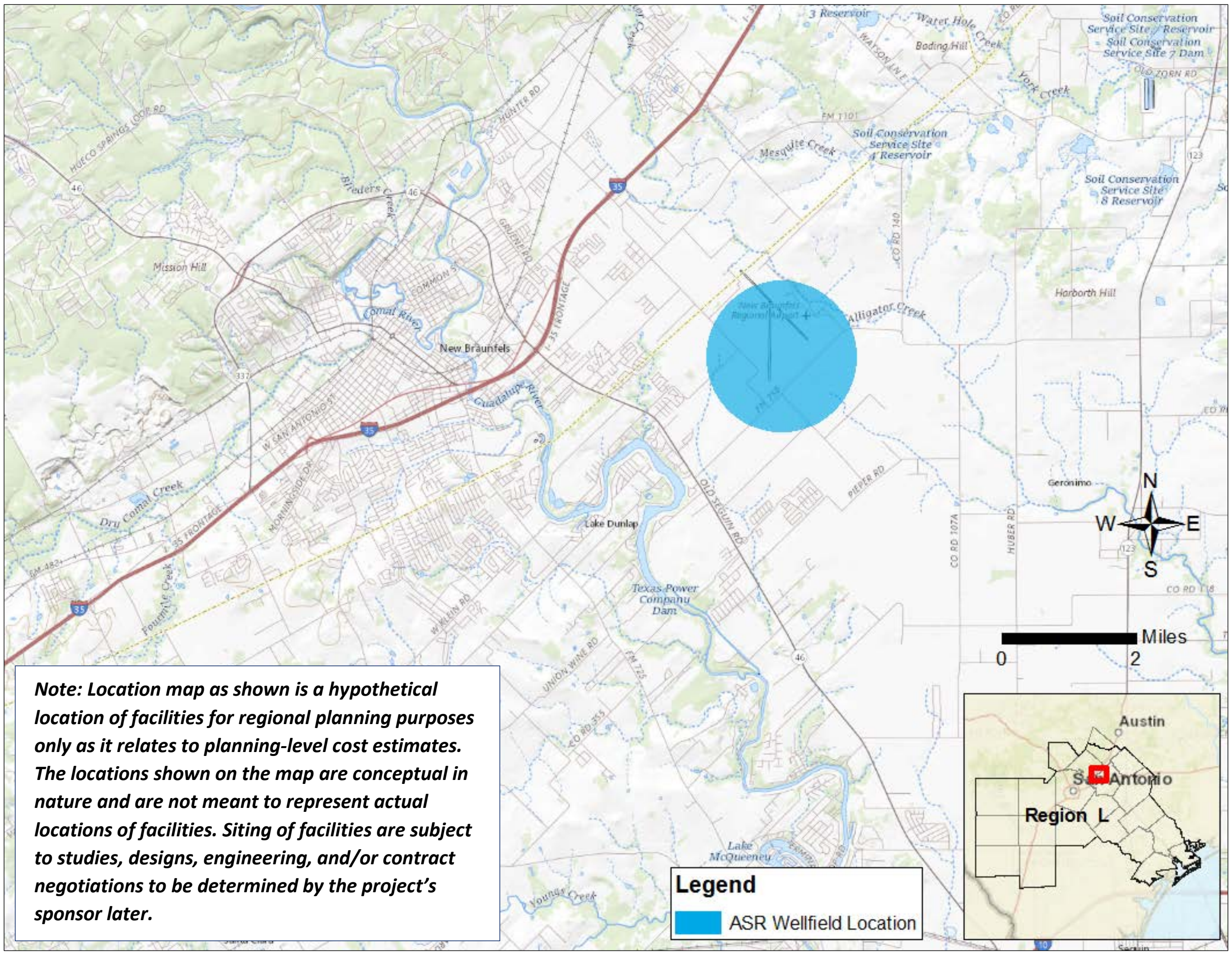

Figure 5.2.25-1 Approximate Location of NBU ASR Project

5.2.25.2 Available Yield

NBU obtains water from multiple sources, including surface water from the Guadalupe River, stored water contracts from Canyon Reservoir, and groundwater from the Edwards Aquifer. When NBU has excess treated water in its distribution system, that water will be injected via the proposed ASR wells for storage in the saline portion of the Edwards Aquifer. NBU will be able to recover the stored water for on-site re-disinfection treatment and distribution into its system.

The project will consist of up to 10 dual-purpose wells for recharge and recovery. Each of the wells is anticipated to have a recovery capacity of about 694 gpm and a recharge capacity of about 347 gpm. The loss of ASR water is assumed to be zero for the purpose of this WMS modeling, but further study is recommended.

The project will increase NBU's firm supply incrementally by 10,818 acft/yr. The stored water volume of water within the aquifer will be 7,000 acft with an additional 7,000 acft buffer zone volume that would remain in the aquifer, resulting in a target storage volume of 14,000 acft.

The NBU ASR Project is designed to work in conjunction with the Surface Water Treatment Plant expansion (Chapter 5.2.8), which is designed to provide increased capacity to treat water for storage in the ASR project. This WMS has a firm yield of 10,818 acft/yr and is planned for implementation beginning in the 2020 decade.

5.2.25.3 Environmental and Cultural Considerations

Environmental Considerations

Vegetation and Land Use

The project area occurs in the Blackland Prairie ecoregion and is generally situated in and near the New Braunfels Regional Airport. The area appears to contain little woody vegetation. As mapped by TPWD,[2] dominant vegetation types in the project vicinity are disturbance/tame grassland, urban, and agricultural, with small areas mapped as mesquite shrubland. Since much of the existing land use is industrial, it is likely the area does not contain significant amounts of native vegetation.

Based on TPWD vegetation mapping, the project may have the potential to impact 376 acres of agricultural resources, including 71 acres mapped as row crops and 305 acres mapped as tame/disturbance grassland which may include pasture areas used for grazing or hay production.

Aquatic Resources

Alligator Creek, an intermittent stream with associated floodplain, runs along the northeastern edge of the project area. The NWI mapping shows small areas (less than 10 acres) mapped as wetlands or ponds. The Texas Integrated Report of 303(d) listed water bodies[3] identifies the water bodies or segments in Texas that do not meet assigned water quality standards. Alligator Creek is not classified as an impaired stream segment. Geronimo Creek, which occurs just downgradient to the southwest of the project area, is listed as impaired. The project area does not contain ecologically significant stream segments as designated by TPWD.

The project will require an on-site delineation of streams, ponds, and wetlands. Well facilities can typically be sited to avoid impacts to waters of the United States, including wetlands.

Threatened, Endangered, and Species of Concern

Table 5.2.25-1 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Guadalupe County [4] [5]. Suitable habitat does not occur for any of the federally listed threatened or endangered species.

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[2] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

[3] Texas Commission on Environmental Quality. 2015. 2014 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/waterquality/assessment/14twqi/14txir.

[4] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Guadalupe County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[5] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Hays County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.

Because of the industrial nature of the project area, suitable habitat is not expected to occur for most state-listed species; however, there is potential suitable habitat for species that utilize open, sparsely vegetated areas, such as the state-threatened Texas horned lizard (*Phrynosoma cornutum*).

There is low to moderate potential for suitable habitat for several wildlife species designated by TPWD as SGCN: Strecker's chorus frog (*Pseudacris streckeri*), Woodhouse's toad (*Anaxyrus woodhousii*), western burrowing owl (*Athene cunicularia hypugaea*), black-tailed prairie dog (*Cynomys ludovicianus*), thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*), eastern spotted skunk (*Spilogale putorius*), plains spotted skunk (*Spilogale putorius interrupta*), western spotted skunk (*Spilogale gracilis*), and eastern box turtle (*Terrepene carolina*). In addition, several bat SGCN species may utilize structures and could, therefore, occur in developed areas. There is a low likelihood of occurrence of the SGCN plant species low spurge (*Euphobia peplidion*) and parks jointweed (*Polygonella parksii*). SGCN species do not have formal protected status but are being monitored by TPWD.

Migratory birds may fly through the project area but are generally not expected to be impacted by well installation.

Site-specific field surveys would be required to determine the quality of habitat and potential for impacts to state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD would likely be required to obtain its recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat is present, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or to avoid vegetation clearing during the general bird nesting season from March 15 to September 15. Although it is no longer on the federal endangered species list, the bald eagle is protected by the federal Bald and Golden Eagle Protection Act, which prohibits impacts to the eagles unless permitted by USFWS. Preconstruction surveys for active bird nests and presence of eagles are recommended.

Table 5.2.25-1 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for NBU ASR Project; Guadalupe County, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Strecker's chorus frog	*Pseudarcris streckeri*	N/A	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Low likelihood of suitable habitat in project vicinity.
Texas blind salamander	*Eurycea rathbuni*	E	SGCN	Water-filled subterranean caverns along 6 miles of the San Marcos Spring Fault.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Low likelihood of suitable habitat in project vicinity.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat does not occur in project area; may fly over during migration.
Black rail	*Laterallus jamaicensis*	N/A	SGCN	Salt, brackish, and freshwater marshes; pond borders; wet meadows; and grassy swamps. Nests in or along edge of marsh.	Suitable habitat does not occur in project area; may fly over during migration.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur within project area; may fly over during migration.
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Unlikely to occur within project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat does not occur within project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur within project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	SGCN	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Project is outside of the expected range of this species.
Swallow-tailed kite	*Elanoides forficatus*	N/A	SGCN	Lowland forest, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds. Nests high in tall trees in clearing or on forest woodland edge, usually pine, cypress, or deciduous trees.	Suitable habitat does not occur in project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots; nests and roosts in abandoned burrows.	Suitable habitat may occur in project vicinity; may fly over during migration.
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat does not occur within project area; may fly over during migration.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio Counties. Roost predominantly in palustrine or riverine wetland systems [during migration].	Suitable habitat does not occur within project area; may fly over during migration.
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Suitable habitat does not occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat does not occur within project area; may fly over during migration.
Fish					
American eel	*Anguila rostrata*	N/A	SGCN	Coastal waterways below reservoirs.	Suitable habitat does not occur within project area.
Fountain darter	*Etheostoma fonticola*	E	E	San Marcos and Comal Rivers; springs and spring-fed streams with dense beds of aquatic plants.	Project is outside of the expected range of this species.
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat does not occur within project area.
Guadalupe darter	*Percina apristis*	N/A	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Plateau shiner	*Cyprinella lepida*	N/A	SGCN	Edwards Plateau portion of the Nueces Basin; cool, clear, spring-fed headwater creeks.	Suitable habitat does not occur within project area.
Texas shiner	*Notropis amabilis*	N/A	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Suitable habitat does not occur within project area.
Insects					
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur within project vicinity.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur within project vicinity.
Big brown bat	*Eptesicus fuscus*	N/A	SGCN	Woodlands or wooded areas.	Suitable habitat does not occur within project area.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls, but will use buildings.	Suitable natural habitat does not occur within project area; may use buildings.
Black-tailed prairie dog	*Cynomys ludovicianus*	N/A	SGCN	Short, flat, dry grasslands with sparse vegetation.	Not expected to occur within the project area.
Cave myotis bat	*Myotis velifer*	N/A	SGCN	Cave-dwelling; also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	Suitable natural habitat does not occur within project area; may use buildings/structures.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat does not occur within project area; may fly through during migration.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges, and woodlands. Prefer wooded, brushy areas; tallgrass prairies.	Suitable habitat may occur within project vicinity.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat does not occur within project area.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	Suitable cave habitat does not occur within project area; may use buildings/structures.
Mexican long-tongued bat	*Choeronycteris mexicana*	N/A	SGCN	Riparian forest in Texas; roost in mines, large crevices, and caves.	Not expected to occur in project area.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Suitable habitat does not occur within project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Use wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Suitable habitat does not occur within project area.
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	SGCN	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur within project vicinity.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat does not occur within project area.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Prefer short-grass prairies; also occur in pastures and along fencerows. Excavate burrows or use abandoned pocket gopher or prairie dog burrows.	Suitable habitat may occur within project vicinity.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat does not occur within project area.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat does not occur within project area.
Western spotted skunk	*Spilogale gracilis*	NA	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur within project vicinity.
White-nosed coati	*Nasua narica*	NA	T	Canyons, riparian corridors, and woodlands.	Suitable habitat does not occur within project area.
Mollusks					

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
False spike	*Fusconaia mitchelli*	N/A	T	Medium to large rivers; present in Guadalupe, Colorado, and Brazos River basins.	Suitable habitat does not occur within project area.
Golden orb	*Cyclonaias aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Suitable habitat does not occur within project area.
No accepted common name	*Cyclonaias necki*	N/A	SGCN	Guadalupe River basin; moderate to large streams with flowing water.	Suitable habitat does not occur within project area.
Plants					
Bracted twistflower	*Streptanthus bracteatus*	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Suitable habitat does not occur within project area.
Buckley tridens	*Tridens buckleyanus*	N/A	SGCN	Juniper-oak woodlands on rocky limestone slopes.	Suitable habitat does not occur within project area.
Elmendorf's onion	*Allium elmendorfii*	N/A	SGCN	Grassland openings in oak woodlands on deep, loose, well-drained sands; to the north it occurs in post oak-black hickory-live oak woodlands over Queen City and similar Eocene formations.	Suitable habitat does not occur within project area.
Engelmann's bladdpod	*Physaria engelmannii*	N/A	SGCN	Grasslands and calcareous rock outcrops along the eastern edge of the Edwards Plateau, ranging as far north as the Red River.	Suitable habitat does not occur within project area.
Heartleaf evening primrose	*Oenothera cordata*	N/A	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Heller's marbleseed	*Omosmodium helleri*	N/A	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Suitable habitat does not occur within project area.
Hill Country wild-mercury	*Argythamnia aphoroides*	N/A	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands; also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Suitable habitat does not occur within project area.
Low spurge	*Euphorbia peplidion*	N/A	SGCN	Occurs in a variety of vernally moist habitats in a number of natural regions.	Low likelihood of suitable habitat in project vicinity.
Net-leaf bundleflower	*Desmanthus reticulatus*	N/A	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat does not occur within project area.
Parks jointweed	*Polygonella parksii*	N/A	SGCN	Mostly on deep, loose, whitish sand blowouts (unstable, deep, xeric, sandhill barrens) in Post Oak Savannah landscapes over the Carrizo and Sparta formations; also occurs in early successional grasslands, along rights-of-way, and on mechanically disturbed areas.	Low likelihood of suitable habitat in project vicinity.
Plateau milkvine	*Matelea edwardsensis*	N/A	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Suitable habitat does not occur within project area.
Sandhill woolywhite	*Hymenopappus carrizoanus*	N/A	SGCN	Disturbed or open areas in grasslands and post oak woodlands on deep sands derived from the Carrizo Sand and similar Eocene formations.	Suitable habitat does not occur within project area.
South Texas spikesedge	*Eleocharis austrotexana*	N/A	SGCN	Wetlands on the coastal plain.	Suitable habitat does not occur within project area.
Texas amorpha	*Amorpha roemeriana*	N/A	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes, sometimes on dry shelves above creeks.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas beebalm	*Monarda viridissima*	N/A	SGCN	Endemic perennial herb of the Carrizo Sands; deep, well-drained sandy soils in openings of post oak woodlands.	Suitable habitat does not occur within project area.
Woolly butterflyweed	*Gaura villosa ssp. parksii*	N/A	SGCN	Sandy soils of Rio Grande plains.	Suitable habitat does not occur within project area.
Wright's trichocoronis	*Trichocoronis wrightii var. wrightii*	N/A	SGCN	Riparian zones, wetlands, pond margins, and wet meadows.	Suitable habitat does not occur within project area.
Reptiles					
American alligator	*Alligator mississippiensis*	N/A	NA	Inland natural rivers, swamps, marshes, coastal marshes, and manmade impoundments.	Suitable habitat does not occur within project area.
Cagle's map turtle	*Graptemys caglei*	N/A	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River System.	Suitable habitat does not occur within project area.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Low likelihood of suitable habitat in project vicinity.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat does not occur within project area.
Northern spot-tailed earless lizard	*Holbrookia lacerata lacerate*	N/A	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edward's Plateau.	Suitable habitat may occur within project area.
Slender glass lizard	*Ophisaurus attenuates*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannas, pine barrens, and oil fields.	Suitable habitat does not occur within project area.
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	N/A	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat may occur within project area.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas tortoise	*Gopherus berlandieri*	N/A	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive, occupies shallow depressions at base of bush or cactus.	Suitable habitat does not occur within project area.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland, prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrows into soil or may use burrows made by other species.	Suitable habitat does not occur within project area.
Western hognose snake	*Heterodon nasicus*	N/A	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas (but not intensively cultivated), and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets. Seems to prefer sandy and loamy soils. Periods of inactivity are spent burrowed in the soil or in existing burrows.	Suitable habitat does not occur within project area.
T = Threatened E = Endangered C = Candidate DL = Delisted N/A = Not applicable SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC,the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[6] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

[6] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

The background literature review identified no previously recorded archaeological sites intersecting or adjacent (within 300 feet) to the project area. The review did identify 20 potential historic-age buildings that intersect the approximate project area (Table 5.2.25-2). No potential cemeteries, historical markers, or NRHP properties are in or adjacent to the project area.

The model used assessed overall unrecorded archaeological site potential within the project area to include low to high potential zones, ranging from 16 percent to 66 percent likelihood that the landform crossed contains significant unidentified archaeological resources. The greatest probability areas were designated adjacent to existing drainages and near the historic buildings and features.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 50. Based on the results of the background review, a structured cultural resources survey of the final design plan is recommended to accurately assess the presence and significance of identified and unrecorded cultural resources within its boundaries.

Table 5.2.25-2 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Historic Structure	20 Historic Structures	Historic	Undetermined	Intersect
			ASSESSMENT SCORE TOTAL:	50.0

5.2.25.4 Engineering and Costing

Preliminary engineering and costing analyses have been performed using 2021 Regional Water Planning methods. Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and methods for calculating unit costs. The costing procedures include all facilities required for water recharge, recovery, collection, and treatment. Water treatment would require standard chloramine disinfection to re-disinfect the water after recovery.

Overall project costs are estimated at $39,198,000 (Table 5.2.25-3). Accounting for debt service, operations and maintenance, and pumping energy, annual cost is estimated at $5,001,000, and the annual unit cost of additional firm supply is about $462/acft ($1.42/kgal). External costs were obtained by NBU's consultant, Arcadis, for nine new ASR wells (to be constructed after an initial demonstration ASR well) as the 2021 Uniform Costing Model could have underestimated the cost for an ASR well by as much as 50 percent.

Table 5.2.25-3 Cost Estimate Summary

ITEM	ESTIMATED COSTS
Well Fields (wells, pumps, and piping)	$27,374,000
Water Treatment Plant (9 mgd)	$514,000
TOTAL COST OF FACILITIES	**$27,888,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$9,761,000
Environmental and Archaeology Studies and Mitigation	$463,000
Interest During Construction (3% for 1 year with a 0.5% return on investment)	$1,050,000
TOTAL COST OF PROJECT	**$39,198,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,758,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$274,000
Water Treatment Plant	$308,000
Pumping Energy Costs (20,762,373 kWh at 0.08 $/kWh)	$1,661,000
TOTAL ANNUAL COST	**$5,001,000**
Available Project Yield (acft/yr)	10,818
Annual Cost of Water ($ per acft)	$462
Annual Cost of Water After Debt Service ($ per acft)	$207
Annual Cost of Water ($ per 1,000 gallons)	$1.42
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.64
Based on a Peaking Factor of 1.0.	

5.2.25.5 Implementation Considerations

Implementation of the ASR strategy for NBU will require permits and approvals from the TCEQ and the EAA. Requirements by each agency are discussed as follows.

- TCEQ:
  - An ASR well is authorized as a Class V injection well. Key requirements for permits to construct and operate a Class V injection well are mechanical integrity of the well, pollution control, demonstration of recoverability in the permitting process, and periodic reports.
  - Under recent legislation related to the Edwards Aquifer (Balcones Fault Zone), the source water for injection by an ASR well in NBU's proposed project area can be blended water directly from NBU's distribution system.
  - Under recent legislation, the run-of-the-river permits will no longer need to be amended for injection and recovery operations.
- EAA:
  - NBU has an interlocal contract with EAA that provides the authorizations needed to implement the ASR project in measured phases.
  - NBU's contractor(s) will obtain a construction permit for each individual ASR well based on the final design of the well, which must meet EAA's standard requirements.

Reliability

Successful ASR development is highly reliable (reliability score = 5). It is normally possible to achieve 90-95% recovery efficiency. Challenges to reliability include natural groundwater flow away from the ASR site and the associated drift of the storage bubble, thus reducing available supplies. Flat hydraulic gradients are not typical in Texas, especially in shallow aquifers. This migration of stored water is an important consideration in determining the reliability and viability of an ASR project. Also, since withdrawal of groundwater is a property right, competition with other nearby users could reduce the reliability of this water. One way to address the issue of other competing wells is to own the property rights over the storage bubble but that will drive up the strategy costs. If the water is recharged and recovered over a relatively short period (e.g., one year), the likelihood of reduced reliability is low. However, short-term ASR operations are highly dependent on the local aquifer hydrogeological features and that may impact reliability as well.

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5.2.26 NBU Trinity Well Field Expansion

5.2.26.1 Description of Water Management Strategy

In the mid-2020 decade, NBU plans to expand upon the existing Trinity wellfield. The project includes drilling additional groundwater wells, expansion of the existing membrane treatment facility, and addition of a new ground storage tank and a new pump station to connect to the existing NBU distribution system (Figure 5.2.26-1).

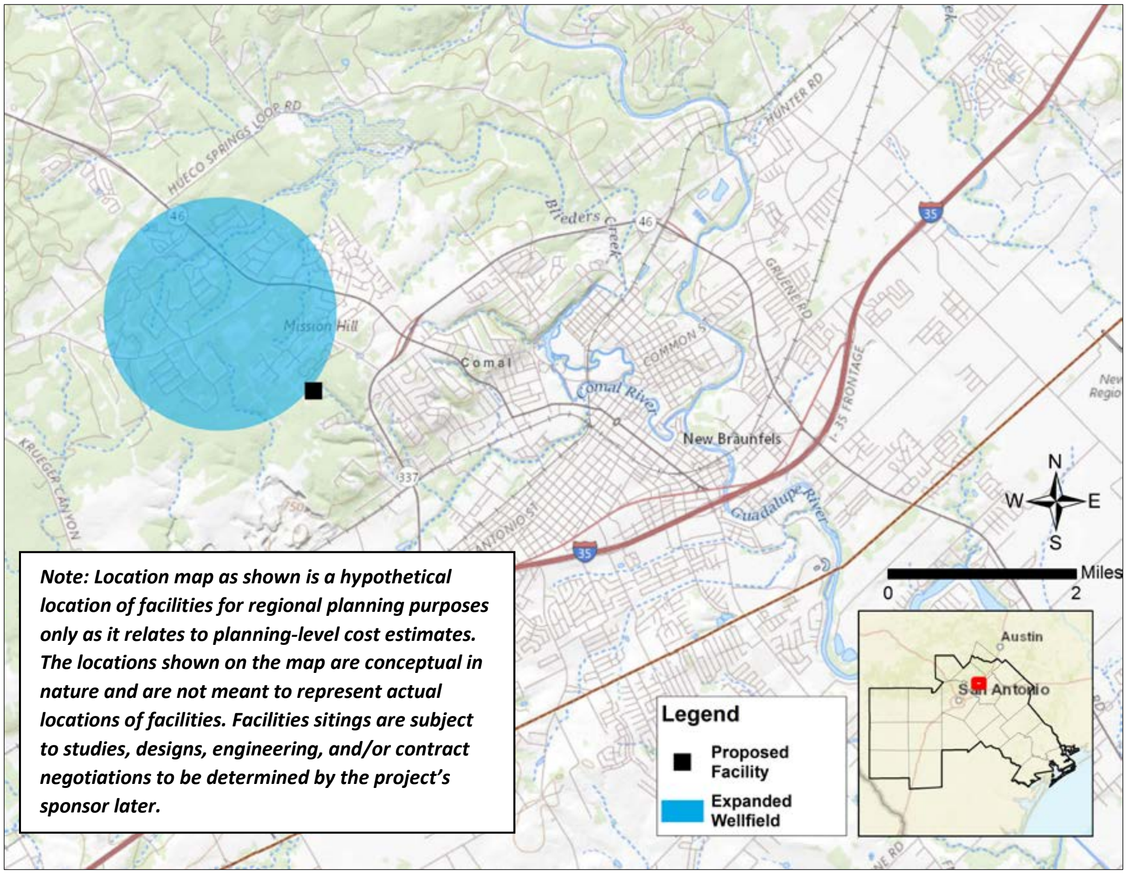

Figure 5.2.26-1 Trinity Well Field Expansion Project Location

5.2.26.2 Available Yield

The project will expand the well field from four wells to eight wells, and increase the supply of the Trinity wellfield from 3,360 acft/yr to 6,720 acft/yr. For purposes of this WMS, it is assumed that four wells are feasible and that each well has a peak capacity of 1.0 mgd, a depth of 620 feet.

An assessment of groundwater availability consists of calculating a water balance of the Trinity Aquifer in Comal County between the supply, as determined from the MAG, and the estimated demands from current users. The MAG for the Trinity Aquifer in Comal County is 43,768 acft/yr for 2020 through

2070[1,2]. This strategy is located within the boundaries of the Comal Trinity GCD, but because this is a new GCD, they have not implemented any type of permitting system at this time. Therefore, this strategy is not limited by the MAG or existing groundwater permits in Comal County. This information suggests that there is sufficient groundwater availability for this project. This WMS has a firm yield of 3,360 acft/yr and is planned for implementation beginning in the 2030 decade.

5.2.26.3 Environmental and Cultural Considerations

Environmental Considerations

Vegetation and Land Use

The project area occurs in the Edwards Plateau ecoregion and most of the project vicinity contains residential and commercial development. As mapped by TPWD,[3] the dominant vegetation type in the project vicinity is urban, with Ashe juniper and mesquite shrubland/woodland communities to the southwest. Since the existing project land use is a well field, the project area likely does not contain significant amounts of native vegetation, although fields and woody vegetation occur nearby.

Based on TPWD vegetation mapping, the project may would not affect agricultural resources mapped as row crops or areas mapped as tame/disturbance grassland that include pasture areas used for grazing or hay production.

Aquatic Resources

No streams are mapped in the project area. The NWI mapping shows small areas in the project vicinity, approximately 3 acres, mapped as wetlands or ponds. The Texas Integrated Report of 303(d)-listed water bodies[4] identifies the water bodies or segments in Texas that do not meet assigned water quality standards. There are no streams within a mile of the project area listed as impaired. The project area does not contain ecologically significant stream segments as designated by TPWD.

The project has a low likelihood of affecting wetlands. Well facilities can typically be sited to avoid impacts to waters of the United States, including wetlands.

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[1] Bradley, R.G., and R. Boghici. 2018. GAM Run 16-033 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 10: Texas Water Development Board. https://www.twdb.texas.gov/groundwater/docs/GAMruns/GR16-033_MAG.pdf?d=19840.414999998757.

[2] Jones, I.C. 2017. GAM Run 16-023 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 9: Texas Water Development Board. https://www.twdb.texas.gov/groundwater/docs/GAMruns/GR16-023_MAG.pdf?d=19840.414999998757.

[3] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

[4] Texas Commission on Environmental Quality. 2018. 2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/waterquality/assessment/14twqi/14txir.

Threatened, Endangered, and Species of Concern

Table 5.2.26-1 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Comal County.[5] [6] Suitable habitat does not occur for any of the federally-listed threatened or endangered species.

Due to the existing development in and around the project area, suitable habitat is not expected to occur for most state-listed species; however, there is potentially suitable habitat in the project vicinity for species that utilize open fields and shrublands such as the state-threatened Texas horned lizard (*Phrynosoma cornutum*) and Texas tortoise (*Gopherus berlandieri*).

There is low to moderate potential for suitable habitat in the project vicinity for several wildlife species designated by TPWD as SGCN, including western burrowing owl (*Athene cunicularia hypugaea*), American bumblebee (*Bombus pensylvanicus*), American badger (*Taxidea taxus*), plains spotted skunk (*Spilogale putorius interrupta*), western spotted skunk (*Spilogale gracilis*), spot-tailed earless lizard (*Holbrookia lacerata*), and western box turtle (*Terrapene ornata*). In addition, SGCN bat species may utilize structures and could therefore occur in developed areas. There is low potential of occurrence of the SGCN plant species tree dodder (*Cuscuta exaltata*). SGCN species do not have formal protected status but are being monitored by TPWD.

Migratory birds may fly through the project area but are generally not expected to be impacted by well field expansion.

Site-specific field surveys would be required to determine the quality of habitat and potential for impacts to state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD would likely be required to obtain their recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15. Preconstruction surveys for active bird nests are recommended.

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[5] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Comal County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[6] US Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Comal County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.

Table 5.2.26-1 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for NBU Trinity Well Field Project, Comal County, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Blanco River Springs salamander	*Eurycea pterophila*	NA	SGCN	Springs and caves in the Blanco River drainage.	Project is outside of the expected range of this species.
Cascade Caverns salamander	*Eurycea latitans*	NA	T	Springs and caves in Guadalupe River, Medina River, and Cibolo Creek watersheds, all within the Edwards Aquifer.	Suitable habitat unlikely to occur within the project area.
Comal blind salamander	*Eurycea tridentifera*	NA	T	Within aphotic zones of shallow limestone caves; found in springs and waters of caves.	Suitable habitat unlikely to occur within the project area.
Comal Springs salamander	*Eurycea sp. 8*	NA	SGCN	Found in Comal Springs.	Project is outside of the expected range of this species.
San Marcos salamander	*Eurycea nana*	T	SGCN	Headwaters of the San Marcos River downstream to about 0.5 mile past IH 35.	Project is outside of the expected range of this species.
Strecker's chorus frog	*Pseudacris streckeri*	NA	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Low likelihood of suitable habitat in project vicinity.
Texas blind salamander	*Eurycea rathbuni*	E	SGCN	Water-filled subterranean caverns along 6 miles of the San Marcos Spring Fault.	Project is outside of the expected range of this species.
Texas salamander	*Eurycea neotenes*	NA	SGCN	Cave streams, seeps, springs, and creek headwaters; Helotes and Leon Creek drainages.	Project is outside of the expected range of this species.
Woodhouse's toad	*Anaxyrus woodhousii*	NA	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Low likelihood of suitable habitat in project vicinity.
Arachnids					
No accepted common name	*Cicurina puentecilla*	NA	SGCN	Subterranean obligate.	Low likelihood of suitable habitat in project vicinity.
No accepted common name	*Cicurina reclusa*	NA	SGCN	Subterranean obligate.	Low likelihood of suitable habitat in project vicinity.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
No accepted common name	*Texella brevidenta*	NA	SGCN	Subterranean obligate.	Low likelihood of suitable habitat in project vicinity.
No accepted common name	*Almuerzothyas comalensis*	NA	SGCN	Found in Comal Springs.	Project is outside of the expected range of this species.
Arthropods					
No accepted common name	*Speodesmus ivyi*	NA	SGCN	Subterranean obligate.	Low likelihood of suitable habitat in project vicinity.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat does not occur in project area; may fly over during migration.
Black-capped vireo	*Vireo articapilla*	DL	E	Patches of oak-juniper woodland with open, grassy spaces; foliage must reach ground level for nesting cover.	Suitable habitat does not occur in project area; may fly over during migration.
Franklin's gull	*Leucophaeus pipixcan*	NA	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur within project area; may fly over during migration.
Golden-cheeked warbler	*Dendroica chrysoparia*	E	E	Mixed stands of Ashe juniper and various oaks; edges of cedar brakes.	Suitable habitat does not occur in project area; may fly over during migration.
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also known to nest on manmade structures (inland beaches, WWTPs, gravel mines, etc.).	Unlikely to occur within project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	NA	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat does not occur within project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur within project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	NA	SGCN	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Red knot	*Calidris canutus rufa*	T	SGCN	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays.	Suitable habitat does not occur within project area; may fly over during migration.
Tropical parula	*Setophaga pitiayumi*	NA	T	Dense or open woods, brush, trees, and undergrowth along edges of river and resacas.	Suitable habitat does not occur within project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	NA	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots, nests, and roosts in abandoned burrows.	Suitable habitat may occur in project vicinity; may fly over during migration.
White-faced ibis	*Plegadis chihi*	NA	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat does not occur within project area; may fly over during migration.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems (during migration).	Suitable habitat does not occur within project area; may fly over during migration.
Wood stork	*Mycteria americana*	NA	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Suitable habitat does not occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	NA	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat does not occur within project area; may fly over during migration.
Crustaceans					
A bathynelid	*Texanobathynella bowmani*	NA	SGCN	Cave dwelling.	Low likelihood of suitable habitat in project vicinity.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Ezell's Cave amphipod	*Stygobromus flagellates*	NA	SGCN	Artesian wells.	Low likelihood of suitable habitat in project vicinity.
No accepted common name	*Artesia subterranea*	NA	SGCN	Cave dwelling.	Low likelihood of suitable habitat in project vicinity.
No accepted common name	*Mexiweckelia hardeni*	NA	SGCN	Cave dwelling; Comal Springs.	Project is outside of the expected range of this species.
No accepted common name	*Nitocrellopsis texana*	NA	SGCN	Cave dwelling; Honey Creek Cave.	Project is outside of the expected range of this species.
No accepted common name	*Palaemonetes texanus*	NA	SGCN	River shrimp found in the Middle Guadalupe and San Marcos watersheds.	Suitable aquatic habitat does not occur in project area.
Peck's cave amphipod	*Stygobromus pecki*	E	E	Lives underground within the Edwards Aquifer; critical habitat defined.	Project is outside of the expected range of this species.
Fish					
Alligator gar	*Atractosteus spatula*	NA	SGCN	Reservoirs and lakes; lowland rivers; and brackish areas of estuaries, bays, and bayous.	Suitable aquatic habitat does not occur in project area.
American eel	*Anguila rostrata*	NA	SGCN	Coastal waterways below reservoirs.	Suitable aquatic habitat does not occur in project area.
Chub shiner	*Notropis potteri*	NA	SGCN	Brazos and Red basins; flowing water with silt or sand substrates.	Project is outside of the expected range of this species.
Fountain darter	*Etheostoma fonticola*	E	E	San Marcos and Comal Rivers; springs and spring-fed streams with dense beds of aquatic plants.	Project is outside of the expected range of this species.
Guadalupe bass	*Micropterus treculii*	NA	SGCN	Perennial streams of the Edwards Plateau region.	Suitable aquatic habitat does not occur in project area.
Guadalupe darter	*Percina apristis*	NA	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Suitable aquatic habitat does not occur in project area.
Headwater catfish	*Ictalurus lupus*	NA	SGCN	Limited to Rio Grande drainage; springs with sandy and rocky riffles, pools of clear creeks, runs, and small rivers.	Project is outside of the expected range of this species.
Ironcolor shiner	*Notropis chalybaeus*	NA	SGCN	Big Cypress Bayou and Sabine River basins.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Plateau shiner	*Cyprinella lepida*	NA	SGCN	Edwards Plateau portion of the Nueces basin; cool, clear, spring-fed headwater creeks.	Suitable aquatic habitat does not occur in project area.
Sharpnose shiner	*Notropis oxyrhynchus*	NA	SGCN	Endemic to the Brazos River drainage; large turbid river habitat.	Project is outside of the expected range of this species
Silverband shiner	*Notropis shumardi*	NA	SGCN	Main channel with moderate to swift current; turbid water over gravel, sand, and silt; Red River and Cypress River drainage.	Project is outside of the expected range of this species
Smalleye shiner	*Notropis buccula*	NA	SGCN	Upper Brazos River system; medium to large prairie streams.	Project is outside of the expected range of this species.
Texas shiner	*Notropis amabilis*	NA	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Suitable aquatic habitat does not occur in project area.
Western creek chubsucker	*Erimyzon claviformis*	NA	SGCN	Clear headwaters, small rivers, and creeks with silt, sand, and gravel bottoms; occasionally in lakes.	Suitable aquatic habitat does not occur in project area.
Insects					
A mayfly	*Pseudocentroptiloides morihari*	NA	SGCN	Aquatic larval stage; adults in shoreline vegetation.	Suitable aquatic habitat does not occur in project area.
American bumblebee	*Bombus pensylvanicus*	NA	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in project vicinity.
Comal Springs diving beetle	*Comaldessus stygius*	NA	SGCN	Outflows of Comal Springs; inhabit water column.	Project is outside of the expected range of this species.
Comal Springs dryopid beetle	*Stygoparnus comalensis*	E	E	Cling to objects within streams or the bottom of streams; critical habitat defined.	Project is outside of the expected range of this species.
Comal Springs riffle beetle	*Heterelmis comalensis*	E	E	Comal and San Marcos Springs; critical habitat defined.	Project is outside of the expected range of this species.
Edwards Aquifer diving beetle	*Haideoporus texanus*	NA	SGCN	Artesian well in Hays County.	Project is outside of the expected range of this species.
No accepted common name	*Rhadine insolita*	NA	SGCN	Subterranean obligate.	Low likelihood of suitable habitat in project vicinity.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
No accepted common name	*Rhadine speca*	NA	SGCN	Subterranean obligate.	Low likelihood of suitable habitat in project vicinity.
No accepted common name	*Hydroptila melia*	NA	SGCN	Aquatic larvae.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Neotrichia juani*	NA	SGCN	Aquatic larvae, primarily found in Edwards Plateau.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Oxyelophila callista*	NA	SGCN	Found in southern and western Texas; larvae are aquatic.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Ochrotrichia capitana*	NA	SGCN	Found in the Brazos River Drainage.	Project is outside of the expected range of this species.
No accepted common name	*Xiphocentron messapus*	NA	SGCN	Outflow of springs.	Suitable aquatic habitat does not occur in project area.
Mammals					
American badger	*Taxidea taxus*	NA	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur in project vicinity.
Big brown bat	*Eptesicus fuscus*	NA	SGCN	Woodlands or wooded areas.	Suitable habitat does not occur in project area.
Big free-tailed bat	*Nyctinomops macrotis*	NA	SGCN	Roost in high canyon walls, but will use buildings.	Suitable aquatic habitat does not occur in project area.
Black-tailed prairie dog	*Cynomys ludovicianus*	NA	SGCN	Short, flat, dry grasslands with sparse vegetation.	Suitable habitat does not occur within project area.
Cave myotis bat	*Myotis velifer*	NA	SGCN	Cave-dwelling, also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau	Suitable natural habitat does not occur in project area; may use buildings/structures.
Eastern red bat	*Lasiurus borealis*	NA	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat does not occur in project area.
Hoary bat	*Lasiurus cinereus*	NA	SGCN	Forests and woods in east and central Texas.	Suitable habitat does not occur in project area.
Long-tailed weasel	*Mustela frenata*	NA	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Mexican free-tailed bat	*Tadarida brasiliensis*	NA	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	Suitable natural habitat does not occur in project area; may use buildings/structures.
Mexican long-tongued bat	*Choeronycteris Mexicana*	NA	SGCN	Riparian forest in Texas; roost in mines, large crevices, and caves.	Project area is outside expected range of species.
Mink	*Neovison vison*	NA	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Suitable habitat does not occur in project area.
Plains spotted skunk	*Spilogale putorius interrupta*	NA	SGCN	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur within project vicinity.
Swamp rabbit	*Sylvilagus aquaticus*	NA	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat does not occur in project area.
Tricolored bat	*Perimyotis subflavus*	NA	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat does not occur in project area.
Western hog-nosed skunk	*Conepatus leuconotus*	NA	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat does not occur in project area.
Western spotted skunk	*Spilogale gracilis*	NA	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur within project vicinity.
White-nosed coati	*Nasua narica*	NA	T	Canyons, riparian corridors, and woodlands.	Suitable habitat does not occur in project area.
Mollusks					
False spike	*Fusconaia mitchelli*	NA	T	Medium to large rivers; present in Guadalupe, Colorado, and Brazos River basins.	Suitable aquatic habitat does not occur in project area.
Glossy wolfsnail	*Euglandina texasiana*	NA	SGCN	Hardwood forests, urban gardens, and roadsides.	Suitable habitat may occur within project vicinity.
Golden orb	*Cyclonaias aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Suitable aquatic habitat does not occur in project area.
Horseshoe liptooth	*Daedalochila hippocrepis*	NA	SGCN	Steep, wooded hillsides; Landa Park in New Braunfels.	Suitable habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
No accepted common name	*Holospira goldfussi*	NA	SGCN	Terrestrial snail; found in New Braunfels.	Suitable habitat may occur within project vicinity.
No accepted common name	*Millerelix gracilis*	NA	SGCN	Terrestrial snail; Edwards Plateau.	Suitable habitat may occur within project vicinity.
No accepted common name	*Elimia comalensis*	NA	SGCN	Spring-fed pool and stream systems with Edwards Plateau and Balcones Escarpment region.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Stygopyrgus bartonensis*	NA	SGCN	Subterranean obligate; freshwater.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Phreatodrobia conica*	NA	SGCN	Subterranean obligate; freshwater.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Phreatodrobia micra*	NA	SGCN	Subterranean obligate; freshwater; found in Guadalupe River.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Phreatodrobia plana*	NA	SGCN	Occurs at Natural Bridge Caverns in Comal County, at San Marcos Springs and artesian well in Hays County.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Phreatodrobia rotunda*	NA	SGCN	Endemic to Hays county within San Marcos Springs and artesian well.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Marstonia comalensis*	NA	SGCN	Springs and fluvial habitats.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Cyclonaias necki*	NA	SGCN	Guadalupe River basin; moderate to large streams with flowing water.	Suitable habitat does not occur within project area.
Texas fatmucket	*Lampsilis bracteata*	C	T	Streams and rivers on sand, mud, and gravel substrates; intolerant of impoundment; broken bedrock and course gravel or sand in moderately flowing water; Colorado and Guadalupe River basins.	Suitable habitat does not occur within project area.
Texas fawnsfoot	*Truncilla macrodon*	C	SGCN	Moderate flow with sand, gravel, and possibly sandy-mud bottoms; portions of San Saba, Colorado, and Brazos River basins.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas pimpleback	*Quadrula petrina*	C	SGCN	Mud, gravel, and sand substrates, generally in areas with slow flow rates; Colorado and Guadalupe River basins.	Suitable habitat does not occur within project area.
Plants					
Bigflower cornsalad	*Valerianella stenocarpa*	NA	SGCN	Rocky ledges and low moist areas, often along rivers.	Suitable habitat does not occur within project area.
Bracted twistflower	*Streptanthus bracteatus*	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Suitable habitat does not occur within project area.
Buckley tridens	*Tridens buckleyanus*	NA	SGCN	Juniper-oak woodlands on rocky limestone slopes.	Suitable habitat does not occur within project area.
Canyon mock-orange	*Philadelphus texensis var. ernestii*	NA	SGCN	Outcrops of cretaceous limestone along mesic canyons, usually within shadow of mixed evergreen-deciduous canyon woodland.	Suitable habitat does not occur within project area.
Comal snakewood	*Colubrina stricta*	NA	SGCN	Shrublands on calcareous, gravelly clay soil associated with woody vegetation.	Suitable habitat unlikely to occur within project area.
Darkstem noseburn	*Tragia nigricans*	NA	SGCN	Oak-juniper woodlands on mesic limestone slopes and canyon bottoms.	Suitable habitat does not occur within project area.
Glass Mountains coral-root	*Hexalectris nitida*	NA	SGCN	Ashe juniper woodlands over limestone in Edwards Plateau.	Suitable habitat unlikely to occur within project area.
Gravelbar brickellbush	*Brickellia dentata*	NA	SGCN	Frequently scoured gravelly alluvial beds in creek and river bottoms.	Suitable habitat does not occur within project area.
Heller’s marbleseed	*Omosmodium helleri*	NA	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Hill Country wild-mercury	*Argythamnia aphoroides*	NA	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands; also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Suitable habitat does not occur within project area.
Lindheimer's tickseed	*Desmodium lindheimeri*	NA	SGCN	Live oak-juniper woodlands along rocky dry ravine bed and banks, steep ravine banks, dry caliche flat roadsides, and shallow soil on outcrops.	Low likelihood of suitable habitat within project vicinity.
Narrowleaf brickellbush	*Brickellia eupatorioides var. gracillima*	NA	SGCN	Gravelly alluvial soils along riverbanks; limestone slopes.	Suitable habitat does not occur within project area.
Net-leaf bundleflower	*Desmanthus reticulatus*	NA	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat does not occur within project area.
Osage Plains false foxglove	*Agalinis densiflora*	NA	SGCN	Grasslands on shallow, gravelly, well-drained calcareous soils; prairies, dry limestone soils.	Suitable habitat may occur within project area.
Plateau loosestrife	*Lythrum ovalifolium*	NA	SGCN	Banks and gravelly beds of perennial or strong intermittent streams on Edwards Plateau.	Suitable habitat does not occur within project area.
Plateau milkvine	*Matelea edwardsensis*	NA	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Suitable habitat does not occur within project area.
Scarlet leather-flower	*Clematis texansis*	NA	SGCN	Oak-juniper woodlands in mesic rocky limestone canyons or along perennial streams.	Suitable habitat does not occur within project area.
Spreading leastdaisy	*Chaetopappa effusa*	NA	SGCN	Limestone cliffs, ledges, bluffs, steep hillsides, sometimes near seeps; oak-juniper, oak or mixed deciduous woods, 300 to 500 meter elevation.	Suitable habitat does not occur within project area.
Sycamore-leaf snowbell	*Styrax platanifolius ssp. platanifolius*	NA	SGCN	Oak-juniper woodlands on steep rocky banks and ledges along intermittent or perennials streams.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas almond	*Prunus minutiflora*	NA	SGCN	Variety of grassland and shrubland habitats, mostly on calcareous soils underlain by limestone.	Low likelihood of suitable habitat in project vicinity.
Texas amorpha	*Amorpha roemeriana*	NA	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes, sometimes on dry shelves above creeks.	Suitable habitat does not occur within project area.
Texas barberry	*Berberis swaseyi*	NA	SGCN	Shallow calcareous stony clay of upland grassland/shrubland over limestone; also loamier soils in open wooded canyons and creek terraces.	Low likelihood of suitable habitat in project vicinity.
Texas claret-cup cactus	*Echinocerueus coccineus var. paucispinus*	NA	SGCN	Oak-juniper woodlands 150 to 2,700 meter elevations.	Low likelihood of suitable habitat in project vicinity.
Texas fescue	*Festuca versuta*	NA	SGCN	Mesic woodlands on limestone-derived soils on stream terraces and canyon slopes.	Suitable habitat does not occur within project area.
Texas mock-orange	*Philadelphus texensis var. texensis*	NA	SGCN	Well-drained soils on limestone outcrops of the Edwards Plateau.	Suitable habitat does not occur within project area.
Texas seymeria	*Seymeria texana*	NA	SGCN	Grassy openings in juniper-oak woodlands on dry rocky slopes or rock outcrops in shaded canyons.	Suitable habitat does not occur within project area.
Texas wild-rice	*Zizania texana*	E	E	Clear, flowing spring-fed rivers in San Marcos springs system.	Project area is outside of the expected range of the species.
Tree dodder	*Cuscuta exaltata*	NA	SGCN	Parasitic on numerous woody plant species, including oak, walnut, sumac, grape, elm, and persimmon.	Suitable host species may occur in project vicinity.
Turnip-root scurfpea	*Pediomelum cyphocalyx*	NA	SGCN	Grasslands and openings in juniper-oak woodlands on limestone substrates in Edwards Plateau.	Suitable habitat does not occur in project area.
Warnock's coral-root	*Hexalectris warnockii*	NA	SGCN	Oak-juniper woodlands on shaded slopes and intermittent, rocky creek beds in canyons.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Wright's milkvetch	*Astragalus wrightii*	NA	SGCN	Edwards Plateau.	Habitat information not available.
Reptiles					
American alligator	*Alligator mississippiensis*	NA	SGCN	Inland natural rivers, swamps, marshes, coastal marshes, and manmade impoundments.	Suitable habitat does not occur within project area.
Cagle's map turtle	*Graptemys caglei*	NA	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River system.	Suitable habitat does not occur within project area.
Eastern box turtle	*Terrapene carolina*	NA	SGCN	Found in fields, forests, forest-brush, and forest-field.	Low likelihood of suitable habitat in project vicinity.
Keeled earless lizard	*Holbrookia propinqua*	NA	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat does not occur within project area.
Northern spot-tailed earless lizard	*Holbrookia lacerata lacerata*	NA	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edward's Plateau.	Suitable habitat does not occur within project area.
Slender glass lizard	*Ophisaurus attenuates*	NA	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannahs, pine barrens, and oil fields.	Suitable habitat does not occur within project area.
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	NA	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat may occur within project area.
Spot-tailed earless lizard	*Holbrookia lacerata*	NA	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat may occur within project area.
Texas garter snake	*Thamnophis sirtalis annectens*	NA	SGCN	Irrigations canals and riparian -corridor farmlands; marshy, flooded pastureland, borders of permanent water bodies.	Suitable habitat does not occur within project area.
Texas horned lizard	*Phrynosoma cornutum*	NA	T	Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas tortoise	*Gopherus berlandieri*	NA	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus.	Suitable habitat may occur within project area.
Western box turtle	*Terrapene ornata*	NA	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrows into soil or may use burrows made by other species.	Suitable habitat may occur in project vicinity.
Western hognose snake	*Heterodon nasicus*	NA	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas (but not intensively cultivated), and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets. Seems to prefer sandy and loamy soils. Periods of inactivity are spent burrowed in the soil or in existing burrows.	Suitable habitat does not occur within project area.
T = Threatened E = Endangered C = Candidate DL = Delisted N/A = Not applicable SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC, the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[7] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

[7] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

The background literature review identified three previously recorded archaeological sites intersecting the project area (Table 5.2.26-2). The review also identified seven potential historic-age buildings that intersect the project area. No cemeteries, historical markers, or NRHP properties are within or adjacent to the project area.

The model used assessed overall unrecorded archaeological site potential within the project area to include moderate to high zones, ranging from 35 percent to 79 percent likelihood that the landform crossed contains significant unidentified archaeological resources. The highest probability areas were designated adjacent to existing drainages and near the archaeological sites.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 67.5. Based on the results of the background review, a structured cultural resources survey of the final design plan is recommended to accurately assess the presence and significance of identified and unrecorded cultural resources within its boundaries.

Table 5.2.26-2 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological Site	Historic Structure	Historic	Undetermined	Intersect
Archaeological Site	Historic Structure and Prehistoric Lithic Scatter	Multicomponent	Undetermined	Intersect
Archaeological Site	Farmstead	Historic	Undetermined	Intersect
Historic Structure	7 Historic Structures	Historic	Undetermined	Intersect
			ASSESSMENT SCORE TOTAL:	**67.5**

5.2.26.4 Engineering and Costing

The proposed site of the Trinity well field is on the northwest side of the City of New Braunfels (City). More specifically, it is in the vicinity of Loop 377 and Oak Run Parkway and on property owned by NBU. A well field consisting of four wells is already on this site and is set to be expanded upon. The existing wells are approximately 620 feet deep. Water quality data indicate that, after treatment, the water meets public drinking water standards.

The engineering and costing analysis for the NBU Trinity Well Project includes all facilities required to deliver treated water to the existing NBU water distribution system. This includes the new Trinity wells, collection pipelines, a ground storage tank, water treatment facilities expansion, and an upgraded pump station to deliver water to the existing distribution system at Oak Run Parkway.

Cost estimates were computed for capital costs, annual debt service, O&M, power, land, and environmental mitigation (Table 5.2.26-3). The project costs, including capital, are estimated to be $19,155,000. As shown, the annual costs, including debt service, O&M, power, and groundwater leases, are estimated to be $2,303,000. This option produces potable water at an estimated cost of $685 per acft ($2.10 per 1,000 gallons).

Table 5.2.26-3 Cost Estimate Summary

ITEM	ESTIMATED COSTS FOR FACILITIES
Primary Pump Station Expansion	$1,058,000
Well Fields (wells, pumps, and piping)	$2,862,000
Storage Tanks (other than at booster pump stations)	$1,516,000
WTP Expansion (3.74 mgd)	$8,264,000
TOTAL COST OF FACILITIES	**$13,700,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$4,795,000
Environmental and Archaeology Studies and Mitigation	$132,000
Interest During Construction (3% for 1 year with a 0.5% return on investment)	$513,000
TOTAL COST OF PROJECT	**$19,155,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,348,000
O&M	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$44,000
Intakes and Pump Stations (2.5% of cost of facilities)	$26,000
WTP	$521,000
Pumping Energy Costs (4,552,850 kWh at 0.08 $/kWh)	$364,000
TOTAL ANNUAL COST	**$2,303,000**
Available Project Yield (acft/yr)	3,360
Annual Cost of Water ($ per acft)	$685
Annual Cost of Water After Debt Service ($ per acft)	$284
Annual Cost of Water ($ per 1,000 gallons)	$2.10
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.87
Based on a Peaking Factor of 1.04.	

5.2.26.5 Implementation Considerations

Information presented in this WMS was provided by NBU and represents the current plan, which is based on the sponsor's current understanding of the system. Implementation of the NBU Trinity Well Field Expansion may include the following considerations:

- TCEQ:
  - Review and approval of technical specifications for all new or rehabilitated components of the public water system;
  - Review and approval of facilities and water quality to begin operations; and
  - Review and approval of injection well permit.
- EAA:
  - Obtain a "Drilling Through the Edwards Aquifer" Well Construction Permit from the EAA for the construction of wells passing through the Edwards Aquifer;
  - Verify available groundwater quantity and well productivity;
  - Verify water quality; and
  - Verify minimal impacts to the aquifers, particularly as it relates to applicable DFCs.
- The Comal Trinity GCD regulates the Trinity Aquifer in Comal County. Thus, any local permits and approvals from the GCD are required.

Reliability

Water from these sources is considered to be reliable based on assessment of groundwater availability and because this strategy is not limited by the MAG or existing groundwater permits in Comal County. Supply is considered to be medium because of the potential of differing well productivity and water quality, potential impacts to natural resources and Carrizo Aquifer user competition. Blending of Carrizo-Wilcox aquifer water is as reliable as the fresh water source (reliability score = 4).

5.2.27 City of Victoria ASR Project

5.2.27.1 Description of Water Management Strategy

Through most of its history, the City of Victoria (Victoria) relied on locally available groundwater supplies withdrawn from the Gulf Coast Aquifer. To support continued growth, limit drawdowns in aquifer levels, and maintain water quality, Victoria obtained a new surface water appropriation (P#5466) in the 1990s that authorized diversions from the Guadalupe River. However, subject to the senior water rights of others and special conditions requiring streamflow passage for environmental protection, supplies available under P#5466 are severely limited during drought. Since the 1990s, Victoria has obtained six additional surface water rights senior in priority to P#5466 from willing sellers.

Victoria plans to firm up its existing water supply with the addition of an ASR project to its water system (Figure 5.2.27-1). ASR is a recognized means for storing treated surface water during periods when it is available in a suitable aquifer formation for subsequent recovery during periods when run-of-river diversions are limited. In this way, evaporative losses associated with storage in a surface reservoir are avoided. Hence, the Victoria ASR Project is a feasible means to firm up periodically limited supplies available under Victoria's surface water rights to ensure that sufficient storage is available for recovery during drought.

The Victoria ASR WMS involves conducting the necessary studies and testing to obtain the required TCEQ permits to allow for aquifer storage; acquisition of necessary well injection, drilling, and production permits; and installation of appurtenant facilities, thereby enhancing the firm surface water supply available to Victoria.

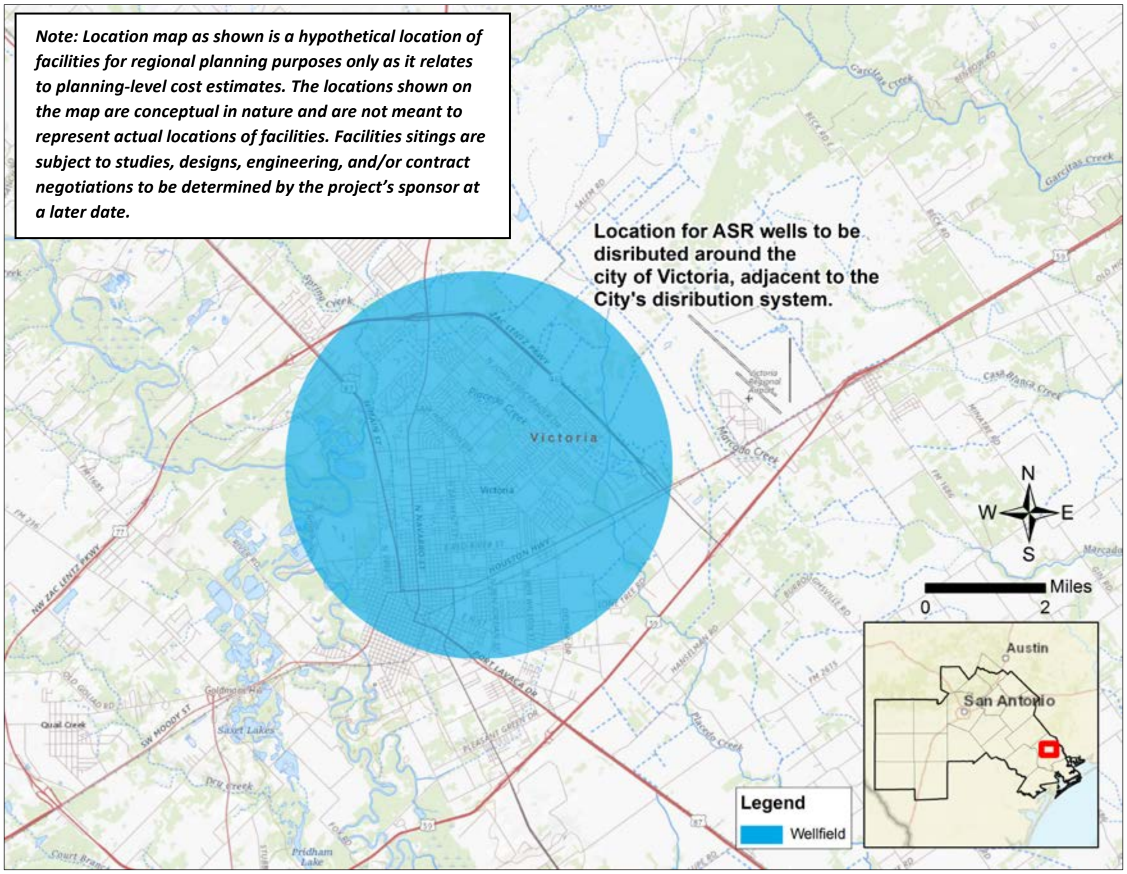

Figure 5.2.27-1 Approximate Project Location for the Victoria ASR Project

5.2.27.2 Available Yield

The six surface water rights held by Victoria are summarized in Table 5.2.27-1 and total 27,007 acft/yr. The ASR Project will be implemented using a phased approach to ultimately firm up Victoria's surface water rights. When fully developed, the ASR Project is anticipated to include 15 new wells that are each capable of recovering at a rate of approximately 1,600 gpm and recharging at a rate of approximately 800 gpm.

Table 5.2.27-1 Victoria Surface Water Rights

CA#/P#	PRIORITY DATE	ANNUAL DIVERSION (AFY)	MAXIMUM DIVERSION (CFS)
CA#18-3844	8/16/1918	608	9.8
CA#18-3858	6/27/1951	1,000	4.44
CA#18-3860	8/15/1951	260	8.91
CA#18-3862	12/12/1951	262.7	12.62
P#3606	7/10/1978	4,676	13.4
P#4117	4/2/1984	200	1.67

CA#/P#	PRIORITY DATE	ANNUAL DIVERSION (AFY)	MAXIMUM DIVERSION (CFS)
P#5466	5/28/1993	20,000	150
	TOTAL	27,006.7	200.84

As shown in evaluations of existing supply (Chapter 3) using the GSA WAM, firm supply available under Victoria's surface water rights is quite limited due to drought and its junior priority (608 acft/yr). Consideration of the volume reliabilities of these rights, however, demonstrates that high percentages (between 52 and 100% percent on a volumetric basis) of its authorized diversion amounts are available in most years. This WMS has a firm yield of 7,900 acft/yr and is planned for implementation beginning in the 2020 decade. The strategy water loss of ASR water is assumed to be zero for the purpose of this WMS modeling, but further study is recommended.

5.2.27.3 Environmental Considerations

Environmental Considerations

Since the potential project could occur within various locations within Victoria, the environmental constraints analysis encompassed the area within city limits. Individual project components can likely be sited to avoid sensitive habitat features. It was assumed that there would not be significant project impacts in the Guadalupe River.

Vegetation and Land Use

The project area occurs in the Gulf Prairies and Marshes ecoregion, with project facilities to be located throughout Victoria near the existing water distribution system. Therefore, the project area is primarily urban/suburban. As mapped by TPWD,[1] there are multiple vegetation types, including urban, agricultural, open water, and a variety of woody and herbaceous communities. Much of the area would be expected to contain maintained lawns and landscape species.

Based on TPWD vegetation mapping, the City of Victoria project area includes 1,281 acres of agricultural resources mapped as row crops. As proposed project components are planned to be sited near existing water infrastructure, impacts to agricultural uses are expected to be minor relative to the mapped area.

Aquatic Resources

The project area contains approximately 12.5 miles of intermittent streams and 4.8 miles of perennial streams. The Guadalupe River flows generally north to south along the western side of the city and has an extensive floodplain area; Pacedo Creek flows generally northwest to southeast through the eastern side of the city. The NWI mapping shows 23.6 acres of emergent wetlands, 96 acres of forested wetlands, and 43 acres of ponds. The Texas Integrated Report of 303(d) listed water bodies[2] identifies

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[1] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

[2] Texas Commission on Environmental Quality. 2018. *2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d).* https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf.

the water bodies or segments in Texas that do not meet assigned water quality standards. The Guadalupe River is not classified as an impaired stream segment. The project area does not contain ecologically significant stream segments as designated by TPWD.

The project will require an on-site delineation of streams, ponds, and wetlands. Well facilities can typically be sited to avoid impacts to waters of the United States, including wetlands. Pipeline crossings, if applicable, may result in temporary impacts to streams and floodplains.

Threatened, Endangered, and Species of Concern

Table 5.2.27-2 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Victoria County [3] [4]. Suitable habitat does not occur for any of the federally listed threatened or endangered species.

Because of the developed nature of much of the project area, suitable habitat is not expected to occur for most state-listed species; however, there is potential suitable habitat for species that utilize open, sparsely vegetated areas, such as the state-threatened Texas horned lizard (*Phrynosoma cornutum*).

There is low to moderate potential for suitable habitat for several wildlife species designated by TPWD as SGCN: American bumblebee (*Bombus pensylvanicus*), southern crawfish frog (*Lithobates areolatus areolatus*), Strecker's chorus frog (*Pseudacris streckeri*), Woodhouse's toad (*Anaxyrus woodhousii*), western burrowing owl (*Athene cunicularia hypugaea*), American badger (*Taxidea taxus*), thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*), eastern spotted skunk (*Spilogale putorius*), and plains spotted skunk (*Spilogale putorius interrupta*). In addition, SGCN bat species may utilize structures and could, therefore, occur in developed areas. SGCN species do not have formal protected status but are being monitored by TPWD.

Migratory birds may fly through the project area but are generally not expected to be impacted by well installation.

Site-specific field surveys would be required to determine the quality of habitat and potential for impacts to state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD would likely be required to obtain its recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or to avoid vegetation clearing during the general bird nesting season from March 15 to September 15. Preconstruction surveys for active bird nests are recommended.

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[3] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Victoria County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[4] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Victoria County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.

Table 5.2.27-2 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for Victoria ASR Project; Victoria County, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Black-spotted newt	*Notophthalmus meridionalis*	N/A	T	Found in wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions in the Gulf Coastal Plain south of the San Antonio River.	Suitable habitat unlikely to occur within project area.
Southern crawfish frog	*Lithobates areolatus areolatus*	N/A	SGCN	Inhabits moist meadows, pasturelands, pine scrub, and river flood plains.	Suitable habitat may occur within project area.
Strecker's chorus frog	*Pseudarcris streckeri*	N/A	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Suitable habitat may occur within project area.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur within project area.
Birds					
Attwater's greater prairie-chicken	*Tympanuchus cupido attwateri*	E	E	Open prairies of mostly thick grass 1 to 3 feet tall; sandhill country with bunch grass, sage, and shinnery oak.	Suitable habitat does not occur within project area; may fly over during migration.
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat does not occur within project area, may fly over during migration.
Black rail	*Laterallus jamaicensis*	PT	SGCN	Salt, brackish, and freshwater marshes; pond borders; wet meadows; and grassy swamps.	Suitable habitat does not occur within project area; may fly over during migration.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur within project area; may fly over during migration.
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also know to nest on manmade structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Suitable habitat does not occur within project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie; feeds in shortgrass fields and bare (e.g., plowed) soil.	Unlikely to occur within project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur within project area; may fly over during migration.
Red knot	*Calidris canutus rufa*	T	SGCN	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays.	Suitable habitat does not occur within project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	SGCN	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Project is outside of the expected range of this species.
Swallow-tailed kite	*Elanoides forficatus*	N/A	T	Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds.	Suitable habitat does not occur within project area; may fly over during migration.
Tropical kingbird	*Tyrannus melancholicus*	N/A	SGCN	Scattered woodlands and forest edges; can also be found in croplands, fields, and residential areas.	May occur within project area; may fly over during migration.
Tropical parula	*Setophaga pitiayumi*	N/A	T	Dense or open woods, brush, trees, and undergrowth along edges of river and resacas.	Suitable habitat does not occur within project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots; nests and roosts in abandoned burrows.	Suitable habitat may occur within the project area.
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat does not occur within project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
White-tailed hawk	*Buteo albicaudatus*	N/A	T	Near coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral.	Unlikely to occur within project area; may fly over during migration.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems (during migration).	Suitable habitat does not occur within project area; may fly over during migration.
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Unlikely to occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous or pine-oak woodland.	Suitable habitat does not occur within project area; may fly over during migration.
Fish					
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams and rivers of the Edwards Plateau region; found outside of the Edwards Plateau streams in decreased abundance.	Suitable habitat does not occur within project area.
Guadalupe darter	*Percina apristis*	N/A	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Suitable habitat does not occur within project area.
Southern flounder	*Paralichthys lethostigma*	N/A	SGCN	Near shore and shallow offshore depths in Gulf of Mexico; can be found several miles upstream in freshwater river systems.	Suitable habitat does not occur within project area.
Texas shiner	*Notropis amabilis*	N/A	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Suitable habitat does not occur within project area.
Insects					

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
A mayfly	*Tortopus circumfluus*	N/A	SGCN	Aquatic larval stage; adults in shoreline vegetation.	Suitable habitat does not occur within project area.
A mayfly	*Tricorythodes curvatus*	N/A	SGCN	Aquatic larval stage; adults in bankside vegetation.	Suitable habitat does not occur within project area.
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	May occur within project area; unlikely to impact.
Comanche harvester ant	*Pogonomyrmex comanche*	N/A	SGCN	Prairies surrounded by oak forests with deep sandy soils.	Unlikely to occur in project area.
No accepted common name	*Cotinis boylei*	N/A	SGCN	South Texas coastal plains; feeds on grapevine leaves.	Suitable habitat does not occur within project area.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur within project vicinity.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls but will use buildings.	Suitable natural habitat does not occur within project area; may use buildings.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat does not occur within project area; may fly through during migration.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges and woodlands. Prefer wooded, brushy areas; tallgrass prairies.	Suitable habitat may occur within project vicinity.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Suitable habitat does not occur within project area.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat does not occur within project area.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	Suitable natural habitat does not occur within project area; may use buildings.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Mountain lion	*Puma concolor*	N/A	SGCN	Use wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Suitable habitat does not occur within project area.
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	N/A	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur within project vicinity.
Southern short-tailed shrew	*Blarina carolinensis*	N/A	SGCN	Wooded and brushy areas; prefers fallen logs and abundant lead litter.	Suitable habitat does not occur within project area.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat does not occur within project area.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Prefer short-grass prairies, also occur in pastures and along fencerows. Excavate burrows or use abandoned pocket gopher or prairie dog burrows.	Suitable habitat may occur within project vicinity.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat does not occur within project area.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat does not occur within project area.
White-nosed coati	*Nasua narica*	N/A	T	Canyons, riparian corridors, and woodlands.	Suitable habitat does not occur within project area.
Mollusks					
False spike	*Fusconaia mitchelli*	N/A	T	Medium to large rivers; historically present in Guadalupe, Colorado, Brazos, and Rio Grande River basins.	Suitable habitat does not occur within project area.
Golden orb	*Quadrula aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Suitable habitat does not occur within project area.
No accepted common name	*Cyclonaias necki*	N/A	N/A	Guadalupe River Basin; moderate to large streams with flowing water.	Suitable habitat does not occur within project area.
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	N/A	SGCN	Found in open, sandy places.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Coastal gay-feather	*Liatris bracteata*	N/A	SGCN	Coastal prairie grasslands of various types, from salty prairie on low-lying somewhat saline clay loams to upland prairie on nonsaline clayey to sandy loams.	Suitable habitat may occur within project area.
Crestless onion	*Allium canadense var. ecristatum*	N/A	SGCN	Occurs on poorly drained sites on sandy substrates within coastal prairies of the Coastal Bend area.	Suitable habitat does not occur within project area.
Florida pinkroot	*Spigelia texana*	N/A	SGCN	Woodlands on loamy soils.	Suitable habitat does not occur within project area.
Heartleaf evening-primrose	*Oenothera cordata*	N/A	SGCN	Occurs in post oak woodlands on sandy soils on the coastal plain.	Suitable habitat does not occur within project area.
Indianola beakrush	*Rhynchospora indianolensis*	N/A	SGCN	Locally abundant in cattle pastures in some areas (at least during wet years).	Suitable habitat may occur within project area.
Jones's rainlilly	*Cooperia jonesii*	N/A	SGCN	Low elevation areas in the Texas coastal bend.	Suitable habitat may occur within project area.
Shiner's sunflower	*Helianthus occidentalis ssp. plantagineus*	N/A	SGCN	Mostly in prairies on the Coastal Plain, with several slightly disjunct populations in the Pineywoods and South Texas Brush Country.	Suitable habitat may occur within project area.
Texas peachbush	*Prunus texana*	N/A	SGCN	Occurs at scattered sites in various well drained sandy situations; deep sand, plains and sand hills, grasslands, and oak woods; 0 to 200 meter elevation.	Suitable habitat may occur within project area.
Texas tauschia	*Tauschia texana*	N/A	SGCN	Occurs in loamy soils in deciduous forests or woodlands on river and stream terraces.	Suitable habitat does not occur within project area.
Threeflower broomweed	*Thurovia trifloral*	N/A	SGCN	Near coast in sparse, low vegetation on a veneer of light-colored silt or fine sand over saline clay along drier upper margins of ecotone between salty prairies and tidal flats; further inland associated with vegetated slick spots on prairie mima mounds.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Two-flower stick-pea	*Calliandra biflora*	N/A	SGCN	Primarily in open areas on caliche outcrops or in shallow sandy soils over caliche.	Suitable habitat does not occur within project area.
Welder machaeranthera	*Psilactis heterocarpa*	N/A	SGCN	Grasslands, varying from midgrass coastal prairies, and open mesquite-huisache woodlands on nearly level, gray to dark gray clayey to silty soils.	Suitable habitat may occur within project area.
Wright's trichocoronis	*Trichocoronis wrightii var. wrightii*	N/A	SGCN	Most records from Texas are historical, perhaps indicating a decline as a result of alteration of wetland habitats.	Suitable habitat does not occur within project area.
Reptiles					
American alligator	*Alligator mississippiensis*	N/A	N/A	Inland natural rivers, swamps, marshes, coastal marshes, and manmade impoundments.	Suitable habitat does not occur within project area.
Cagle's map turtle	*Graptemys caglei*	N/A	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River System.	Suitable habitat does not occur within project area.
Common garter snake	*Thamnophis sirtalis*	N/A	N/A	Wide range of habitat, from wetland and riparian corridors to upland woodlands and grasslands.	Low likelihood of suitable habitat in project vicinity.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Low likelihood of suitable habitat in project vicinity.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat does not occur within project area.
Massasauga	*Sistrurus tergeminus*	N/A	SGCN	Grasslands and on woodland edges.	Low likelihood of suitable habitat in project vicinity.
Slender glass lizard	*Ophisaurus attenuates*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannas, pine barrens, and oil fields.	Suitable habitat does not occur within project area.
Texas diamondback terrapin	*Malaclemys terrapin littoralis*	N/A	SGCN	Brackish or salt water in estuaries, tidal creeks, and saltwater marshes.	Suitable habitat does not occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur within project area.
Texas tortoise	*Gopherus berlandieri*	N/A	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus.	Suitable habitat does not occur within project area.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrows into soil or may use burrows made by other species.	Suitable habitat does not occur within project area.
T = Threatened E = Endangered PT = Proposed Threatened C = Candidate DL = Delisted N/A = Not applicable SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC and the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the Project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[5] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

[5] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

The project area, as currently defined, will be located within the city of Victoria, which has many historic and archaeological resources recorded within its confines. The background literature review identified ten previously recorded archaeological sites within the project area. These sites consist of prehistoric campsites and historic homesteads and structures. Five of the ten sites are recommended as eligible for listing in the NRHP while the remaining five have an undetermined NRHP eligibility (THC 2019). Additionally, eight cemeteries, 81 historical markers, 103 NRHP-listed properties, and over 1,500 potential historic-age structures are located within the project area. Two historic-age railroads, the Texas and New Orleans and the Brownsville and Mexico, also bisect the project area.

The model used assessed unrecorded archaeological site potential within the project area to include low to high potential zones, ranging from 0.2 to 100 percent likelihood that the landforms crossed contain unidentified archaeological resources. The greatest probability areas were designated adjacent to existing streams, known archaeological sites, NRHP properties, and cemeteries.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 2,243.5. Based on the results of the background review, SWCA recommends that as the project design advances, it incorporates the known cultural resources and is positioned to avoid the numerous cemeteries, NRHP properties, and five NRHP-eligible archaeological sites. SWCA also recommends that the final design plan includes additional studies to accurately assess the presence and significance of identified and unrecorded cultural resources within its boundaries.

Table 5.2.27-3 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Texas and New Orleans Railroad	Linear	Historic	Undetermined	Intersect
Brownsville and Mexico Railroad	Linear	Historic	Undetermined	Intersect
Historical Structures	1,500+ buildings	Historic	Undetermined	Intersect
41VT169	Archaeological Site	Historic	Undetermined	Intersect
41VT10	Archaeological Site	Prehistoric/ Historic	Eligible	Intersect
41VT104	Archaeological Site	Prehistoric	Undetermined	Intersect
41VT105	Archaeological Site	Historic	Eligible	Intersect
41VT112	Archaeological Site/SAL	Prehistoric	Eligible	Intersect
41VT134	Archaeological Site/SAL	Historic	Eligible	Intersect
41VT138	Archaeological Site	Historic	Eligible	Intersect
41VT7	Archaeological Site	Unknown	Undetermined	Intersect

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
41VT143	Archaeological Site	Historic	Undetermined	Intersect
41VT142	Archaeological Site	Prehistoric	Undetermined	Intersect
Alden, C. R., Building	NRHP Property	Historic	Listed	Intersect
Alonso, Frank, House	NRHP Property	Historic	Listed	Intersect
Band Stand	Historical Marker	Historic	None	Intersect
Barden--O'Connor House	NRHP Property	Historic	Listed	Intersect
Barnes, W. C., House	NRHP Property	Historic	Listed	Intersect
Belk Ranch Headquarters	Historical Marker	Historic	None	Intersect
Bendt, E. H. D., House	NRHP Property	Historic	Listed	Intersect
Bettin, Max, House	NRHP Property	Historic	Listed	Intersect
B'nai Israel Cemetery	Cemetery	Historic	Listed	Intersect
Braman House	NRHP Property	Historic	Listed	Intersect
Brownson's Bank	Historical Marker	Historic	None	Intersect
Buhler, Theodore, House	NRHP Property	Historic	Listed	Intersect
Building at 205 East Constitution	NRHP Property	Historic	Listed	Intersect
Burrough--Daniel House	NRHP Property	Historic	Listed	Intersect
Calhoun Bakery (Gone)	NRHP Property	Historic	Listed	Intersect
Callender House	Historical Marker	Historic	Listed	Intersect
Camp Henry E. McCulloch	Historical Marker	Historic	None	Intersect
Camp Victoria	Historical Marker	Historic	None	Intersect
Case, Viola	Historical Marker	Historic	None	Intersect
City of Victoria Pumping Plant--Waterworks	NRHP Property	Historic	Listed	Intersect
Clark House	NRHP Property	Historic	Listed	Intersect
Clark, Robert, House	NRHP Property	Historic	Listed	Intersect
Clegg, John H., House	NRHP Property	Historic	Listed	Intersect
Conrad, Edward	Historical Marker	Historic	None	Intersect
Crain, F. H., House	NRHP Property	Historic	Listed	Intersect
Cunningham, Abel Seymour	Historical Marker	Historic	None	Intersect
De Leon, Agapito	Historical Marker	Historic	None	Intersect
De Leon, Don Martin	Historical Marker	Historic	None	Intersect
De Leon, Dona Patricia De La Garza	Historical Marker	Historic	None	Intersect

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
De Leon, Felix	Historical Marker	Historic	None	Intersect
De Leon, Fernando	Historical Marker	Historic	None	Intersect
De Leon, Martin, Home of	Historical Marker	Historic	None	Intersect
De Leon, Silvestre	Historical Marker	Historic	None	Intersect
Diebel--Hyak House	NRHP Property	Historic	Listed	Intersect
Evergreen Cemetery	Cemetery/Historical Marker	Historic	None	Intersect
F.W. Gross High School	Historical Marker	Historic	None	Intersect
Farmers and Merchants Cotton Gin Warehouse	NRHP Property	Historic	Listed	Intersect
Federal Building	Historical Marker	Historic	None	Intersect
First Baptist Church of Victoria	Historical Marker	Historic	None	Intersect
First Presbyterian Church	Historical Marker	Historic	None	Intersect
First United Methodist Church	Historical Marker	Historic	None	Intersect
Fleming-Welder House	Historical Marker	Historic	Listed	Intersect
Fossati, E. J., House	NRHP Property	Historic	Listed	Intersect
Fossati's Delicatessen	Historical Marker	Historic	Listed	Intersect
Fox, Jacob, House	Historical Marker	Historic	Listed	Intersect
Friedrech and Margaretha Hiller House	Historical Marker	Historic	None	Intersect
Gaylord--Levy House	NRHP Property	Historic	Listed	Intersect
Gervais House	NRHP Property	Historic	Listed	Intersect
Goldman Ginnery	Historical Marker	Historic	None	Intersect
Goldman, A., Building	NRHP Property	Historic	Listed	Intersect
Goldman's Cotton Gin Warehouse	NRHP Property	Historic	Listed	Intersect
Gramann House	NRHP Property	Historic	Listed	Intersect
Guadalupe River	Historical Marker	Historic	None	Intersect
Hauschild Opera House	Historical Marker	Historic	None	Intersect
Hauschild, George and Adele, House (Gone?)	NRHP Property	Historic	Listed	Intersect
Hauschild, George H., Building	NRHP Property	Historic	Listed	Intersect

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Heaton, L.D., Home	Historical Marker	Historic	None	Intersect
Henderson House	Historical Marker	Historic	None	Intersect
Hill Cemetery	Cemetery	Historic	None	Intersect
Hiller House	NRHP Property	Historic	Listed	Intersect
Hiller House	NRHP Property	Historic	Listed	Intersect
Hill-Howard House	NRHP Property	Historic	Listed	Intersect
Hill-O'Connor-Howard House	Historical Marker	Historic	None	Intersect
House at 1602 North Moody	NRHP Property	Historic	Listed	Intersect
House at 1907 Southwest Ben Jordan	NRHP Property	Historic	Listed	Intersect
House at 304 West Stayton	NRHP Property	Historic	Listed	Intersect
House at 306 East Forrest	NRHP Property	Historic	Listed	Intersect
House at 401 East Stayton	NRHP Property	Historic	Listed	Intersect
House at 402 W. Colorado	NRHP Property	Historic	Listed	Intersect
House at 407 East Convent	NRHP Property	Historic	Listed	Intersect
House at 4402 East Juan Linn	NRHP Property	Historic	Listed	Intersect
House at 604 East Santa Rosa	NRHP Property	Historic	Listed	Intersect
House at 702 Siegfried	NRHP Property	Historic	Listed	Intersect
House at 706 Siegfried (Gone)	NRHP Property	Historic	Listed	Intersect
House at 804 Siegfried	NRHP Property	Historic	Listed	Intersect
Hull House	NRHP Property	Historic	Listed	Intersect
J. Meredith Tatton House	Historical Marker	Historic	None	Intersect
January, Captain James P.	Historical Marker	Historic	None	Intersect
Jecker, E. J., House	NRHP Property	Historic	Listed	Intersect
Jecker, J. T., House	NRHP Property	Historic	Listed	Intersect
Jewett-Booker Cemetery	Cemetery	Historic	None	Intersect
Joe F. and Amelia Jecker House	Historical Marker	Historic	None	Intersect
Jordan--Koch House	NRHP Property	Historic	Listed	Intersect
Kaufman, E. C., House	NRHP Property	Historic	Listed	Intersect
Keef--Filley Building	NRHP Property	Historic	Listed	Intersect
Krenek House (Gone)	NRHP Property	Historic	Listed	Intersect
Lander--Hopkins House	NRHP Property	Historic	Listed	Intersect

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Lane--Tarkington House	NRHP Property	Historic	Listed	Intersect
Lawrence House	NRHP Property	Historic	Listed	Intersect
Leffland, Jules, House	NRHP Property	Historic	Listed	Intersect
Levi, Abraham, House	Historical Marker	Historic	None	Intersect
Levi--Welder House	NRHP Property	Historic	Listed	Intersect
Linn, John J.	Historical Marker	Historic	None	Intersect
Linn, John Joseph	Historical Marker	Historic	None	Intersect
Little House	NRHP Property	Historic	Listed	Intersect
Lowe, Alexander, House	Historical Marker	Historic	None	Intersect
Magnolia Service Station No. 122 (Gone)	NRHP Property	Historic	Listed	Intersect
Martin--Fiek-Thumford, Vera, House	NRHP Property	Historic	Listed	Intersect
McCabe Building (Gone)	NRHP Property	Historic	Listed	Intersect
McCan--Nave House	NRHP Property	Historic	Listed	Intersect
McDonald House	NRHP Property	Historic	Listed	Intersect
McFaddin, James A., Home	Historical Marker	Historic	None	Intersect
McFaddin, James, House	NRHP Property	Historic	Listed	Intersect
McLean, William Pinckney	Historical Marker	Historic	None	Intersect
McNamara House	Historical Marker	Historic	None	Intersect
McNamara--O'Conner House	NRHP Property	Historic	Listed	Intersect
Memorial Park Cemetery	Cemetery	Historic	None	Intersect
Memorial Square	Historical Marker	Historic	None	Intersect
Memorial Square Cemetery	Historical Marker	Historic	None	Intersect
Mitchell School	Historical Marker	Historic	None	Intersect
Mitchell, Guy, House	NRHP Property	Historic	Listed	Intersect
Moeller House (Gone?)	NRHP Property	Historic	Listed	Intersect
Mohris-Abschier House	NRHP Property	Historic	Listed	Intersect
Mount Salem American Baptist Church	Historical Marker	Historic	None	Intersect
Mundt Place	Historical Marker	Historic	None	Intersect
Murphy, Mrs. J. V., House	NRHP Property	Historic	Listed	Intersect
Nave, Royston, Memorial	NRHP Property	Historic	Listed	Intersect
O'Connor, Thomas M., House	NRHP Property	Historic	Listed	Intersect

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
O'Connor, Thomas, House	NRHP Property	Historic	Listed	Intersect
O'Connor-Proctor Building	Historical Marker	Historic	None	Intersect
O'Connor--Proctor Building	NRHP Property	Historic	Listed	Intersect
Old Brownson School	NRHP Property	Historic	Listed	Intersect
Old Federal Building and Post Office	NRHP Property	Historic	Listed	Intersect
Old Municipal Assembly Hall (Gone?)	NRHP Property	Historic	Listed	Intersect
Old Nazareth Academy	NRHP Property	Historic	Listed	Intersect
Old Victoria County Courthouse	NRHP Property	Historic	Listed	Intersect
Our Lady of Lourdes Catholic Church	Historical Marker	Historic	None	Intersect
Our Lady of Lourdes Church	NRHP Property	Historic	Listed	Intersect
Palestine Missionary Baptist Church	Historical Marker	Historic	None	Intersect
Pela House	NRHP Property	Historic	Listed	Intersect
Phillips, Judge Alexander H., House	NRHP Property	Historic	Listed	Intersect
Phillips-Sale House	Historical Marker	Historic	None	Intersect
Pickering House	NRHP Property	Historic	Listed	Intersect
Pioneer Marker	Historical Marker	Historic	None	Intersect
Pippert House (Gone?)	NRHP Property	Historic	Listed	Intersect
Pleasant Green Cemetery	Cemetery	Historic	None	Intersect
Presbyterian Iglesia Nicea	NRHP Property	Historic	Listed	Intersect
Pridham, Peter Underhay	Historical Marker	Historic	None	Intersect
Proctor House	Historical Marker	Historic	Listed	Intersect
Proctor--Vandenberge House	NRHP Property	Historic	Listed	Intersect
Randall Building	NRHP Property	Historic	Listed	Intersect
Regan, D. H., House	Historical Marker	Historic	Listed	Intersect
Resurrection Catholic Cemetery	Cemetery	Historic	None	Intersect
Robert H. and Pauline Clark House	Historical Marker	Historic	None	Intersect
Rose, Victor M.	Historical Marker	Historic	None	Intersect

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Rose, Victor Marion	Historical Marker	Historic	None	Intersect
Roselle--Smith House	NRHP Property	Historic	Listed	Intersect
Round Top House, Site of	Historical Marker	Historic	None	Intersect
Saint Mary's Catholic Church	Historical Marker	Historic	Listed	Intersect
Schroeder House	NRHP Property	Historic	Listed	Intersect
Schummacker Company Building	NRHP Property	Historic	Listed	Intersect
Sengele, Alphonse T., House	NRHP Property	Historic	Listed	Intersect
Shrader, Henry, House	NRHP Property	Historic	Listed	Intersect
Sigmund House	NRHP Property	Historic	Listed	Intersect
Smith, William Robert	Historical Marker	Historic	None	Intersect
Southern Pacific Railroad Depot, Site of	Historical Marker	Historic	None	Intersect
Southern Pacific RR Guadalupe Bridge	NRHP Property	Historic	Listed	Intersect
Stapp, Darwin M.	Historical Marker	Historic	None	Intersect
Stuart House	NRHP Property	Historic	Listed	Intersect
Tasin House	NRHP Property	Historic	Listed	Intersect
Texas Company Filling Station	NRHP Property	Historic	Listed	Intersect
Thurmond Building	Historical Marker	Historic	None	Intersect
Tonkawa Bank (Vista of Mission Espiritu Santo)	Historical Marker	Historic	None	Intersect
Townsend--Wilkins House	NRHP Property	Historic	Listed	Intersect
Trinity Evangelical Lutheran Church	Historical Marker	Historic	None	Intersect
Trinity Lutheran Church	NRHP Property	Historic	Listed	Intersect
Unknown Cemetery	Cemetery	Historic	None	Intersect
Urban, Fred, House	NRHP Property	Historic	Listed	Intersect
Van Bibber, John	Historical Marker	Historic	None	Intersect
Vandenberge, J. V., House	NRHP Property	Historic	Listed	Intersect
Victoria Advocate, The	Historical Marker	Historic	None	Intersect
Victoria Colored School	NRHP Property	Historic	Listed	Intersect
Victoria County	Historical Marker	Historic	None	Intersect

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/ HISTORIC	NRHP ELIGIBILITY	LOCATION
Victoria County Courthouse, Former	Historical Marker	Historic	None	Intersect
Victoria County Honor Roll	Historical Marker	Historic	None	Intersect
Victoria County Monument	Historical Marker	Historic	None	Intersect
Victoria County, C.S.A.	Historical Marker	Historic	None	Intersect
Victoria Pumping Station	Historical Marker	Historic	None	Intersect
Victoria's First Church, Site of	Historical Marker	Historic	None	Intersect
Weber--Schuchert House	NRHP Property	Historic	Listed	Intersect
Webster Chapel United Methodist Church	Historical Marker/NRHP Property	Historic	Listed	Intersect
Weisiger, Robert S.	Historical Marker	Historic	None	Intersect
Weisiger, Sidney Roper	Historical Marker	Historic	None	Intersect
Welder, Robert H., House	NRHP Property	Historic	Listed	Intersect
Wheeler, William, House	NRHP Property	Historic	Listed	Intersect
Williams, B.F., House	Historical Marker	Historic	Listed	Intersect
Wood, John Howland	Historical Marker	Historic	None	Intersect
Woodhouse House	Historical Marker/ NRHP Property	Historic	Listed	Intersect
Zahn, Herman and Alvina, House	NRHP Property	Historic	Listed	Intersect
			ASSESSMENT SCORE TOTAL:	2,243.5

5.2.27.4 Engineering and Costing

Preliminary engineering and costing analyses have been performed using 2021 Regional Water Planning methods. Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and the method for calculating unit costs. The costing procedures include all facilities required for water recharge, recovery, and collection.

Overall project costs are estimated at $37,982,000. Accounting for debt service, operations and maintenance, and pumping energy, annual cost is estimated at $3,042,000, and the annual unit cost of additional firm supply is about $385/acft ($1.18/kgal) (Table 5.2.27-4). The cost for the ASR wells was externally calculated based on the recommendation of a consultant, Arcadis, as the 2021 Uniform Costing Model could have underestimated the cost for an ASR well by as much as 50 percent.

Table 5.2.27-4 Cost Estimate Summary

ITEM	ESTIMATED COSTS FOR FACILITIES
Well Fields (wells, pumps, and piping)	$27,023,000
TOTAL COST OF FACILITIES	**$27,023,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$9,458,000
Environmental and Archaeology Studies and Mitigation	$453,000
Interest During Construction (3% for 1 year with a 0.5% return on investment)	$1,017,000
TOTAL COST OF PROJECT	**$37,982,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,672,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$270,000
Pumping Energy Costs (1,245,025 kWh at 0.08 $/kWh)	$100,000
TOTAL ANNUAL COST	**$3,042,000**
Available Project Yield (acft/yr)	7,900
Annual Cost of Water ($ per acft)	$385
Annual Cost of Water After Debt Service ($ per acft)	$47
Annual Cost of Water ($ per 1,000 gallons)	$1.18
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.14
Based on a Peaking Factor of 1.0.	

5.2.27.5 Implementation Considerations

It will be necessary to obtain the following permits and authorizations:

- Because of recent legislation, amendments to Victoria's surface water rights to include aquifer storage authorizations are no longer required,
- TCEQ Class V injection permits for ASR wells, and
- Although ASR projects are not subject to regulation by the VCGCD, the design of all wells should be permitted according to VCGCD rules, and all injection and recovery water quality and hydraulic data should be reported to VCGCD. Additionally, as a precautionary method, TCEQ recommends obtaining appropriate GCD permits for all ASR wells if additional water is extracted from the well during cycle testing or normal operations.

Reliability

Successful ASR development is highly reliable (reliability score = 5). It is normally possible to achieve 90-95% recovery efficiency. Challenges to reliability include natural groundwater flow away from the ASR site and the associated drift of the storage bubble, thus reducing available supplies. Flat hydraulic gradients are not typical in Texas, especially in shallow aquifers. This migration of stored water is an important consideration in determining the reliability and viability of an ASR project. Also, since withdrawal of groundwater is a property right, competition with other nearby users could reduce the reliability of this water. One way to address the issue of other competing wells is to own the property rights over the storage bubble but that will drive up the strategy costs. If the water is recharged and recovered over a relatively short period (e.g., one year), the likelihood of reduced reliability is low. However, short-term ASR operations are highly dependent on the local aquifer hydrogeological features and that may impact reliability as well.

5.2.28 City of Victoria Groundwater-Surface Water Exchange

5.2.28.1 Description of Water Management Strategy

Historically, the City of Victoria (Victoria) has relied primarily on locally-available groundwater supplies withdrawn from the Gulf Coast Aquifer. To support continued growth, limit drawdowns in aquifer levels, and maintain water quality, Victoria obtained a surface water appropriation (P#5466) in the 1990s authorizing diversions of up to 20,000 acft/yr from the Guadalupe River. Subject to the senior water rights of others and special conditions requiring inflow passage for environmental protection, however, supplies available under P#5466 are severely limited during drought. Since the 1990s, Victoria has obtained six additional surface water rights senior in priority to P#5466 and totaling 7,007 acft/yr from willing sellers. Each of these rights has been amended to allow diversions for municipal uses at the same location as P#5466. Two of these water rights, totaling 4,939 acft/yr, include provisions for offset of surface water diversions with discharged groundwater during drought. This groundwater offset effectively firms up these previously interruptible surface water rights.

The City of Victoria Groundwater-Surface Water Exchange WMS involves potential amendment of additional Victoria surface water rights to authorize groundwater offset, thereby enhancing the firm surface water supply available to Victoria. Figure 5.2.28-1 shows the locations of the diversion pump station on the Guadalupe River, surface water treatment plant (SWTP), wells potentially used to firm up surface water rights through groundwater offset and/or conjunctive use, and the Guadalupe River tributary into which groundwater is discharged.

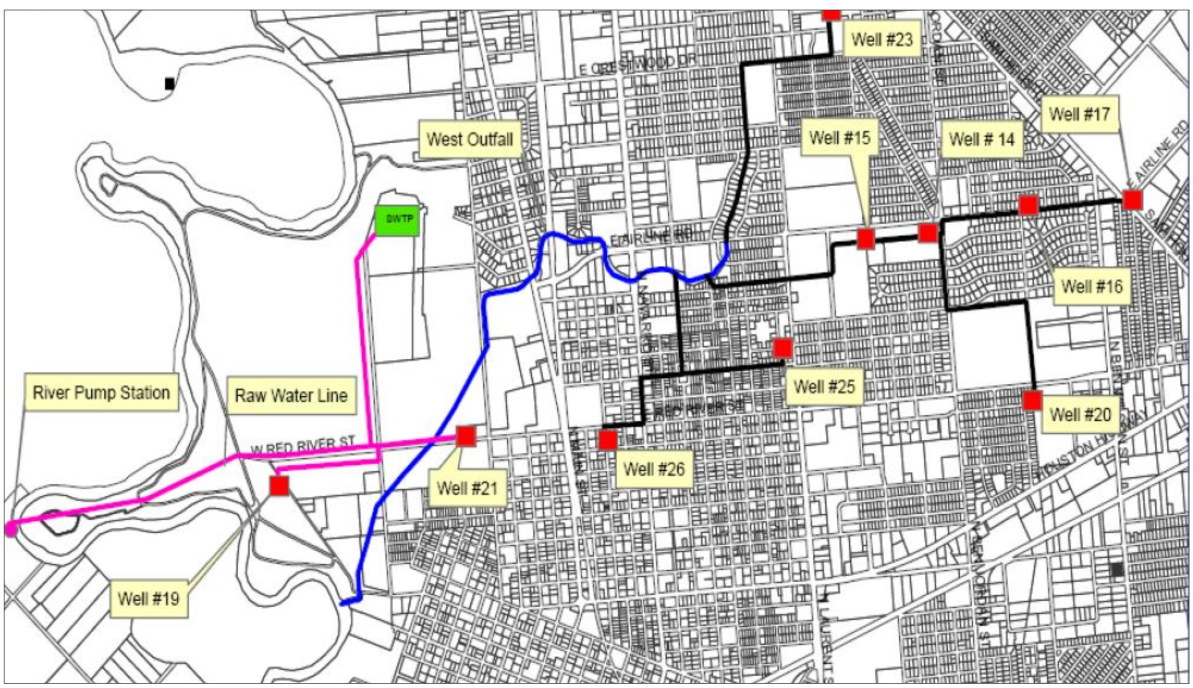

Figure 5.2.28-1 Facility Locations for Victoria Groundwater – Surface Water Exchange

5.2.28.2 Available Yield

As shown in evaluations of existing supply (Chapter 3) using the GSA WAM, firm supply available under Victoria's surface water rights is limited. Surface water rights totaling 27,007 acft/yr held by Victoria are summarized in Table 5.2.28-1. Among these rights, CA #18-3862 (as amended) and Permit (P) #3606 (as amended), totaling 4,939 acft/yr, include provisions for offset of surface water diversions with discharged groundwater during drought. Hence, Victoria has up to 22,068 acft/yr in additional surface water rights that could potentially be amended to authorize groundwater offset during drought. However, because of production capacity limitations, the firm yield is 8,544 acft/yr.

The tested capacities of and authorized annual production rates from Victoria wells potentially involved in the City of Victoria Groundwater-Surface Water Exchange WMS are summarized in Table 5.2.28-2. As detailed in this table, physical groundwater production capacity (27,081 acft/yr) slightly exceeds authorized surface water diversions on an annual basis. Production capacity authorized by the VCGCD for the listed wells, however, is limited to 8,544 acft/yr.

Recognizing that some water is available under Victoria's surface water rights during the drought year on record, it is understood that allocation of the full authorized groundwater production of 8,544 acft/yr to offset Victoria surface water diversions would enhance the firm supply available under those surface water rights by at least 8,544 acft/yr. This minimum amount is, therefore, the firm yield assigned to the Victoria Groundwater-Surface Water Exchange strategy in the 2021 SCTRWP. This WMS has a firm yield of 8,544 acft/yr and is planned for implementation beginning in the 2020 decade.

Table 5.2.28-1 Victoria Surface Water Rights

CA#/P#	PRIORITY DATE	ANNUAL DIVERSION (ACFT/YR)	MAXIMUM DIVERSION (CFS)
3844	8/16/1918	608	9.8
3858	6/27/1951	1,000	4.44
3860	8/15/1951	260	8.91
3862	12/12/1951	262.7	12.62
3606	7/10/1978	4,676	13.4
4117	4/2/1984	200	1.67
5466	5/28/1993	20,000	150
	Total	**27,006.7**	**200.84**

Table 5.2.28-2 Victoria Well Capacity and Authorized Production

WELL NO.	CAPACITY (GPM)	CAPACITY (CFS)	CAPACITY (ACFT/YR)	VICTORIA COUNTY GCD AUTHORIZED PRODUCTION (ACFT/YR)
14	1,560	3.48	2,516	825
15	2,100	4.68	3,387	1,158
16	1,557	3.47	2,511	1,344
17	1,529	3.41	2,466	285
19	500	1.11	807	664
20	1,538	3.43	2,481	623
21	2,090	4.66	3,371	639
23	1,830	4.08	2,952	333
25	1,705	3.80	2,750	1,264
26	2,380	5.30	3,839	1,408
Total	**16,789**	**37.41**	**27,081**	**8,544**

Water Loss

Strategies involving transfers of water rights are assumed to have no additional water losses associated with the use of existing infrastructure.

5.2.28.3 Environmental Considerations

Environmental Considerations

Potential environmental issues associated with this water management strategy are rather limited because the physical facilities and surface water and groundwater permits are already in place. Primary environmental concerns would likely be related to potential changes in surface water quality resulting from the offset discharge of groundwater. These concerns could be addressed by integration of special conditions in future surface water rights amendments to authorize groundwater offset similar to those included in amended CA#18-3862 and P#3606. Such special conditions include compliance with applicable water quality standards, weekly water quality monitoring of both groundwater discharged and the Guadalupe River upstream and downstream of the groundwater discharge, water sample analyses for multiple constituents, biotic and aquatic habitat sampling, and limitation of groundwater discharge to 33 percent of the flow in the river.

Vegetation and Land Use

The project area lies in both the Post Oak Savanah and Western Gulf Coastal Plain ecoregions and within mostly urban areas within Victoria, Texas. As mapped by TPWD[1], dominant vegetation types in the project area consist mostly of urban low and high intensity; these mapping categories reflect urban development and associated lawns and landscaping that are typically dominated by non-native vegetation. The project area also contains riparian vegetation, mapped by TPWD as floodplain grassland and floodplain hardwood forest, in riparian zones associated with the Guadalupe River.

Based on TPWD vegetation mapping, the project has the potential to impact 1 acre of agricultural resources mapped as row crops. The project proposes to utilize existing facilities and infrastructure; therefore, environmental vegetation, land use and agricultural impacts from construction are expected to be minimal. Existing project pipeline easements would continue to require long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Maintenance of easements and any required revegetation provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each water management strategy to determine the best course of action regarding revegetation.

Aquatic Resources

The project area includes unnamed, mapped streams and a diversion pump station on the Guadalupe River. NWI mapping shows approximately 2.5 acres of emergent, forested/shrub, and riverine wetlands in the project area.

No streams designated as impaired stream segments in the Texas Integrated Report of 303(d)-listed water bodies occur in the project area. This list identifies the water bodies or segments in Texas that do not meet assigned water quality standards. The Lower Guadalupe River within the project area is listed as an ecologically significant stream segment by TPWD.

Since the project will utilize existing facilities, no stream/wetland delineations or USACE permitting would be required.

Threatened, Endangered, and Species of Concern

Table 5.2.28-3 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Victoria County [2] [3]. Suitable habitat does not occur for any of the federally threatened or endangered species with the potential to occur in the project region.

Suitable habitat may occur for state-listed threatened species and numerous wildlife, plant, and insect species designated by TPWD as SGCN. These species do not have formal protected status but are being

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[1] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

[2] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Victoria County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[3] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Victoria County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.

monitored by TPWD. Migratory birds may occur in the project area, particularly in riparian zones and wetland areas. As summarized in Table 5.2.28-3, habitat and species impacts are expected to be minimal since the project will use existing infrastructure.

The Guadalupe River in the project area likely contains suitable habitat for federal candidate/state-threatened freshwater mussel species. Suitable habitat may occur in perennial rivers/streams and perennial pools of intermittent streams. No construction impacts are anticipated; however, as discussed in Section 5.2.28.3, potential changes in surface water quality resulting from the offset discharge of groundwater could affect native mussels downstream of the discharge location. Candidate mussel species may be listed as federally threatened or endangered during the project timeline; in which case, any species impacts would require USFWS consultation.

Table 5.2.28-3 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for Victoria Groundwater/Surface Water Exchange Project, Victoria County, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Black-spotted newt	*Notophthalmus meridionalis*	N/A	T	May be found in resacas and bodies of water with firm bottoms and little or no vegetation. Wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; the absence of predatory fish is probably important. Aestivates in the ground during dry periods; Gulf Coastal Plain south of the San Antonio River.	Suitable habitat does not occur within the project area.
Southern crawfish frog	*Lithobates areolatus*	N/A	SGCN	Found in abandoned crawfish holes and small mammal burrows, shallow water, herbaceous wetland, riparian, temporary pools, cropland/hedgerow, grassland/herbaceous, suburban/orchard, woodland – conifer.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Strecker's chorus frog	*Pseudacris streckeri*	N/A	SGCN	Wooded floodplains and flats, prairies, cultivated fields, and marshes. Likes sandy substrates.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Birds					
Attwater's greater prairie-chicken	*Tympanuchus cupido attwateri*	E	E	Open prairies of mostly thick grass 1 to 3 feet tall; sandhill country with bunch grass, sage, and shinnery oak. From near sea level to 200 feet along coastal plain on upper two-thirds of Texas coast.	Suitable habitat does not occur within the project area.
Bald eagle	*Haliaeetus leucocephalus*	N/A	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Low potential for suitable habitat in project area; may fly over the project area during migration and in the winter.
Black rail	*Laterallus jamaicensis*	PT	SGCN	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh.	Suitable habitat does not occur in project area; may fly over during migration.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes, may use fields and beaches during migration.	Suitable habitat does not occur in project area; may fly over during migration.
Interior least tern	*Sternula antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also known to nest on manmade structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Suitable habitat does not occur in project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat does not occur in project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur in project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	T	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Suitable habitat does not occur in project area; may fly over during migration.
Red knot	*Calidris canutus rufa*	T	SGCN	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays.	Suitable habitat does not occur in project area; may fly over during migration.
Swallow-tailed kite	*Elanoides forficatus*	N/A	T	Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge.	Suitable habitat does not occur in project area; may fly over during migration.
Tropical kingbird	*Tyrannus melancholicus*	N/A	SGCN	Open to semi-open habitat from savannahs to agricultural fields, also parks and neighborhoods.	Suitable habitat may occur in project area; may fly over during migration. The project will use existing facilities, and no new impacts are anticipated.
Tropical parula	*Setophaga pitiayumi*	N/A	T	Semi-tropical evergreen woodland along rivers and resacas.	Suitable habitat does not occur in project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs, may use open areas such as vacant lots, nests, and roosts in abandoned burrows.	Suitable wintering habitat may occur in the project area. The project will use existing facilities, and no new impacts are anticipated.
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat does not occur in project area; may fly over during migration.
White-tailed hawk	*Buteo albicaudatus*	N/A	T	Near coast on prairies, cordgrass flats, and scrub live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral.	Suitable habitat does not occur in project area; may fly over during migration.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems (during migration).	Suitable habitat does not occur in project area; may fly over during migration.
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Suitable foraging habitat does not occur in project area.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat does not occur in project area; may fly over during migration.
Fishes					

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Guadalupe darter	*Percina apristis*	N/A	SGCN	Endemic to the Guadalupe River basin; found in riffles; most common under or around 25 to 30 cm boulders in the main current; seems to prefer moderately turbid water.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Southern flounder	*Paralichthys lethostigma*	N/A	SGCN	Brackish bays, estuaries, and coastal waters to about 40 meter depth; move to deeper waters in winter.	Suitable habitat does not occur in project area.
Texas shiner	*Notropis amabilis*	N/A	SGCN	In Texas, it is found primarily in Edwards Plateau streams from the San Gabriel River in the east to the Pecos River in the west. Typical habitat includes rocky or sandy runs, as well as pools.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Insects					
A mayfly	*Tortopus circumfluus*	N/A	SGCN	Mayflies distinguished by aquatic larval stage; adult stage generally found in shoreline vegetation.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
A mayfly	*Tricorythodes curvatus*	N/A	SGCN	Arkansas, Oklahoma, Texas; mayflies distinguished by aquatic larval stage; adult stage generally found in bankside vegetation.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Comanche harvester ant	*Pogonomyrmex comanche*	N/A	SGCN	Barren or sparsely vegetated areas.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
No accepted common name	*Cotinis boylei*	N/A	SGCN	South Texas coastal plains.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls, will use buildings.	Suitable habitat may occur within project area; may use buildings/ structures. The project will use existing facilities, and no new impacts are anticipated.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat may occur within project area; may use buildings/ structures. The project will use existing facilities, and no new impacts are anticipated.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	Suitable habitat may occur within project area; may use buildings/ structures. The project will use existing facilities, and no new impacts are anticipated.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps and marshes.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Mountain lion	*Puma concolor*	N/A	SGCN	Wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Suitable habitat does not occur in project area.
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	SGCN	Open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Southern short-tailed shrew	*Blarina carolinensis*	N/A	SGCN	Various upland and wetland habitats, including moist deciduous woods, brushy areas, pine woodland and forest, mixed oak-pine-juniper woods, grassy situations, densely wooded floodplains. Nest sites are probably under logs, stumps, and other debris.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Restricted to dry and sandy soils of open areas, such as grasslands, cultivated fields, meadows, roadsides, airfields, shrublands, and suburb lawns.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat does not occur in project area.
White-nosed coati	*Nasua narica*	N/A	T	Canyons, riparian corridors, and woodlands.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Mollusks					

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
False spike	*Fusconaia mitchelli*	N/A	T	Medium to large rivers; present in Guadalupe, Colorado, and Brazos river basins.	Suitable habitat likely to occur in the Guadalupe River. Potential for impacts depends on maintaining water quality.
Golden orb	*Quadrula aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, lower San Marcos, and Nueces river basins.	Suitable habitat likely to occur in the Guadalupe River. Potential for impacts depends on maintaining water quality. This species was recently a federal candidate species, but its listing as federally threatened or endangered was not warranted as it is not a valid species.
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	N/A	SGCN	Endemic to sandy regions of southern and south-central Texas.	Suitable habitat does not occur in project area.
Coastal gay-feather	*Liatris bracteate*	N/A	SGCN	Coastal prairie grasslands of various types, from salty prairie on low-lying somewhat saline clay loams to upland prairie on nonsaline clayey to sandy loams.	Suitable habitat does not occur in project area.
Crestless onion	*Allium canadense var. ecristatum*	N/A	SGCN	Occurs on poorly drained sites on sandy substrates within coastal prairies of the Coastal Bend area.	Suitable habitat does not occur in project area.
Florida pinkroot	*Spigelia texana*	N/A	SGCN	Woodlands on loamy soils.	Suitable habitat does not occur in project area.
Heartleaf evening-primrose	*Oenothera cordata*	N/A	SGCN	Occurs in post oak woodlands on sandy soils on the coastal plain.	Suitable habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Indianola beakrush	*Rhynchospora indianolensis*	N/A	SGCN	Locally abundant in cattle pastures in some areas (at least during wet years), possibly becoming a management problem in such sites.	Suitable habitat does not occur in project area.
Jones's rainlilly	*Cooperia jonesii*	N/A	SGCN	Texas coastal bend, primarily low fields subject to seasonal inundation.	Project is outside of expected range of this species.
Shinner's sunflower	*Helianthus occidentalis ssp. plantagineus*	N/A	SGCN	Mostly in prairies on the Coastal Plain, with several slightly disjunct populations in the Pineywoods and South Texas Brush Country.	Suitable habitat does not occur in project area.
Texas peachbush	*Prunus texana*	N/A	SGCN	Occurs at scattered sites in various well drained sandy situations; deep sand, plains and sand hills, grasslands, oak woods, 0 to 200 meter elevation.	Suitable habitat may occur in project area.
Texas tauschia	*Tauschia texana*	N/A	SGCN	Occurs in loamy soils in deciduous forests or woodlands on river and stream terraces.	Suitable habitat may occur in project area.
Threeflower broomweed	*Thurovia trifloral*	N/A	SGCN	Near coast in sparse, low vegetation on a veneer of light-colored silt or fine sand over saline clay along drier upper margins of ecotone between salty prairies and tidal flats; further inland associated with vegetated slick spots on prairie mima mounds.	Suitable habitat does not occur in project area.
Two-flower stick-pea	*Calliandra biflora*	N/A	SGCN	Primarily in open areas on caliche outcrops or in shallow sandy soils over caliche.	Suitable habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Welder machaeranthera	*Psilactis heterocarpa*	N/A	SGCN	Grasslands, varying from midgrass coastal prairies, and open mesquite-huisache woodlands on nearly level, gray to dark gray clayey to silty soils; known locations mapped on Victoria clay, Edroy clay, Dacosta sandy clay loam over Beaumont and Lissie formations.	Suitable habitat does not occur in project area.
Wright's trichocoronis	*Trichocoronis wrightii var. wrightii*	N/A	SGCN	Most records from Texas are historical, perhaps indicating a decline as a result of alteration of wetland habitats.	Suitable habitat does not occur in project area.
Reptiles					
Cagle's map turtle	*Graptemys caglei*	N/A	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River system.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Common garter snake	*Thamnophis sirtalis*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Low likelihood of suitable habitat in project area.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Low likelihood of suitable habitat in project area.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable dune habitat does not occur in project area.
Massasauga	*Sistrurus tergeminus*	N/A	SGCN	Quite common in gently rolling prairie occasionally broken by creek valley or rocky hillside.	Low likelihood of suitable habitat in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Slender glass lizard	*Ophisaurus attenuatus*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannas, pine barrens, and oil fields.	Low likelihood of suitable habitat in project area.
Texas diamondback terrapin	*Malaclemys terrapin littoralis*	N/A	SGCN	Coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches; brackish and salt water; burrows into mud when inactive; may venture into lowlands at high tide.	Suitable aquatic habitat does not occur in project area.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Texas tortoise	*Gopherus berlandieri*	N/A	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus.	Low likelihood of suitable habitat in project area.
Timber rattlesnake	*Crotalus horridus*	N/A	T	Swamps, floodplains, upland pine, and deciduous woodland, riparian zones, abandoned farmland. Limestone bluffs, sandy soil, or black clay.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland, prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrows into soil or may use burrows made by other species.	Suitable habitat may occur within the project area; however, the project will use existing facilities, and no new impacts are anticipated.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
PT = Proposed Threatened T = Threatened E = Endangered C = Candidate N/A = Not applicable DL = Delisted SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC, the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the Project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[4] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified no previously recorded archaeological sites intersecting or immediately adjacent (within 300 feet) to the project area (THC 2019). The review identified seven OTHM, two cemeteries, and up to 18 potentially historic-age buildings intersecting or immediately adjacent to the project area (Table 5.2.28-4; THC 2019). No NRHP-listed properties are known to be near the project.

The model used assessed unrecorded archaeological site potential within the project area to include low to high potential zones, ranging from 4 percent to 100 percent likelihood for the landform crossed to contain unidentified archaeological resources. The areas with greatest archaeological probability are located near the landforms adjacent to existing drainages (e.g., Guadalupe River).

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As previously discussed, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 88.0. A high cultural resources assessment score equates to a greater likelihood that the project may potentially impact cultural resources as currently defined. However, for this project all activities are expected to be limited to existing facilities that would equate to little new land disturbance. In such situations the THC may approve the project based only on the submission of documentation. SWCA recommends that consultation be performed with the THC when the project facilities and activities are finalized to determine whether cultural resources field surveys are required for ACT and Section 106 regulatory compliance.

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[4] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

Table 5.2.28-4 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/HISTORIC	NRHP ELIGIBILITY	LOCATION
Cunningham, Abel Seymour	OTHM #6537	Historic	Unknown	Adjacent
January, Captain James P.	OTHM #6553	Historic	Unknown	Adjacent
Rose, Victor Marion	OTHM #6561	Historic	Unknown	Adjacent
Stapp, Darwin M.	OTHM #6569	Historic	Unknown	Adjacent
Van Bibber, John	OTHM #6574	Historic	Unknown	Adjacent
Weisiger, Sidney Roper	OTHM #6579	Historic	Unknown	Adjacent
Weisiger, Robert S.	OTHM #6580	Historic	Unknown	Adjacent
Evergreen	Cemetery	Historic	Unknown	Adjacent
Unknown	Cemetery	Historic	Unknown	Adjacent
None	18 Buildings	Historic	Unknown	Adjacent or Intersect
			ASSESSMENT SCORE TOTAL	**88.0**

5.2.28.4 Engineering and Costing

A cost estimate is not provided for this water management strategy because the physical facilities and surface water and groundwater permits are already in place. Although some costs would be incurred in amending additional surface water rights for groundwater offset and complying with special conditions potentially included therein, water supply operations costs are avoided by elimination of process changes at the WTP and flushing of the distribution system associated with periodic switching between surface water and groundwater sources.

5.2.28.5 Implementation Issues

Facility issues are limited because the physical facilities are already in place. However, the WMS requires the amendment of additional Victoria surface water rights to authorize groundwater offset.

Reliability

The reliability of this supply is considered medium (reliability score = 3) because of uncertainty involved with obtaining necessary water rights amendments.

5.2.29 SS WSC Brackish Wilcox Groundwater Project

5.2.29.1 Description of Water Management Strategy

The SS WSC Brackish Wilcox Groundwater Project was a recommended WMS in the 2016 SCTRWP. It includes development of a 1,120 acft/yr brackish groundwater supply from the Carrizo-Wilcox Aquifer in Wilson County to meet the needs of SS WSC. It is designed to produce an average annual water supply of 1.0 mgd and a peak demand of 2.0 mgd. The facilities of the project are planned to be located in the vicinity of SS WSC's Sutherland Springs Road Plant, which is located approximately 3 miles west-northwest of the town of Sutherland Springs. The facilities include Carrizo-Wilcox Aquifer wells to provide a brackish groundwater supply, water treatment plant for pretreatment and desalination, delivery of treated water to the existing distribution system, and concentrate disposal to a deep injection well. The location of the project is shown on Figure 5.2.29-1.

This strategy builds on a preliminary assessment of potential brackish groundwater supplies from the Carrizo-Wilcox Aquifer in a target area that is generally a 10 to 20 mile wide band that is south of Interstate 10 and between Loop 410 and Seguin[1]. The study and a summary of the findings are briefly discussed in the following section.

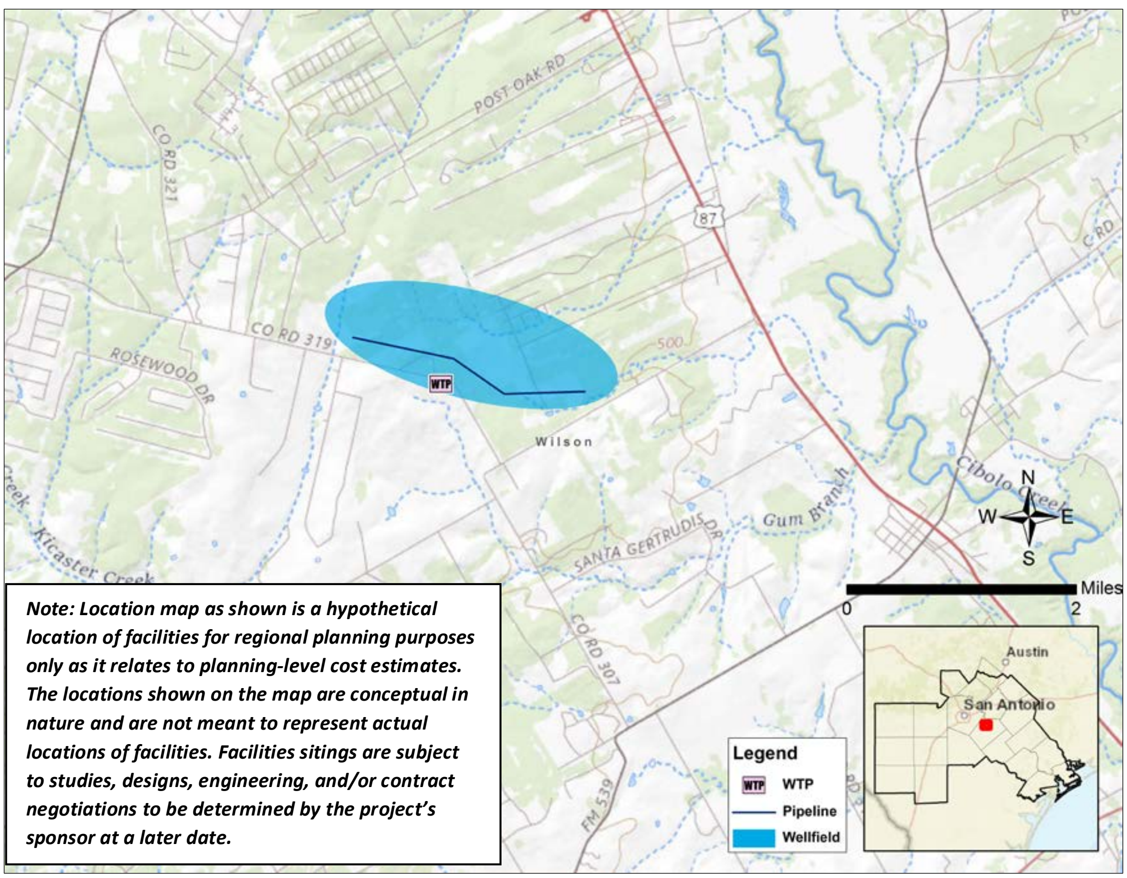

Figure 5.2.29-1 Approximate Location of SS WSC Brackish Wilcox Groundwater Project

[1] HDR Engineering, Inc, February 2008, Preliminary assessment of potential water supplies from the Wilcox Aquifer in parts of Bexar, Guadalupe, and Wilson Counties: Prepared for San Antonio River Authority.

5.2.29.2 Available Yield

Groundwater production and well spacing in the Carrizo-Wilcox Aquifer are regulated by the Evergreen Underground Water Conservation District. In November 2016, GMA-13 established the DFC for the Carrizo-Wilcox, Queen City Sparta Aquifer[2]. Based on the approved DFC, TWDB has determined that the MAG for 2070 in the Carrizo-Wilcox Aquifer is 111,093 acft/yr for Wilson County[3].

Based on the results from the earlier study and for planning purposes, a typical Carrizo-Wilcox Aquifer well in this location is expected to be about 1,100 ft deep, yield about 750 gpm, and produce water with a TDS concentration of about 1,200 mg/L. This WMS has a firm yield of 1,120 acft/yr[4] and is considered for implementation beginning in the 2060 decade.

Water Loss

Brackish groundwater desalination strategies include water loss associated with desalination treatment technologies and disposal of brine concentrate. This brackish groundwater desalination WMS has a calculated percent water loss of 10%.

5.2.29.3 Environmental and Cultural Considerations

Environmental Considerations

Vegetation and Land Use

The project area occurs in the Post Oak Savannah ecoregion, with the majority of the project area mapped as savannah grassland by TPWD;[5] the project area is mostly open fields that contain little woody vegetation.

Based on TPWD vegetation mapping, the project may have the potential to impact 125 acres of agricultural resources, including 48 acres mapped as row crops and 77 acres mapped as tame/disturbance grassland that may be used for grazing or hay production.

The proposed well pads and treatment facility would result in conversion of land use from undeveloped fields and agricultural areas to small areas of industrial use. Project pipeline easements would require removal of woody vegetation and long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each WMS to determine the best course of action regarding revegetation. Pipeline easements may continue to be used for agricultural purposes.

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[2] Wade, S.C. 2017. GAM Run 17-027 MAG: Modeled Available Groundwater for the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson Aquifers in Groundwater Management Area 13: Texas Water Development Board.

[3] http://www.twdb.texas.gov/groundwater/dfc/docs/summary/GMA13_MAG_2016b.pdf?d=52712.51999999731

[4] This project is limited by the MAG. For purposes of this WMS and DB22, it is assumed that SS WSC will utilize the "SS WSC Brackish Carrizo-Wilcox Groundwater (GW Conversion)" WMS to secure the remaining supplies for the project.

[5] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

Aquatic Resources

The project area does not contain mapped streams, ponds, or wetlands. The project would not affect impaired stream segments as defined by TCEQ or ecologically significant stream segments as designated by TPWD. Based on the current configuration, the project is not expected to require stream/wetland delineation or USACE permitting.

Threatened, Endangered, and Species of Concern

Table 5.2.29-1 provides a summary of threatened, endangered and candidate species and species of concern that have potential to occur in Wilson County.[6,7] It should be noted that the county species lists are current as of August 9, 2019, but may be updated as new species information becomes available. Suitable habitat does not occur for any of the federally listed species. Suitable habitat may occur for the state-listed threatened species Texas horned lizard (*Phrynosoma cornutum*) and Texas tortoise (*Gopherus berlandieri*). Potentially suitable habitat may occur for two species of concern: Strecker's chorus frog (*Pseudacris streckeri*) and Woodhouse's toad (*Anaxyrus woodhousii*). These species do not have formal protected status but are being monitored by TPWD. Migratory birds, particularly ground nesting species, may occur in the project area.

Since suitable habitat does not occur for federally-listed threatened or endangered species, consultation with the USFWS would not be required. Site-specific field surveys would be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain their recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request pre-construction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15.

Table 5.2.29-1 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for SS WSC, Wilson County, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Strecker's chorus frog	*Pseudarcris streckeri*	N/A	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Suitable habitat may occur in wetland areas along pipeline alignment and well pad sites.

[6] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Wilson County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[7] US Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Wilson County. https://ecos.fws.gov/ipac/location/FX45LGWSGVBZLJHV4APLVP7LU4/resources.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur in wetland areas along pipeline alignment and well pad sites.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Unlikely to occur within project area; may fly over during migration.
Black rail	*Laterallus jamaicensis*	PT	SGCN	Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh.	Unlikely to occur within project area; may fly over during migration.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur within project area; may fly over during migration.
Interior least tern	*Sterna antillarum athalassos*	LE	E	Nests along sand and gravel bars within braided streams, rivers; also know to nest on manmade structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Unlikely to occur within project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable breeding habitat does not occur within project area; may fly over during migration.
Piping plover	*Charadrius melodus*	LT	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur within project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	T	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Swallow-tailed kite	*Elanoides forficatus*	N/A	SGCN	Lowland forest, especially swampy areas, ranges to open woodland; marshes, along rivers, lakes, and ponds. Nests high in tall trees in clearing or on forest woodland edge, usually pine, cypress, or deciduous trees.	Suitable habitat does not occur within project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs, may use open areas such as vacant lots, nests, and roosts in abandoned burrows.	Suitable open habitats may occur in the project area along the pipeline and well field sites.
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Unlikely to occur within project area; may fly over during migration.
Whooping crane	*Grus americana*	LE	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems [during migration].	Suitable habitat does not occur within project area; may fly over during migration.
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Unlikely to occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat does not occur within project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Fishes					
River darter	*Percina shumardi*	N/A	SGCN	Large rivers and lower part of tributaries; deep chutes and riffles where current is swift and bottom is coarse gravel or rock.	Suitable habitat does not occur within project area.
Insects					
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in the project area along the pipeline alignment and well field sites.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Potential to occur in sandy areas of the pipeline alignment and well field sites.
Big brown bat	*Eptesicus fuscus*	N/A	SGCN	Woodlands or wooded areas.	May possibly occur within woodlands along the pipeline alignment and well field sites.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls but will use buildings.	May possibly occur within woodlands along the pipeline alignment and well field sites.
Cave myotis bat	*Myotis velifer*	N/A	SGCN	Cave-dwelling, also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	Suitable habitat does not occur within project area.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	May possibly occur within woodlands along the pipeline alignment and well field sites.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges, and woodlands. Prefer wooded, brushy areas; tallgrass prairies.	May occur within woodlands along the pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	May possibly occur within woodlands along the pipeline alignment and well field sites.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	May possibly occur within along the pipeline alignment and well field sites.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	May forage along portions of the pipeline alignment and well field sites.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Unlikely to occur within project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Use wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Very low potential to occur as a vagrant along pipeline alignment and wells sites.
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	SGCN	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur along pipeline alignment and well field sites.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Very low potential to occur in wetland/riparian areas along the pipeline alignment and well field sites.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Prefer short-grass prairies; also occur in pastures and along fencerows. Excavate burrows or use abandoned pocket gopher or prairie dog burrows.	Suitable habitat may occur along pipeline alignment and well field sites.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat may occur along pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat may occur along pipeline alignment and well field sites.
Western spotted skunk	*Spilogale gracilis*	N/A	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur along pipeline alignment and well field sites.
White-nosed coati	*Nasua narica*	N/A	T	Canyons, riparian corridors, and woodlands.	Project area is outside the expected range of this species.
Mollusks					
Golden orb	*Cyclonaias aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Suitable habitat does not occur within project area.
No accepted common name	*Cyclonaias necki*	N/A	N/A	Guadalupe River basin; moderate to large streams with flowing water.	Suitable habitat does not occur within project area.
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	N/A	SGCN	Habitat description is not available at this time.	Suitable sandy habitats may occur along pipeline alignment and well field sites.
Big red sage	*Salvia pentstemonoides*	N/A	SGCN	Moist to seasonally wet, steep limestone outcrops on seeps within canyons or along creek banks.	Not expected to occur in project area.
Bigflower cornsalad	*Valerianella stenocarpa*	N/A	SGCN	Usually along creekbeds or in vernally moist grassy open areas.	Suitable habitat may occur along pipeline alignment and well field sites.
Bristle nailwort	*Paronychia setacea*	N/A	SGCN	Endemic to eastern southcentral Texas, occurring in sandy soils.	Suitable sandy habitats may occur along pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Burridge greenthread	*Thelesperma burridgeanum*	N/A	SGCN	Sandy open areas.	Suitable sandy habitats may occur along pipeline alignment and well field sites.
Drummond's rushpea	*Caesalpinia drummondii*	N/A	SGCN	Open areas on sandy clay.	Suitable sandy habitats may occur along pipeline alignment and well field sites.
Elmendorf's onion	*Allium elmendorfii*	N/A	SGCN	Grassland openings in oak woodlands on deep, loose, well-drained sands; to the north it occurs in post oak-black hickory-live oak woodlands over Queen City and similar Eocene formations.	Suitable habitat likely occurs along pipeline alignment and well field sites.
Heartleaf evening primrose	*Oenothera cordata*	N/A	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Suitable habitat may occur along pipeline alignment and well field sites.
Low spurge	*Euphorbia peplidion*	N/A	SGCN	Occurs in a variety of vernally moist habitats in a number of natural regions.	Suitable habitat may occur along pipeline alignment and well field sites.
Net-leaf bundleflower	*Desmanthus reticulatus*	N/A	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat may occur along pipeline alignment and well field sites.
Parks jointweed	*Polygonella parksii*	N/A	SGCN	Mostly on deep, loose, whitish sand blowouts (unstable, deep, xeric, sandhill barrens) in Post Oak savannah landscapes over the Carrizo and Sparta formations; also occurs in early successional grasslands, along rights-of-way and on mechanically disturbed areas.	Suitable habitat may occur along pipeline alignment and well field sites.
Texas beebalm	*Monarda viridissima*	N/A	SGCN	Endemic perennial herb of the Carrizo Sands; deep, well-drained sandy soils in openings of post oak woodlands.	Suitable habitat may occur along pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas peachbush	*Prunus texana*	N/A	SGCN	Occurs at scattered sites in various well drained sandy situations; deep sand, plains and sand hills, grasslands, oak woods.	Suitable habitat may occur along pipeline alignment and well field sites.
Wright's trichocoronis	*Trichocoronis wrightii var. wrightii*	N/A	SGCN	Riparian zones, wetlands, pond margins, wet meadows.	Suitable habitat may occur along pipeline alignment and well field sites.
Reptiles					
American alligator	*Alligator mississippiensis*	N/A	SGCN	Inland natural rivers, swamps, marshes, coastal marshes, and manmade impoundments.	Suitable habitat does not occur within project area.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur along pipeline alignment and well field site.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat may occur along pipeline alignment and well field site.
Slender glass lizard	*Ophisaurus attenuates*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannahs, pine barrens, and oil fields.	Suitable sandy habitats likely occur along pipeline alignment and well field sites.
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	N/A	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat may occur along pipeline alignment and well field sites.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur along pipeline alignment and well field sites.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas tortoise	*Gopherus berlandieri*	N/A	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus.	Suitable habitat may occur along pipeline alignment and well field sites.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrows into soil or may use burrows made by other species.	Suitable habitat may occur along pipeline alignment and well field sites.
T = Threatened E = Endangered C = Candidate DL = Delisted N/A = Not applicable SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC, the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the Project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[8] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

No recorded cultural resources were identified within or adjacent (within 300 feet) to the project area. The model used assessed the overall archaeological potential within the project area to be low, ranging from 8 percent to 17 percent likelihood for the project area to contain significant unidentified archaeological resources. The greatest probability areas were designated adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 11. Based on the results of the background review, a structured cultural resources survey of the final design plan is recommended to assess the presence and significance of cultural resources within its boundaries.

[8] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

5.2.29.4 Engineering and Costing

Preliminary engineering and costing analyses have been performed for both the production and injection well fields using 2021 Regional Water Planning methods. For Region L, Black & Veatch used the Uniform Costing Tool, which includes standard costing procedures and unit costs. The facilities for this project will be located in the vicinity of SS WSC's Sutherland Springs Road Plant. The brackish well field will consist of three wells located along CR 319, spaced approximately 1 mile apart. The desalination water treatment plant will be collocated at SS WSC's existing water plant. The disposal well for the brine concentrate is planned to be in the general area of the desalination plant. A raw water collector pipeline will deliver brackish Carrizo-Wilcox Aquifer water from the wells to the water treatment plant. Water treatment will consist of pretreatment and desalination. A treated water pipeline and booster pump station would deliver water to the Sutherland Springs Road Plant. A concentrate water pipeline would deliver reject water to a ground storage tank. A small pump and a pipeline will transport the concentrate to a new, deep injection well. The system is designed to provide an annual average 1.0 mgd (1,120 acft/yr) and to meet a peak day demand of 2.0 mgd.

The engineering and costing analysis for SS WSC Brackish Wilcox Groundwater Project includes all facilities required for water production from the Carrizo-Wilcox Aquifer, including wells, collector pipeline, water treatment, treated water pipeline and pump stations, and disposal of concentrate to deep injection wells. The well field consists of three brackish water supply wells, 2 miles of collector pipelines with a diameter of 12 inches. Water treatment will consist of pretreatment and desalination. Pretreatment will include filtration and possibly other processes to remove particulates such as iron or manganese and to condition the water for optimal desalination. RO technology is the planned method for desalination. The treated water facilities consist of a short 12 inch diameter transmission pipeline, a pump station, and integration into the existing distribution system. A concentrate disposal well, ground storage tank, pipelines, and facilities are planned near the Sutherland Springs Road Plant. The target disposal of the concentration will be deep well injection into depleted or partially depleted oil and gas producing reservoirs (Austin Chalk or Edwards Limestone).

The required secondary MCL for TDS is 1,000 mg/L. The design of the water treatment facilities is to produce potable water with a TDS concentration of about 400 to 500 mg/L. The preliminary water treatment design includes: (1) pretreatment of all raw water; (2) about 60 percent of this water will be sent to the desalination water treatment plant; and (3) the remaining 40 percent will be blended with the desalinated water. The desalination plant recovery rate using conventional RO with raw water having a TDS of about 1,200 mg/L is estimated to be 85 percent, meaning that 85 percent of the water entering the desalination plant becomes purified water and 15 percent of the water remains as concentrated brine. The desalinated water and the treated brackish water are blended to produce treated water with a TDS of about 480 mg/L. This process converts about 90 percent of the quantity of raw water produced from the well field into potable water. The remaining 10 percent is a concentrate and is discharged to a deep injection well.

Cost estimates were computed for capital costs, annual debt service, O&M, power, land, and environmental mitigation for seasonal and peak day demands. These costs are summarized in Table 5.2.29-2. Treatment costs are for removal of iron, manganese, and desalination. The project costs, including capital, are estimated to be $20,384,000. As shown, the annual costs, including debt service, O&M, power, and groundwater leases, are estimated to be $3,260,000. This option produces potable water at an estimated cost of $2,911 per acft/yr.

Table 5.2.29-2 Cost Estimate Summary

ITEM	ESTIMATED COSTS
Transmission Pipeline (12 in. diameter, 2 miles)	$29,000
Transmission Pump Station(s) and Storage Tank(s)	$1,262,000
Well Fields (wells, pumps, and piping)	$6,282,000
Two Water Treatment Plants (2.2 mgd and 1.4 mgd)	$6,890,000
Integration, Relocations, and Other	$112,000
TOTAL COST OF FACILITIES	**$14,575,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$5,100,000
Environmental & Archaeology Studies and Mitigation	$95,000
Land Acquisition and Surveying (67 acres)	$68,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$546,000
TOTAL COST OF PROJECT	**$20,384,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,434,000
Operations and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$74,000
Intakes and Pump Stations (2.5% of cost of facilities)	$8,000
Water Treatment Plant	$1,620,000
Pumping Energy Costs (392,273 kWh at 0.08 $/kWh)	$31,000
Purchase of Water (1,120 acft/yr at 83.71 $/acft)	$93,000
TOTAL ANNUAL COST	**$3,260,000**
Available Project Yield (acft/yr)	1,120
Annual Cost of Water ($ per acft)	$2,911
Annual Cost of Water After Debt Service ($ per acft)	$1,630
Annual Cost of Water ($ per 1,000 gallons)	$8.93
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$5.00
Based on a Peaking Factor of 2.	

5.2.29.5 Implementation Considerations

Information presented in this WMS was provided by SS WSC and represents the current plan, which is based on the sponsor's current understanding of the system. Implementation of the SS WSC Brackish Wilcox Groundwater Project WMS includes the following considerations:

- Verification of available groundwater quantity and well productivity;
- Verification of water quality for concentrations of dissolved constituents, such as TDS, chloride, sulfate, iron, manganese and hydrogen sulfide;
- Verification of the potential for deep well injection of concentrate;
- Verification that desalinated Carrizo-Wilcox Aquifer water is compatible with other water sources being used by customers and will meet all water quality requirements in the end user's distribution system;
- Potential for differing water qualities/chemical constituents in the water;
- Potential adverse impacts on other aquifers, including potential interaction between the Wilcox and Carrizo formations (additional research regarding potential interaction between the Wilcox and Carrizo formations has been suggested);
- Permitting Class 1 disposal wells for deep well injection of desalination concentrate through TCEQ General Permit;
- Regulations by TCEQ;
- Regulations by and securing permits from the Evergreen Underground Water Conservation District; and
- Experience in operating and maintaining a desalination water treatment plant.

Additional considerations may include the following:

- Impacts on the following:
  - Endangered and threatened species;
  - Water levels in the aquifer, including potential dewatering of the current artesian part of the aquifer;
  - Baseflow in streams; and
  - Wetlands.
- Competition with others in the area for groundwater in the Carrizo Aquifer to include the following:
  - Private water purveyors,
  - Public water purveyors in the area, and/or
  - Future oil and gas drilling operations.

Reliability

Water from these sources is considered to be very reliable based on earlier studies. Supply is considered to be medium because of the potential of differing well productivity and water quality, potential impacts to natural resources and Carrizo Aquifer user competition. Blending of Carrizo-Wilcox aquifer water is as reliable as the fresh water source (reliability score = 4).

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5.2.30 Martindale WSC Alluvial Well

5.2.30.1 Description of Water Management Strategy

Martindale WSC plants to add a well in the quaternary alluvium near the San Marcos River. This project is projected for the 2030 decade and will have a firm yield of 240 acft/yr. The new source of water for Martindale WSC will be delivered to the existing WTP across the San Marcos River. The general location is anticipated to be near the San Marcos River in Guadalupe County (Figure 5.2.30-1).

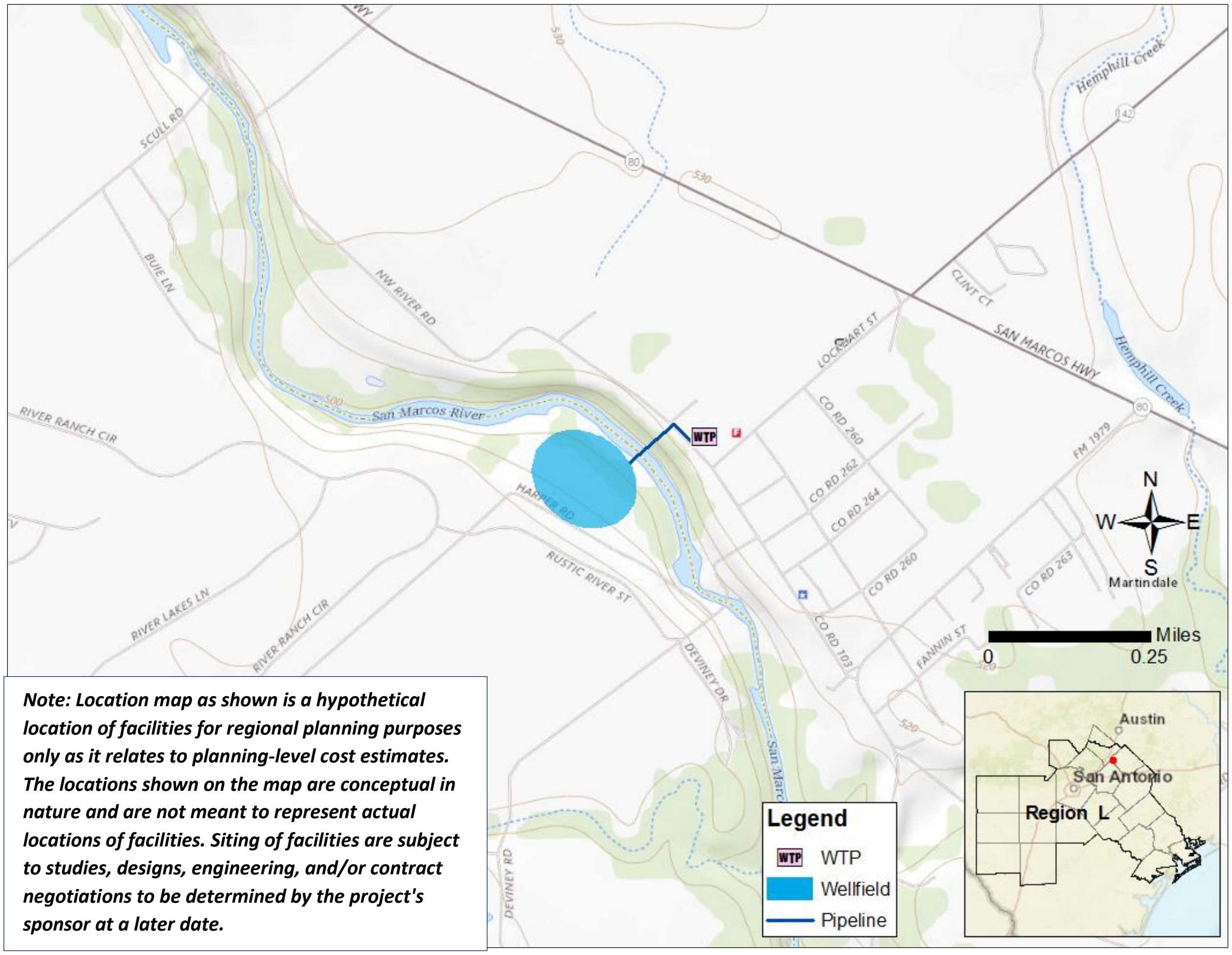

Figure 5.2.30-1 Location of Martindale WSC Alluvial Well Project

5.2.30.2 Available Yield

The project consists of one alluvial well with a pumping capacity of 150 gpm. The following assumptions were made for planning purposes: the well will have a depth of approximately 50 feet; and the water is anticipated to have a TDS of 500 mg/L. However, the alluvial aquifer materials are not laterally extensive, often highly heterogenous, and limited data are available. Test hole drilling and evaluation are recommended prior to well installation to determine site-specific aquifer properties and water quality. This WMS has a firm yield of 240 acft/yr and is planned for implementation beginning in the 2030 decade.

5.2.30.3 Environmental Considerations

Environmental Considerations

Vegetation and Land Use

The project area is located in the Blackland Prairie ecoregion within two vegetation types: open field and riparian zone along the San Marcos River. As mapped by TPWD[1], dominant vegetation types in the project area are disturbance/tame grassland within the well field site and floodplain hardwood forest and floodplain herbaceous vegetation within both the well field site and pipeline crossing the San Marcos River.

Based on TPWD vegetation mapping, the project would not affect area mapped as row crops, but has the potential to impact 4 acres of agricultural resources mapped as tame/disturbance grassland that may include pasture areas used for grazing or hay production.

Project pipeline easements would require removal of woody vegetation and long-term maintenance (mowing and woody vegetation clearing) to maintain easement access, including in riparian zones along the San Marcos River. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each water management strategy to determine the best course of action regarding revegetation. Pipeline easements may continue to be used for agricultural purposes.

Aquatic Resources

The project pipeline alignment crosses the San Marcos River and its associated floodplain within the central portion of the project area. There are no other stream or wetland crossings within the project area. The NWI mapping shows approximately 0.9 acre of mapped riverine features (San Marcos River) in the project area. The NWI does not map any ponds, lakes, or wetlands within the project area.

The project pipeline crosses Segment 1808 of the San Marcos River. This stream segment has been designated as an impaired stream segment in the Texas Integrated Report of 303(d) listed water bodies[2]. This list identifies the water bodies or segments in Texas that do not meet assigned water quality standards.

The project will require an on-site delineation of streams, ponds, and wetlands. Stream crossings for pipeline construction would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including cases where

[1] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

[2] Texas Commission on Environmental Quality. 2018. 2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf.

there would be permanent impacts to over 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under streams/rivers (e.g., through horizontal directional drilling) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

Table 5.2.30-1 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Caldwell and Guadalupe Counties [3] [4] [5] [6]. Suitable habitat does not occur for any of the federally listed species with the potential to occur in the project region. However, several freshwater mussel species are under review for federal listing as threatened or endangered, and the project pipeline crosses the San Marcos River, which may provide suitable habitat for freshwater mussels.

Suitable habitat may occur for several state-listed threatened species, including Texas horned lizard (*Phrynosoma cornutum*) and timber rattlesnake (*Crotalus horridus*). Potentially suitable habitat may occur for numerous state fish, wildlife, plant, and insect species designated by TPWD as SGCN. These species do not have formal protected status but are being monitored by TPWD. Migratory birds may occur in the project area, particularly in riparian zones.

The San Marcos River in the project area may contain suitable habitat for federal candidate/state threatened freshwater mussel species. Suitable habitat may occur in perennial rivers/streams and perennial pools of intermittent streams. If any such habitat would be affected by construction, presence/absence surveys and relocation of native mussel species would be required. Handling and relocation of mussels and other aquatic species must be conducted by TPWD-permitted personnel and in accordance with an approved Aquatic Resources Relocation Plan. Furthermore, these candidate species may be listed as federally threatened or endangered during the project timeline, in which case any species impacts would require USFWS consultation.

Site-specific field surveys would be required to determine the quality of habitat for state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD will likely be required to obtain its recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

The federal MBTA protects birds, nests, and eggs from impacts unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct

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[3] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Caldwell County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.
[4] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Caldwell County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.
[5] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Guadalupe County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.
[6] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Guadalupe County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.

preconstruction nest surveys or to avoid vegetation clearing during the general bird nesting season from March 15 to September 15. Preconstruction surveys for active bird nests are recommended.

Table 5.2.30-1 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for the Martindale WSC Alluvial Well Project; Caldwell and Guadalupe Counties, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Houston toad	*Anaxyrus houstonensis*	E	E	Sandy soils near ephemeral pools and populations of loblolly pine.	Project is outside of the expected range of this species.
San Marcos salamander	*Eurycea nana*	T	T	Headwaters of the San Marcos River downstream to about 0.5 mile past IH 35.	Project is outside of the expected range of this species.
Strecker's chorus frog	*Pseudarcris streckeri*	N/A	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Suitable habitat may occur within project area.
Texas blind salamander	*Eurycea rathbuni*	E	E	Water-filled subterranean caverns along 6 miles of the San Marcos Spring Fault.	Project is outside of the expected range of this species.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur within project area.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	N/A	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat may occur along the San Marcos River; may fly over during migration.
Black rail	*Laterallus jamaicensis*	PT	SGCN	Salt, brackish, and freshwater marshes; pond borders; wet meadows; and grassy swamps. Nests in or along edge of marsh.	Suitable habitat may occur within project area; may fly over during migration.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes; may use fields and beaches during migration.	Suitable habitat does not occur within project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also known to nest on manmade structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Unlikely to occur within project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie; feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat may occur within project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur in project area; may fly over during migration.
Reddish egret	*Egretta rufescens*	N/A	T	Brackish marshes, shallow salt ponds, and tidal flats along Texas Gulf Coast; nests on dry coastal islands.	Suitable habitat does not occur in project area; may fly over during migration.
Red knot	*Calidris canutus rufa*	T	SGCN	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays.	Suitable habitat does not occur in project area; may fly over during migration.
Swallow-tailed kite	*Elanoides forficatus*	N/A	T	Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge.	Unlikely to occur within project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots; nests and roosts in abandoned burrows.	Suitable wintering habitat may occur in project vicinity; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat may occur in project vicinity; may fly over during migration.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems (during migration).	Suitable habitat does not occur in project area; may fly over during migration.
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Unlikely to occur within project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat may occur along the San Marcos River; may fly over during migration.
Fishes					
American eel	*Anguilla rostrate*	N/A	SGCN	Coastal waterways below reservoirs.	May occur in the San Marcos River.
Fountain darter	*Etheostoma fonticola*	E	E	San Marcos and Comal Rivers; springs and spring-fed streams with dense beds of aquatic plants.	Project is outside of the expected range of this species.
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat may occur within project area.
Guadalupe darter	*Percina apristis*	N/A	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Headwater catfish	*Ictalurus lupus*	N/A	SGCN	Limited to Rio Grande drainage; springs with sandy and rocky riffles, pools of clear creeks, runs, and small rivers.	Project is outside of the expected range of this species.
Plateau shiner	*Cyprinella lepida*	N/A	SGCN	Edwards Plateau portion of the Nueces basin; cool, clear, spring-fed headwater creeks.	Suitable habitat may occur within project area.
Texas shiner	*Notropis amabilis*	N/A	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Suitable habitat may occur within project area.
Insects					
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in project area.
Comanche harvester ant	*Pogonomyrmex comanche*	N/A	SGCN	Barren, sparse vegetation.	Suitable habitat may occur in project area.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur within project area.
Aransas short-tailed shrew	*Blarina hylophaga plumbea*	N/A	SGCN	Excavates burrows in sandy soils underlying mottes of live oak trees or in areas with little to no ground cover.	Suitable habitat may occur within project area.
Big brown bat	*Eptesicus fuscus*	N/A	SGCN	Woodlands or wooded areas.	Suitable habitat may occur within project area.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls; will use buildings.	Suitable habitat may occur within project area.
Black-tailed prairie dog	*Cynomys ludovicianus*	N/A	SGCN	Dry, flat, short grasslands with low, relatively sparse vegetation, including areas overgrazed by cattle.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Cave myotis bat	*Myotis velifer*	N/A	SGCN	Cave-dwelling; also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	Suitable habitat may occur within project area.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat may occur within project area.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, and forest edges.	Suitable habitat may occur within project area.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Suitable habitat may occur within project area.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur within project area.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	Suitable habitat may occur within project area; may use buildings/ structures.
Mexican long-tongued bat	*Choeronycteris Mexicana*	N/A	SGCN	Riparian forest in Texas; roost in mines, large crevices, and caves.	Suitable habitat may occur within project area.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Suitable habitat may occur within project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Low potential for suitable habitat to occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	N/A	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur within project area.
Southern short-tailed shrew	*Blarina carolinensis*	N/A	SGCN	Various upland and wetland habitats, including moist deciduous woods, brushy areas, pine woodland and forest, and mixed oak-pine-juniper woods.	Suitable habitat may occur within project area.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Suitable habitat may occur within project area.
Thirteen-lined ground squirrel	*Ictidomys tridecemlineatus*	N/A	SGCN	Restricted to dry and sandy soils of open areas, such as grasslands, cultivated fields, meadows, roadsides, airfields, shrublands, and suburb lawns.	Suitable habitat may occur within project area.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Suitable habitat may occur within project area.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Suitable habitat may occur within project area.
Western spotted skunk	*Spilogale gracilis*	N/A	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur within project area.
White-nosed coati	*Nasua narica*	N/A	T	Canyons, riparian corridors, and woodlands.	Project area is outside the expected range of this species.
Mollusks					
False spike	*Fusconaia mitchelli*	N/A	T	Medium to large rivers; present in Guadalupe, Colorado, and Brazos river basins.	Suitable habitat may occur in San Marcos River.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Golden orb	*Cyclonaias aurea*	N/A	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Suitable habitat may occur in San Marcos River. This species was recently a federal candidate species but its listing as federally threatened or endangered was not warranted.
No accepted common name	*Millerelix gracilis*	N/A	SGCN	Terrestrial snail; Edwards Plateau.	Project area is outside the expected range of this species.
No accepted common name	*Cyclonaias necki*	N/A	SGCN	Guadalupe River basin; moderate to large streams with flowing water.	Suitable habitat may occur in San Marcos River.
Texas fatmucket	*Lampsilis bracteata*	C	T	Colorado River basin; streams and rivers on sand, mud, and gravel substrates; mistakenly thought to occur in the Guadalupe River basin.	Project area is outside the expected range of this species.
Texas fawnsfoot	*Truncilla macrodon*	C	T	Historically occurred in the Colorado and Brazos drainages of Central Texas. A recently discovered population in the Brazos River between Possum Kingdom and the mouth of the Navasota River represents the only known surviving population.	Project area is outside the expected range of this species.
Texas pimpleback	*Cyclonaias petrina*	C	T	Colorado River basin; mud, gravel, and sand substrates in areas with slow flow rates.	Project area is outside the expected range of this species.
Plants					
Awnless leastdaisy	*Chaetopappa imberbis*	N/A	SGCN	Endemic to sandy regions of southern and south-central Texas.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Big red sage	*Salvia pentstemonoides*	N/A	SGCN	Steep limestone outcrops on seeps within canyons or along creek banks; occasionally on clayey to silty soils of creek banks and terraces, in partial shade to full sun.	Project area is outside the expected range of this species.
Bracted twistflower	*Streptanthus bracteatus*	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Project area is outside the expected range of this species.
Buckley tridens	*Tridens buckleyanus*	N/A	SGCN	Occurs in juniper-oak woodlands on rocky limestone slopes.	Project area is outside the expected range of this species.
Elmendorf's onion	*Allium elmendorfii*	N/A	SGCN	Grassland openings in oak woodlands on deep, loose, well-drained sands; to the north it occurs in post oak-black hickory-live oak woodlands over Queen City and similar Eocene formations.	Project area is outside the expected range of this species.
Engelmann's bladderpod	*Physaria engelmannii*	N/A	SGCN	Grasslands and calcareous rock outcrops in a band along the eastern edge of the Edwards Plateau.	Project area is outside the expected range of this species.
Heartleaf evening-primrose	*Oenothera cordata*	N/A	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Project area is outside the expected range of this species.
Heller's marbleseed	*Omosmodium helleri*	N/A	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Hill Country wild-mercury	*Argythamnia aphoroides*	N/A	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands; also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Project area is outside the expected range of this species.
Low spurge	*Euphorbia peplidion*	N/A	SGCN	Occurs in a variety of vernally-moist situations in a number of natural regions.	Suitable habitat may occur within project area.
Net-leaf bundleflower	*Desmanthus reticulatus*	N/A	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Project area is outside the expected range of this species.
Parks jointweed	*Polygonella parksii*	N/A	SGCN	Mostly on deep, loose, whitish sand blowouts (unstable, deep, xeric, sandhill barrens) in Post Oak Savanna landscapes over the Carrizo and Sparta formations; also occurs in early successional grasslands, along rights-of-way, and on mechanically disturbed areas.	Project area is outside the expected range of this species.
Plateau milkvine	*Matelea edwardsensis*	N/A	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Suitable habitat does not occur in project area.
Sandhill woolywhite	*Hymenopappus carrizoanus*	N/A	SGCN	Disturbed or open areas in grasslands and post oak woodlands on deep sands derived from the Carrizo Sand and similar Eocene formations.	Suitable habitat may occur within project area.
Shinner's sunflower	*Helianthus occidentalis* ssp. *plantagineus*	N/A	SGCN	Mostly in prairies on the Coastal Plain, with several slightly disjunct populations in the Pineywoods and South Texas Brush Country.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
South Texas spikesedge	*Eleocharis austrotexana*	N/A	SGCN	Wetlands on the coastal plain.	Project area is outside the expected range of this species.
Sycamore-leaf snowbell	*Styrax platanifolius* ssp. *platanifolius*	N/A	SGCN	Oak-juniper woodlands on steep rocky banks and ledges along intermittent or perennials streams.	Suitable habitat does not occur within project area.
Texas amorpha	*Amorpha roemeriana*	N/A	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes; sometimes on dry shelves above creeks.	Suitable habitat does not occur within project area.
Texas beebalm	*Monarda viridissima*	N/A	SGCN	Endemic perennial herb of the Carrizo Sands; deep, well-drained sandy soils in openings of post oak woodlands.	Project area is outside the expected range of this species.
Texas sandmint	*Rhododon ciliatus*	N/A	SGCN	Open sandy areas in the Post Oak Belt of east-central Texas.	Project area is outside the expected range of this species.
Texas tauschia	*Tauschia texana*	N/A	SGCN	Occurs in loamy soils in deciduous forests or woodlands on river and stream terraces.	Suitable habitat may occur within project area.
Woolly butterflyweed	*Gaura villosa* ssp. *parksii*	N/A	SGCN	Sandy soils of Rio Grande plains.	Project area is outside the expected range of this species.
Wright's trichocoronis	*Trichocoronis wrightii* var. *wrightii*	N/A	SGCN	Riparian zones, wetlands, pond margins, and wet meadows.	Suitable habitat may occur within project area.
Reptiles					
Cagle's map turtle	*Graptemys caglei*	N/A	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River System.	Suitable habitat may occur within project area.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur within project area.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Northern spot-tailed earless lizard	*Holbrookia lacerata lacerata*	N/A	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edwards Plateau.	Project area is outside the expected range of this species.
Slender glass lizard	*Ophisaurus attenuatus*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannas, pine barrens, and oil fields.	Suitable habitat may occur within project area.
Southern spot-tailed earless lizard	*Holbrookia lacerata subcaudalis*	N/A	SGCN	Rocky desert flats, areas with sparse vegetation or mesquite-prickly pear associations, and uplands of central Texas Edwards Plateau.	Suitable habitat does not occur within project area.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur within project area.
Texas tortoise	*Gopherus berlandieri*	N/A	T	Open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive, occupies shallow depressions at base of bush or cactus.	Suitable habitat does not occur within project area.
Timber rattlesnake	*Crotalus horridus*	N/A	T	Swamps, floodplains, upland pine and deciduous woodland, riparian zones, and abandoned farmland. Limestone bluffs, sandy soil, or black clay.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrows into soil or may use burrows made by other species.	Suitable habitat may occur within project area.
Western hognose snake	*Heterodon nasicus*	N/A	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas (but not intensively cultivated), and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets. Seems to prefer sandy and loamy soils.	Suitable habitat may occur within project area.
PT = Proposed Threatened T = Threatened E = Endangered C = Candidate DL = Delisted N/A = Not applicable SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC and the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the Project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[7] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified no previously recorded archaeological sites intersecting or immediately adjacent (within 300 feet) to the project area (THC 2019). The review identified 16

[7] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

potentially historic-age buildings and two cemeteries intersecting or immediately adjacent to the project area (Table 5.2.30-2). No historical markers or NRHP listed properties are known to be near the project.

The model used assessed unrecorded archaeological site potential within the project area to include moderate to high potential zones, ranging from 42 percent to 76 percent likelihood for the project area to contain significant unidentified archaeological resources. The areas with greatest archaeological probability are located near the landforms adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 85.0 (a higher score indicates higher probability of cultural resources; further information regarding methodology for developing the assessment score is provided in Section 5.2). Based on the results of the background review, SWCA recommends that a structured cultural resources survey of the final design plan be performed to accurately assess the presence and significance of identified and unrecorded cultural resources within its boundaries.

Table 5.2.30-2 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/HISTORIC	NRHP ELIGIBILITY	LOCATION
None	2 Buildings	Historic	–	Intersect
None	14 Buildings	Historic	–	Adjacent
Martindale City	Cemetery	–	–	Adjacent
Crayton-Spruill	Cemetery	–	–	Adjacent
			ASSESSMENT SCORE TOTAL:	**85.0**

5.2.30.4 Engineering and Costing

Preliminary engineering and costing analyses have been performed using the 2021 Regional Water Planning methods. Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and methods for calculating unit costs. A cost estimate summary for the Martindale WSC Alluvial Well Project has been prepared and is provided in Table 5.2.30-3. The cost estimate includes all facilities required for water production, collection, and transmission. The well field will require wells and a collector pipeline and a 0.15 mile transmission pipeline. Conventional treatment and chlorine disinfection are required to treat the water. Well pumps will be sized to deliver the raw water to the existing Martindale WSC WTP in Caldwell County.

The overall project costs are estimated to be $1,253,000. Accounting for debt service, operations and maintenance, and pumping energy, the annual cost is estimated to be $111,000, and the annual unit cost of additional firm supply is about $463/acft per year.

Table 5.2.30-3 Cost Estimate Summary

ITEM	ESTIMATED COST FOR FACILITIES
Primary Pump Station	$775,000
Transmission Pipeline (6 in. dia., 0.15 mile)	$58,000
Well Fields (wells, pumps, and piping)	$4,000
TOTAL COST OF FACILITIES	**$837,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$290,000
Environmental and Archaeology Studies and Mitigation	$40,000
Land Acquisition and Surveying (7 acres)	$52,000
Interest During Construction (3% for 1 year with a 0.5% return on investment)	$34,000
TOTAL COST OF PROJECT	**$1,253,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$88,000
Operation and Maintenance	
Intakes and Pump Stations (2.5% of cost of facilities)	$19,000
Pumping Energy Costs (37,771 kWh @ 0.08 $/kWh)	$3,000
TOTAL ANNUAL COST	**$111,000**
Available Project Yield (acft/yr)	240
Annual Cost of Water ($ per acft)	$463
Annual Cost of Water After Debt Service ($ per acft)	$96
Annual Cost of Water ($ per 1,000 gallons)	$1.42
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.29
Based on a Peaking Factor of 1.0	

5.2.30.5 Implementation Considerations

Information presented in this WMS was provided by Martindale WSC and represents the current plan, which is based on the sponsor's current understanding of the system. Implementation of the Martindale WSC Alluvial Well WMS includes the following considerations:

- Implementation of the Martindale WSC Alluvial Well WMS will require permits and approvals for public water supply wells from the TCEQ.
- Because the target aquifer has alluvial materials in proximity to the river, effects of groundwater extraction on the river should be considered and carefully evaluated.
- The TCEQ issues water rights for ordinary flow, underflow, and tides. Since this proposed alluvial well could impact underflow of the San Marcos River, coordination with TCEQ is likely to be required.

Reliability

Water from these sources is considered to be medium since alluvial aquifer materials are not laterally extensive, often highly heterogenous, and limited data is available. Test hole drilling and evaluation is recommended. Potential for effects of groundwater extractor on the river (reliability score = 4).

5.2.31 Maxwell WSC Trinity Well Field

5.2.31.1 Description of Water Management Strategy

Maxwell WSC plans to add a well in the Trinity Aquifer in the 2040 decade that will develop a firm supply of 230 acft/yr. The new source of water for Maxwell WSC will be treated via brackish water treatment at the well field and delivered to the existing distribution system via a new 16-inch pipeline that will replace the existing infrastructure. The projected general location is anticipated to be at the existing Maxwell WSC Edwards well field site in Hays County (Figure 5.2.31-1).

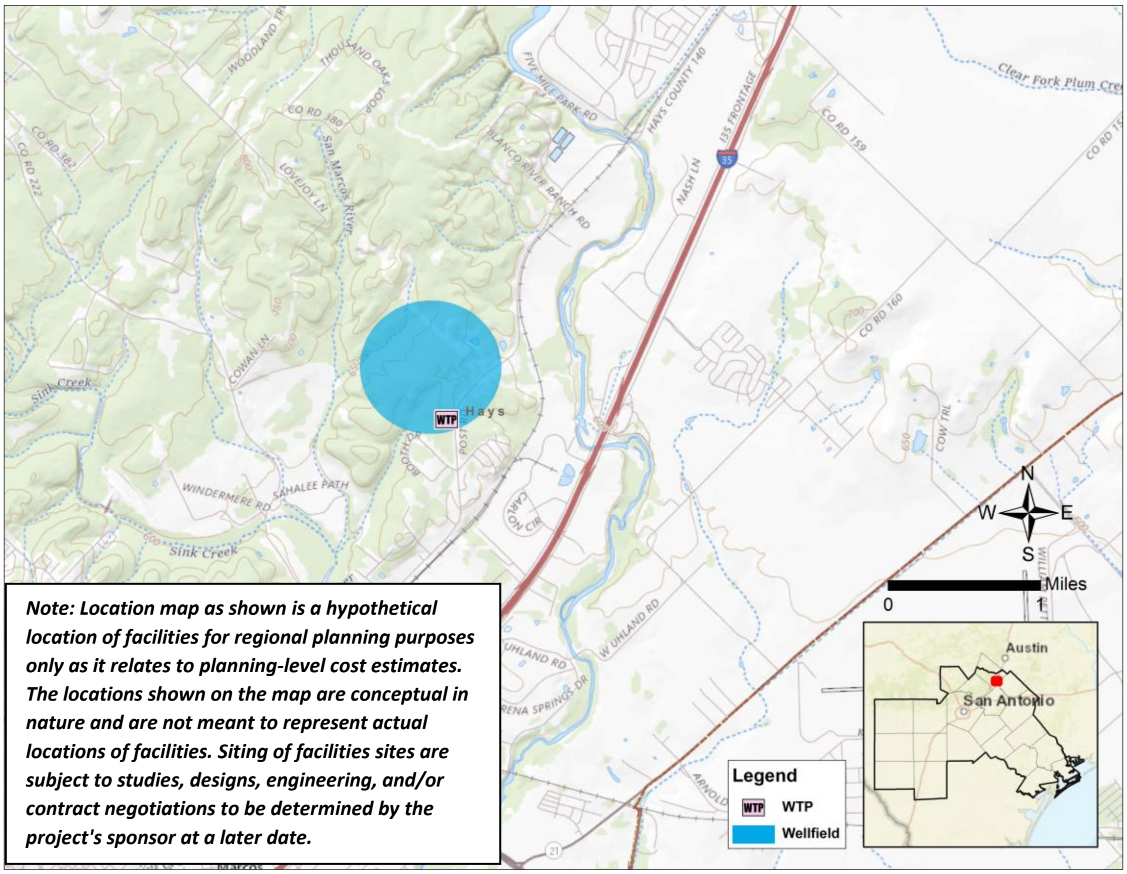

Figure 5.2.31-1 Location of Maxwell WSC Trinity Well Field

5.2.31.2 Available Yield

The project is anticipated to consist of one new well in the Trinity Aquifer with a pumping capacity of approximately 250 gpm. In this region of the Trinity Aquifer, the depth of the well is expected to be approximately 1,200 feet, and the water is anticipated to have a TDS concentration of approximately 2,000 mg/L. Most of the wells in the proposed well field area are completed in the overlying Edwards Aquifer, and therefore, little data exist on the deeper Trinity Aquifer. Any potential project in the area should include test well drilling and evaluation to determine aquifer characteristics and water quality in the vicinity of the planned Trinity Aquifer wells. The project lies within the purview of the Barton Springs Edwards Aquifer Conservation District. This WMS has a firm yield of 230 acft/yr is considered for implementation beginning in the 2040 decade.

Water Loss

Since water quality may be high in TDS, brackish treatment may be necessary. Brackish groundwater desalination strategies include water loss associated with desalination treatment technologies and disposal of brine concentrate. This brackish groundwater desalination WMS has a calculated percent water loss of 10%.

5.2.31.3 Environmental and Cultural Considerations

Environmental Considerations

Vegetation and Land Use

The project area is located in the Edwards Plateau ecoregion, and the project vicinity contains low-density residential development. As mapped by TPWD[1], the dominant vegetation types in the project area are deciduous oak/evergreen motte and woodland, oak/hardwood motte and woodland, savanna grassland, and Ashe juniper motte and woodland.

Based on TPWD vegetation mapping, the project would not affect area mapped as row crops, but has the potential to impact 2 acres of agricultural resources mapped as tame/disturbance grassland that may include pasture areas used for grazing or hay production.

Construction of project facilities would result in conversion of native herbaceous and woody vegetation areas to industrial use. Pipeline construction would require removal of woody vegetation and long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each water management strategy to determine the best course of action regarding revegetation. Pipeline easements may continue to be used for agricultural purposes.

Aquatic Resources

Two intermittent streams are mapped in the project area. The NWI mapping shows small areas in the project vicinity, approximately 0.8 acre, mapped as wetlands or ponds. There are no streams within one mile of the project area listed as impaired on the Texas Integrated Report of 303(d)-listed water bodies,[2] which identifies water bodies in Texas that do not meet assigned water quality standards. The project area does not contain ecologically significant stream segments as designated by TPWD.

The project has a low likelihood of affecting wetlands. Well facilities and small water treatment plants can typically be sited to avoid impacts to waters of the United States, including wetlands.

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[1] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

[2] Texas Commission on Environmental Quality. 2018. 2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d). https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf.

The project will require an on-site delineation of streams, ponds, and wetlands. Stream crossings for pipeline construction would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including if there would be permanent impacts to over 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under stream (e.g., through horizontal directional drilling) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

Table 5.2.31-1 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Hays County [3] [4]. Suitable habitat for the federally endangered golden-cheeked warbler (*Setophaga chrysoparia*) may occur within the central and western portions of the project area. The project will require an on-site habitat assessment to determine whether suitable habitat is present within this area. Suitable habitat does not occur for any other federally endangered species with the potential to occur in the project region. However, the plant species bracted twistflower (*Streptanthus bracteatus*) and several freshwater mussel species are under review for federal listing as threatened or endangered. The proposed well field project area contains streams that may provide suitable habitat for freshwater mussels and may also contain suitable habitat for bracted twistflower.

Suitable habitat may occur for the state endangered species black-capped vireo (*Vireo atricapilla*) and for the state threatened wood stork (*Mycteria americana*) and Texas horned lizard (*Phrynosoma cornutum*). Potentially suitable habitat may occur for numerous state wildlife, plant, and insect species designated by TPWD as SGCN. These species do not have formal protected status but are being monitored by TPWD. Migratory birds may occur in the project area, particularly in riparian zones and wetland areas.

Site-specific field surveys would be required to determine the quality of habitat and potential for impacts to state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD would likely be required to obtain their recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

Migratory birds may fly through or nest in the project area. The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15. Preconstruction surveys for active bird nests are recommended.

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[3] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Hays County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[4] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Hays County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.

Table 5.2.31-1 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for Maxwell WSC Trinity Well Project, Hays County, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Barton Springs salamander	*Eurycea sosorum*	E	E	Outlets of Barton Springs and subterranean water-filled caverns; found under rocks, in gravel, or among aquatic vascular plants and algae.	Project is outside of the expected range of this species.
Blanco blind salamander	*Eurycea robusta*	N/A	T	Water-filled subterranean caverns; may inhabit deep levels of the Balcones aquifer to the north and east of the Blanco River.	Project is outside of the expected range of this species.
Blanco River Springs salamander	*Eurycea pterophila*	N/A	SGCN	Springs and caves in the Blanco River drainage.	Project is outside of the expected range of this species.
San Marcos salamander	*Eurycea nana*	T	T	Headwaters of the San Marcos River downstream to about 0.5 mile past IH 35.	Project is outside of the expected range of this species.
Strecker's chorus frog	*Pseudarcris streckeri*	N/A	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Project is outside of the expected range of this species.
Texas blind salamander	*Eurycea rathbuni*	E	SGCN	Water-filled subterranean caverns along six miles of the San Marcos Springs Fault.	Project is outside of the expected range of this species.
Texas salamander	*Eurycea neotenes*	N/A	SGCN	Cave streams, seeps, springs, and creek headwaters; Helotes and Leon Creek drainages.	Project is outside of the expected range of this species.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur in project area.
Arachnids					
No accepted common name	*Cicurina russelli*	N/A	SGCN	Karst features.	Suitable karst habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
No accepted common name	*Cicurina ubicki*	N/A	SGCN	Karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Texella mulaiki*	N/A	SGCN	Karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Texella renkesae*	N/A	SGCN	Karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Cicurina ezelli*	N/A	SGCN	Karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Texella diplospina*	N/A	SGCN	Karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Texella grubbsi*	N/A	SGCN	Karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Tartarocreagris grubbsi*	N/A	SGCN	Karst features.	Suitable karst habitat does not occur in project area.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable habitat does not occur in project area; may fly over or forage in wetlands during migration.
Black-capped vireo	*Vireo atricapilla*	DL	E	Oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces.	Suitable habitat may occur in project area.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes, may use fields and beaches during migration.	Suitable habitat does not occur in project area; may fly over during migration.
Golden-cheeked warbler	*Setophaga chrysoparia*	E	E	Ashe juniper in mixed stands with various oaks (*Quercus* species). Edges of cedar brakes.	Suitable habitat may occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams and rivers; also known to nest on manmade structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Suitable habitat does not occur in project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat does not occur in project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur in project area; may fly over during migration.
Tropical parula	*Setophaga pitiayumi*	N/A	T	Semi-tropical evergreen woodland along rivers and resacas.	Suitable habitat does not occur in project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots; nests and roosts in abandoned burrows.	Suitable habitat may occur in project area.
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat does not occur in project area; may fly over during migration.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems (during migration).	Suitable habitat does not occur in project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Low likelihood of suitable habitat in project area; may fly over during migration.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous or pine/oak woodland.	Suitable habitat does not occur within project area; may fly over during migration.
Crustaceans					
Balcones Cave amphipod	*Stygobromus balconis*	N/A	SGCN	Subaquatic, subterranean obligate amphipod.	Project is outside of the expected range of this species.
Ezell's Cave amphipod	*Stygobromus flagellatus*	N/A	SGCN	Known only from artesian wells.	Project is outside of the expected range of this species.
No accepted common name	*Artesia subterranea*	N/A	SGCN	Cave obligate amphipod.	Suitable karst habitat does not occur in project area.
No accepted common name	*Texiweckelia texensis*	N/A	SGCN	Cave dwelling.	Suitable karst habitat does not occur in project area.
No accepted common name	*Palaemonetes texanus*	N/A	SGCN	River shrimp found in the Middle Guadalupe and San Marcos watersheds.	Suitable river habitat does not occur in project area.
No accepted common name	*Calathaemon holthuisi*	N/A	SGCN	Cave obligate shrimp.	Suitable karst habitat does not occur in project area.
Texas troglobitic water slater	*Lirceolus smithii*	N/A	SGCN	Subaquatic, subterranean obligate, aquifer.	Project is outside of the expected range of this species.
Fishes					
American eel	*Anguila rostrata*	N/A	SGCN	Coastal waterways below reservoirs	Suitable stream habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Fountain darter	*Etheostoma fonticola*	E	E	San Marcos and Comal Rivers; springs and spring-fed streams with dense beds of aquatic plants.	Suitable spring/stream habitat does not occur in project area.
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams of the Edwards Plateau region.	Suitable stream habitat does not occur in project area.
Guadalupe darter	*Percina apristis*	N/A	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Suitable river/stream habitat does not occur in project area.
Headwater catfish	*Ictalurus lupus*	N/A	SGCN	Rio Grande drainage, including Pecos River basin; springs, and sandy and rocky riffles, runs, and pools of clear creeks and small rivers.	Project is outside of the expected range of this species.
Ironcolor shiner	*Notropis chalybaeus*	N/A	SGCN	Often at the upstream ends of pools, with a moderate to sluggish current and sand, mud, silt, or detritus substrates.	Suitable stream habitat does not occur in project area.
Texas shiner	*Notropis amabilis*	N/A	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Suitable stream habitat does not occur in project area.
Insects					
A cave obligate beetle	*Rhadine austinica*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
A mayfly	*Procloeon distinctum*	N/A	SGCN	Found in shoreline vegetation	Suitable aquatic habitat does not occur in project area.
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in project area.
Comal Springs diving beetle	*Comaldessus stygius*	N/A	SGCN	Known only from the outflows at Comal Springs; generally, inhabit the water column.	Project is outside of the expected range of this species.
Comal Springs dryopid beetle	*Stygoparnus comalensis*	E	E	Found crawling on stream bottoms or along shores	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Comal Springs riffle beetle	*Heterelmis comalensis*	E	E	Comal and San Marcos Springs.	Project is outside of the expected range of this species.
Edwards Aquifer diving beetle	*Haideoporus texanus*	N/A	SGCN	Habitat poorly known; known from an artesian well in Hays County.	Project is outside of the expected range of this species.
No accepted common name	*Rhadine insolita*	N/A	SGCN	Cave obligate beetle.	Suitable karst habitat does not occur in project area.
No accepted common name	*Batrisodes grubbsi*	N/A	SGCN	Cave obligate beetle.	Suitable karst habitat does not occur in project area.
No accepted common name	*Neotrichia juani*	N/A	SGCN	Riparian and riverine habitats.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Oxyelophila callista*	N/A	SGCN	Woodland.	Suitable habitat may occur in project area.
No accepted common name	*Ochrotrichia capitana*	N/A	SGCN	Aquatic.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Plauditus texanus*	N/A	SGCN	Aquatic.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Xiphocentron messapus*	N/A	SGCN	Riparian and riverine habitats.	Suitable aquatic habitat does not occur in project area.
San Marcos saddle-case caddisfly	*Protoptila arca*	N/A	SGCN	Known from an artesian well in Hays County.	Suitable aquatic habitat does not occur in project area.
Texas austrotinodes caddisfly	*Austrotinodes texensis*	N/A	SGCN	Ranges from cobble and gravel to limestone bedrock; many limestone outcroppings also found along the streams.	Suitable aquatic habitat does not occur in project area.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur in project area.
Big brown bat	*Eptesicus fuscus*	N/A	SGCN	Woodlands or wooded areas.	Suitable habitat may occur in project area.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls but will use buildings.	May use buildings/ structures in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Cave myotis bat	*Myotis velifer*	N/A	SGCN	Cave-dwelling, also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	May use buildings/ structures in project area.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat may occur in project area.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges and woodlands. Prefer wooded, brushy areas; tallgrass prairies.	Suitable habitat may occur in project area.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Suitable habitat may occur in project area.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur in project area.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	May use buildings/ structures in project area.
Mexican long-tongued bat	*Choeronycteris mexicana*	N/A	SGCN	Riparian forest in Texas; roost in mines, large crevices, and caves.	Low potential for suitable habitat within project area.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Low potential for suitable habitat within project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Use wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Low potential for suitable habitat within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	SGCN	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur in project area.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Low potential for suitable habitat within project area.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Low potential for suitable habitat within project area.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Low potential for suitable habitat within project area.
Western spotted skunk	*Spilogale gracilis*	N/A	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur within project area.
Woodland vole	*Microtus pinetorum*	N/A	SGCN	Includes grassy marshes, swamp edges, old-field/pine woodland ecotones, tallgrass fields; generally sandy soils.	Low potential for suitable habitat within project area.
Mollusks					
False spike	*Fusconaia mitchelli*	N/A	T	Medium to large rivers; present in Guadalupe, Colorado, and Brazos river basins.	Suitable stream habitat does not occur in project area.
Glossy wolfsnail	*Euglandina texasiana*	N/A	SGCN	Lower Rio Grande valley.	Project is outside of the expected range of this species.
Golden orb	*Cyclonaias aurea*	C	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River Basins.	Suitable stream habitat does not occur in project area.
No accepted common name	*Holospira goldfussi*	N/A	SGCN	Woodland.	Suitable habitat may occur in project area.
No accepted common name	*Millerelix gracilis*	N/A	SGCN	Woodland.	Suitable habitat may occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
No accepted common name	*Elimia comalensis*	N/A	SGCN	Springs.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Phreatodrobia conica*	N/A	SGCN	Caves/karst.	Suitable karst habitat does not occur in project area.
No accepted common name	*Phreatodrobia micra*	N/A	SGCN	Caves/karst.	Suitable karst habitat does not occur in project area.
No accepted common name	*Phreatodrobia plana*	N/A	SGCN	Caves/karst.	Suitable karst habitat does not occur in project area.
No accepted common name	*Phreatodrobia punctata*	N/A	SGCN	Caves/karst.	Suitable karst habitat does not occur in project area.
No accepted common name	*Phreatodrobia rotunda*	N/A	SGCN	Caves/karst.	Suitable karst habitat does not occur in project area.
No accepted common name	*Cyclonaias necki*	N/A	SGCN	Guadalupe River basin; moderate to large streams with flowing water.	Suitable stream habitat does not occur in project area.
Texas fatmucket	*Lampsilis bracteata*	C	T	Colorado River basin; streams and rivers on sand, mud, and gravel substrates; mistakenly thought to occur in the Guadalupe River basin.	Suitable stream habitat does not occur in project area.
Texas pimpleback	*Cyclonaias petrina*	C	T	Colorado River basin; mud, gravel, and sand substrates in areas with slow flow rates; mistakenly thought to occur in the Guadalupe River basin.	Suitable stream habitat does not occur in project area.
Plants					
Bigflower cornsalad	*Valerianella stenocarpa*	N/A	SGCN	Along creek beds or in vernally moist grassy open areas.	Low potential for habitat to occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Bracted twistflower	*Streptanthus bracteatus*	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes, and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Suitable habitat may occur within project area.
Buckley tridens	*Tridens buckleyanus*	N/A	SGCN	Juniper-oak woodlands on rocky limestone slopes.	Suitable habitat may occur within project area.
Canyon mock-orange	*Philadelphus texensis var. ernestii*	N/A	SGCN	On outcrops of Cretaceous limestone exposed as rimrock along mesic canyons, usually in the shade of mixed evergreen-deciduous canyon woodland.	Low potential for suitable habitat to occur within project area.
Engelmann's bladdpod	*Physaria engelmannii*	N/A	SGCN	Grasslands and calcareous rock outcrops along the eastern edge of the Edwards Plateau, ranging as far north as the Red River.	Suitable habitat may occur within project area.
Glass Mountains coral-root	*Hexalectris nitida*	N/A	SGCN	Under Ashe juniper in woodlands over limestone on the Edwards Plateau, Callahan Divide, and Lampasas Cutplain.	Suitable habitat may occur within project area.
Gravelbar brickellbush	*Brickellia dentata*	N/A	SGCN	Frequently-scoured gravelly alluvial beds in creek and river bottoms.	Low potential for suitable habitat to occur within project area.
Hall's prairie clover	*Dalea hallii*	N/A	SGCN	In grasslands on eroded limestone or chalk and in oak scrub on rocky hillsides.	Suitable habitat may occur within project area.
Heller's beardtongue	*Penstemon triflorus ssp. integrifolius*	N/A	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Heller's marbleseed	*Omosmodium helleri*	N/A	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Suitable habitat may occur within project area.
Hill Country wild-mercury	*Argythamnia aphoroides*	N/A	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands, also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Suitable habitat may occur within project area.
Narrowleaf brickellbush	*Brickellia eupatorioides var. gracillima*	N/A	SGCN	Occurs in a variety of vernally moist habitats in a number of natural regions.	Suitable habitat may occur within project area.
Net-leaf bundleflower	*Desmanthus reticulatus*	N/A	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Project area is outside the expected range of this species.
Osage Plains false foxglove	*Agalinis densiflora*	N/A	SGCN	Grasslands on shallow, gravelly, well drained, calcareous soils; prairies, dry limestone soils.	Suitable habitat may occur within project area.
Plateau loosestrife	*Lythrum ovalifolium*	N/A	SGCN	Banks and gravelly beds of perennial (or strong intermittent) streams on the Edwards Plateau, Llano Uplift, and Lampasas Cutplain.	Low potential for suitable habitat to occur within project area.
Plateau milkvine	*Matelea edwardsensis*	N/A	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Suitable habitat may occur within project area.
Scarlet leather-flower	*Clematis texensis*	N/A	SGCN	In oak-juniper woodlands in mesic rocky limestone canyons or along perennial streams.	Suitable habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Spreading leastdaisy	*Chaetopappa effusa*	N/A	SGCN	Limestone cliffs, ledges, bluffs, steep hillsides, sometimes in seepy areas, oak-juniper, oak, or mixed deciduous woods, 300 to 500 meter elevation.	Suitable habitat does not occur in project area.
Sycamore-leaf snowbell	*Styrax platanifolius ssp. platanifolius*	N/A	SGCN	Usually in oak-juniper woodlands on steep rocky banks and ledges along intermittent or perennial streams.	Low potential for suitable habitat to occur within project area.
Texas amorpha	*Amorpha roemeriana*	N/A	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes, sometimes on dry shelves above creeks.	Suitable habitat does not occur in project area.
Texas barberry	*Berberis swaseyi*	N/A	SGCN	Shallow calcareous stony clay of upland grasslands/shrublands over limestone as well as in loamier soils in openly wooded canyons and on creek terraces.	Suitable habitat does not occur in project area.
Texas claret-cup cactus	*Echinocereus coccineus var. paucispinus*	N/A	SGCN	Occurs in rocky outcroppings, often in the partial-shade of oak and pine-oak woodlands and mixed conifer forest.	Project area is outside the expected range of this species.
Texas fescue	*Festuca versuta*	N/A	SGCN	Occurs in mesic woodlands on limestone-derived soils on stream terraces and canyon slopes.	Suitable habitat does not occur in project area.
Texas seymeria	*Seymeria texana*	N/A	SGCN	Found primarily in grassy openings in juniper-oak woodlands on dry rocky slopes but sometimes on rock outcrops in shaded canyons.	Low potential for suitable habitat to occur within project area.
Texas wild-rice	*Zizania texana*	E	E	Spring-fed river, in clear, cool, swift water mostly less than 1 meter deep, with coarse sandy soils.	Suitable river/stream habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Threeflower penstemon	*Penstemon triflorus ssp. triflorus*	N/A	SGCN	Occurs sparingly on rock outcrops and in grasslands associated with juniper-oak woodlands.	Suitable habitat may occur in project area.
Tree dodder	*Cuscuta exaltata*	N/A	SGCN	Parasitic on various *Quercus*, *Juglans*, *Rhus*, *Vitis*, *Ulmus*, and *Diospyros* species as well as *Acacia berlandieri*.	Suitable habitat may occur within project area.
Turnip-root scurf	*Pediomelum cyphocalyx*	N/A	SGCN	Grasslands and openings in juniper-oak woodlands on limestone substrates on the Edwards Plateau and in north-central Texas.	Suitable habitat may occur within project area.
Warnock's coral-root	*Hexalectris warnockii*	N/A	SGCN	In leaf litter and humus in oak-juniper woodlands on shaded slopes and intermittent, rocky creek beds in canyons.	Suitable habitat may occur within project area.
Reptiles					
Cagle's map turtle	*Graptemys caglei*	N/A	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River system.	Suitable aquatic habitat does not occur in project area.
Common garter snake	*Thamnophis sirtalis*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable aquatic habitat does not occur in project area.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur within project area.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Northern spot-tailed earless lizard	*Holbrookia lacerata lacerate*	N/A	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edward's Plateau.	Suitable habitat may occur within project area.
Slender glass lizard	*Ophisaurus attenuates*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannas, pine barrens, and oil fields.	Suitable habitat may occur within project area.
Spot-tailed earless lizard	*Holbrookia lacerata*	N/A	SGCN	Moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas.	Suitable habitat may occur within project area.
Texas garter snake	*Thamnophis sirtalis annectens*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable aquatic habitat does not occur in project area.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur within project area.
Texas map turtle	*Graptemys versa*	N/A	SGCN	Rivers with moderate current, abundant aquatic vegetation, and basking logs; also associated oxbows and lakes.	Suitable aquatic habitat does not occur in project area.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools. Burrows into soil or may use burrows made by other species.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Western hognose snake	*Heterodon nasicus*	N/A	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas (but not intensively cultivated), and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets. Seems to prefer sandy and loamy soils.	Suitable habitat may occur within project area.

T = Threatened
E = Endangered
C = Candidate
DL = Delisted
N/A = Not applicable
SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC, the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the Project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[5] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

No previously recorded archaeological sites intersect or are located immediately adjacent (within 300 feet) to the project area (THC 2019). The background literature review identified one cemetery designated as an OTHM and nine potentially historic-age structures intersecting or immediately adjacent to the project area (Table 5.2.31-2). No NRHP listed properties are known to be near the project.

The model used assessed unrecorded archaeological site potential within the project area to include low to high potential zones, ranging from 34 percent to 86 percent likelihood for the project area to contain significant unidentified archaeological resources. The areas with greatest archaeological probability are located near landforms adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 73.0 (a higher

[5] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

score indicates higher probability of cultural resources). Based on the results of the background review, SWCA recommends that a structured cultural resources survey of the final design plan be performed to accurately assess the presence and significance of identified and unrecorded cultural resources within its boundaries.

Table 5.2.31-2 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/HISTORIC	NRHP ELIGIBILITY	LOCATION
San Marcos-Blanco	Cemetery	Historic	OTHM	Intersect
None	9 Structures	Historic	–	Intersect/ Adjacent
			ASSESSMENT SCORE TOTAL:	73.0

5.2.31.4 Engineering and Costing

Preliminary engineering and costing analyses have been performed using the 2021 Regional Water Planning methods. Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and method for calculating unit costs. A cost estimate summary for the Maxwell WSC Trinity Well field water management strategy has been prepared and is provided in Table 5.2.31-3. The engineering and costing analysis includes all facilities required for water production, collection, transmission, and treatment, including a new production well, an injection well, collector pipelines, ground storage tank, and a WTP. Brackish groundwater treatment facilities may be required to meet drinking water quality standards. Well pumps will be sized to deliver the raw water to the water treatment infrastructure and storage tank. Treated water will be delivered to Maxwell WSC's distribution system via a new 16-inch pipeline that will replace the existing 6- and 8-inch pipelines.

The overall project costs are estimated to be $7,971,000. Accounting for debt service, operations and maintenance, and pumping energy, the annual cost is estimated to be $980,000 per year, and the annual unit cost of additional firm supply is about $4,261 acft/yr.

Table 5.2.31-3 Cost Estimate Summary

ITEM	ESTIMATED COST FOR FACILITIES
Transmission Pipeline	$748,000
Well Fields (wells, pumps, and piping)	$1,996,000
Storage Tanks (other than at booster pump stations)	$989,000
Water Treatment Plant (0.3 mgd)	$2,012,000
TOTAL COST OF FACILITIES	**$5,745,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$1,973,000
Environmental and Archaeology Studies and Mitigation	$28,000
Land Acquisition and Surveying (4 acres)	$11,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$214,000
TOTAL COST OF PROJECT	**$7,971,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$561,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$37,000
Water Treatment Plant	$381,000
Pumping Energy Costs (9,899 kWh at 0.08 $/kWh)	$1,000
TOTAL ANNUAL COST	**$980,000**
Available Project Yield (acft/yr)	230
Annual Cost of Water ($ per acft)	$4,261
Annual Cost of Water After Debt Service ($ per acft)	$1,822
Annual Cost of Water ($ per 1,000 gallons)	$13.07
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$5.59
Based on a Peaking Factor of 1.0	

5.2.31.5 Implementation Considerations

Information presented in this WMS was provided by Maxwell WSC and represents the current plan, which is based on the sponsor's current understanding of the system. Implementation of the Maxwell WSC Trinity Well field water management strategy will require permits and approvals from TCEQ, the EAA, and the Barton Springs Edwards Aquifer Conservation District (BSEACD). Requirements by each agency are discussed below.

- TCEQ:
  - Review and approval of technical specifications for all new or rehabilitated components of the public water system;
  - Review and approval of facilities and water quality to begin operations; and
  - Review and approval of injection well permit.
- EAA:
  - Obtain a "Drilling Through the Edwards Aquifer" Well Construction Permit from the EAA for the construction of wells passing through the Edwards Aquifer;
  - Verification of available groundwater quantity and well productivity;
  - Verification of water quality; and
  - Verification of minimal impacts to the Trinity, particularly as it relates to applicable DFC.

Reliability

Water from these sources is considered to be low to medium because of uncertainty involved in the little data available from the Trinity Aquifer. Test hole drilling and evaluation are recommended. (reliability score = 2).

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5.2.32 County Line SUD Trinity Well Field

5.2.32.1 Description of Water Management Strategy

The County Line SUD plans to add a well field in the Trinity Aquifer as a new source of water. The project will be delivered to their system in a phased approach. Phase 1 is projected for the 2050 decade and will have a firm yield of 500 acft/yr. Phase 2 is projected for the 2060 decade and will expand upon Phase 1 with an additional firm yield of 500 acft/yr. The total project is envisioned to result in a firm yield of 1,000 acft/yr after Phase 2, but because of MAG limitations the project will result in a total project firm yield of 740 acft/yr. Both phases are included and evaluated as part of this WMS.

Water is to be pumped from the downdip portion of the Trinity Aquifer and will be treated. The project's general location is anticipated to be near the northwest boundary of County Line SUD and the City of Kyle in Hays County (Figure 5.2.32-1). This WMS utilizes the same facilities and is within the same area as the County Line SUD Brackish Edwards Project (see Section 5.2.33). Locations will be defined when the project is executed.

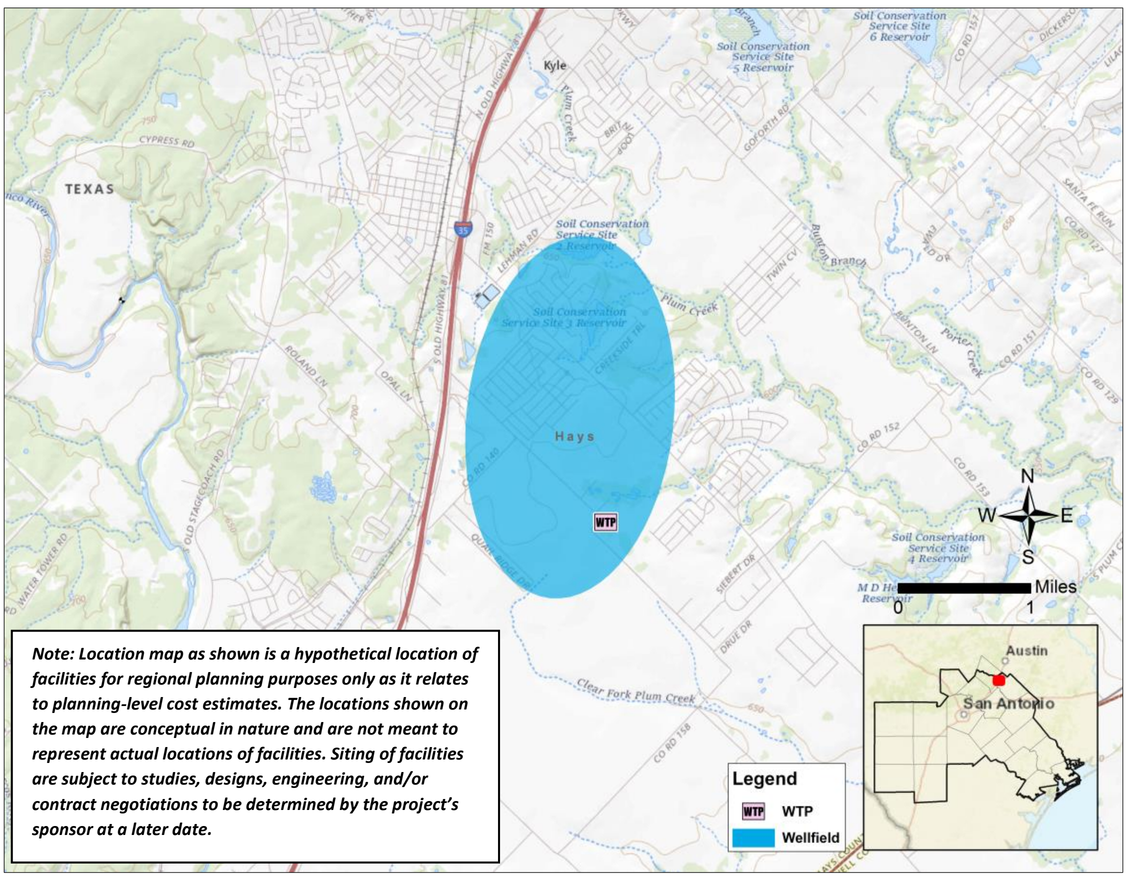

Figure 5.2.32-1 Approximate Location of County Line SUD Trinity Well Field

5.2.32.2 Available Yield

The project will consist of three wells: two wells in Phase 1 and one well in Phase 2, each with an estimated pumping capacity of 350 gpm. In this downdip region of the Trinity Aquifer, the well depth is expected to be approximately 1,200 feet, and have a TDS concentration of 1,000 mg/L. This area is near the edge of the Trinity Aquifer system, and there are limited wells in the area. The lack of available data and the fractured and heterogenous nature of the aquifer system in this area are such that it is difficult to predict well characteristics. Test hole drilling and evaluation is recommended prior to well installation to determine site-specific aquifer properties and water quality. This WMS has a firm yield of 740 acft/yr in 2070 and is considered for implementation beginning in the 2050 decade.

Table 5.2.32-1. Decadal Water Management Strategy Yields by Phase (acft/yr)

PROJECT PHASE	VOLUME BY DECADE (ACFT/YR)					
	2020	2030	2040	2050	2060	2070
Phase 1	--	--	--	500	500	500
Phase 2	--	--	--	--	240	240
Total	**0**	**0**	**0**	**500**	**740**	**740**

Water Loss

Due to the unpredictable water quality for wells in this area, the project is assumed to include brackish groundwater desalination treatment. Brackish groundwater desalination strategies include water loss associated with desalination treatment technologies and disposal of brine concentrate. Each brackish groundwater desalination WMS has a calculated percent water loss of 10%.

5.2.32.3 Environmental and Cultural Considerations

Environmental Considerations

Vegetation and Land Use

The project area occurs in the Blackland Prairie ecoregion, and the project vicinity contains low-density residential development, agricultural fields, and a small amount of uncleared woodland. As mapped by TPWD[1], the dominant vegetation types in the project area are disturbance or tame grassland, row crops, and mesquite shrubland.

Based on TPWD vegetation mapping, the project may have the potential to impact 1,305 acres of agricultural resources, including 520 acres mapped as row crops, and 785 acres mapped as tame/disturbance grassland which may include pasture areas used for grazing or hay production.

Construction of the WTP would result in conversion of native herbaceous and woody vegetation and agricultural areas into industrial use. Project pipeline easements would require removal of woody vegetation and long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of

[1] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

each WMS to determine the best course of action regarding revegetation. Pipeline easements may continue to be used for agricultural purposes.

Aquatic Resources

Several intermittent streams, their associated floodplains, and relatively small on-channel impoundments are mapped in the project area. The NWI mapping shows 40.1 acres of ponds and riverine wetlands in the project area.

The Texas Integrated Report of 303(d)-listed water bodies[2] identifies the water bodies or segments in Texas that do not meet assigned water quality standards. Segment 1810 of Plum Creek, a tributary of the San Marcos River, is listed as impaired. The project area does not contain ecologically significant stream segments as designated by TPWD.

The project will require an on-site delineation of streams, ponds, and wetlands. Stream crossings for pipeline construction, if applicable, would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including if there would be permanent impacts to over 0.1 acre of waters of the United States. The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under stream (e.g., through horizontal directional drilling) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

Table 5.2.32-1 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Hays County [3] [4]. Suitable habitat does not occur for any of the federally listed species with the potential to occur in the project region. However, several freshwater mussel species are under review for federal listing as threatened or endangered, and the well field study area includes portions of Plum Creek that may provide suitable habitat for freshwater mussels.

Suitable habitat may occur for the state threatened wood stork (*Mycteria americana*), white-faced ibis (*Plegadis chihi*), and Texas horned lizard (*Phrynosoma cornutum*). Potentially suitable habitat may occur for numerous state wildlife, plant, and insect species designated by TPWD as SGCN. These species do not have formal protected status but are being monitored by TPWD. Migratory birds may occur in the project area, particularly in riparian zones and wetland areas.

Site-specific field surveys would be required to determine the quality of habitat and potential for impacts to state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD would likely be

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[2] Texas Commission on Environmental Quality. 2018. *2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d).* https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf.

[3] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Hays County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[4] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Hays County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.

required to obtain their recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

Migratory birds may fly through or nest in the project area. The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15. Preconstruction surveys for active bird nests are recommended.

Table 5.2.32-1 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for County Line SUD Trinity Well Field, Hays County, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Barton Springs salamander	*Eurycea sosorum*	E	E	Outlets of Barton Springs and subterranean water-filled caverns; found under rocks, in gravel, or among aquatic vascular plants and algae.	Project is outside of the expected range of this species.
Blanco blind salamander	*Eurycea robusta*	N/A	T	Water-filled subterranean caverns; may inhabit deep levels of the Balcones Aquifer to the north and east of the Blanco River.	Project is outside of the expected range of this species.
Blanco River Springs salamander	*Eurycea pterophila*	N/A	SGCN	Springs and caves in the Blanco River drainage.	Project is outside of the expected range of this species.
San Marcos salamander	*Eurycea nana*	T	T	Headwaters of the San Marcos River downstream to about 0.5 mile past IH 35.	Project is outside of the expected range of this species.
Strecker's chorus frog	*Pseudarcris streckeri*	N/A	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Low likelihood of suitable habitat in project vicinity.
Texas blind salamander	*Eurycea rathbuni*	E	SGCN	Water-filled subterranean caverns along 6 miles of the San Marcos Spring Fault.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas salamander	*Eurycea neotenes*	N/A	SGCN	Cave streams, seeps, springs, and creek headwaters; Helotes and Leon Creek drainages.	Project is outside of the expected range of this species.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur in project area.
Arachnids					
No accepted common name	*Cicurina russelli*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Cicurina ubicki*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Texella mulaiki*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Texella renkesae*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Cicurina ezelli*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Texella diplospina*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Texella grubbsi*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Tartarocreagris grubbsi*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
Birds					
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable nesting habitat does not occur in project area; may fly over or forage in wetlands during migration.
Black-capped vireo	*Vireo atricapilla*	DL	E	Oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces.	Suitable habitat does not occur in project area; may fly over during migration.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes, may use fields and beaches during migration.	Suitable habitat does not occur in project area; may fly over during migration.
Golden-cheeked warbler	*Setophaga chrysoparia*	E	E	Ashe juniper in mixed stands with various oaks (*Quercus* species). Edges of cedar brakes.	Suitable habitat does not occur in project area; may fly over during migration.
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also known to nest on manmade structures (inland beaches, WTPs, gravel mines, etc.).	Suitable habitat does not occur in project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat does not occur in project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur in project area; may fly over during migration.
Tropical parula	*Setophaga pitiayumi*	N/A	T	Semi-tropical evergreen woodland along rivers and resacas.	Suitable habitat does not occur in project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots; nests and roosts in abandoned burrows.	Suitable habitat may occur in project area.
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems (during migration).	Suitable habitat does not occur in project area; may fly over during migration.
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Suitable habitat may occur within project area.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat does not occur within project area; may fly over during migration.
Crustaceans					
Balcones Cave amphipod	*Stygobromus balconis*	N/A	SGCN	Subaquatic, subterranean obligate amphipod.	Suitable karst habitat does not occur in project area.
Ezell's Cave amphipod	*Stygobromus flagellatus*	N/A	SGCN	Known only from artesian wells.	Suitable karst habitat does not occur in project area.
No accepted common name	*Artesia subterranea*	N/A	SGCN	Cave dwelling.	Suitable karst habitat does not occur in project area.
No accepted common name	*Texiweckelia texensis*	N/A	SGCN	Cave dwelling.	Suitable karst habitat does not occur in project area.
No accepted common name	*Palaemonetes texanus*	N/A	SGCN	Found in fresh water.	Suitable habitat does not occur in project area.
No accepted common name	*Calathaemon holthuisi*	N/A	SGCN	Cave dwelling.	Suitable karst habitat does not occur in project area.
Texas troglobitic water slater	*Lirceolus smithii*	N/A	SGCN	Subaquatic, subterranean obligate, aquifer.	Suitable karst habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Fishes					
American eel	*Anguila rostrata*	N/A	SGCN	Coastal waterways below reservoirs.	Suitable habitat does not occur in project area.
Fountain darter	*Etheostoma fonticola*	E	E	San Marcos and Comal Rivers; springs and spring-fed streams with dense beds of aquatic plants.	Project is outside of the expected range of this species.
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat does not occur in project area.
Guadalupe darter	*Percina apristis*	N/A	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Suitable river/stream habitat does not occur in project area.
Headwater catfish	*Ictalurus lupus*	N/A	SGCN	Rio Grande drainage, including Pecos River basin; springs, and sandy and rocky riffles, runs, and pools of clear creeks and small rivers.	Suitable habitat does not occur in project area.
Ironcolor shiner	*Notropis chalybaeus*	N/A	SGCN	Often at the upstream ends of pools, with a moderate to sluggish current and sand, mud, silt, or detritus substrates.	Suitable stream habitat may occur in project area.
Texas shiner	*Notropis amabilis*	N/A	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Project is outside of the expected range of this species.
Insects					
A cave obligate beetle	*Rhadine austinica*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
A mayfly	*Procloeon distinctum*	N/A	SGCN	Found in shoreline vegetation.	Suitable aquatic habitat may occur in project area.
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Comal Springs diving beetle	*Comaldessus stygius*	N/A	SGCN	Known only from the outflows at Comal Springs; generally, inhabit the water column.	Project is outside of the expected range of this species.
Comal Springs dryopid beetle	*Stygoparnus comalensis*	E	E	Found crawling on stream bottoms or along shores.	Project is outside of the expected range of this species.
Comal Springs riffle beetle	*Heterelmis comalensis*	E	E	Comal and San Marcos Springs.	Project is outside of the expected range of this species.
Edwards Aquifer diving beetle	*Haideoporus texanus*	N/A	SGCN	Habitat poorly known; known from an artesian well in Hays County.	Project is outside of the expected range of this species.
No accepted common name	*Rhadine insolita*	N/A	SGCN	Cave dwelling.	Suitable karst habitat does not occur in project area.
No accepted common name	*Batrisodes grubbsi*	N/A	SGCN	Cave dwelling.	Suitable karst habitat does not occur in project area.
No accepted common name	*Neotrichia juani*	N/A	SGCN	Riparian/riverine.	Suitable aquatic habitat may occur in project area.
No accepted common name	*Oxyelophila callista*	N/A	SGCN	Woodlands.	Suitable habitat may occur in project area.
No accepted common name	*Ochrotrichia capitana*	N/A	SGCN	Riparian/riverine.	Suitable aquatic habitat may occur in project area.
No accepted common name	*Plauditus texanus*	N/A	SGCN	Riparian/riverine.	Suitable aquatic habitat may occur in project area.
No accepted common name	*Xiphocentron messapus*	N/A	SGCN	Riparian/riverine.	Suitable aquatic habitat may occur in project area.
San Marcos saddle-case caddisfly	*Protoptila arca*	N/A	SGCN	Known from an artesian well in Hays County.	Project is outside of the expected range of this species.
Texas austrotinodes caddisfly	*Austrotinodes texensis*	N/A	SGCN	Ranges from cobble and gravel to limestone bedrock; many limestone outcroppings also found along the streams.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur in the project area.
Big brown bat	*Eptesicus fuscus*	N/A	SGCN	Woodlands or wooded areas.	Suitable habitat may occur in the project area.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls but will use buildings.	May use buildings/ structures in the project area.
Cave myotis bat	*Myotis velifer*	N/A	SGCN	Cave-dwelling, also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	May use buildings/ structures in the project area.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat may occur in the project area.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges, and woodlands. Prefer wooded, brushy areas; tallgrass prairies.	Suitable habitat may occur in the project area.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Suitable habitat may occur in the project area.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur in the project area.
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	May use buildings/ structures in the project area.
Mexican long-tongued bat	*Choeronycteris mexicana*	N/A	SGCN	Riparian forest in Texas; roost in mines, large crevices, and caves.	Low potential for suitable habitat within the project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps and marshes.	Low potential for suitable habitat within the project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Use wide range of habitats, especially rocky areas, canyons, riparian zones and dense brush.	Low potential for suitable habitat within the project area.
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	SGCN	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur in the project area.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Low potential for suitable habitat within the project area.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Low potential for suitable habitat within the project area.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Low potential for suitable habitat within the project area.
Western spotted skunk	*Spilogale gracilis*	N/A	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur within the project area.
Woodland vole	*Microtus pinetorum*	N/A	SGCN	Includes grassy marshes, swamp edges, old-field/pine woodland ecotones, tallgrass fields; generally sandy soils.	Suitable habitat may occur within the project area.
Mollusks					
False spike	*Fusconaia mitchelli*	N/A	T	Medium to large rivers; present in Guadalupe, Colorado, and Brazos river basins.	Low potential for suitable habitat to occur within project area.
Glossy wolfsnail	*Euglandina texasiana*	N/A	SGCN	Terrestrial; south Texas, Rio Grande.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Golden orb	*Cyclonaias aurea*	N/A	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Low potential for suitable habitat to occur within project area. This species was recently a federal candidate species but its listing as federally threatened or endangered was not warranted as it is not a valid species.
No accepted common name	*Holospira goldfussi*	N/A	SGCN	Terrestrial snail; Edwards Plateau.	Project area is outside the expected range of this species.
No accepted common name	*Millerelix gracilis*	N/A	SGCN	Terrestrial snail; Edwards Plateau.	Project area is outside the expected range of this species.
No accepted common name	*Elimia comalensis*	N/A	SGCN	Aquatic; found in springs in Central Texas.	Project area is outside the expected range of this species.
No accepted common name	*Phreatodrobia conica*	N/A	SGCN	Subaquatic; subterranean obligate.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Phreatodrobia micra*	N/A	SGCN	Subaquatic; subterranean obligate.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Phreatodrobia plana*	N/A	SGCN	Subaquatic; subterranean obligate.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Phreatodrobia punctata*	N/A	SGCN	Subaquatic; subterranean obligate.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Phreatodrobia rotunda*	N/A	SGCN	Subaquatic; subterranean obligate.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Cyclonaias necki*	N/A	SGCN	Guadalupe River basin; moderate to large streams with flowing water.	Low potential for suitable habitat to occur within project area.
Texas fatmucket	*Lampsilis bracteata*	C	T	Colorado River basin; streams and rivers on sand, mud, and gravel substrates; previously thought to occur in the Guadalupe River basin.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas pimpleback	*Cyclonaias petrina*	C	T	Colorado River basin; mud, gravel, and sand substrates in areas with slow flow rates; previously thought to occur in the Guadalupe River basin.	Project area is outside the expected range of this species.
Plants					
Bigflower cornsalad	*Valerianella stenocarpa*	N/A	SGCN	Along creek beds or in vernally moist grassy open areas.	Suitable habitat may occur within project area.
Bracted twistflower	*Streptanthus bracteatus*	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Project area is outside the expected range of this species.
Buckley tridens	*Tridens buckleyanus*	N/A	SGCN	Juniper-oak woodlands on rocky limestone slopes.	Project area is outside the expected range of this species.
Canyon mock-orange	*Philadelphus texensis var. ernestii*	N/A	SGCN	On outcrops of Cretaceous limestone exposed as rimrock along mesic canyons, usually in the shade of mixed evergreen-deciduous canyon woodland.	Project area is outside the expected range of this species.
Engelmann's bladdpod	*Physaria engelmannii*	N/A	SGCN	Grasslands and calcareous rock outcrops along the eastern edge of the Edwards Plateau, ranging as far north as the Red River.	Project area is outside the expected range of this species.
Glass Mountains coral-root	*Hexalectris nitida*	N/A	SGCN	Under Ashe juniper in woodlands over limestone on the Edwards Plateau, Callahan Divide, and Lampasas Cutplain.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Gravelbar brickellbush	*Brickellia dentata*	N/A	SGCN	Frequently-scoured gravelly alluvial beds in creek and river bottoms.	Suitable habitat may occur within project area.
Hall's prairie clover	*Dalea hallii*	N/A	SGCN	In grasslands on eroded limestone or chalk and in oak scrub on rocky hillsides.	Project area is outside the expected range of this species.
Heller's beardtongue	*Penstemon triflorus ssp. integrifolius*	N/A	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Project area is outside the expected range of this species.
Heller's marbleseed	*Omosmodium helleri*	N/A	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Project area is outside the expected range of this species.
Hill Country wild-mercury	*Argythamnia aphoroides*	N/A	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands, also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Project area is outside the expected range of this species.
Narrowleaf brickellbush	*Brickellia eupatorioides var. gracillima*	N/A	SGCN	Occurs in a variety of vernally moist habitats in a number of natural regions.	Suitable habitat may occur within project area.
Net-leaf bundleflower	*Desmanthus reticulatus*	N/A	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat may occur within project area.
Osage Plains false foxglove	*Agalinis densiflora*	N/A	SGCN	Grasslands on shallow, gravelly, well drained, calcareous soils; Prairies, dry limestone soils.	Suitable habitat may occur within project area.
Plateau loosestrife	*Lythrum ovalifolium*	N/A	SGCN	Banks and gravelly beds of perennial (or strong intermittent) streams on the Edwards Plateau, Llano Uplift, and Lampasas Cutplain.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Plateau milkvine	*Matelea edwardsensis*	N/A	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Project area is outside the expected range of this species.
Scarlet leather-flower	*Clematis texensis*	N/A	SGCN	In oak-juniper woodlands in mesic rocky limestone canyons or along perennial streams.	Project area is outside the expected range of this species.
Spreading leastdaisy	*Chaetopappa effusa*	N/A	SGCN	Limestone cliffs, ledges, bluffs, steep hillsides, sometimes in seepy areas, oak-juniper, oak, or mixed deciduous woods, 300 to 500 meter elevation.	Project area is outside the expected range of this species.
Sycamore-leaf snowbell	*Styrax platanifolius ssp. platanifolius*	N/A	SGCN	Usually in oak-juniper woodlands on steep rocky banks and ledges along intermittent or perennial streams.	Project area is outside the expected range of this species.
Texas amorpha	*Amorpha roemeriana*	N/A	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes, sometimes on dry shelves above creeks.	Project area is outside the expected range of this species.
Texas barberry	*Berberis swaseyi*	N/A	SGCN	Shallow calcareous stony clay of upland grasslands/shrublands over limestone as well as in loamier soils in openly wooded canyons and on creek terraces.	Project area is outside the expected range of this species.
Texas claret-cup cactus	*Echinocereus coccineus var. paucispinus*	N/A	SGCN	Occurs in rocky outcroppings, often in the partial-shade of oak and pine-oak woodlands and mixed conifer forest.	Project area is outside the expected range of this species.
Texas fescue	*Festuca versuta*	N/A	SGCN	Occurs in mesic woodlands on limestone-derived soils on stream terraces and canyon slopes.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas seymeria	*Seymeria texana*	N/A	SGCN	Found primarily in grassy openings in juniper-oak woodlands on dry rocky slopes but sometimes on rock outcrops in shaded canyons.	Project area is outside the expected range of this species.
Texas wild-rice	*Zizania texana*	E	E	Spring-fed river, in clear, cool, swift water mostly less than 1 meter deep, with coarse sandy soils.	Project area is outside the expected range of this species.
Threeflower penstemon	*Penstemon triflorus ssp. triflorus*	N/A	SGCN	Occurs sparingly on rock outcrops and in grasslands associated with juniper-oak woodlands.	Project area is outside the expected range of this species.
Tree dodder	*Cuscuta exaltata*	N/A	SGCN	Parasitic on various *Quercus, Juglans, Rhus, Vitis, Ulmus,* and *Diospyros* species as well as *Acacia berlandieri*.	Suitable habitat may occur within project area.
Turnip-root scurf	*Pediomelum cyphocalyx*	N/A	SGCN	Grasslands and openings in juniper-oak woodlands on limestone substrates on the Edwards Plateau and in north-central Texas.	Project area is outside the expected range of this species.
Warnock's coral-root	*Hexalectris warnockii*	N/A	SGCN	In leaf litter and humus in oak-juniper woodlands on shaded slopes and intermittent, rocky creek beds in canyons.	Project area is outside the expected range of this species.
Reptiles					
Cagle's map turtle	*Graptemys caglei*	N/A	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River system.	Suitable aquatic habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Common garter snake	*Thamnophis sirtalis*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur within project area.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur within project area.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat may occur within project area.
Northern spot-tailed earless lizard	*Holbrookia lacerata lacerate*	N/A	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edwards Plateau.	Suitable habitat does not occur in project area.
Slender glass lizard	*Ophisaurus attenuates*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannas, pine barrens, and oil fields.	Suitable habitat may occur within project area.
Spot-tailed earless lizard	*Holbrookia lacerata*	N/A	SGCN	Moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas.	Suitable habitat may occur within project area.
Texas garter snake	*Thamnophis sirtalis annectens*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur within project area.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas map turtle	*Graptemys versa*	N/A	SGCN	Rivers with moderate current, abundant aquatic vegetation, and basking logs; also associated oxbows and lakes.	Suitable aquatic habitat does not occur in project area.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools.	Suitable habitat may occur within project area.
Western hognose snake	*Heterodon nasicus*	N/A	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas (but not intensively cultivated), and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets.	Suitable habitat does not occur in project area.
T = Threatened E = Endangered C = Candidate DL = Delisted N/A = Not applicable SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC, the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the Project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[5] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified two previously recorded archaeological sites intersecting or immediately adjacent (within 300 feet) to the project area (Table 5.2.32-2; THC 2019). One archaeological site is a historic farmstead determined to be ineligible for listing in the NRHP. The other

[5] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

site is a prehistoric lithic artifact scatter and historic farmstead also determined to be ineligible for NRHP listing. The review identified 187 potentially historic-age buildings intersecting or immediately adjacent to the project area. No cemeteries or NRHP-listed properties are known to be near the project.

The model used assessed unrecorded archaeological site potential within the project area to include low to moderate potential zones, ranging from 26 percent to 49 percent likelihood for the project area to contain unidentified archaeological resources. The areas with greatest archaeological probability are located near the two previously documented archaeological sites and the landforms adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As discussed previously, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 237.0 (higher scores indicate higher potential for cultural resources). Based on the results of the background review, SWCA recommends that a structured cultural resources survey of the final design plan be performed to accurately assess the presence and significance of identified and unrecorded cultural resources within its boundaries. While the overall assessment score is high, the majority of the nearby resources are potential historic-age structures, which can likely be avoided during the project design phase pending the results of a cultural resources inventory.

Table 5.2.32-2 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological site	Lithic Artifact Scatter & Farmstead	Prehistoric & Historic	Ineligible	Intersect
Archaeological site	Farmstead	Historic	Ineligible	Intersect
None	187 Buildings	Historic	–	Adjacent/ Intersect
			ASSESSMENT SCORE TOTAL:	237.0

5.2.32.4 Engineering and Costing

Preliminary engineering and costing analyses have been performed using the 2021 Regional Water Planning methods. Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and method for calculating unit costs. The estimated costs include all facilities required for water production, collection, transmission, and treatment. Phase 1 of the County Line SUD Trinity Well Field Project will produce 500 acft/yr of potable water. Facilities included in Phase 1 will consist of two wells, infrastructure for brackish groundwater treatment, one injection well, and a 1 MG ground storage tank. Phase 2 was envisioned to produce an additional 500 acft/yr, but because of MAG limitations, Phase 2 will consist of one additional well that produces an additional 240 acft/yr for the purposes of the 2021 RWP.

Given the anticipated TDS concentration of the water, treatment for desalination and disinfection is assumed to be necessary to meet drinking water standards. Well pumps will be sized to deliver raw water to the water treatment infrastructure. The cost estimate does not include delivery of treated water to the County Line SUD distribution system. Costs associated with land acquisition, WTP, injection well, and pump station are shared with the County Line SUD Brackish Edwards Project WMS (See Section 5.2.33), which is co-located with this County Line Trinity Well Field WMS.

Cost estimates were calculated for capital costs, annual debt service, O&M, power, land acquisition, and environmental mitigation for each phase. The estimated project costs for: Phase 1 are $10,552,000 (Table 5.2.32-3) and for Phase 2 are $1,217,000 (Table 5.2.32-4). The total project costs are $11,761,000. Due to this WMS being a phased project, the associated annual and unit costs for each phase are detailed for the decades of phased implementation (Refer to Chapter 5.3). The annual unit cost of Phase 1 is about $2,888 per acft/yr and of Phase 2 is about $400 per acft/yr.

Table 5.2.32-3 Phase 1 Cost Estimate Summary

ITEM	ESTIMATED COST FOR FACILITIES
Well Fields (wells, pumps, and piping)	$2,757,000
Storage Tanks (other than at booster pump stations)	$1,297,000
Water Treatment Plant (2.3 mgd)	$3,518,000
TOTAL COST OF FACILITIES	**$7,572,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$2,650,000
Environmental and Archaeology Studies and Mitigation	$15,000
Land Acquisition and Surveying (5 acres)	$32,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$283,000
TOTAL COST OF PROJECT	**$10,552,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$742,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$41,000
Water Treatment Plant	$660,000
Pumping Energy Costs (14,362 kWh at 0.08 $/kWh)	$1,000
TOTAL ANNUAL COST	**$1,444,000**
Available Project Yield (acft/yr)	500
Annual Cost of Water ($ per acft)	$2,888
Annual Cost of Water After Debt Service ($ per acft)	$1,404
Annual Cost of Water ($ per 1,000 gallons)	$8.86

ITEM	ESTIMATED COST FOR FACILITIES
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$4.31
Based on a Peaking Factor of 1.0	

Table 5.2.32-4 Phase 2 Cost Estimate Summary

ITEM	ESTIMATED COST FOR FACILITIES
Well Fields (wells, pumps, and piping)	$868,000
TOTAL COST OF FACILITIES	**$868,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$304,000
Environmental and Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (5 acres)	$6,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$33,000
TOTAL COST OF PROJECT	**$1,217,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$86,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$9,000
Pumping Energy Costs (14,362 kWh at 0.08 $/kWh)	$1,000
TOTAL ANNUAL COST	**$96,000**
Available Project Yield (acft/yr)	240
Annual Cost of Water ($ per acft)	$400
Annual Cost of Water After Debt Service ($ per acft)	$42
Annual Cost of Water ($ per 1,000 gallons)	$1.23
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.13
Based on a Peaking Factor of 1.0	

5.2.32.5 Implementation Considerations

Information presented in this WMS was provided by County Line SUD and represents the current plan, which is based on the sponsor's current understanding of the system. Implementation of the County Line

SUD Trinity Well Field WMS will require permits and approvals from TCEQ and the EAA. Given the approximate location of the well field, the proposed wells could be regulated by Plum Creek GCD, Barton Springs Edwards Aquifer CD, or EAA. Close coordination with the regulating entity will be required to secure appropriate permits. General requirements for the TCEQ and EAA are discussed below.

TCEQ:

- Review and approval of technical specifications for all new or rehabilitated components of the public water system;
- Review and approval of facilities and water quality to begin operations; and
- Review and approval of injection well permit.

EAA:

- Obtain a “Drilling Through the Edwards Aquifer” Well Construction Permit from the EAA for the construction of wells passing through the Edwards Aquifer;
- Verification of available groundwater quantity and well productivity;
- Verification of water quality; and
- Verification of minimal impacts to aquifers, particularly as it relates to applicable DFCs.

Reliability

Water from these sources is considered to be low to medium because of uncertainty involved in the little data available from the Trinity Aquifer. Test hole drilling and evaluation recommended (reliability score = 2).

5.2.33 County Line SUD Brackish Edwards Project

5.2.33.1 Description of Water Management Strategy

The County Line SUD plans to add wells in the brackish portion of the Edwards Aquifer. The new source of water for County Line SUD will be delivered to their system in a three-phased approach. Phase 1 is projected for the 2050 decade and will have a firm yield of 500 acft/yr. Phase 2 is projected for the 2060 decade and will expand upon Phase 1, resulting in a combined firm yield of 1,000 acft/yr. Finally, Phase 3 is projected for the 2070 decade and will result in a total project firm yield of 1,500 acft/yr. All three phases are included and evaluated as part of this WMS.

A new desalination WTP will be included to treat the brackish Edwards Aquifer water. The project's general location is anticipated to be near the northwest boundary of County Line SUD and the City of Kyle in Hays County (Figure 5.2.33-1). This WMS utilizes the same facilities and is within the same area as the County Line SUD Trinity Well Field project (see Section 5.2.32). Locations will be defined when the project is executed.

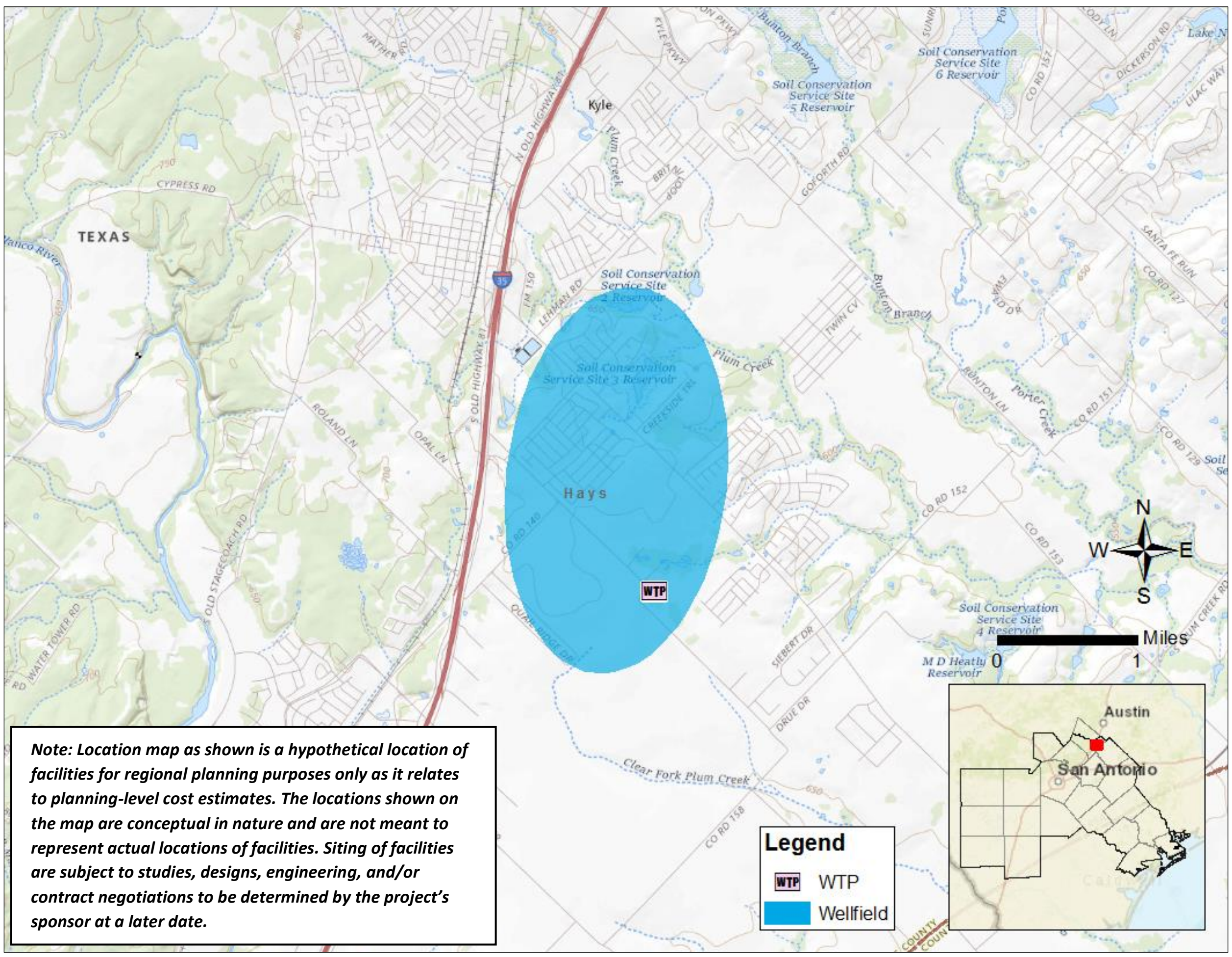

Figure 5.2.33-1 Approximate Location of County Line SUD Brackish Edwards Well Field

5.2.33.2 Available Yield

The project will consist of four wells: two wells in Phase 1, one well in Phase 2, and one well in Phase 3, each with an estimated pumping capacity of 350 gpm. In this downdip region of the Brackish Edwards Aquifer, the exact well depth is unknown because of limited information available for this area. It is recommended that a test well be drilled and additional studies performed in the area to determine more accurate well field information. For planning purposes, the well depth is assumed to be approximately 1,200 feet, and have a TDS concentration of 1,500 mg/L. This area is close to the transition zone of the Edwards Aquifer where water quality changes from fresh to brackish, and there are limited wells in the area. The lack of available data and the fractured and heterogenous nature of the aquifer system in this area are such that it is difficult to predict the well characteristics. Test hole drilling and evaluation is recommended prior to well installation to determine site-specific aquifer properties and water quality.

Table 5.2.33-1. Decadal Water Management Strategy Yields by Phase (acft/yr)

PROJECT PHASE	VOLUME BY DECADE (ACFT/YR)					
	2020	2030	2040	2050	2060	2070
Phase 1	--	--	--	500	500	500
Phase 2	--	--	--	--	500	500
Phase 3	--	--	--	--	--	500
Total	**0**	**0**	**0**	**500**	**1,000**	**1,500**

Water Loss

Brackish groundwater desalination strategies include water loss associated with desalination treatment technologies and disposal of brine concentrate. Each brackish groundwater desalination WMS has a calculated percent water loss of 10%.

5.2.33.3 Environmental and Cultural Considerations

Environmental Considerations

Vegetation and Land Use

The project area occurs in the Blackland Prairie ecoregion, and the project vicinity contains low-density residential development, agricultural fields, and some uncleared woodland. As mapped by TPWD[1], the dominant vegetation types in the project area are deciduous oak/evergreen motte and woodland, oak/hardwood motte and woodland, savanna grassland, and Ashe juniper motte and woodland.

Based on TPWD vegetation mapping, the project may have the potential to impact 1,305 acres of agricultural resources including 520 acres mapped as row crops, and 785 acres mapped as tame/disturbance grassland which may include pasture areas used for grazing or hay production.

[1] Texas Parks and Wildlife Department. 2019. Ecological Mapping Systems of Texas. https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/.

Construction of the WPT would result in conversion of native herbaceous and woody vegetation into industrial use. Project pipeline easements would require removal of woody vegetation and long-term maintenance (mowing, woody vegetation clearing) to maintain easement access. Herbaceous vegetation would be expected to quickly re-establish within pipeline easements once construction has been completed. Revegetation of easements and other disturbed areas provides the opportunity to plant native species that are beneficial to native wildlife. Revegetation plans are typically completed during preliminary studies and design phases of projects. It is up to the sponsors of each WMS to determine the best course of action regarding revegetation. Pipeline easements may continue to be used for agricultural purposes.

Aquatic Resources

Several intermittent streams and their associated floodplains are mapped in the project area. The NWI mapping shows 21.7 acres of ponds, lakes, and riverine wetlands as well as emergent wetlands in the project area.

The Texas Integrated Report of 303(d)-listed water bodies[2] identifies the water bodies or segments in Texas that do not meet assigned water quality standards. There are no streams within a mile of the project area listed as impaired. The project area does not contain ecologically significant stream segments as designated by TPWD.

The project will require an on-site delineation of streams, ponds, and wetlands. Stream crossings for pipeline construction would result in temporary stream impacts that would require USACE permitting. Pipeline stream crossings are typically covered by USACE Nationwide Permit 12, Utility Line Activities. A preconstruction notification to the USACE is required under certain conditions, including if there would be permanent impacts to over 0.1 acre of waters of the United States The USACE permit requires that there will be no change in preconstruction contours of waters of the United States. Utility crossings under stream (e.g., through horizontal directional drilling) would not require a USACE permit.

Threatened, Endangered, and Species of Concern

Table 5.2.33-1 provides a summary of threatened, endangered, and candidate species and species of concern that may occur in Hays County [3] [4]. Suitable habitat does not occur for any of the federally listed species with the potential to occur in the project region. However, several freshwater mussel species are under review for federal listing as threatened or endangered, and the well field study area includes portions of Plum Creek that may provide suitable habitat for freshwater mussels.

Suitable habitat may occur for the state threatened wood stork (*Mycteria americana*), white-faced ibis (*Plegadis chihi*), and Texas horned lizard (*Phrynosoma cornutum*). Potentially suitable habitat may occur

[2] Texas Commission on Environmental Quality. 2018. *2016 Texas Integrated Report of Surface Water Quality for the Clean Water Act Section 305(b) and 303(d).* https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf.

[3] Texas Parks and Wildlife Department. 2019. Annotated County Lists of Rare Species – Hays County. Last Update: July 17, 2019. https://tpwd.texas.gov/gis/rtest/.

[4] U.S. Fish and Wildlife Service. 2019. Information for Planning and Consultation Resource List – Hays County. https://ecos.fws.gov/ipac/location/4AS27B7475G4TDN27NPEFF2FYY/resources.

for numerous state wildlife, plant, and insect species designated by TPWD as SGCN. These species do not have formal protected status but are being monitored by TPWD. Migratory birds may occur in the project area, particularly in riparian zones and wetland areas.

Site-specific field surveys would be required to determine the quality of habitat and potential for impacts to state-listed species. Coordination with TPWD may be required to mitigate species impacts. If TWDB funding/financing will be used for the project, formal coordination with TPWD would likely be required to obtain their recommendations on minimizing impacts to protected species and sensitive habitats. If suitable habitat occurs, TPWD may request preconstruction surveys to search for and relocate any protected species that occur in the project area.

Migratory birds may fly through or nest in the project area. The federal MBTA protects birds, nests, and eggs unless permitted by USFWS. TPWD recommendations for project due diligence typically include a recommendation to conduct preconstruction nest surveys or avoid vegetation clearing during the general bird nesting season of March 15 to September 15. Preconstruction surveys for active bird nests are recommended.

Table 5.2.33-1 Summary of Potential Habitat and Anticipated Impacts to Threatened, Endangered, and Rare Species for County Line SUD Brackish Edwards Project, Hays County, Texas

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Amphibians					
Barton Springs salamander	*Eurycea sosorum*	E	E	Outlets of Barton Springs and subterranean water-filled caverns; found under rocks, in gravel, or among aquatic vascular plants and algae.	Project is outside of the expected range of this species.
Blanco blind salamander	*Eurycea robusta*	N/A	T	Water-filled subterranean caverns; may inhabit deep levels of the Balcones aquifer to the north and east of the Blanco River.	Project is outside of the expected range of this species.
Blanco River Springs salamander	*Eurycea pterophila*	N/A	SGCN	Springs and caves in the Blanco River drainage.	Project is outside of the expected range of this species.
San Marcos salamander	*Eurycea nana*	T	T	Headwaters of the San Marcos River downstream to about 0.5 mile past IH 35.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Strecker's chorus frog	*Pseudarcris streckeri*	N/A	SGCN	Prairies, wooded floodplains and flats, marshes, and cultivated fields; sand substrates preferred.	Low likelihood of suitable habitat in project vicinity.
Texas blind salamander	*Eurycea rathbuni*	E	SGCN	Water-filled subterranean caverns along six miles of the San Marcos Spring Fault.	Project is outside of the expected range of this species.
Texas salamander	*Eurycea neotenes*	N/A	SGCN	Cave streams, seeps, springs, and creek headwaters; Helotes and Leon Creek drainages.	Project is outside of the expected range of this species.
Woodhouse's toad	*Anaxyrus woodhousii*	N/A	SGCN	May use a variety of habitat types up to 5,000 feet elevation.	Suitable habitat may occur in project area.
Arachnids					
No accepted common name	*Cicurina russelli*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Cicurina ubicki*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Texella mulaiki*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Texella renkesae*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Cicurina ezelli*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Texella diplospina*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Texella grubbsi*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
No accepted common name	*Tartarocreagris grubbsi*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
Birds					

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water.	Suitable nesting habitat does not occur in project area; may fly over or forage in wetlands during migration.
Black-capped vireo	*Vireo atricapilla*	DL	E	Oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces.	Suitable habitat does not occur in project area; may fly over during migration.
Franklin's gull	*Leucophaeus pipixcan*	N/A	SGCN	Nests around lakes and marshes, may use fields and beaches during migration.	Suitable habitat does not occur in project area; may fly over during migration.
Golden-cheeked warbler	*Setophaga chrysoparia*	E	E	Ashe juniper in mixed stands with various oaks (*Quercus* species). Edges of cedar brakes.	Suitable habitat does not occur in project area; may fly over during migration.
Interior least tern	*Sterna antillarum athalassos*	E	E	Nests along sand and gravel bars within braided streams, rivers; also known to nest on manmade structures (inland beaches, wastewater treatment plants, gravel mines, etc.).	Suitable habitat does not occur in project area; may fly over during migration.
Mountain plover	*Charadrius montanus*	N/A	SGCN	Nests in shortgrass prairie, feeds in shortgrass fields and bare (e.g., plowed) soil.	Suitable habitat does not occur in project area; may fly over during migration.
Piping plover	*Charadrius melodus*	T	T	Winters along the Texas coast where it can be found on barrier islands and beaches or mudflats.	Suitable habitat does not occur in project area; may fly over during migration.
Tropical parula	*Setophaga pitiayumi*	N/A	T	Semi-tropical evergreen woodland along rivers and resacas.	Suitable habitat does not occur in project area; may fly over during migration.
Western burrowing owl	*Athene cunicularia hypugaea*	N/A	SGCN	Open grasslands and savannahs; may use open areas such as vacant lots; nests and roosts in abandoned burrows.	Suitable habitat may occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
White-faced ibis	*Plegadis chihi*	N/A	T	Irrigated rice fields, sloughs, and freshwater marshes; will attend brackish and saltwater habitats; confined to near-coastal rockeries.	Suitable habitat may occur within project area.
Whooping crane	*Grus americana*	E	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties. Roost predominantly in palustrine or riverine wetland systems (during migration).	Suitable habitat does not occur in project area; may fly over during migration.
Wood stork	*Mycteria americana*	N/A	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water. No breeding records in Texas since 1960.	Suitable habitat may occur within project area.
Zone-tailed hawk	*Buteo albonotatus*	N/A	T	Often near watercourses in arid open country, including mountain country, mesa, open deciduous, or pine-oak woodland.	Suitable habitat does not occur within project area; may fly over during migration.
Crustaceans					
Balcones Cave amphipod	*Stygobromus balconis*	N/A	SGCN	Subaquatic, subterranean obligate amphipod.	Suitable karst habitat does not occur in project area.
Ezell's Cave amphipod	*Stygobromus flagellatus*	N/A	SGCN	Known only from artesian wells.	Suitable karst habitat does not occur in project area.
No accepted common name	*Artesia subterranea*	N/A	SGCN	Cave dwelling.	Suitable karst habitat does not occur in project area.
No accepted common name	*Texiweckelia texensis*	N/A	SGCN	Cave dwelling.	Suitable karst habitat does not occur in project area.
No accepted common name	*Palaemonetes texanus*	N/A	SGCN	Found in fresh water.	Suitable habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
No accepted common name	*Calathaemon holthuisi*	N/A	SGCN	Cave dwelling.	Suitable karst habitat does not occur in project area.
Texas troglobitic water slater	*Lirceolus smithii*	N/A	SGCN	Subaquatic, subterranean obligate, aquifer.	Suitable karst habitat does not occur in project area.
Fishes					
American eel	*Anguila rostrata*	N/A	SGCN	Coastal waterways below reservoirs.	Suitable habitat does not occur in project area.
Fountain darter	*Etheostoma fonticola*	E	E	San Marcos and Comal Rivers; springs and spring-fed streams with dense beds of aquatic plants.	Project is outside of the expected range of this species.
Guadalupe bass	*Micropterus treculii*	N/A	SGCN	Perennial streams of the Edwards Plateau region.	Suitable habitat does not occur in project area.
Guadalupe darter	*Percina apristis*	N/A	SGCN	Over gravel or gravel and sand raceways of large rivers and streams.	Suitable river/stream habitat does not occur in project area.
Headwater catfish	*Ictalurus lupus*	N/A	SGCN	Rio Grande drainage, including Pecos River basin; springs and sandy and rocky riffles, runs, and pools of clear creeks and small rivers.	Suitable habitat does not occur in project area.
Ironcolor shiner	*Notropis chalybaeus*	N/A	SGCN	Often at the upstream ends of pools, with a moderate to sluggish current and sand, mud, silt, or detritus substrates.	Suitable stream habitat may occur in project area.
Texas shiner	*Notropis amabilis*	N/A	SGCN	Streams within the Edwards Plateau; rocky or sandy runs or pools.	Project is outside of the expected range of this species.
Insects					
A cave obligate beetle	*Rhadine austinica*	N/A	SGCN	Caves/karst features.	Suitable karst habitat does not occur in project area.
A mayfly	*Procloeon distinctum*	N/A	SGCN	Found in shoreline vegetation.	Suitable aquatic habitat may occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
American bumblebee	*Bombus pensylvanicus*	N/A	SGCN	Meadows, parks, gardens, forests, and open fields.	Suitable habitat may occur in project area.
Comal Springs diving beetle	*Comaldessus stygius*	N/A	SGCN	Known only from the outflows at Comal Springs; generally, inhabit the water column.	Project is outside of the expected range of this species.
Comal Springs dryopid beetle	*Stygoparnus comalensis*	E	E	Found crawling on stream bottoms or along shores.	Project is outside of the expected range of this species.
Comal Springs riffle beetle	*Heterelmis comalensis*	E	E	Comal and San Marcos Springs.	Project is outside of the expected range of this species.
Edwards Aquifer diving beetle	*Haideoporus texanus*	N/A	SGCN	Habitat poorly known; known from an artesian well in Hays County.	Project is outside of the expected range of this species.
No accepted common name	*Rhadine insolita*	N/A	SGCN	Cave dwelling.	Suitable karst habitat does not occur in project area.
No accepted common name	*Batrisodes grubbsi*	N/A	SGCN	Cave dwelling.	Suitable karst habitat does not occur in project area.
No accepted common name	*Neotrichia juani*	N/A	SGCN	Riparian/riverine.	Suitable aquatic habitat may occur in project area.
No accepted common name	*Oxyelophila callista*	N/A	SGCN	Woodlands.	Suitable habitat may occur in project area.
No accepted common name	*Ochrotrichia capitana*	N/A	SGCN	Riparian/riverine.	Suitable aquatic habitat may occur in project area.
No accepted common name	*Plauditus texanus*	N/A	SGCN	Riparian/riverine.	Suitable aquatic habitat may occur in project area.
No accepted common name	*Xiphocentron messapus*	N/A	SGCN	Riparian/riverine.	Suitable aquatic habitat may occur in project area.
San Marcos saddle-case caddisfly	*Protoptila arca*	N/A	SGCN	Known from an artesian well in Hays County.	Project is outside of the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas austrotinodes caddisfly	*Austrotinodes texensis*	N/A	SGCN	Ranges from cobble and gravel to limestone bedrock; many limestone outcroppings also found along the streams.	Project is outside of the expected range of this species.
Mammals					
American badger	*Taxidea taxus*	N/A	SGCN	Prefer grasslands and open areas.	Suitable habitat may occur in the project area.
Big brown bat	*Eptesicus fuscus*	N/A	SGCN	Woodlands or wooded areas.	Suitable habitat may occur in the project area.
Big free-tailed bat	*Nyctinomops macrotis*	N/A	SGCN	Roost in high canyon walls but will use buildings.	May use buildings/ structures in the project area.
Cave myotis bat	*Myotis velifer*	N/A	SGCN	Cave-dwelling, also roost in rock crevices, carports, bridges, old buildings, and abandoned cliff swallow nests; hibernate in limestone caves of Edwards Plateau.	May use buildings/ structures in the project area.
Eastern red bat	*Lasiurus borealis*	N/A	SGCN	Often associated with wooded areas; found in urban areas during migration.	Suitable habitat may occur in the project area.
Eastern spotted skunk	*Spilogale putorius*	N/A	SGCN	Open fields prairies, croplands, fence rows, farmyards, forest edges, and woodlands. Prefer wooded, brushy areas; tallgrass prairies.	Suitable habitat may occur in the project area.
Hoary bat	*Lasiurus cinereus*	N/A	SGCN	Forests and woods in east and central Texas.	Suitable habitat may occur in the project area.
Long-tailed weasel	*Mustela frenata*	N/A	SGCN	Usually close to water; rocky desert shrub, forest edges, brushlands, upland woods, fence rows, and bottomland hardwoods.	Suitable habitat may occur in the project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Mexican free-tailed bat	*Tadarida brasiliensis*	N/A	SGCN	Roosts in buildings or limestone caves on the Edwards Plateau; found in all habitats.	May use buildings/ structures in the project area.
Mexican long-tongued bat	*Choeronycteris mexicana*	N/A	SGCN	Riparian forest in Texas; roost in mines, large crevices, and caves.	Low potential for suitable habitat within the project area.
Mink	*Neovison vison*	N/A	SGCN	Close association with water; edges of lakes, wooded riparian zones, coastal swamps, and marshes.	Low potential for suitable habitat within the project area.
Mountain lion	*Puma concolor*	N/A	SGCN	Use wide range of habitats, especially rocky areas, canyons, riparian zones, and dense brush.	Low potential for suitable habitat within the project area.
Plains spotted skunk	*Spilogale putorius interrupta*	N/A	SGCN	Wide range of habitats; prefers tallgrass prairie and wooded, brushy areas.	Suitable habitat may occur in the project area.
Swamp rabbit	*Sylvilagus aquaticus*	N/A	SGCN	Found near water in fallen trees, thickets, and stumps.	Low potential for suitable habitat within the project area.
Tricolored bat	*Perimyotis subflavus*	N/A	SGCN	Caves; riparian areas, woodland, and forest.	Low potential for suitable habitat within the project area.
Western hog-nosed skunk	*Conepatus leuconotus*	N/A	SGCN	Deserts, woodlands, and grasslands; common in rocky canyon country.	Low potential for suitable habitat within the project area.
Western spotted skunk	*Spilogale gracilis*	N/A	SGCN	Farmlands, open areas, and woodlands.	Suitable habitat may occur within the project area.
Woodland vole	*Microtus pinetorum*	N/A	SGCN	Includes grassy marshes, swamp edges, old-field/pine woodland ecotones, tallgrass fields; generally sandy soils.	Suitable habitat may occur within the project area.
Mollusks					
False spike	*Fusconaia mitchelli*	N/A	T	Medium to large rivers; present in Guadalupe, Colorado, and Brazos river basins.	Low potential for suitable habitat to occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Glossy wolfsnail	*Euglandina texasiana*	N/A	SGCN	Terrestrial; south Texas, Rio Grande.	Project area is outside the expected range of this species.
Golden orb	*Cyclonaias aurea*	N/A	T	Sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins.	Low potential for suitable habitat to occur within project area. This species was recently a federal candidate species, but its listing as federally threatened or endangered was not warranted as it is not a valid species.
No accepted common name	*Holospira goldfussi*	N/A	SGCN	Terrestrial snail; Edwards Plateau.	Project area is outside the expected range of this species.
No accepted common name	*Millerelix gracilis*	N/A	SGCN	Terrestrial snail; Edwards Plateau.	Project area is outside the expected range of this species.
No accepted common name	*Elimia comalensis*	N/A	SGCN	Aquatic; found in springs in Central Texas.	Project area is outside the expected range of this species.
No accepted common name	*Phreatodrobia conica*	N/A	SGCN	Subaquatic; subterranean obligate.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Phreatodrobia micra*	N/A	SGCN	Subaquatic; subterranean obligate.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Phreatodrobia plana*	N/A	SGCN	Subaquatic; subterranean obligate.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Phreatodrobia punctata*	N/A	SGCN	Subaquatic; subterranean obligate.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Phreatodrobia rotunda*	N/A	SGCN	Subaquatic; subterranean obligate.	Suitable aquatic habitat does not occur in project area.
No accepted common name	*Cyclonaias necki*	N/A	SGCN	Guadalupe River basin; moderate to large streams with flowing water.	Low potential for suitable habitat to occur within project area.
Texas fatmucket	*Lampsilis bracteata*	C	T	Colorado River basin; streams and rivers on sand, mud, and gravel substrates; previously thought to occur in the Guadalupe River basin.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas pimpleback	*Cyclonaias petrina*	C	T	Colorado River basin; mud, gravel, and sand substrates in areas with slow flow rates; previously thought to occur in the Guadalupe River basin.	Project area is outside the expected range of this species.
Plants					
Bigflower cornsalad	*Valerianella stenocarpa*	N/A	SGCN	Along creek beds or in vernally moist grassy open areas.	Suitable habitat may occur within project area.
Bracted twistflower	*Streptanthus bracteatus*	C	SGCN	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations.	Project area is outside the expected range of this species.
Buckley tridens	*Tridens buckleyanus*	N/A	SGCN	Juniper-oak woodlands on rocky limestone slopes.	Project area is outside the expected range of this species.
Canyon mock-orange	*Philadelphus texensis var. ernestii*	N/A	SGCN	On outcrops of Cretaceous limestone exposed as rimrock along mesic canyons, usually in the shade of mixed evergreen-deciduous canyon woodland.	Project area is outside the expected range of this species.
Engelmann's bladdpod	*Physaria engelmannii*	N/A	SGCN	Grasslands and calcareous rock outcrops along the eastern edge of the Edwards Plateau, ranging as far north as the Red River.	Project area is outside the expected range of this species.
Glass Mountains coral-root	*Hexalectris nitida*	N/A	SGCN	Under Ashe juniper in woodlands over limestone on the Edwards Plateau, Callahan Divide, and Lampasas Cutplain.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Gravelbar brickellbush	*Brickellia dentata*	N/A	SGCN	Frequently-scoured gravelly alluvial beds in creek and river bottoms.	Suitable habitat may occur within project area.
Hall's prairie clover	*Dalea hallii*	N/A	SGCN	In grasslands on eroded limestone or chalk and in oak scrub on rocky hillsides.	Project area is outside the expected range of this species.
Heller's beardtongue	*Penstemon triflorus ssp. integrifolius*	N/A	SGCN	Post oak woodlands on sandy soils on the coastal plain.	Project area is outside the expected range of this species.
Heller's marbleseed	*Omosmodium helleri*	N/A	SGCN	Loamy calcareous soils in oak-juniper woodlands on rocky limestone slopes, often in more mesic portions of canyons.	Project area is outside the expected range of this species.
Hill Country wild-mercury	*Argythamnia aphoroides*	N/A	SGCN	Mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands, also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes.	Project area is outside the expected range of this species.
Narrowleaf brickellbush	*Brickellia eupatorioides var. gracillima*	N/A	SGCN	Occurs in a variety of vernally moist habitats in a number of natural regions.	Suitable habitat may occur within project area.
Net-leaf bundleflower	*Desmanthus reticulatus*	N/A	SGCN	Mostly on clay prairies of the coastal plain of central and south Texas.	Suitable habitat may occur within project area.
Osage Plains false foxglove	*Agalinis densiflora*	N/A	SGCN	Grasslands on shallow, gravelly, well drained, calcareous soils; prairies, dry limestone soils.	Suitable habitat may occur within project area.
Plateau loosestrife	*Lythrum ovalifolium*	N/A	SGCN	Banks and gravelly beds of perennial (or strong intermittent) streams on the Edwards Plateau, Llano Uplift, and Lampasas Cutplain.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Plateau milkvine	*Matelea edwardsensis*	N/A	SGCN	Various types of juniper-oak and oak-juniper woodlands.	Project area is outside the expected range of this species.
Scarlet leather-flower	*Clematis texensis*	N/A	SGCN	In oak-juniper woodlands in mesic rocky limestone canyons or along perennial streams.	Project area is outside the expected range of this species.
Spreading leastdaisy	*Chaetopappa effusa*	N/A	SGCN	Limestone cliffs, ledges, bluffs, steep hillsides, sometimes in seepy areas, oak-juniper, oak, or mixed deciduous woods, 300 to 500 meter elevation.	Project area is outside the expected range of this species.
Sycamore-leaf snowbell	*Styrax platanifolius ssp. platanifolius*	N/A	SGCN	Usually in oak-juniper woodlands on steep rocky banks and ledges along intermittent or perennial streams.	Project area is outside the expected range of this species.
Texas amorpha	*Amorpha roemeriana*	N/A	SGCN	Juniper-oak woodlands or shrublands on rocky limestone slopes, sometimes on dry shelves above creeks.	Project area is outside the expected range of this species.
Texas barberry	*Berberis swaseyi*	N/A	SGCN	Shallow calcareous stony clay of upland grasslands/shrublands over limestone as well as in loamier soils in openly wooded canyons and on creek terraces.	Project area is outside the expected range of this species.
Texas claret-cup cactus	*Echinocereus coccineus var. paucispinus*	N/A	SGCN	Occurs in rocky outcroppings, often in the partial-shade of oak and pine-oak woodlands and mixed conifer forest.	Project area is outside the expected range of this species.
Texas fescue	*Festuca versuta*	N/A	SGCN	Occurs in mesic woodlands on limestone-derived soils on stream terraces and canyon slopes.	Project area is outside the expected range of this species.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas seymeria	*Seymeria texana*	N/A	SGCN	Found primarily in grassy openings in juniper-oak woodlands on dry rocky slopes but sometimes on rock outcrops in shaded canyons.	Project area is outside the expected range of this species.
Texas wild-rice	*Zizania texana*	E	E	Spring-fed river, in clear, cool, swift water mostly less than 1 meter deep, with coarse sandy soils.	Project area is outside the expected range of this species.
Threeflower penstemon	*Penstemon triflorus ssp. triflorus*	N/A	SGCN	Occurs sparingly on rock outcrops and in grasslands associated with juniper-oak woodlands.	Project area is outside the expected range of this species.
Tree dodder	*Cuscuta exaltata*	N/A	SGCN	Parasitic on various *Quercus, Juglans, Rhus, Vitis, Ulmus,* and *Diospyros* species as well as *Acacia berlandieri*.	Suitable habitat may occur within project area.
Turnip-root scurf	*Pediomelum cyphocalyx*	N/A	SGCN	Grasslands and openings in juniper-oak woodlands on limestone substrates on the Edwards Plateau and in north-central Texas.	Project area is outside the expected range of this species.
Warnock's coral-root	*Hexalectris warnockii*	N/A	SGCN	In leaf litter and humus in oak-juniper woodlands on shaded slopes and intermittent, rocky creek beds in canyons.	Project area is outside the expected range of this species.
Reptiles					
Cagle's map turtle	*Graptemys caglei*	N/A	T	Shallow water with gravel or cobble bottom and swift to moderate flow; Guadalupe River system.	Suitable aquatic habitat does not occur in project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Common garter snake	*Thamnophis sirtalis*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur within project area.
Eastern box turtle	*Terrapene carolina*	N/A	SGCN	Found in fields, forests, forest-brush, and forest-field.	Suitable habitat may occur within project area.
Keeled earless lizard	*Holbrookia propinqua*	N/A	SGCN	Barrier islands, coastal dunes, and other sandy areas.	Suitable habitat may occur within project area.
Northern spot-tailed earless lizard	*Holbrookia lacerata lacerate*	N/A	SGCN	Open prairie-brushland, free of vegetation or obstructions; Edwards Plateau.	Suitable habitat does not occur in project area.
Slender glass lizard	*Ophisaurus attenuates*	N/A	SGCN	Wooded areas, dry grasslands, sand prairies, oak savannahs, pine barrens, and oil fields.	Suitable habitat may occur within project area.
Spot-tailed earless lizard	*Holbrookia lacerata*	N/A	SGCN	Moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas.	Suitable habitat may occur within project area.
Texas garter snake	*Thamnophis sirtalis annectens*	N/A	SGCN	Irrigation canals and riparian-corridor farmlands in west; marshy, flooded pastureland, grassy or brushy borders of permanent bodies of water; coastal salt marshes.	Suitable habitat may occur within project area.
Texas horned lizard	*Phrynosoma cornutum*	N/A	T	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush, or scrubby trees.	Suitable habitat may occur within project area.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	SUITABLE HABITAT	POTENTIAL IMPACTS
Texas map turtle	*Graptemys versa*	N/A	SGCN	Rivers with moderate current, abundant aquatic vegetation, and basking logs; also associated oxbows and lakes.	Suitable aquatic habitat does not occur in project area.
Western box turtle	*Terrapene ornata*	N/A	SGCN	Prairie grassland, pasture, fields, sandhills, and open woodland; prefer sandy soils. Sometimes enter slow, shallow streams and creek pools.	Suitable habitat may occur within project area.
Western hognose snake	*Heterodon nasicus*	N/A	SGCN	Sandy or gravelly soils, including prairies, sandhills, wide valleys, river floodplains, bajadas, semi-agricultural areas (but not intensively cultivated), and margins of irrigation ditches. Also, thornscrub woodlands and chaparral thickets.	Suitable habitat does not occur in project area.
T = Threatened E = Endangered C = Candidate DL = Delisted N/A – Not applicable SGCN = Species of Greatest Conservation Need (designated by TPWD, but not formally listed as T or E)					

Cultural Considerations

Projects in Texas can come under the purview of the NHPA and the ACT. Both are administered by the THC, the SHPO in Austin, Texas. If an undertaking is federally permitted, licensed, or partially funded, the Project must comply with Section 106 of the NHPA. The ACT requires projects on land owned or operated by a political subdivision of the State of Texas[5] to assess whether the project will impact cultural resources that meet the requirements for listing as a State Antiquities Landmark.

The background literature review identified two previously recorded archaeological sites intersecting or immediately adjacent (within 300 feet) to the project area (Table 5.2.33-2; THC 2019). One archaeological site is a historic farmstead determined to be ineligible for listing in the NRHP. The other site is a prehistoric lithic artifact scatter and historic farmstead also determined to be ineligible for NRHP

[5] Political subdivision entities include any county, municipality, special district, river authority or compact, Title 4 Water Code District, soil and water conservation district, county or municipal improvement district, regional planning commission, council of government, or utility that is public-owned. Refer to TX Code § 2254.021.

listing. The review identified 187 potentially historic-age buildings intersecting or immediately adjacent to the project area. No cemeteries or NRHP-listed properties are known to be near the project.

The model used assessed unrecorded archaeological site potential within the project area to include low to moderate potential zones, ranging from 26 percent to 49 percent likelihood for the project area to contain unidentified archaeological resources. The areas with greatest archaeological probability are located near the two previously documented archaeological sites and the landforms adjacent to existing drainages.

Projects under control of political subdivisions of the State of Texas, such as water agencies, counties, and city-owned entities, must comply with the ACT. As previously discussed, the project may also have to comply with the NHPA. The overall calculated cultural resources assessment score is 237.0 (higher scores indicate higher potential for cultural resources). Based on the results of the background review, SWCA recommends that a structured cultural resources survey of the final design plan be performed to accurately assess the presence and significance of identified and unrecorded cultural resources within its boundaries. While the overall assessment score is high, the majority of the nearby resources are potential historic-age structures, which can likely be avoided during the project design phase pending the results of a cultural resources inventory.

Table 5.2.33-2 Cultural Resources Results

RESOURCE NAME	RESOURCE TYPE	PREHISTORIC/HISTORIC	NRHP ELIGIBILITY	LOCATION
Archaeological site	Lithic Artifact Scatter and Farmstead	Prehistoric and Historic	Ineligible	Intersect
Archaeological site	Farmstead	Historic	Ineligible	Intersect
None	187 Buildings	Historic	–	Adjacent/Intersect
			ASSESSMENT SCORE TOTAL:	**237.0**

5.2.33.4 Engineering and Costing

Preliminary engineering and costing analyses have been performed using the 2021 Regional Water Planning methods. Black & Veatch utilized the Uniform Costing Tool, which includes standard costing procedures and method for calculating unit costs. The estimated costs include all facilities required for water production, collection, transmission, and treatment. Phase 1 of the County Line SUD Brackish Edwards Project will consist of two production wells, one injection well, and infrastructure for desalination and disinfection. Phase 1 is expected to produce 500 acft/yr of potable water. Phases 2 and 3 will each consist of one additional production well for each phase in the existing wellfield. Phases 2 and 3 will each produce an additional 500 acft/yr.

Given the anticipated TDS concentration of the water, treatment for desalination and disinfection is assumed to be necessary to meet drinking water standards. Well pumps will be sized to deliver raw water to the water treatment infrastructure. The cost estimate does not include delivery of treated water to the County Line SUD distribution system. Costs associated with land acquisition, WTP, injection well, and pump station are shared with the County Line SUD Trinity Well Field WMS (See Section 5.2.32 for the WMS evaluation), which is co-located with this County Line SUD Brackish Edwards Project.

Cost estimates were calculated for capital costs, annual debt service, O&M, power, land acquisition, and environmental mitigation. Estimated project costs for Phase 1 are $11,185,000 (Table 5.2.33-3) and for Phases 2 and 3 are each $1,217,000 (Table 5.2.33-4 and Table 5.2.33-5). Accounting for debt service, O&M, and pumping energy, the annual cost for Phase 1 is about $3,610 per acft/yr and Phase 2 and Phase 3 each are $192 per acft/yr.

Table 5.2.33-3 Phase 1 Cost Estimate Summary

ITEM	ESTIMATED COST FOR FACILITIES
Well Fields (wells, pumps, and piping)	$2,757,000
Water Treatment Plant (2.3 mgd)	$5,277,000
TOTAL COST OF FACILITIES	**$8,034,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$2,812,000
Environmental and Archaeology Studies and Mitigation	$19,000
Land Acquisition and Surveying (3 acres)	$20,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$300,000
TOTAL COST OF PROJECT	**$11,185,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$787,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$28,000
Water Treatment Plant	$989,000
Pumping Energy Costs (50,641 kWh at 0.08 $/kWh)	$1,000
TOTAL ANNUAL COST	**$1,805,000**
Available Project Yield (acft/yr)	500
Annual Cost of Water ($ per acft)	$3,610
Annual Cost of Water After Debt Service ($ per acft)	$2,036
Annual Cost of Water ($ per 1,000 gallons)	$11.08
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$6.25
Based on a Peaking Factor of 1.0	

Table 5.2.33-4 Phase 2 Cost Estimate Summary

ITEM	ESTIMATED COST FOR FACILITIES
Well Fields (wells, pumps, and piping)	$868,000
TOTAL COST OF FACILITIES	**$868,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$304,000
Environmental and Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$6,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$33,000
TOTAL COST OF PROJECT	**$1,217,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$86,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$9,000
Water Treatment Plant	$1,000
Pumping Energy Costs (14,362 kWh at 0.08 $/kWh)	**$96,000**
TOTAL ANNUAL COST	$86,000
Available Project Yield (acft/yr)	500
Annual Cost of Water ($ per acft)	$192
Annual Cost of Water After Debt Service ($ per acft)	$20
Annual Cost of Water ($ per 1,000 gallons)	$0.59
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.06
Based on a Peaking Factor of 1.0	

Table 5.2.33-5 Phase 3 Cost Estimate Summary

ITEM	ESTIMATED COST FOR FACILITIES
Well Fields (wells, pumps, and piping)	$868,000
TOTAL COST OF FACILITIES	**$868,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes and 35% for all other facilities)	$304,000
Environmental and Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$6,000
Interest During Construction (3% for 1 years with a 0.5% return on investment)	$33,000
TOTAL COST OF PROJECT	**$1,217,000**
ANNUAL COST	
Debt Service (3.5%, 20 years)	$86,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of cost of facilities)	$9,000
Water Treatment Plant	$1,000
Pumping Energy Costs (14,362 kWh at 0.08 $/kWh)	**$96,000**
TOTAL ANNUAL COST	$86,000
Available Project Yield (acft/yr)	500
Annual Cost of Water ($ per acft)	$192
Annual Cost of Water After Debt Service ($ per acft)	$20
Annual Cost of Water ($ per 1,000 gallons)	$0.59
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.06
Based on a Peaking Factor of 1.0	

5.2.33.5 Implementation Considerations

Information presented in this WMS was provided by County Line SUD and represents the current plan, which is based on the sponsor's current understanding of the system. Implementation of the County Line SUD Brackish Edwards Project WMS will require permits and approvals from TCEQ and the EAA. Given the approximate location of the well field, the proposed wells could be regulated by Plum Creek GCD, Barton Springs Edwards Aquifer CD, or EAA. Close coordination with the regulating entity will be required to secure appropriate permits. General requirements for the TCEQ and EAA are discussed below.

- TCEQ:
  - Review and approval of technical specifications for all new or rehabilitated components of the public water system;
  - Review and approval of facilities and water quality to begin operations; and
  - Review and approval of injection well permit.
- EAA:
  - Obtain a "Drilling Through the Edwards Aquifer" Well Construction Permit from the EAA for the construction of wells passing through the Edwards Aquifer;
  - Verification of available groundwater quantity and well productivity;
  - Verification of water quality; and
  - Verification of minimal impacts to the aquifers, particularly as it relates to applicable DFCs.

Reliability

Water from these sources is considered to be low to medium because of uncertainty involved in the little data available from this area. Test hole drilling and evaluation recommended (reliability score = 2).

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FINAL PLAN

SECTION 5.3: WATER USER GROUP PLANS BY COUNTY

South Central Texas Regional Water Plan

B&V PROJECT NO. 123456

PREPARED FOR

South Central Texas Regional Water Planning Group

5 NOVEMBER 2020

BLACK & VEATCH

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5.3 WATER USER GROUP PLANS BY COUNTY

The following section presents recommended WMSs for each WUG to meet projected needs in the planning horizon. The proposed plan to meet the specific needs of municipal, industrial, steam-electric power, and mining WUGs located within the region is to implement water conservation programs to reduce water demands to the extent possible, and develop additional groundwater and surface water supplies located as near as possible to each respective water user to the extent that supplies are available. As local supply development potentials for each respective user group are exhausted, WMSs located at greater distances from the water users are recommended.

In the case of the irrigation WUG, the SCTRWPG found that, at the present time, it is not economically feasible to meet all of the projected irrigation water needs (shortages). However, the proposed plan encourages includes Advanced Water Conservation as a recommended WMS for irrigation to meet as much as possible of the projected irrigation needs of the region. Therefore, each individual irrigation water user is encouraged to install Low Energy Precision Application (LEPA), or other efficient irrigation systems, that will result in irrigation water savings because of the lower irrigation water application requirements.

In the case of "County-Other" (individual households and business establishments) water users, the projections have included local surface and groundwater quantities to meet projected needs. However, no specific plans have been formulated to supply the projected quantities of water needed. Instead, it is presumed that those individual households and businesses that are located in rural areas, and rural- and investor-owned water supply districts, authorities, and companies that operate public water supply systems to serve rural areas will meet these needs either from locally available supplies, or through arrangements to obtain water from other water utilities.

Tables included in this section illustrate the phased implementation of WMSs to meet the needs of WUGs located within the county. Counties are presented in alphabetical order from Atascosa County to Zavala County, with WUGs listed within each county. More detailed information regarding allocation of new water supplies to specific WUGs may be found in the subsequent subsections under each county. In each county plan, each WUG of the county is listed, and Advanced Water Conservation has been included in the plan for each municipal water user and irrigation user, where appropriate. In addition, if the WUG has a need (shortage) during the planning horizon, one or more WMS is recommended to meet the need.

The total unit costs of potable water (surface water treated to regulatory standards for public supply and/or groundwater that meets regulatory standards for public supply), delivered to the WUGs' retail distribution systems were calculated in September 2018 dollars. For more information on how costs were calculated for a specific WMS, see Section 5.2.

It was necessary to allocate the costs of large-scale, regional WMSs among the WUGs they are intended to serve. The allocation procedure was to prorate the total annual costs to each WUG to be supplied from a WMS based on the WUG's proportion or share of quantity obtained from that strategy in each decade. In this way, a unit cost representative of the strategy in full operation is shown for all participating WUGs. WUGs may actually be required to begin paying their pro-rata share of annual debt service at the time the strategy is implemented based on their ultimate share of the new supply whether or not they have begun taking water. The basis for this principle of dividing debt service among WUGs is to facilitate the development of a strategy to its relevant size, and to ensure that those user groups who need the water will have invested in and thereby reserved their respective shares so that water will be there when needed. In the case of Region L, many WUGs will need the water as soon as the WMS can be implemented. It is important to note that individual WUGs could participate in the development of a WMS in the cost sharing manner outlined here, and then lease part or all of their respective shares to others until they have grown enough to fully utilize them. Therefore, few, if any, user groups would be paying debt service for idle capacity.

It has been assumed that one or more WWPs will implement the large-scale, distantly located WMSs recommended in the Regional Plan, and since these supplies are needed as soon as possible, the WUGs (customers) will begin paying debt service and O&M costs on the basis of their pro-rata share of the quantities of water taken. Recommended WMSs to meet the projected needs of each WUG and WWP in the South Central Texas Region are summarized in tables generated by the TWDB Regional Water Planning Database (DB22) in Appendix 2-A.

Notes when reviewing these tables:

- Volumes and costs with a dash, " – ", indicate that the WMS or project is not online yet; and
- Zero dollar costs indicate WMS is online, but no infrastructure is required in or in place already (e.g. Local Groundwater strategy that requires additional permits).

5.3.1 Atascosa County Water Supply Plan

Table 5.3.1-1 lists each WUG in Atascosa County and its corresponding management supply surplus or shortage (need) in the 2020 and 2070 decades. For each WUG with a projected need, or shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.1-1 Atascosa County Supply Surplus/Need by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED)		COMMENT
	2020 (ACFT/YR)	2070 (ACFT/YR)	
Benton City WSC	732	(345)	Projected Needs (2050 through 2070)
City of Charlotte	759	558	No Projected Needs
County-Other, Atascosa	464	614	No Projected Needs
Irrigation, Atascosa	3,618	3,482	No Projected Needs
Jourdanton	1,229	605	No Projected Needs
Livestock, Atascosa	0	0	No Projected Needs
Lytle	(354)	(884)	Projected Needs (2020 through 2070)
Manufacturing, Atascosa	0	0	No Projected Needs

WATER USER GROUP	PROJECTED SURPLUS / (NEED)		COMMENT
	2020 (ACFT/YR)	2070 (ACFT/YR)	
McCoy WSC	1,135	577	No Projected Needs
Mining, Atascosa	0	0	No Projected Needs
Pleasanton	2,596	1,103	No Projected Needs
Poteet	328	66	No Projected Needs
Steam-Electric Power, Atascosa	0	0	No Projected Needs

5.3.1.1 Benton City WSC

Current water supply for Benton City WSC is obtained from the Carrizo-Wilcox Aquifer. Benton City WSC is projected to need additional water supplies prior to 2060. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Benton City WSC implement the following water supply plan to meet their projected needs (Table 5.3.1-2):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 60 acft/yr by 2070.
- Expansion of Local Groundwater sources is to be implemented prior to 2060. This strategy can provide an additional 153 acft/yr by 2060, increasing to 345 acft/yr by 2070.

Table 5.3.1-2 Recommended Water Supply Plan for Benton City WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	732	490	268	54	(153)	(345)
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	60
Local Groundwater	-	-	-	-	153	345
WMS Supply	**0**	**0**	**0**	**0**	**153**	**405**

Estimated costs associated with the recommended WMSs to meet Benton City WSC's projected needs are shown in Table 5.3.1-3.

Table 5.3.1-3 Recommended Plan Costs by Decade for Benton City WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	46,427
Unit Cost ($/acft)	-	-	-	-	-	770

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Local Groundwater						
Annual Cost ($/yr)	-	-	-	-	0	0
Unit Cost ($/acft)	-	-	-	-	0	0

5.3.1.2 City of Charlotte

The City of Charlotte is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the City's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Charlotte implement the following water supply plan (Table 5.3.1-4).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 8 acft/yr by 2020, increasing to 73 acft/yr of supply in 2070.

Table 5.3.1-4 Recommended Water Supply Plan for Charlotte

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	759	717	678	637	596	558
Recommended WMS						
Advanced Water Conservation	8	27	33	43	57	73
WMS Supply	**8**	**27**	**33**	**43**	**57**	**73**

Estimated costs of the recommended plan for the City of Charlotte are shown in Table 5.3.1-5.

Table 5.3.1-5 Recommended Plan Costs by Decade for Charlotte

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	6,095	20,700	25,027	32,895	43,991	55,922
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.1.3 County-Other, Atascosa

Current water supply for County-Other, Atascosa is obtained from the Carrizo-Wilcox Aquifer and is projected to have adequate supply through 2070.

5.3.1.4 Irrigation, Atascosa

Irrigation, Atascosa is projected to have adequate water supplies available from the Edwards, Carrizo-Wilcox, Sparta, and Queen City Aquifers, and run-of-river rights.

5.3.1.5 Jourdanton

Current water supply for the City of Jourdanton is obtained from the Carrizo-Wilcox Aquifer and is projected to have adequate supply through 2070. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Jourdanton implement the following water supply plan (Table 5.3.1-6).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 38 acft/yr by 2020, increasing to 442 acft/yr of supply in 2070.

Table 5.3.1-6 Recommended Water Supply Plan for Jourdanton

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	1,229	1,097	974	848	723	605
Recommended WMS						
Advanced Water Conservation	38	125	232	326	382	442
WMS Supply	**38**	**125**	**232**	**326**	**382**	**442**

Estimated costs of the recommended plan to meet the City of Jourdanton's projected needs are shown in Table 5.3.1-7.

Table 5.3.1-7 Recommended Plan Costs by Decade for Jourdanton

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	29,003	96,548	178,941	250,912	294,316	340,566
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.1.6 Livestock, Atascosa

Livestock, Atascosa is projected to have adequate water supplies available from local sources to meet the WUG's projected demand during the planning period.

5.3.1.7 Lytle

Current water supply for the City of Lytle is obtained from the Edwards Aquifer. Lytle is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Lytle implement the following water supply plan to meet the projected needs for the city (Table 5.3.1-8).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 25 acft/yr by 2020, increasing to 286 acft/yr of supply in 2070.
- Edwards Transfers is to be implemented prior to 2020. This strategy can provide an additional 350 acft/yr by 2020, increasing to 650 acft/yr by 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 18 acft/yr in 2020.

Table 5.3.1-8 Recommended Water Supply Plan for Lytle

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(354)	(472)	(578)	(684)	(789)	(884)
Recommended WMS						
Advanced Water Conservation	25	94	166	199	242	286
Drought Management	18	-	-	-	-	-
Edwards Transfers	350	400	450	500	600	650
WMS Supply	**393**	**494**	**616**	**699**	**842**	**936**

Estimated costs of the recommended plan to meet the City of Lytle's projected needs are shown in Table 5.3.1-9.

Table 5.3.1-9 Recommended Plan Costs by Decade for Lytle

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	16,941	63,827	112,932	135,777	164,868	194,546
Unit Cost ($/acft)	681	681	681	681	681	681
Drought Management						
Annual Cost ($/yr)	804	-	-	-	-	-
Unit Cost ($/acft)	45	-	-	-	-	-
Edwards Transfers						
Annual Cost ($/yr)	434,874	496,999	559,124	621,249	745,498	807,623
Unit Cost ($/acft)	1,242	1,242	1,242	1,242	1,242	1,242

5.3.1.8 Manufacturing, Atascosa

Manufacturing, Atascosa is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the WUG's projected demand during the planning period.

5.3.1.9 McCoy WSC

McCoy WSC is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet projected demands during the planning period.

5.3.1.10 Mining, Atascosa

Mining, Atascosa is projected to have adequate water supplies available from the Carrizo-Wilcox and Queen City Aquifers to meet the WUG's projected demand during the planning period.

5.3.1.11 Pleasanton

The City of Pleasanton is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Pleasanton implement the following water supply plan (Table 5.3.1-10).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 95 acft/yr by 2020, increasing to 1,130 acft/yr of supply in 2070.

Table 5.3.1-10 Recommended Water Supply Plan for Pleasanton

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	2,596	2,278	1,983	1,681	1,383	1,103
Recommended WMS						
Advanced Water Conservation	95	307	565	846	985	1,130
WMS Supply	**95**	**307**	**565**	**846**	**985**	**1,130**

Estimated costs of the recommended plan to meet the City of Pleasanton projected needs are shown in Table 5.3.1-11.

Table 5.3.1-11 Recommended Plan Costs by Decade for Pleasanton

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	72,948	236,736	435,117	651,528	758,350	870,461
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.1.12 Poteet

The City of Poteet is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the city's projected demands during the planning period.

5.3.1.13 Steam-Electric Power, Atascosa

Steam-Electric, Atascosa is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the WUG's projected demand during the planning period.

5.3.2 Bexar County Water Supply Plan

Table 5.3.2-1 lists each WUG in Bexar County and its corresponding management supply or shortage in 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.2-1 Bexar County Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED) 2020 (ACFT/YR)	PROJECTED SURPLUS / (NEED) 2070 (ACFT/YR)	COMMENT
Air Force Village II Inc	(104)	(144)	Projected Needs (2020 through 2070)
Alamo Heights	(942)	(950)	Projected Needs (2020 through 2070)
Atascosa Rural WSC	(871)	(2,017)	Projected Needs (2020 through 2070)
Bexar County WCID 10	(417)	(555)	Projected Needs (2020 through 2070)
Converse	(350)	(713)	Projected Needs (2020 through 2070)
County-Other, Bexar	3,685	3,685	No Projected Needs
East Central SUD	1,100	101	No Projected Needs
Elmendorf	(31)	(419)	Projected Needs (2020 through 2070)
Fair Oaks Ranch	351	(1,070)	Projected Needs (2040 through 2070)
Fort Sam Houston	(1,919)	(1,008)	Projected Needs (2020 through 2070)
Irrigation	0	0	No Projected Needs
Kirby	(191)	(222)	Projected Needs (2020 through 2070)
Lackland Air Force Base	(9)	100	Projected Needs 2020 decade only
Leon Valley	(263)	(908)	Projected Needs (2020 through 2070)
Live Oak	(482)	(448)	Projected Needs (2020 through 2070)
Livestock	0	0	No Projected Needs
Lytle	-	-	See Atascosa County
Manufacturing, Bexar	936	85	No Projected Needs
Mining, Bexar	0	0	No Projected Needs
Randolph Air Force Base	79	11	No Projected Needs
SAWS (WUG Data)	8,019	(97,624)	Projected Needs (2030 through 2070); refer to Section 5.4 for WWP informatio

WATER USER GROUP	PROJECTED SURPLUS / (NEED) 2020 (ACFT/YR)	2070 (ACFT/YR)	COMMENT
Selma	500	(403)	Projected Needs (2030 through 2070)
Shavano Park	(264)	(633)	Projected Needs (2020 through 2070)
Steam-Electric Power, Bexar	(2,872)	(2,872)	Projected Needs (2020 through 2070)
The Oaks WSC	(138)	(368)	Projected Needs (2020 through 2070)
Universal City	(299)	(216)	Projected Needs (2020 through 2070)
Water Services	66	(485)	Projected Needs (2030 through 2070)
Green Valley SUD	-	-	See Comal County
Schertz	-	-	See Guadalupe County

5.3.2.1 Air Force Village II Inc

Current water supply for the Air Force Village II Inc is obtained from the Edwards Aquifer. Air Force Village II Inc is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Air Force Village II Inc implement the following water supply plan to meet the projected needs for the WUG (Table 5.3.2-2):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 9 acft/yr by 2020, increasing to 85 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 3 acft/yr in 2020.
- Purchase from WWP (SAWS) is to be implemented prior to 2020. This strategy can provide an additional supply of 107 acft/yr by 2020, increasing to 74 acft/yr of additional supply by 2070.

Table 5.3.2-2 Recommended Water Supply Plan for Air Force Village II Inc

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(104)	(126)	(145)	(144)	(144)	(144)
Recommended WMS						
Advanced Water Conservation	9	27	46	62	78	85
Drought Management	3	-	-	-	-	-
Purchase from WWP (SAWS)	107	114	114	97	81	74
WMS Supply	**119**	**141**	**160**	**159**	**159**	**159**

Estimated costs of the recommended plan to meet the Air Force Village II Inc projected needs are shown in Table 5.3.2-3.

Table 5.3.2-3 Recommended Plan Costs by Decade for Air Force Village II Inc

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	6,786	20,606	35,192	47,917	60,122	65,496
Unit Cost ($/acft)	770	770	770	770	770	770
Drought Management						
Annual Cost ($/yr)	382	-	-	-	-	-
Unit Cost ($/acft)	127	-	-	-	-	-
Purchase from WWP (SAWS)						
Annual Cost ($/yr)	74,964	79,868	79,868	67,958	118,501	108,260
Unit Cost ($/acft)	701	701	701	701	1,463	1,463

5.3.2.2 Alamo Heights

Current water supply for the City of Alamo Heights is obtained from the Edwards Aquifer. Alamo Heights is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Alamo Heights implement the following water supply plan to meet the projected needs for the city (Table 5.3.2-4):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 103 acft/yr by 2020, increasing to 892 acft/yr of supply in 2070.
- Edwards Transfers is to be implemented prior to 2020. This strategy can provide an additional supply of 804 acft/yr by 2020, increasing to 73 acft/yr of additional supply by 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 50 acft/yr in 2020.

Table 5.3.2-4 Recommended Water Supply Plan for Alamo Heights

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(942)	(993)	(965)	(953)	(950)	(950)
Recommended WMS						
Advanced Water Conservation	103	279	440	600	752	892
Drought Management	50	-	-	-	-	-
Edwards Transfers	804	729	540	369	213	73
WMS Supply	**957**	**1,008**	**980**	**969**	**965**	**965**

Estimated costs of the recommended plan to meet Alamo Heights projected needs are shown in Table 5.3.2-5.

Table 5.3.2-5 Recommended Plan Costs by Decade for Alamo Heights

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	70,470	189,818	299,827	408,389	511,919	607,397
Unit Cost ($/acft)	681	681	681	681	681	681
Drought Management						
Annual Cost ($/yr)	4,414	-	-	-	-	-
Unit Cost ($/acft)	88	-	-	-	-	-
Edwards Transfers						
Annual Cost ($/yr)	997,972	905,749	670,340	457,440	264,898	90,765
Unit Cost ($/acft)	1,242	1,242	1,242	1,242	1,242	1,242

5.3.2.3 Atascosa Rural WSC

Current water supply for Atascosa Rural WSC is obtained from the Edwards Aquifer. Atascosa Rural WSC is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Atascosa Rural WSC implement the following water supply plan to meet the projected needs for the WSC (Table 5.3.2-6):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 50 acft/yr by 2070.
- Local Groundwater management is to be implemented prior to the 2020 decade. This strategy can provide an additional 1,049 acft/yr of supply by 2020, increasing to 2,098 acft/yr by 2030.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 59 acft/yr by 2020.
- Facilities Expansion: Atascosa Rural WSC Interconnects are to be implemented or enhanced in the immediate future. The anticipated total capacity for this strategy is 5,600 acft/yr by the 2020 decade. This is not new water supply. Data shown below represents WMS supply water availability consistent with TWDB data. See Section 5.2.8.2 for more details.

Table 5.3.2-6 Recommended Water Supply Plan for Atascosa Rural WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(871)	(1,119)	(1,353)	(1,588)	(1,811)	(2,017)
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	50

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Drought Management	59	-	-	-	-	-
Local Groundwater	1,049	2,098	2,098	2,098	2,098	2,098
Facilities Expansion: Atascosa Rural WSC Interconnects	31	31	31	31	31	31
WMS Supply	**1,139**	**2,129**	**2,129**	**2,129**	**2,129**	**2,179**

Estimated costs of the recommended plan to meet Atascosa Rural WSC's projected needs are shown in Table 5.3.2-7.

Table 5.3.2-7 Recommended Plan Costs by Decade for Atascosa Rural WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	0	0	0	0	0	38,360
Unit Cost ($/acft)	0	0	0	0	0	770
Drought Management						
Annual Cost ($/yr)	5,234	-	-	-	-	-
Unit Cost ($/acft)	89	-	-	-	-	-
Local Groundwater						
Annual Cost ($/yr)	491,000	982,000	753,500	525,000	525,000	525,000
Unit Cost ($/acft)	468	468	359	250	250	250
Facilities Expansion: Atascosa Rural WSC Interconnects[1]						
Annual Cost ($/yr)	274,000	274,000	67,000	67,000	67,000	67,000
Unit Cost ($/acft)	8,839	8,839	2,161	2,161	2,161	2,161

[1] Facilities Expansion unit costs are representative of WMS supplies detailed in Table 5.4-3; not the anticipated volumes.

5.3.2.4 Bexar County WCID 10

Current water supply for Bexar County WCID 10 is obtained from the Edwards Aquifer. Bexar County WCID 10 is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Bexar County WCID 10 implement the following water supply plan to meet the projected needs for the WSC (Table 5.3.2-8):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 51 acft/yr by 2020, increasing to 372 acft/yr by 2070.

- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 33 acft/yr by 2020.
- Purchase from WWP (SAWS) is to be implemented prior to 2020. This strategy can provide an additional supply of 348 acft/yr by 2020, and up to 198 acft/yr of additional supply by 2070.

Table 5.3.2-8 Recommended Water Supply Plan for Bexar County WCID 10

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(417)	(438)	(462)	(492)	(524)	(555)
Recommended WMS						
Advanced Water Conservation	51	141	234	310	340	372
Drought Management	33	-	-	-	-	-
Purchase from WWP (SAWS)	348	312	243	197	199	198
WMS Supply	**432**	**453**	**477**	**507**	**539**	**570**

Estimated costs of the recommended plan for Bexar County WCID 10 are shown in Table 5.3.2-9.

Table 5.3.2-9 Recommended Plan Costs by Decade for Bexar County WCID 10

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	38,954	108,618	180,472	238,794	262,023	286,588
Unit Cost ($/acft)	770	770	770	770	770	770
Drought Management						
Annual Cost ($/yr)	2,929	-	-	-	-	-
Unit Cost ($/acft)	89	-	-	-	-	-
Purchase from WWP (SAWS)						
Annual Cost ($/yr)	243,807	218,586	170,245	138,017	291,131	289,668
Unit Cost ($/acft)	701	701	701	701	1,463	1,463

5.3.2.5 Converse

Current water supply for the City of Converse is obtained from the Edwards Aquifer. Converse is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Converse implement the following water supply plan to meet the projected needs for the city (Table 5.3.2-10):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 8 acft/yr by 2070.

- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 101 acft/yr by 2020.
- Purchase from WWP (CRWA) is to be implemented prior to 2020. This strategy can provide an additional 264 acft/yr of supply by 2020, increasing to 720 acft/yr by 2070.

Table 5.3.2-10 Recommended Water Supply Plan for Converse

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(350)	(560)	(747)	(721)	(715)	(713)
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	8
Drought Management	101	-	-	-	-	-
Purchase from WWP (CRWA)	264	575	762	736	730	720
WMS Supply	**365**	**575**	**762**	**736**	**730**	**728**

Estimated costs of the recommended plan for Converse are shown in Table 5.3.2-9.

Table 5.3.2-11 Recommended Plan Costs by Decade for Converse

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	5,516
Unit Cost ($/acft)	-	-	-	-	-	681
Drought Management						
Annual Cost ($/yr)	9,040	-	-	-	-	-
Unit Cost ($/acft)	90	-	-	-	-	-
Purchase from WWP (CRWA)						
Annual Cost ($/yr)	9,308,000	9,308,000	5,942,000	5,942,000	5,942,000	5,942,000
Unit Cost ($/acft)	1,330	1,330	849	849	849	849

5.3.2.6 County-Other, Bexar

County-Other, Bexar, is projected to have adequate water supplies available from the Edwards Aquifer. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that County-Other, Bexar implement the following water supply plan to meet the projected needs for the WUG (Table 5.3.2-12):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 16 acft/yr by 2070.

Table 5.3.2-12 Recommended Water Supply Plan for County-Other, Bexar

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	3,685	3,685	4,347	3,685	3,685	3,685
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	16
WMS Supply	**0**	**0**	**0**	**0**	**0**	**16**

Estimated costs of the recommended plan for County-Other are shown in Table 5.3.2-13.

Table 5.3.2-13 Recommended Plan Costs by Decade for County-Other, Bexar

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	11,211
Unit Cost ($/acft)	-	-	-	-	-	681

5.3.2.7 East Central SUD

East Central SUD is projected to have adequate water supplies available from the Edwards and Carrizo-Wilcox Aquifers and surface water from Canyon Reservoir during the planning period.

5.3.2.8 Elmendorf

Current water supply for the City of Elmendorf is obtained from the Edwards Aquifer. The City of Elmendorf is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Elmendorf implement the following water supply plan to meet the projected needs for the city (Table 5.3.2-14):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 1 acft/yr by 2050, increasing to 35 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 8 acft/yr by 2020.
- Purchase from WWP (SAWS) is to be implemented prior to 2020. This strategy can provide an additional 46 acft/yr of supply by 2020, increasing to 399 acft/yr by 2070.

Table 5.3.2-14 Recommended Water Supply Plan for the Elmendorf

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(31)	(118)	(199)	(278)	(352)	(419)
Recommended WMS						

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Advanced Water Conservation	0	0	0	1	17	35
Drought Management	8	-	-	-	-	-
Purchase from WWP (SAWS)	46	133	214	292	350	399
WMS Supply	**54**	**133**	**214**	**293**	**367**	**434**

Estimated costs of the recommended plan for Elmendorf are shown in Table 5.3.2-15.

Table 5.3.2-15 Recommended Plan Costs by Decade for Elmendorf

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	759	11,256	23,517
Unit Cost ($/acft)	-	-	-	681	681	681
Drought Management						
Annual Cost ($/yr)	1,868	-	-	-	-	-
Unit Cost ($/acft)	234	-	-	-	-	-
Purchase from WWP (SAWS)						
Annual Cost ($/yr)	32,227	93,179	149,927	204,574	512,040	583,725
Unit Cost ($/acft)	701	701	701	701	1,463	1,463

5.3.2.9 Fair Oaks Ranch

Current water supply for the Fair Oaks Ranch is obtained from the Trinity Aquifer and Canyon Reservoir. Fair Oaks Ranch is projected to need additional water supplies prior to 2040. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended Fair Oaks Ranch implement the following water supply plan to meet the projected needs for the city (Table 5.3.2-16):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 117 acft/yr by 2020, increasing to 1,423 acft/yr of supply in 2070.
- Recycle Water Strategies: Fair Oaks Ranch Non-Potable Reuse is to be implemented by the 2020 decade. This strategy can provide an additional 672 acft/yr by 2030 through 2070.

Table 5.3.2-16 Recommended Water Supply Plan for Fair Oaks Ranch

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	351	14	(267)	(425)	(752)	(1,070)
Recommended WMS						

Advanced Water Conservation	117	334	587	831	1,141	1,423
Recycled Water Strategies: Fair Oaks Ranch Non-Potable Reuse	0	672	672	672	672	672
WMS Supply	**117**	**1,006**	**1,259**	**1,503**	**1,813**	**2,095**

Estimated costs of the recommended plan for Fair Oaks Ranch are shown in Table 5.3.2-17.

Table 5.3.2-17 Recommended Plan Costs by Decade for Fair Oaks Ranch

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	79,546	227,665	399,630	566,010	776,824	968,946
Unit Cost ($/acft)	681	681	681	681	681	681
Recycled Water Strategies						
Annual Cost ($/yr)	-	271,000	271,000	271,000	271,000	271,000
Unit Cost ($/acft)	-	403	403	403	403	403

5.3.2.10 Fort Sam Houston

Current water supply for the Fort Sam Houston is obtained from the Edwards Aquifer. Fort Sam Houston is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Fort Sam Houston implement the following water supply plan to meet its projected needs (Table 5.3.2-18):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 213 acft/yr by 2020, increasing to 1,144 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 5 acft/yr by 2020.
- Purchase from WWP (SAWS) is to be implemented prior to 2020. This strategy can provide an additional 1,716 acft/yr of supply by 2020, with variation through 2060 to meet projected needs.

Table 5.3.2-18 Recommended Water Supply Plan for Fort Sam Houston

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(1,919)	(1,736)	(1,551)	(1,366)	(1,185)	(1,008)
Recommended WMS						
Advanced Water Conservation	213	436	639	824	993	1,144
Drought Management	5	-	-	-	-	-

Purchase from WWP (SAWS)	1,716	1,315	927	557	207	-
WMS Supply	**1,934**	**1,751**	**1,566**	**1,381**	**1,200**	**1,144**

Estimated costs of the recommended plan for the Fort Sam Houston are shown in Table 5.3.2-19.

Table 5.3.2-19 Recommended Plan Costs by Decade for Fort Sam Houston

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	127,514	261,856	383,123	494,365	595,513	686,390
Unit Cost ($/acft)	600	600	600	600	600	600
Drought Management						
Annual Cost ($/yr)	530	-	-	-	-	-
Unit Cost ($/acft)	106	-	-	-	-	-
Purchase from WWP (SAWS)						
Annual Cost ($/yr)	1,202,221	921,283	649,452	390,232	302,835	-
Unit Cost ($/acft)	701	701	701	701	1,463	-

5.3.2.11 Irrigation, Bexar

Irrigation, Bexar, is projected to have adequate water supplies available from the Edwards Aquifer, Carrizo-Wilcox Aquifer, and run-of-river rights. However, because of limited economically feasible supplies for irrigation, any potential needs may be left unmet. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual irrigators implement water conservation measures associated with the Advanced Water Conservation WMS to meet a portion of potential projected needs for Irrigation, Bexar.

5.3.2.12 Kirby

Current water supply for the City of Kirby is obtained from the Edwards Aquifer. Kirby is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Kirby implement the following water supply plan to meet the projected needs for the city (Table 5.3.2-20):

- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 32 acft/yr by 2020.
- Purchase from WWP (SAWS) is to be implemented prior to 2020. This strategy can provide an additional 174 acft/yr of supply by 2020, with variation through the planning period to meet projected needs.

Table 5.3.2-20 Recommended Water Supply Plan for Kirby

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(191)	(260)	(234)	(225)	(223)	(222)
Recommended WMS						
Drought Management	32	-	-	-	-	-
Purchase from WWP (SAWS)	174	275	249	240	238	237
WMS Supply	**206**	**275**	**249**	**240**	**238**	**237**

Estimated costs of the recommended plan to meet Kirby's projected needs are shown in Table 5.3.2-21.

Table 5.3.2-21 Recommended Plan Costs by Decade for Kirby

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Drought Management						
Annual Cost ($/yr)	1,968	-	-	-	-	-
Unit Cost ($/acft)	62	-	-	-	-	-
Purchase from WWP (SAWS)						
Annual Cost ($/yr)	121,904	192,664	174,448	168,143	348,187	346,724
Unit Cost ($/acft)	701	701	701	701	1,463	1,463

5.3.2.13 Lackland Air Force Base

Current water supply for Lackland Air Force Base is obtained from the Edwards Aquifer. Lackland Air Force Base is projected to need additional water supplies only in the 2020 decade. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Lackland Air Force Base implement the following water supply plan to meet the projected needs for the WUG (Table 5.3.2-22).

- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 67 acft/yr by 2020.

Table 5.3.2-22 Recommended Water Supply Plan for Lackland Air Force Base

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(9)	37	75	96	100	100
Recommended WMS						
Drought Management	67	-	-	-	-	-
WMS Supply	**67**	**0**	**0**	**0**	**0**	**0**

Estimated costs of the recommended plan to meet Lackland Air Force Base's projected needs are shown in Table 5.3.2-23.

Table 5.3.2-23 Recommended Plan Costs by Decade for Lackland Air Force Base

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Drought Management						
Annual Cost ($/yr)	5,954	-	-	-	-	-
Unit Cost ($/acft)	89	-	-	-	-	-

5.3.2.14 Leon Valley

Leon Valley obtains water supplies available from the Edwards Aquifer. Leon Valley is expected to have needs prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Leon Valley implement the following water supply plan (Table 5.3.2-24).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 42 acft/yr by 2020, increasing to 265 acft/yr in 2070.
- Edwards Transfers is to be implemented prior to 2020. This strategy can provide an additional supply of 171 acft/yr by 2020, increasing to 658 acft/yr of additional supply by 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 65 acft/yr by 2020.

Table 5.3.2-24 Recommended Water Supply Plan for Leon Valley

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(263)	(316)	(369)	(748)	(830)	(908)
Recommended WMS						
Advanced Water Conservation	42	102	112	165	212	265
Drought Management	65	-	-	-	-	-
Edwards Transfers	171	228	272	599	632	658
WMS Supply	**278**	**330**	**384**	**764**	**844**	**923**

Estimated costs of the recommended plan for Leon Valley are shown in Table 5.3.2-25.

Table 5.3.2-25 Recommended Plan Costs by Decade for Leon Valley

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	25,012	61,201	67,303	98,730	127,366	159,192
Unit Cost ($/acft)	600	600	600	600	600	600

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Drought Management						
Annual Cost ($/yr)	7,222	-	-	-	-	-
Unit Cost ($/acft)	111	-	-	-	-	-
Edwards Transfers						
Annual Cost ($/yr)	114,163	144,394	186,698	370,795	407,989	441,542
Unit Cost ($/acft)	1,242	1,242	1,242	1,242	1,242	1,242

5.3.2.15 Live Oak

The City of Live Oak is projected to have adequate water supplies available from the Edwards Aquifer. Live Oak is expected to have needs prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Live Oak implement the following water supply plan (Table 5.3.2-26):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 57 acft/yr by 2020, increasing to 271 acft/yr in 2070.
- Purchase from WWP (SAWS) is to be implemented prior to 2020. This strategy can provide an additional supply of 392 acft/yr by 2020, with variation through the planning period to meet projected needs.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 48 acft/yr by 2020.

Table 5.3.2-26 Recommended Water Supply Plan for Live Oak

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(482)	(489)	(465)	(451)	(448)	(448)
Recommended WMS						
Advanced Water Conservation	57	171	183	205	237	271
Drought Management	48	-	-	-	-	-
Purchase from WWP (SAWS)	392	333	297	261	226	192
WMS Supply	**497**	**504**	**480**	**466**	**463**	**463**

Estimated costs of the recommended plan for Live Oak are shown in Table 5.3.2-27.

Table 5.3.2-27 Recommended Plan Costs by Decade for the City of Live Oak

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	38,816	116,232	124,910	139,779	161,537	184,748
Unit Cost ($/acft)	681	681	681	681	681	681
Drought Management						
Annual Cost ($/yr)	2,726	-	-	-	-	-
Unit Cost ($/acft)	57	-	-	-	-	-
Purchase from WWP (SAWS)						
Annual Cost ($/yr)	274,633	233,298	208,077	182,855	330,631	280,890
Unit Cost ($/acft)	701	701	701	701	1,463	1,463

5.3.2.16 Livestock, Bexar

Current water supply for Livestock, Bexar is obtained from the Edwards, Carrizo, and Trinity Aquifers and local sources. Livestock is projected to have adequate water supplies available.

5.3.2.17 Manufacturing, Bexar

Current water supply for Manufacturing, Bexar is obtained from the Edwards Aquifer, Trinity Aquifer, run-of-river rights, and direct reuse and is projected to have adequate water supplies through the planning period.

5.3.2.18 Mining, Bexar

Current water supply for Mining, Bexar is obtained from the Edwards, Carrizo, and Trinity Aquifers and local sources. Mining is projected to have adequate water supplies available.

5.3.2.19 Randolph Air Force Base

Randolph Air Force Base is projected to have adequate water supplies available from the Edwards Aquifer to meet the City’s projected demands during the planning period.

5.3.2.20 San Antonio Water System (SAWS; WUG Data)

SAWS is expected to have needs from year 2030. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that SAWS implement the following water supply plan (Table 5.3.2-28):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 24,367 acft/yr by 2020, increasing to 115,929 acft/yr by 2070.
- Advanced Meter Infrastructure is to be implemented prior to 2020. This strategy can provide an additional 426 acft/yr through 2020, 606 acft/yr through 2030, and 510 acft/yr through 2040 – an average of 545 acft/yr from 2020 through 2040.

- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 11,951 acft/yr by 2020, increasing to 56,588 acft/yr in 2070.
- Expanded Local Carrizo Project is to be implemented in the 2040 decade for additional supply of 21,000 acft/yr in 2040 through 2070.
- Expanded Brackish Groundwater Project is to be implemented in the 2040 decade for additional supply of 20,160 acft/yr, increasing to 70,160 acft/yr through 2070.
- Recycled Water Strategies, Direct Recycled Water Programs is to be implemented or enhanced in the immediate future. This strategy can provide an additional 5,000 acft/yr by 2020, increasing to 40,000 acft/yr in 2070.
- Facilities Expansion: ASR WTP Expansion is to be implemented in the 2030 decade. This strategy increases capacity for SAWS by 33,600 acft/yr by the decade 2030 through 2070. This is not new water supply. Data shown in Table 5.4-9 represents WMS supply water availability consistent with TWDB data. See Section 5.2.8.2 for more details.
- Facilities Expansion: Western Integration Pipeline Phase 2 is to be implemented prior to 2020. This strategy increases capacity for SAWS by 84,100 acft/yr by the 2020 decade through 2070. This is not new water supply. Data shown in Table 5.4-9 represents WMS supply water availability consistent with TWDB data. See Section 5.2.8.2 for more details.

Table 5.3.2-28 Recommended Water Supply Plan for San Antonio Water System

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	8,019	(14,468)	(34,780)	(54,469)	(75,881)	(97,624)
Recommended WMS						
Advanced Water Conservation	24,367	50,667	74,313	89,629	102,682	115,929
Advanced Meter Infrastructure	426	606	510	-	-	-
Drought Management	11,951	31,476	45,677	49,377	53,109	56,588
SAWS Expanded Local Carrizo Project	-	-	21,000	21,000	21,000	21,000
SAWS Expanded Brackish Groundwater Project	-	-	20,160	20,160	70,160	70,160
Direct Recycled Water Programs	-	5,000	5,000	15,000	25,000	40,000
Facilities Expansion: ASR WTP Expansion[1]	-	33,600	33,600	33,600	33,600	33,600
Facilities Expansion: Western Integration Pipeline Phase 2[2]	1,406	4,000	4,000	4,000	4,000	4,000
WMS Supply	**38,150**	**125,349**	**204,260**	**232,766**	**309,551**	**341,277**

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
[1] Anticipated capacity for Facilities Expansion: ASR WTP Expansion is 33,600 acft/yr from 2030 through 2070. Volumes shown are based on water availability consistent with TWDB data. See Section 5.2.8.2 for more details. [2] Anticipated capacity for Facilities Expansion: Western Integration Pipeline Phase 2 is 84,100 acft/yr from 2020 through 2070. Volumes shown are based on water availability consistent with TWDB data. See Section 5.2.8.2 for more details.						

Estimated costs of the recommended plan to meet SAWS' projected needs are shown in Table 5.3.2-29.

Table 5.3.2-29 Recommended Plan Costs by Decade for San Antonio Water System

Plan Elements	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	14,620,200	30,400,200	44,587,800	53,777,400	61,609,200	69,557,400
Unit Cost ($/acft)	600	600	600	600	600	600
Advanced Meter Infrastructure						
Annual Cost ($/yr)	22,388,000	22,388,000	2,081,000	-	-	-
Unit Cost ($/acft)	52,554	36,944	4,080	-	-	-
Drought Management						
Annual Cost ($/yr)	1,183,149	8,057,856	16,352,366	17,676,966	19,013,022	20,258,504
Unit Cost ($/acft)	99	256	358	358	358	358
SAWS Expanded Local Carrizo Project						
Annual Cost ($/yr)	-	-	2,632,000	2,632,000	884,000	884,000
Unit Cost ($/acft)	-	-	125	125	42	42
SAWS Expanded Brackish Groundwater Project						
Annual Cost ($/yr)	-	-	14,124,000	14,124,000	102,642,000	102,642,000
Unit Cost ($/acft)	-	-	701	701	1,463	1,463
Direct Recycled Water Programs						
Annual Cost ($/yr)	$26,648,000	$26,648,000	$14,052,000	$14,052,000	$14,052,000	$14,052,000
Unit Cost ($/acft)	$658	$658	$347	$347	$347	$347
Facilities Expansion: ASR WTP Expansion[1]						
Annual Cost ($/yr)	-	6,631,000	6,631,000	3,851,000	3,851,000	3,851,000
Unit Cost ($/acft)	-	197	197	115	115	115
Facilities Expansion: Western Integration Pipeline Phase 2[1]						
Annual Cost ($/yr)	9,124,000	9,124,000	1,170,000	1,170,000	1,170,000	1,170,000
Unit Cost ($/acft)	2,281	2,281	293	293	293	293

Plan Elements	2020	2030	2040	2050	2060	2070
[1] Facilities Expansion unit costs are representative of WMS supplies detailed in Table 5.4-9; not the anticipated volumes (unless they fit within the MAG – e.g. ASR WTP Expansion).						

5.3.2.21 Schertz

Refer to Guadalupe County for details.

5.3.2.22 Selma

Current water supply for the City of Selma is obtained from the Edwards and Carrizo-Wilcox Aquifers and SSLGC Contract. Selma is projected to need additional water supplies prior to 2030. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Selma implement the following water supply plan to meet the projected needs for the city (Table 5.3.2-30):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 62 acft/yr by 2020, increasing to 309 acft/yr of supply in 2070.
- Edwards Transfers is to be implemented prior to 2030. This strategy can provide an additional 31 acft/yr of supply by 2030, increasing to 223 acft/yr in 2070.

Table 5.3.2-30 Recommended Water Supply Plan for Selma

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	500	(57)	(151)	(241)	(324)	(403)
Recommended WMS						
Advanced Water Conservation	62	109	154	202	253	309
Edwards Transfers	-	31	88	123	172	223
WMS Supply	**62**	**140**	**242**	**325**	**425**	**532**

Estimated costs of the recommended plan for Selma are shown in Table 5.3.2-31.

Table 5.3.2-31 Recommended Plan Costs by Decade for Selma

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	41,891	73,983	104,848	137,498	172,142	210,204
Unit Cost ($/acft)	681	681	681	681	681	681
Edwards Transfers						
Annual Cost ($/yr)	-	38,460	109,768	153,161	213,993	276,874
Unit Cost ($/acft)	-	1,242	1,242	1,242	1,242	1,242

5.3.2.23 Shavano Park

Current water supply for the City of Shavano Park is obtained from the Edwards Aquifer. Shavano Park is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Shavano Park implement the following water supply plan to meet the projected needs for the city (Table 5.3.2-32):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 42 acft/yr by 2020, increasing to 444 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 47 acft/yr by 2020.
- Edwards Transfers is to be implemented prior to 2020. This strategy can provide an additional supply of 190 acft/yr by 2020, increasing to 203 acft/yr of additional supply by 2070.

Table 5.3.2-32 Recommended Water Supply Plan for Shavano Park

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(264)	(346)	(422)	(498)	(568)	(633)
Recommended WMS						
Advanced Water Conservation	42	109	185	269	356	444
Drought Management	47	-	-	-	-	-
Edwards Transfers	190	252	252	244	227	203
WMS Supply	**279**	**361**	**437**	**513**	**583**	**647**

Estimated costs of the recommended plan for Shavano Park are shown in Table 5.3.2-33.

Table 5.3.2-33 Recommended Plan Costs by Decade for Shavano Park

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	28,557	74,523	125,983	183,287	242,430	302,637
Unit Cost ($/acft)	681	681	681	681	681	681
Drought Management						
Annual Cost ($/yr)	3,635	-	-	-	-	-
Unit Cost ($/acft)	77	-	-	-	-	-
Edwards Transfers						
Annual Cost ($/yr)	127,859	159,622	172,287	145,443	140,026	129,574
Unit Cost ($/acft)	1,242	1,242	1,242	1,242	1,242	1,242

5.3.2.24 Steam-Electric Power, Bexar

Water supply for Steam-Electric Power, Bexar is available from Victor Braunig Lake and Calaveras Lake and is projected to need additional water supplies to meet the WUG's projected demand during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended to implement the following water supply plan to meet the projected needs for the Steam-electric power (Table 5.3.2-32):

- Purchase from WWP (SAWS) is to be implemented by 2020. This strategy can provide an additional supply of 2,797 acft/yr by 2020 through 2070.
- Facilities Expansion: CPS Energy Direct Recycle Pipeline to be implemented by the 2030 decade. The anticipated total capacity for this strategy is 50,000 acft/yr by the 2030 decade continuing through 2070. This is not new water supply. Data shown in Table 5.4-9 represents WMS supply water availability consistent with TWDB data. See Section 5.2.8.2 for more details.

Table 5.3.2-34 Recommended Water Supply Plan for Steam-Electric Power, Bexar

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(2,782)	(2,782)	(2,782)	(2,782)	(2,782)	(2,782)
Recommended WMS						
Facilities Expansion: CPS Energy Direct Recycle Pipeline	0	50,000	50,000	50,000	50,000	50,000
Purchase from WWP (SAWS)	2,797	2,797	2,797	2,797	2,797	2,797
WMS Supply	**2,797**	**52,797**	**52,797**	**52,797**	**52,797**	**52,797**

Estimated costs of the recommended plan to meet the Steam-Electric Power projected needs are shown in Table 5.3.2-35.

Table 5.3.2-35 Recommended Plan Costs by Decade for Steam-Electric Power, Bexar

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Facilities Expansion: CPS Energy Direct Recycle Pipeline						
Annual Cost ($/yr)	3,512,000	3,512,000	1,334,560	1,334,560	1,334,560	1,334,560
Unit Cost ($/acft)	70	70	27	27	27	27
Purchase from WWP (SAWS)						
Annual Cost ($/yr)	303,807	379,950	925,799	903,759	1,509,460	1,509,460
Unit Cost ($/acft)	109	136	331	323	540	540

5.3.2.25 The Oaks WSC

Current water supply for The Oaks WSC is obtained from SAWS and the Trinity Aquifer. The Oaks WSC is projected to need additional water supplies prior the 2020 decade. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the Oaks WSC implement the following water supply plan to meet the projected needs for the WSC (Table 5.3.2-36):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 12 acft/yr by 2020, increasing to 89 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 9 acft/yr by 2020.
- Purchase from WWP (SAWS) is to be implemented by 2020. This strategy can provide an additional 132 acft/yr by 2020, increasing to 294 acft/yr of supply in 2070.

Table 5.3.2-36 Recommended Water Supply Plan for The Oaks WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(138)	(189)	(237)	(284)	(328)	(368)
Recommended WMS						
Advanced Water Conservation	12	34	44	57	72	89
Drought Management	9	-	-	-	-	-
Purchase from WWP (SAWS)	132	170	208	242	271	294
WMS Supply	**153**	**204**	**252**	**299**	**343**	**383**

Estimated costs of the recommended plan to meet the Oaks WSC projected needs are shown in Table 5.3.2-37.

Table 5.3.2-37 Recommended Plan Costs by Decade for The Oaks WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	7,225	20,218	26,350	34,271	43,424	53,195
Unit Cost ($/acft)	600	600	600	600	600	600
Drought Management						
Annual Cost ($/yr)	1,004	-	-	-	-	-
Unit Cost ($/acft)	112	-	-	-	-	-
Purchase from WWP (SAWS)						
Annual Cost ($/yr)	92,479	119,101	145,724	169,544	396,465	430,113
Unit Cost ($/acft)	701	701	701	701	1,463	1,463

5.3.2.26 Universal City

Current water supply for Universal City is obtained from the Edwards and Carrizo-Wilcox Aquifers. Universal City is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Universal City implement the following water supply plan to meet the projected needs for the city (Table 5.3.2-38):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 67 acft/yr by 2060, increasing to 140 acft/yr of supply in 2070.
- Edwards Transfers is to be implemented prior to 2020. This strategy can provide an additional 177 acft/yr of supply by 2020, decreasing to 119 acft/yr by 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 192 acft/yr by 2020.

Table 5.3.2-38 Recommended Water Supply Plan for Universal City

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(299)	(314)	(256)	(224)	(217)	(216)
Recommended WMS						
Advanced Water Conservation	0	0	0	0	67	140
Drought Management	192	-	-	-	-	-
Edwards Transfers	177	329	271	238	165	119
WMS Supply	**367**	**329**	**271**	**238**	**232**	**259**

Estimated costs of the recommended plan to meet Universal City's projected needs are shown in Table 5.3.2-39.

Table 5.3.2-39 Recommended Plan Costs by Decade for Universal City

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	0	0	0	0	45,534	95,460
Unit Cost ($/acft)	0	0	0	0	681	681
Drought Management						
Annual Cost ($/yr)	12,608	-	-	-	-	-
Unit Cost ($/acft)	66	-	-	-	-	-
Edwards Transfers						
Annual Cost ($/yr)	218,374	211,869	186,096	142,357	143,322	148,399
Unit Cost ($/acft)	1,242	1,242	1,242	1,242	1,242	1,242

5.3.2.27 Water Services

Water Services water supplies is available from the Edwards Aquifer. Water Services is projected to need additional water supplies prior to 2030. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Water Services implement the following water supply plan (Table 5.3.2-40):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 24 acft/yr by 2020, increasing to 144 acft/yr of supply in 2070.
- Local Groundwater management is to be implemented prior to 2030. This strategy can provide an additional 252 acft/yr of supply by 2030, increasing to 504 acft/yr by 2070.

Table 5.3.2-40 Recommended Water Supply Plan for Water Services

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	66	(40)	(143)	(260)	(376)	(485)
Recommended WMS						
Advanced Water Conservation	24	26	31	59	99	144
Local Groundwater	-	252	252	315	379	504
WMS Supply	**24**	**278**	**283**	**374**	**478**	**648**

Estimated costs of the recommended plan to meet Water Services' projected needs are shown in Table 5.3.2-41.

Table 5.3.2-41 Recommended Plan Costs by Decade for Water Services

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	14,105	15,596	18,463	35,352	59,173	86,290
Unit Cost ($/acft)	600	600	600	600	600	600
Local Groundwater						
Annual Cost ($/yr)	-	269,500	269,500	182,875	442,750	308,000
Unit Cost ($/acft)	-	1,069	1,069	581	1,168	611

5.3.3 Caldwell County Water Supply Plan

Table 5.3.3-1 lists each WUG in Caldwell County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.3-1 Caldwell County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED) 2020 (ACFT/YR)	PROJECTED SURPLUS / (NEED) 2070 (ACFT/YR)	COMMENT
ARWA (WWP only)	-	-	WWP data summary provided in Section 5.4
Aqua WSC	341	56	No Projected Needs
County-Other, Caldwell	1,315	1,338	No Projected Needs
Creedmoor-Maha WSC	0	0	No Projected Needs
Irrigation	0	0	No Projected Needs
Livestock	0	0	No Projected Needs
Lockhart	817	(1,402)	Projected Needs (2040 through 2070)
Luling	127	(799)	Projected Needs (2030 through 2070)
Manufacturing, Caldwell	0	0	No Projected Needs
Martindale WSC	(130)	(730)	Projected Needs (2020 through 2070)
Maxwell WSC	570	105	No Projected Needs
Mining, Caldwell	3	0	No Projected Needs
Polonia WSC	1,586	664	No Projected Needs
Tri Community WSC	323	150	No Projected Needs
Gonzales County WSC	-	-	See Gonzales County
County Line SUD	-	-	See Hays County
Goforth SUD	-	-	See Hays County
San Marcos	-	-	See Hays County

5.3.3.1 Aqua WSC

Aqua WSC is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Aqua WSC implement the following water supply plan to meet the projected needs for the WSC (Table 5.3.3-2):

- Advanced Water Conservation is to be implemented or enhanced in the future. This strategy can provide an additional 1 acft/yr by 2050 and maintain throughout 2070

Table 5.3.3-2 Recommended Water Supply Plan for Aqua WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	341	286	230	173	114	56
Recommended WMS						
Advanced Water Conservation	-	-	-	1	1	1
WMS Supply	**0**	**0**	**0**	**1**	**1**	**1**

Estimated costs of the recommended plan to meet Aqua WSC's projected needs are shown in

Table 5.3.3-3.

Table 5.3.3-3 Recommended Water Supply Plan for Aqua WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	770	770	770
Unit Cost ($/acft)	-	-	-	770	770	770

5.3.3.2 County-Other, Caldwell

County-Other is projected to have adequate water supplies available from the Edwards (Barton Springs) Aquifer.

5.3.3.3 Creedmoor-Maha WSC

Creedmoor-Maha WSC is projected to have adequate water supplies available from the Edwards Aquifer to meet the WUG's projected demands during the planning period.

5.3.3.4 Irrigation, Caldwell

Irrigation, Caldwell is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer, Queen City Aquifer, and run-of-river rights to meet the WUG's projected demands during the planning period.

5.3.3.5 Livestock, Caldwell

Livestock, Caldwell is projected to have adequate water supplies available from local sources to meet the WUG's projected demands during the planning period.

5.3.3.6 Lockhart

Current water supply for Lockhart is obtained from the Carrizo-Wilcox Aquifer and Guadalupe-Blanco River Authority run-of-river rights. Lockhart is projected to need additional water supplies prior to 2040. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Lockhart implement the following water supply plan to meet the projected needs for the city (Table 5.3.3-4):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 71 acft/yr by 2070.
- Purchase from WWP (ARWA/GBRA) is to be implemented prior to 2020. This strategy can provide an additional 3,000 acft/yr in the planning year.

Table 5.3.3-4 Recommended Water Supply Plan for Lockhart

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	817	392	(39)	(482)	(946)	(1,402)
Recommended WMS						
Advanced Water Conservation	0	0	0	0	0	71
ARWA/GBRA Project (Phase 1)	3,000	3,000	3,000	3,000	3,000	3,000
WMS Supply	**3,000**	**3,000**	**3,000**	**3,000**	**3,000**	**3,071**

Estimated costs of the recommended plan to meet Lockhart's projected needs are shown in Table 5.3.3-5.

Table 5.3.3-5 Recommended Plan Costs by Decade for Lockhart

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	0	0	0	0	0	48,465
Unit Cost ($/acft)	0	0	0	0	0	681
ARWA/GBRA Project (Phase 1)						
Annual Cost ($/yr)	2,161,800	2,161,800	848,600	848,600	848,600	848,600
Unit Cost ($/acft)	721	721	283	283	283	283

5.3.3.7 Luling

Current water supply for the City of Luling is obtained from the Carrizo-Wilcox Aquifer and Guadalupe-Blanco River Authority run-of-river rights. Luling is projected to need additional water supplies prior to 2030. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Luling implement the following water supply plan to meet the projected needs for the city (Table 5.3.3-6):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 2 acft/yr by 2070.
- Local Groundwater management is to be implemented prior to the 2030 decade. This strategy can provide an additional 353 acft/yr from 2030, increasing to 1,059 acft/yr by 2070.

Table 5.3.3-6 Recommended Water Supply Plan for Luling

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	127	(49)	(227)	(412)	(608)	(799)
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	2
Local Groundwater	-	353	353	706	706	1,059
WMS Supply	**0**	**353**	**353**	**706**	**706**	**1,061**

Estimated costs of the recommended plan to meet Luling's projected needs are shown in Table 5.3.3-7.

Table 5.3.3-7 Recommended Plan Costs by Decade for Luling

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	1,237
Unit Cost ($/acft)	-	-	-	-	-	770
Local Groundwater						
Annual Cost ($/yr)	-	223,000	223,000	351,333	351,333	479,667
Unit Cost ($/acft)	-	632	632	498	498	453

5.3.3.8 Manufacturing, Caldwell

Manufacturing, Caldwell is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the WUG's projected demands during the planning period.

5.3.3.9 Martindale WSC

Current water supply for Martindale WSC is obtained from run-of-river rights. Martindale WSC is projected to need additional water supplies prior to 2030. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Martindale WSC implement the following water supply plan to meet the projected needs for the WSC (Table 5.3.3-8):

- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 21 acft/yr by 2020.
- Facilities Expansion: CRWA Hays Caldwell WTP Expansion is to be implemented by the 2020 decade. This strategy can provide an additional 255 acft/yr by 2020 through 2070.

- Martindale WSC Alluvial Well Project is to be implemented by the 2030 decade. This strategy can provide an additional 240 acft/yr from 2030 through 2070.
- Purchase from WWP (CRWA) is to be implemented prior to the 2030 decade. This strategy can provide an additional supply of 65 acft/yr by 2030, increasing to 854 acft/yr of additional supply by 2070.

Table 5.3.3-8 Recommended Water Supply Plan for Martindale WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(130)	(230)	(317)	(428)	(568)	(730)
Recommended WMS						
Drought Management	21	-	-	-	-	-
Facilities Expansion: CRWA Hays Caldwell WTP Expansion	255	255	255	255	255	255
Martindale WSC Alluvial Well Project	-	240	240	240	240	240
Purchase from WWP (CRWA)	-	65	140	250	530	854
WMS Supply	**276**	**560**	**635**	**745**	**1,025**	**1,349**

Estimated costs of the recommended plan for Martindale are shown in Table 5.3.3-9.

Table 5.3.3-9 Recommended Plan Costs by Decade for Martindale WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Drought Management						
Annual Cost ($/yr)	2,381	-	-	-	-	-
Unit Cost ($/acft)	113	-	-	-	-	-
Facilities Expansion: CRWA Hays Caldwell WTP Expansion						
Annual Cost ($/yr)	399,330	399,330	177,990	177,990	177,990	177,990
Unit Cost ($/acft)	1,566	1,566	698	698	698	698
Martindale WSC Alluvial Well Project						
Annual Cost ($/yr)	-	111,000	111,000	23,000	23,000	23,000
Unit Cost ($/acft)	-	463	463	96	96	96
Purchase from WWP (CRWA)						
Annual Cost ($/yr)	-	65,780	108,080	193,000	409,009	659,044
Unit Cost ($/acft)	-	1,012	772	772	772	772

5.3.3.10 Maxwell WSC

Maxwell WSC is obtained from the Edwards Aquifer, Canyon Reservoir, and run-of-river rights through CRWA. Maxwell WSC is projected to have adequate water supplies for the planning year. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Maxwell WSC implement the following water supply plan to meet the projected needs of the WSC (Table 5.3.3-10):

- Maxwell WSC Trinity Well use is to be implemented by 2040 to provide an additional 230 acft/yr through 2070.

Table 5.3.3-10 Recommended Water Supply Plan for Maxwell WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	570	489	404	310	208	105
Recommended WMS						
Maxwell WSC Trinity Well	-	-	230	230	230	230
WMS Supply	**0**	**0**	**230**	**230**	**230**	**230**

Estimated costs of the recommended plan to meet the Maxwell WSC's projected needs are shown in Table 5.3.3-11.

Table 5.3.3-11 Recommended Plan Costs by Decade for Maxwell WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Maxwell WSC Trinity Well						
Annual Cost ($/yr)	-	-	980,000	980,000	419,000	419,000
Unit Cost ($/acft)	-	-	4,261	4,261	1,822	1,822

5.3.3.11 Mining, Caldwell

Mining, Caldwell is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the WUG's projected demands during the planning period.

5.3.3.12 Polonia WSC

Current water supply for Polonia WSC is obtained from the Carrizo-Wilcox Aquifer. Polonia WSC is projected to have adequate water supplies available for the planning period (Table 5.3.3-12):

- Advanced Water Conservation is to be implemented by 2070 and provide an additional 4 acft/yr.

Table 5.3.3-12 Recommended Water Supply Plan for Polonia WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	1,586	1,418	1,244	1,060	863	664

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	4
WMS Supply	**0**	**0**	**0**	**0**	**0**	**4**

Estimated costs of the recommended plan to meet Polonia WSC's projected needs are shown in Table 5.3.3-13.

Table 5.3.3-13 Recommended Plan Costs by Decade for Polonia WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	2,467
Unit Cost ($/acft)	-	-	-	-	-	681

5.3.3.13 Tri Community WSC

Current water supply for Tri Community WSC is obtained from the Carrizo-Wilcox Aquifer. Tri Community WSC is projected to have adequate water supplies available for the planning period (Table 5.3.3-14).

- Advanced Water Conservation is to be implemented by 2070 and provide an additional 2 acft/yr.

Table 5.3.3-14 Recommended Water Supply Plan for Tri Community WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	323	290	256	223	186	150
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	2
WMS Supply	**0**	**0**	**0**	**0**	**0**	**2**

Estimated costs of the recommended plans for Tri Community WSC are shown in Table 5.3.3-15.

Table 5.3.3-15 Recommended Plan Costs by Decade for Tri Community WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	1,585
Unit Cost ($/acft)	-	-	-	-	-	681

5.3.3.14 Gonzales County WSC

See Gonzales County for details.

5.3.3.15 County Line SUD

See Hays County for details.

5.3.3.16 Goforth SUD

See Hays County for details.

5.3.3.17 San Marcos

See Hays County for details.

5.3.4 Calhoun County Water Supply Plan

Table 5.3.4-1 lists each WUG in Calhoun County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.4-1 Calhoun County Management Supply/Shortage by WUG

WATER USER GROUP	PROJECTED SURPLUS / (NEED) 2020 (ACFT/YR)	PROJECTED SURPLUS / (NEED) 2070 (ACFT/YR)	COMMENT
County-Other, Calhoun	137	(37)	Projected Needs (2060 through 2070)
Irrigation, Calhoun	(14,088)	(14,088)	Projected Needs (2020 through 2070)
Livestock, Calhoun	110	110	No Projected Needs
Manufacturing, Calhoun	14,235	7,796	No Projected Needs
Mining, Calhoun	0	0	No Projected Needs
Point Comfort	91	55	No Projected Needs
Port Lavaca	2,494	1,609	No Projected Needs
Port O'Connor MUD	1,120	1,120	No Projected Needs
Seadrift	0	0	No Projected Needs

5.3.4.1 County-Other, Calhoun

County-Other, Calhoun, water supply is obtained from run-of-river rights of GBRA and is projected to need additional water supplies prior to 2060. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that County-Other, Calhoun, implement the following water supply plan to meet the projected needs (Table 5.3.4-2):

- Local Groundwater management is to be implemented by the 2060 decade. This strategy can provide an additional 412 acft/yr by 2060 through 2070.

Table 5.3.4-2 Recommended Water Supply Plan for County-Other, Calhoun

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	137	110	72	35	(1)	(37)
Recommended WMS						
Local Groundwater	-	-	-	-	412	412
WMS Supply	0	0	0	0	412	412

Estimated costs of the recommended plan to meet County-Other projected needs are shown in Table 5.3.4-3.

Table 5.3.4-3 Recommended Water Supply Plan for County-Other, Calhoun

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Local Groundwater						
Annual Cost ($/yr)	-	-	-	-	293,000	293,000
Unit Cost ($/acft)	-	-	-	-	711	711

5.3.4.2 Irrigation, Calhoun

Current water supply for Irrigation, Calhoun, is obtained from run-of-river rights. Irrigation, Calhoun, is projected to need additional water supplies prior to 2020. Because of limited economically feasible supplies for irrigation, these needs remain unmet. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual Irrigators implement water conservation measures associated with the Advanced Water Conservation WMS to meet a portion of the projected needs for irrigation (Table 5.3.4-4).

- Irrigation water conservation, while not a recommended strategy, is encouraged and can provide additional supply when possible. The SCTRWPG has determined that it is not economically feasible for agricultural producers to purchase additional supplies to meet projected needs.

Table 5.3.4-4 Recommended Water Supply Plan for Irrigation, Calhoun

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(14,088)	(14,088)	(14,088)	(14,088)	(14,088)	(14,088)
Recommended WMS						
WMS Supply	**0**	**0**	**0**	**0**	**0**	**0**

5.3.4.3 Livestock, Calhoun

Livestock, Calhoun is projected to have adequate water supplies available from local sources to meet the WUG's projected demands during the planning period.

5.3.4.4 Manufacturing, Calhoun

Manufacturing, Calhoun obtains adequate water supplies from the Gulf Coast Aquifer, Lake Texana, and run-of-river rights of GBRA to meet the WUG's current demands.

5.3.4.5 Mining, Calhoun

Mining, Calhoun is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the WUG's projected demands during the planning period.

5.3.4.6 Point Comfort

The City of Point Comfort is projected to have adequate water supplies available from Lake Texana to meet the city's projected demands during the planning period.

5.3.4.7 Port Lavaca

The City of Port Lavaca is projected to have adequate water supplies available from run-of-river rights of GBRA to meet the city's projected demands during the planning period.

5.3.4.8 Port O'Connor MUD

Port O' Connor MUD is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the city's projected demands during the planning period.

5.3.4.9 Seadrift

The City of Seadrift is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Seadrift implement the following water supply plan (Table 5.3.4-5):

- Advanced Water Conservation is to be implemented or enhanced in the future. This strategy can provide an additional 6 acft/yr by 2020, increasing to 41 acft/yr of supply in 2070.

Table 5.3.4-5 Recommended Water Supply Plan for Seadrift

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	0	0	0	0
Recommended WMS						
Advanced Water Conservation	6	13	15	21	31	41
WMS Supply	**6**	**13**	**15**	**21**	**31**	**41**

Estimated costs of the recommended plan for Seadrift are shown in Table 5.3.4-6.

Table 5.3.4-6 Recommended Plan Costs by Decade for Seadrift

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	4,942	10,098	11,712	16,425	23,821	31,643
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.5 Comal County Water Supply Plan

Table 5.3.5-1 lists each WUG in Comal County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.5-1 Comal County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED)		COMMENT
	2020 (ACFT/YR)	2070 (ACFT/YR)	
Canyon Lake Water Service	8,488	(931)	Projected Needs in 2070
CRWA (WUG Data)	906	906	No Projected Needs; See Section 5.4 for more details
Clear Water Estates Water System	(627)	(1,528)	Projected Needs (2020 through 2070)
County-Other, Comal	1,419	1,305	No Projected Needs
Garden Ridge	(918)	(2,565)	Projected Needs (2020 through 2070)
Green Valley SUD	5,555	(281)	Projected Needs (2070 only)
Irrigation, Comal	211	211	No Projected Needs
KT Water Development	(26)	(589)	Projected Needs (2020 through 2070)
Livestock, Comal	0	0	No Projected Needs
Manufacturing, Comal	(2,786)	(3,768)	Projected Needs (2020 through 2070)
Mining, Comal	(3,861)	(8,849)	Projected Needs (2020 through 2070)
New Braunfels	842	(21,832)	Projected Needs (2030 through 2070)
Wingert Water Systems	(32)	(185)	Projected Needs (2020 through 2070)

5.3.5.1 Canyon Lake Water Service

Current water supply for Canyon Lake Water Service is obtained from Canyon Reservoir and the Trinity Aquifer, and is split with Region K. Canyon Lake Water Service is projected to need additional water supplies prior to 2070. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Canyon Lake Water Service implement the following water supply plan to meet the projected needs in Region L for the utility (Table 5.3.5-2):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 89 acft/yr by 2050, increasing to 759 acft/yr of supply in 2070.

- Purchase from WWP (GBRA) is to be implemented prior to 2070. This strategy can provide an additional 174 acft/yr in 2070.

Table 5.3.5-2 Recommended Water Supply Plan for Canyon Lake Water Service

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	8,488	6,748	4,812	2,823	885	(931)
Recommended WMS						
Advanced Water Conservation	-	-	-	89	380	759
Purchase from WWP (GBRA)	-	-	-	-	-	174
WMS Supply	**0**	**0**	**0**	**89**	**380**	**933**

Estimated costs of the recommended plan to meet Canyon Lake Water Service's projected needs are shown in Table 5.3.5-3.

Table 5.3.5-3 Recommended Plan Costs by Decade for Canyon Lake Water Service

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	60,609	258,780	516,879
Unit Cost ($/acft)	-	-	-	681	681	681
Purchase from WWP (GBRA)						
Annual Cost ($/yr)	-	-	-	-	-	76,908
Unit Cost ($/acft)	-	-	-	-	-	442

5.3.5.2 Clear Water Estates Water System

Current water supply for Clear Water Estates Water System is obtained from Canyon Reservoir and the Trinity Aquifer. Clear Water Estates Water System is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Clear Water Estates Water System implement the following water supply plan to meet the projected needs for the water system (Table 5.3.5-4):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 54 acft/yr by 2020, increasing to 695 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 4 acft/yr by 2020.
- Local Groundwater use is to be implemented or enhanced in the immediate future. This strategy can provide an additional 627 acft/yr by 2020, increasing to 1,528 acft/yr by 2070.

Table 5.3.5-4 Recommended Water Supply Plan for Clear Water Estates Water System

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(627)	(806)	(987)	(1,171)	(1,352)	(1,528)
Recommended WMS						
Advanced Water Conservation	54	142	253	386	534	695
Drought Management	4	-	-	-	-	-
Local Groundwater	627	806	987	1,171	1,352	1,528
WMS Supply	**685**	**948**	**1,240**	**1,557**	**1,886**	**2,223**

Estimated costs of the recommended plan to meet Clear Water Estates Water System's projected needs are shown in Table 5.3.5-5.

Table 5.3.5-5 Recommended Plan Costs by Decade for Clear Water Estates Water System

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	36,441	96,585	172,541	262,909	363,811	473,079
Unit Cost ($/acft)	681	681	681	681	681	681
Drought Management						
Annual Cost ($/yr)	407	-	-	-	-	-
Unit Cost ($/acft)	102	-	-	-	-	-
Local Groundwater						
Annual Cost ($/yr)	0	0	0	0	0	0
Unit Cost ($/acft)	0	0	0	0	0	0

5.3.5.3 County-Other, Comal

Current water supply for County-Other, Comal is obtained from the Edwards and Trinity Aquifers. County-Other, Comal is projected to have adequate water supplies for the planning year. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that County-Other implement the following water supply plan to meet the projected needs for the WSC (Table 5.3.5-6):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 117 acft/yr by 2020, increasing to 671 acft/yr of supply in 2070.

Table 5.3.5-6 Recommended Water Supply Plan for County-Other, Comal

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	1,419	1,397	1,406	1,387	1,350	1,305
Recommended WMS						
Advanced Water Conservation	117	264	296	388	520	671
WMS Supply	**117**	**264**	**296**	**388**	**520**	**671**

Estimated costs of the recommended plan to meet County-Other, Comal's projected needs are shown in Table 5.3.5-7.

Table 5.3.5-7 Recommended Plan Costs by Decade for County-Other, Comal

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	90,162	203,418	227,973	298,392	400,386	516,721
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.5.4 Garden Ridge

Current water supply for the City of Garden Ridge is obtained from the Edwards Aquifer. Garden Ridge is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Garden Ridge implement the following water supply plan to meet the projected needs for the city (Table 5.3.5-8):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 108 acft/yr by 2020, increasing to 1,449 acft/yr in 2070.
- Local Groundwater management is to be implemented prior to 2020 can provide an additional 918 acft/yr by 2020, increasing to 2,565 acft/yr in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 47 acft/yr by 2020.

Table 5.3.5-8 Recommended Water Supply Plan for Garden Ridge

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(918)	(1,241)	(1,638)	(1,788)	(2,184)	(2,565)
Recommended WMS						
Advanced Water Conservation	108	300	553	781	1,102	1,449
Drought Management	47	-	-	-	-	-
Local Groundwater	918	1,241	1,638	1,788	2,184	2,565
WMS Supply	**1,073**	**1,541**	**2,191**	**2,569**	**3,286**	**4,014**

Estimated costs of the recommended plan to meet Garden Ridge's projected needs are shown in Table 5.3.5-9.

Table 5.3.5-9 Recommended Plan Costs by Decade for Garden Ridge

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	73,295	204,418	376,917	532,052	750,578	986,600
Unit Cost ($/acft)	681	681	681	681	681	681
Drought Management						
Annual Cost ($/yr)	3,004	-	-	-	-	-
Unit Cost ($/acft)	64	-	-	-	-	-
Local Groundwater						
Annual Cost ($/yr)	0	0	0	0	0	0
Unit Cost ($/acft)	0	0	0	0	0	0

5.3.5.5 Green Valley SUD

Current water supply for Green Valley SUD is obtained from the Edwards Aquifer and Canyon Reservoir. Green Valley SUD is projected to need additional water supplies prior to 2070. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Green Valley SUD implement the following water supply plan to meet the projected needs for the SUD (Table 5.3.5-10):

- ARWA/GBRA Project (Phase 1) is to be implemented by 2020 and can provide an additional 1,595 acft/yr in 2020 through 2070.
- ARWA Project (Phase 2) is to be implemented by 2040 and can provide an additional 2,232 acft/yr in 2040 through 2070.
- ARWA Project (Phase 3) is to be implemented by 2060 and can provide an additional 594 acft/yr in 2060 through 2070.

Table 5.3.5-10 Recommended Water Supply Plan for Green Valley SUD

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	5,555	4,384	3,524	2,403	1,081	(281)
Recommended WMS						
ARWA/GBRA Project (Phase 1)	1,595	1,595	1,595	1,595	1,595	1,595
ARWA Project (Phase 2)	-	-	2,232	2,232	2,232	2,232
ARWA Project (Phase 3)	-	-	-	-	594	594
WMS Supply	**1,595**	**1,595**	**3,827**	**3,827**	**4,421**	**4,421**

Estimated costs of the recommended plan to meet Green Valley SUD projected needs are shown in Table 5.3.5-11.

Table 5.3.5-11 Recommended Plan Costs by Decade for Green Valley SUD

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
ARWA/GBRA Project (Phase 1)						
Annual Cost ($/yr)	2,281,275	2,281,275	571,116	571,116	571,116	571,116
Unit Cost ($/acft)	1,430	1,430	358	358	358	358
ARWA Project (Phase 2)						
Annual Cost ($/yr)	-	-	1,423,272	1,423,272	447,144	447,144
Unit Cost ($/acft)	-	-	635	635	199	199
ARWA Project (Phase 3)						
Annual Cost ($/yr)	-	-	-	-	1,184,924	1,184,924
Unit Cost ($/acft)	-	-	-	-	2,001	2,001

5.3.5.6 Irrigation, Comal

Irrigation, Comal is projected to have adequate water supplies available from the Edwards Aquifer, Canyon Reservoir, and run-of-river rights to meet the WUG's projected demand during the planning period.

5.3.5.7 KT Water Development

Current water supply for KT Water Development is obtained from the Trinity Aquifer. KT Water Development is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that KT Water Development implement the following water supply plan to meet the projected needs for the WUG (Table 5.3.5-12):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 28 acft/yr by 2020, increasing to 421 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 7 acft/yr by 2020.
- Local Groundwater management is to be implemented prior to the 2020 decade. This strategy can provide an additional 161 acft/yr by 2020, increasing to 644 acft/yr by 2070.

Table 5.3.5-12 Recommended Water Supply Plan for KT Water Development

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(26)	(136)	(249)	(364)	(479)	(589)
Recommended WMS						
Advanced Water Conservation	28	78	146	228	321	421
Drought Management	7	-	-	-	-	-
Local Groundwater	161	161	322	483	483	644
WMS Supply	**196**	**239**	**468**	**711**	**804**	**1,065**

Estimated costs of the recommended plan to meet KT Water Development projected needs are shown in Table 5.3.5-13.

Table 5.3.5-13 Recommended Plan Costs by Decade for KT Water Development

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	18,741	53,350	99,164	155,021	218,490	286,736
Unit Cost ($/acft)	681	681	681	681	681	681
Drought Management						
Annual Cost ($/yr)	859	-	-	-	-	-
Unit Cost ($/acft)	123	-	-	-	-	-
Local Groundwater						
Annual Cost ($/yr)	129,750	129,750	196,250	326,000	262,750	329,250
Unit Cost ($/acft)	806	806	609	675	544	511

5.3.5.8 Livestock, Comal

Current water supply for Livestock, Comal is obtained from the Trinity Aquifer and local sources. Livestock is projected to have adequate water supplies through the planning period.

5.3.5.9 Manufacturing, Comal

Current water supply for Manufacturing, Comal is obtained from the Edwards Aquifer, Canyon Reservoir, and run-of-river rights. Manufacturing, Comal is projected to need additional water supplies prior to the year 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual industrial operations implement the following water supply plan to meet projected needs (Table 5.3.5-14):

- Purchase from WWP (ARWA) is to be implemented prior to 2020. This strategy can provide an additional 2,786 acft/yr of supply by 2020.
- Purchase from WWP (GBRA) is to be implemented prior to 2030. This strategy can provide an additional 3,783 acft/yr of supply by 2030 through 2070.

Table 5.3.5-14 Recommended Water Supply Plan for Manufacturing, Comal

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(2,786)	(3,768)	(3,768)	(3,768)	(3,768)	(3,768)
Recommended WMS						
Purchase from WWP (ARWA)	2,786	-	-	-	-	-
Purchase from WWP (GBRA)	-	3,783	3,783	3,783	3,783	3,783
WMS Supply	**2,786**	**3,783**	**3,783**	**3,783**	**3,783**	**3,783**

Estimated costs of the recommended plan to meet manufacturing, Comal projected needs are shown in Table 5.3.5-15.

Table 5.3.5-15 Recommended Plan Costs by Decade for Manufacturing, Comal

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Purchase from WWP (ARWA)						
Annual Cost ($/yr)	3,983,980	-	-	-	-	-
Unit Cost ($/acft)	1,430	-	-	-	-	-
Purchase from WWP (GBRA)						
Annual Cost ($/yr)	-	5,643,816	5,643,816	1,670,405	1,670,405	185,367
Unit Cost ($/acft)	-	1,492	1,492	442	442	442

5.3.5.10 Mining, Comal

Current water supply for Mining, Comal is obtained from the Trinity Aquifer. Mining, Comal is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual industrial operations implement the following water supply plan to meet projected needs (Table 5.3.5-16):

- Local Groundwater is to be implemented prior to the 2020 decade. This strategy can provide an additional 4,114 acft/yr by 2020, increasing to 9,922 acft/yr in 2070.

Table 5.3.5-16 Recommended Water Supply Plan for Mining, Comal

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(3,861)	(5,201)	(6,491)	(7,617)	(8,849)	(8,849)
Recommended WMS						
Local Groundwater	4,116	5,566	7,018	8,228	9,206	9,185
WMS Supply	**4,116**	**5,566**	**7,018**	**8,228**	**9,206**	**9,185**

Estimated costs of the recommended plan to meet Mining, Comal projected needs are shown in Table 5.3.5-17.

Table 5.3.5-17 Recommended Plan Costs by Decade for Mining, Comal

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Local Groundwater						
Annual Cost ($/yr)	288,646	390,521	238,104	233,250	262,354	306,417
Unit Cost ($/acft)	70	70	34	28	28	33

5.3.5.11 New Braunfels

Current water supply for New Braunfels is obtained from the Edwards Aquifer, Canyon Reservoir, and run-of-river rights. New Braunfels is projected to need additional water supplies prior to 2030. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that New Braunfels implement the following water supply plan to meet projected needs (Table 5.3.5-18):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 663 acft/yr by 2020, increasing to 8,631 acft/yr of supply in 2070.
- Facilities Expansion: NBU South WTP Expansion is to be implemented by the 2030 decade. The anticipated total capacity for this strategy is 9,000 acft/y. Due to MAG limitations and consistency with TWDB data, the allotted WMS supply is 1 acft/yr by 2030 through 2070. This is not new water supply or representative of the physical project. Data shown in Table 5.4-9 represents WMS supply water availability consistent with TWDB data. See Section 5.2.8.2 for more details.
- Facilities Expansion: NBU-Seguin Interconnect is to be implemented by the 2020 decade. The anticipated total capacity for this strategy is 11,500 acft/y. Due to MAG limitations and consistency with TWDB data, the allotted WMS supply is 2,500 acft/yr by 2020 through 2070. This is not new water supply or representative of the physical project. Volume shown is to maintain consistency with TWDB data.
- ARWA/GBRA Project (Phase 1) is to be implemented or enhanced in the immediate future. This strategy can provide an additional 8,000 acft/yr by 2020 through 2070.
- The NBU ASR WMS is to be implemented prior to 2020 and can provide an additional 10,818 acft/yr of new supply through 2070.
- The NBU Trinity WMS is to be implemented prior to 2030 and can provide an additional 3,360 acft/yr through 2070.

Table 5.3.5-18 Recommended Water Supply Plan for New Braunfels

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	842	(3,649)	(8,108)	(12,763)	(17,342)	(21,832)
Recommended WMS						
Advanced Water Conservation	663	2,240	4,381	5,814	7,168	8,631
Facilities Expansion: NBU South WTP Expansion	0	1	1	1	1	1
Facilities Expansion: NBU-Seguin Interconnect	2,500	2,500	2,500	2,500	2,500	2,500
ARWA/GBRA Project (Phase 1)	8,000	8,000	8,000	8,000	8,000	8,000
NBU ASR	10,818	10,818	10,818	10,818	10,818	10,818

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
NBU Trinity Well Field Expansion	0	3,360	3,360	3,360	3,360	3,360
WMS Supply	**21,981**	**26,919**	**29,060**	**30,493**	**31,847**	**33,310**

Estimated costs of the recommended plan to meet the City of New Braunfels' projected needs are shown in Table 5.3.5-19.

Table 5.3.5-19 Recommended Plan Costs by Decade for New Braunfels

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	398,011	1,344,167	2,628,390	3,488,484	4,300,880	5,178,526
Unit Cost ($/acft)	600	600	600	600	600	600
Facilities Expansion: NBU South WTP Expansion[1]						
Annual Cost ($/yr)	-	3,387,000	3,387,000	1,438,000	1,438,000	1,438,000
Unit Cost ($/acft)	-	3,387,000	3,387,000	1,438,000	1,438,000	1,438,000
Facilities Expansion: NBU-Seguin Interconnect[1]						
Annual Cost ($/yr)	529,000	529,000	358,000	358,000	358,000	358,000
Unit Cost ($/acft)	212	212	143	143	143	143
ARWA/GBRA Project (Phase 1)						
Annual Cost ($/yr)	5,764,800	5,764,800	2,262,933	2,262,933	2,262,933	2,262,933
Unit Cost ($/acft)	721	721	283	283	283	283
NBU ASR						
Annual Cost ($/yr)	5,001,000	5,001,000	2,243,000	2,243,000	2,243,000	2,243,000
Unit Cost ($/acft)	462	462	207	207	207	207
NBU Trinity Well Field Expansion						
Annual Cost ($/yr)	-	2,303,000	2,303,000	955,000	955,000	955,000
Unit Cost ($/acft)	-	685	685	284	284	284

[1] Facilities Expansion unit costs are representative of WMS supplies detailed in Table 5.4-3; not the anticipated volumes.

5.3.5.12 Wingert Water Systems

Current water supply for Wingert Water Systems is obtained from the Trinity Aquifer. Wingert Water Systems is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Wingert Water Systems implement the following water supply plan to meet projected needs (Table 5.3.5-20):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 5 acft/yr by 2020, increasing to 119 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 10 acft/yr by 2020.
- Local Groundwater management is to be implemented prior to the 2020 decade. This strategy can provide an additional 296 acft/yr by 2020 through 2070.

Table 5.3.5-20 Recommended Water Supply Plan for Wingert Water Systems

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(32)	(108)	(185)	(185)	(185)	(185)
Recommended WMS						
Advanced Water Conservation	5	40	86	102	111	119
Drought Management	10	-	-	-	-	-
Local Groundwater	296	296	296	296	296	296
WMS Supply	**311**	**336**	**382**	**398**	**407**	**415**

Estimated costs of the recommended plan to meet the Wingert Water Systems' projected needs are shown in Table 5.3.5-21.

Table 5.3.5-21 Recommended Plan Costs by Decade for Wingert Water Systems

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	3,270	27,402	58,574	69,670	75,287	80,766
Unit Cost ($/acft)	681	681	681	681	681	681
Drought Management						
Annual Cost ($/yr)	1,149	-	-	-	-	-
Unit Cost ($/acft)	115	-	-	-	-	-
Local Groundwater						
Annual Cost ($/yr)	258,000	258,000	155,000	155,000	155,000	155,000
Unit Cost ($/acft)	872	872	524	524	524	524

5.3.6 DeWitt County Water Supply Plan

Table 5.3.6-1 lists each WUG in DeWitt County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.6-1 DeWitt County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED) 2020 (ACFT/YR)	PROJECTED SURPLUS / (NEED) 2070 (ACFT/YR)	COMMENT
County-Other, DeWitt	61	61	No Projected Needs
Cuero	0	0	No Projected Needs
Irrigation, DeWitt	(266)	722	Projected Needs (2020 through 2040)
Livestock, DeWitt	0	0	No Projected Needs
Manufacturing, DeWitt	47	6	Projected Needs (2030 and 2040, only)
Mining, DeWitt	(1,718)	0	Projected Needs (2020 through 2050)
Yoakum	7	0	No Projected Needs
Yorktown	0	0	No Projected Needs

5.3.6.1 County-Other, DeWitt

County-Other, DeWitt are projected to have adequate water supplies available from the Gulf Coast Aquifer to meet their projected demands during the planning period.

5.3.6.2 Cuero

The City of Cuero is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Cuero implement the following water supply plan (Table 5.3.6-2):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 91 acft/yr by 2020, increasing to 744 acft/yr of supply in 2070.

Table 5.3.6-2 Recommended Water Supply Plan for Cuero

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	0	0	0	0
Recommended WMS						
Advanced Water Conservation	91	233	367	503	637	744
WMS Supply	**91**	**233**	**367**	**503**	**637**	**744**

Estimated costs of the recommended plan for Cuero are shown in Table 5.3.6-3.

Table 5.3.6-3 Recommended Plan Costs by Decade for Cuero

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	70,158	179,132	282,744	387,387	490,629	572,811
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.6.3 Irrigation, DeWitt

Current water supply for irrigation, DeWitt is obtained from the Gulf Coast Aquifer and run-of-river rights. Irrigation, DeWitt is projected to need additional water supplies from 2020 through 2040. Irrigation, DeWitt is projected to have adequate supplies from 2050 through 2070. Because of limited economically feasible supplies for irrigation, any needs may be left unmet. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual irrigators implement water conservation measures associated with the Advanced Water Conservation WMS to meet a portion of the projected needs for irrigation (Table 5.3.6-4).

- Irrigation water conservation, while not a recommended strategy, is encouraged and can provide additional supply when possible. The SCTRWPG has determined that it is not economically feasible for agricultural producers to purchase additional supplies to meet projected needs.

Table 5.3.6-4 Recommended Water Supply Plan for Irrigation, DeWitt

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(266)	(247)	(61)	27	666	722
Recommended WMS						
WMS Supply	**0**	**0**	**0**	**0**	**0**	**0**

5.3.6.4 Livestock, DeWitt

Livestock, DeWitt is projected to have adequate water supplies available from local sources to meet the WUG's projected demand during the planning period.

5.3.6.5 Manufacturing, DeWitt

Manufacturing, DeWitt is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the WUG's projected demand during the planning period, except for 2030 through 2040. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended to implement the following water supply plan to meet manufacturing needs (Table 5.3.6-5):

- Local Groundwater management is to be implemented prior to the 2030 decade. This strategy can provide an additional 242 acft/yr by 2030 through 2070.

Table 5.3.6-5 Recommended Water Supply Plan for Manufacturing, DeWitt

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	47	(22)	(10)	4	6	6
Recommended WMS						
Local Groundwater	-	242	242	242	242	242
WMS Supply	**0**	**242**	**242**	**242**	**242**	**242**

Estimated costs of the recommended plan for Manufacturing, DeWitt are shown in Table 5.3.6-6.

Table 5.3.6-6 Recommended Plan Costs by Decade for Manufacturing, DeWitt

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Local Groundwater						
Annual Cost ($/yr)	-	14,000	14,000	2,000	2,000	2,000
Unit Cost ($/acft)	-	58	58	8	8	8

5.3.6.6 Mining, DeWitt

Current water supply for Mining, DeWitt is obtained from the Gulf Coast Aquifer. Mining, DeWitt is projected to need additional water supplies prior to 2020 through 2050. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual miners implement the following water supply plan to meet the projected needs for mining (Table 5.3.6-7):

- Local Groundwater management is to be implemented prior to the 2020 decade. This strategy can provide an additional 1,937 acft/yr by 2020 through 2070.

Table 5.3.6-7 Recommended Water Supply Plan for Mining, DeWitt

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(1,718)	(1,595)	(362)	(2)	0	0
Recommended WMS						
Local Groundwater	1,937	1,937	1,937	1,937	1,937	1,937
WMS Supply	**1,937**	**1,937**	**1,937**	**1,937**	**1,937**	**1,937**

Estimated costs of the recommended plan for Mining, DeWitt are shown in Table 5.3.6-8.

Table 5.3.6-8 Recommended Plan Costs by Decade for Mining, DeWitt

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Local Groundwater						
Annual Cost ($/yr)	107,000	107,000	13,000	13,000	13,000	13,000
Unit Cost ($/acft)	55	55	7	7	7	7

5.3.6.7 Yoakum

The City of Yoakum is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Yoakum implement the following water supply plan (Table 5.3.6-9):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 13 acft/yr by 2020, increasing to 63 acft/yr of supply in 2070.

Table 5.3.6-9 Recommended Water Supply Plan for Yoakum

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	7	4	7	6	3	0
Recommended WMS						
Advanced Water Conservation	13	40	40	45	53	63
WMS Supply	**13**	**40**	**40**	**45**	**53**	**63**

Estimated costs of the recommended plan for the City of Yoakum are shown in Table 5.3.6-10.

Table 5.3.6-10 Recommended Plan Costs by Decade for Yoakum

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	9,747	30,980	31,182	34,733	41,184	48,351
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.6.8 Yorktown

The City of Yorktown is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Yorktown implement the following water supply plan (Table 5.3.6-11):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 12 acft/yr by 2020, increasing to 60 acft/yr of supply in 2070.

Table 5.3.6-11 Recommended Water Supply Plan for Yorktown

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	0	0	0	0
Recommended WMS						
Advanced Water Conservation	12	35	36	43	52	60
WMS Supply	**12**	**35**	**36**	**43**	**52**	**60**

Estimated costs of the recommended plan for Yorktown are shown in Table 5.3.6-12.

Table 5.3.6-12 Recommended Plan Costs by Decade for Yorktown

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	9,254	27,277	27,406	33,430	39,932	46,382
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.7 Dimmit County Water Supply Plan

Table 5.3.7-1 lists each WUG in Dimmit County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.7-1 Dimmit County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED)		COMMENT
	2020 (ACFT/YR)	2070 (ACFT/YR)	
Asherton	0	0	No Projected Needs
Big Wells	0	0	No Projected Needs
Carrizo Hill WSC	0	0	No Projected Needs
Carrizo Springs	0	0	No Projected Needs
County-Other, Dimmit	52	0	No Projected Needs
Irrigation, Dimmit	(5,249)	(5,249)	Projected Needs (2020 through 2070)
Livestock, Dimmit	0	0	No Projected Needs
Mining, Dimmit	(4,224)	61	Projected Needs (2020 through 2060)

5.3.7.1 Asherton

Current supplies for the City of Asherton come from the Carrizo-Wilcox Aquifer. The City of Asherton is projected to have adequate water supplies for the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the Asherton implement the following water supply plan (Table 5.3.7-2):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 7 acft/yr by 2020, increasing to 72 acft/yr of supply in 2070.

Table 5.3.7-2 Recommended Water Supply Plan for Asherton

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	0	0	0	0
Recommended WMS						
Advanced Water Conservation	7	24	47	57	65	72
WMS Supply	**7**	**24**	**47**	**57**	**65**	**72**

Estimated costs of the recommended plan for Asherton are shown in Table 5.3.7-3.

Table 5.3.7-3 Recommended Plan Costs by Decade for Asherton

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	5,679	18,607	36,246	44,188	49,879	55,204
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.7.2 Big Wells

The City of Big Wells is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Big Wells implement the following water supply plan (Table 5.3.7-4):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 3 acft/yr by 2020, increasing to 11 acft/yr of supply in 2070.

Table 5.3.7-4 Recommended Water Supply Plan for Big Wells

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	0	0	0	0
Recommended WMS						
Advanced Water Conservation	3	2	2	4	7	11
WMS Supply	**3**	**2**	**2**	**4**	**7**	**11**

Estimated costs of the recommended plan for Big Wells are shown in Table 5.3.7-5.

Table 5.3.7-5 Recommended Plan Costs by Decade for the City of Big Wells

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	2,269	1,475	1,818	2,976	5,372	8,391
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.7.3 Carrizo Hill WSC

Carrizo Hill WSC is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the WSC implement the following water supply plan (Table 5.3.7-6):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 2 acft/yr by 2020, increasing to 20 acft/yr of supply in 2070.

Table 5.3.7-6 Recommended Water Supply Plan for the Carrizo Hill WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	0	0	0	0
Recommended WMS						
Advanced Water Conservation	2	10	11	14	17	20
WMS Supply	**2**	**10**	**11**	**14**	**17**	**20**

Estimated costs of the recommended plan for Carrizo Hill WSC are shown in Table 5.3.7-7.

Table 5.3.7-7 Recommended Plan Costs by Decade for Carrizo Hill WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	1,905	7,385	8,563	10,773	13,130	15,461
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.7.4 Carrizo Springs

City of Carrizo Springs is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Carrizo Springs implement the following water supply plan (Table 5.3.7-8):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 77 acft/yr by 2020, increasing to 784 acft/yr of supply in 2070.

Table 5.3.7-8 Recommended Water Supply Plan for Carrizo Springs

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	0	0	0	0
Recommended WMS						
Advanced Water Conservation	77	210	346	498	645	784
WMS Supply	**77**	**210**	**346**	**498**	**645**	**784**

Estimated costs of the recommended plan for Carrizo Springs are shown in Table 5.3.7-9.

Table 5.3.7-9 Recommended Plan Costs by Decade for Carrizo Springs

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	59,569	161,709	266,575	383,185	496,303	603,647
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.7.5 County-Other, Dimmit

Current water supply for County-Other, Dimmit is obtained from the Carrizo-Wilcox Aquifer. County-Other, Dimmit are projected to have adequate water supplies for the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that County-Other, Dimmit implement the following water supply plan to meet the projected needs for rural areas (Table 5.3.7-10):

- Advanced Water Conservation is to be implemented or enhanced in the future. This strategy can provide an additional 2 acft/yr of supply in 2070.

Table 5.3.7-10 Recommended Water Supply Plan for County-Other, Dimmit

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	52	37	30	19	9	0
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	2
WMS Supply	**0**	**0**	**0**	**0**	**0**	**2**

Estimated costs of the recommended plan to meet the projected needs of County-Other, Dimmit are shown in Table 5.3.7-11.

Table 5.3.7-11 Recommended Plan Costs by Decade for County-Other, Dimmit

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	1,858
Unit Cost ($/acft)	-	-	-	-	-	770

5.3.7.6 Irrigation, Dimmit

Current water supply for Irrigation, Dimmit is obtained from the Carrizo-Wilcox Aquifer and run-of-river rights. Irrigation, Dimmit is projected to need additional water supplies prior to 2020. Due to limited economically feasible supplies for irrigation, these needs remain unmet. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual irrigators implement water conservation measures associated with the Advanced Water Conservation WMS to meet a portion of the projected needs for irrigation following water supply plan (Table 5.3.7-12).

- Irrigation water conservation, while not a recommended strategy, is encouraged and can provide additional supply when possible. The SCTRWPG has determined that it is not economically feasible for agricultural producers to pay for additional supplies to meet projected needs.

Table 5.3.7-12 Recommended Water Supply Plan for Irrigation, Dimmit

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(5,249)	(5,249)	(5,249)	(5,249)	(5,249)	(5,249)
Recommended WMS						
WMS Supply	**0**	**0**	**0**	**0**	**0**	**0**

5.3.7.7 Livestock, Dimmit

Livestock, Dimmit is projected to have adequate water supplies available from local sources to meet the WUG’s projected demand during the planning period.

5.3.7.8 Mining, Dimmit

Current water supply for Mining is obtained from the Carrizo-Wilcox Aquifer and run-of-river rights. Mining, Dimmit is projected to need additional water supplies prior to 2020. Due to limited economically feasible supplies for mining, these needs remain unmet. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual Miners implement water conservation measures associated with the Advanced Water Conservation WMS to meet a portion of the projected needs for mining (Table 5.3.7-13).

- Mining water conservation, while not a recommended strategy, is encouraged and can provide additional supply when possible. The SCTRWPG has determined that it is not economically feasible for mining associations to purchase additional supplies to meet projected needs.

Table 5.3.7-13 Recommended Water Supply Plan for Mining, Dimmit

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(4,224)	(4,312)	(3,652)	(2,144)	(639)	61
Recommended WMS						
WMS Supply	**0**	**0**	**0**	**0**	**0**	**0**

5.3.8 Frio County Water Supply Plan

Table 5.3.8-1 lists each WUG in Frio County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.8-1 Frio County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED) 2020 (ACFT/YR)	PROJECTED SURPLUS / (NEED) 2070 (ACFT/YR)	COMMENT
County-Other, Frio	149	4	No Projected Needs
Dilley	1,056	650	No Projected Needs
Irrigation, Frio	0	(7,146)	Projected Needs (2040 through 2070)
Livestock, Frio	0	0	No Projected Needs
Mining, Frio	0	0	No Projected Needs
Moore WSC	3,921	3,879	No Projected Needs
Pearsall	(611)	(1,340)	Projected Needs (2020 through 2070)
Steam-Electric Power, Frio	0	0	No Projected Needs

5.3.8.1 County-Other, Frio

County-Other, Frio is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet their projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the rural area water supply districts and authorities and individual households and/or businesses not served by public water supply systems implement the following water supply plan for the County-Other, Frio (Table 5.3.8-2):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 1 acft/yr in 2070.

Table 5.3.8-2 Recommended Water Supply Plan for County-Other, Frio

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	149	125	92	60	31	4
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	1
WMS Supply	**0**	**0**	**0**	**0**	**0**	**1**

Estimated costs of the recommended plan for County-Other are shown in Table 5.3.8-3.

Table 5.3.8-3 Recommended Plan Costs by Decade for County-Other, Frio

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	982
Unit Cost ($/acft)	-	-	-	-	-	770

5.3.8.2 Dilley

The City of Dilley is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the City's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Dilley implement the following water supply plan (Table 5.3.8-4):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 50 acft/yr by 2020, increasing to 501 acft/yr of supply in 2070.

Table 5.3.8-4 Recommended Water Supply Plan for Dilley

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	1,056	965	885	802	723	650
Recommended WMS						
Advanced Water Conservation	50	145	248	362	453	501
WMS Supply	**50**	**145**	**248**	**362**	**453**	**501**

Estimated costs of the recommended plan for Dilley are shown in Table 5.3.8-5.

Table 5.3.8-5 Recommended Plan Costs by Decade for Dilley

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	38,710	111,410	191,112	279,017	348,555	385,838
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.8.3 Irrigation, Frio

Current water supply for Irrigation, Frio is obtained from the Carrizo-Wilcox Aquifer, Queen City Aquifer, Sparta Aquifer, and run-of-river rights. Irrigation, Frio is projected to need additional water supplies prior to 2040. Due to limited economically feasible supplies for irrigation, these needs remain unmet. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual Irrigators implement water conservation measures associated with the Advanced Water Conservation WMS to meet a portion of the projected needs for irrigation following water supply plan (Table 5.3.8-6).

- Irrigation water conservation, while not a recommended strategy, is encouraged and can provide additional supply when possible. The SCTRWPG has determined that it is not economically feasible for agricultural producers to purchase additional supplies to meet projected needs.

Table 5.3.8-6 Recommended Water Supply Plan for Irrigation, Frio

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	(1,838)	(3,612)	(5,332)	(7,146)
Recommended WMS						
WMS Supply	**0**	**0**	**0**	**0**	**0**	**0**

5.3.8.4 Livestock, Frio

Livestock, Frio is projected to have adequate water supplies available from local sources to meet the WUG's projected demand during the planning period.

5.3.8.5 Mining, Frio

Mining, Frio is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the WUG's projected demand during the planning period.

5.3.8.6 Moore WSC

The Moore WSC is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the Moore WSC to implement the following water supply plan (Table 5.3.8-7):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 5 acft/yr by 2020, increasing to 36 acft/yr of supply in 2070.

Table 5.3.8-7 Recommended Water Supply Plan for Moore WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	3,921	3,912	3,903	3,895	3,887	3,879
Recommended WMS						
Advanced Water Conservation	5	14	24	27	31	36
WMS Supply	**5**	**14**	**24**	**27**	**31**	**36**

Estimated costs of the recommended plan to meet Moore WSC projected needs are shown in Table 5.3.8-8.

Table 5.3.8-8 Recommended Plan Costs by Decade for Moore WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	3,498	10,817	18,297	20,789	23,965	27,894
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.8.7 Pearsall

The City of Pearsall is projected to need additional water supplies available from the Carrizo-Wilcox Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Pearsall implement the following water supply plan (Table 5.3.8-9):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 81 acft/yr by 2020, increasing to 655 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 26 acft/yr by 2020.
- Local Groundwater management is to be implemented prior to 2020. This strategy can provide an additional 807 acft/yr by 2020, increasing to 1,614 acft/yr by 2040 through 2070.

Table 5.3.8-9 Recommended Water Supply Plan for Pearsall

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(611)	(771)	(913)	(1,061)	(1,206)	(1,340)
Recommended WMS						
Advanced Water Conservation	81	247	434	496	573	655
Drought Management	26	-	-	-	-	-
Local Groundwater	807	807	1,614	1,614	1,614	1,614
WMS Supply	914	1,054	2,048	2,110	2,187	2,269

Estimated costs of the recommended plan to meet Pearsall projected needs are shown in Table 5.3.8-10.

Table 5.3.8-10 Recommended Plan Cost by Decade for Pearsall

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	62,503	190,551	333,889	381,874	441,504	504,617
Unit Cost ($/acft)	770	770	770	770	770	770

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Drought Management						
Annual Cost ($/yr)	1,759	-	-	-	-	-
Unit Cost ($/acft)	68	-	-	-	-	-
Local Groundwater						
Annual Cost ($/yr)	455,000	455,000	694,000	694,000	478,000	478,000
Unit Cost ($/acft)	564	564	430	430	296	296

5.3.8.8 Steam-Electric Power, Frio

Steam-Electric Power, Frio is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the WUG's projected demand during the planning period.

5.3.9 Goliad County Water Supply Plan

Table 5.3.9-1 lists each WUG in Goliad County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.9-1 Goliad County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED)		COMMENT
	2020 (ACFT/YR)	2070 (ACFT/YR)	
County-Other, Goliad	357	280	No Projected Needs
Goliad	460	355	No Projected Needs
Irrigation, Goliad	0	0	No Projected Needs
Livestock, Goliad	0	0	No Projected Needs
Manufacturing, Goliad	3	3	No Projected Needs
Mining, Goliad	0	0	No Projected Needs
Steam-Electric Power, Goliad	24,160	24,160	No Projected Needs

5.3.9.1 County-Other, Goliad

County-Other, Goliad is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet their projected demands during the planning period.

5.3.9.2 Goliad

The City of Goliad is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the City’s projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Goliad implement the following water supply plan (Table 5.3.9-2):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 15 acft/yr by 2020, increasing to 135 acft/yr in 2070.

Table 5.3.9-2 Recommended Water Supply Plan for Goliad

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	460	414	385	372	362	355
Recommended WMS						
Advanced Water Conservation	15	51	93	111	123	135
WMS Supply	**15**	**51**	**93**	**111**	**123**	**135**

Estimated costs of the recommended plan for the City of Goliad are shown in Table 5.3.9-3.

Table 5.3.9-3 Recommended Plan Costs by Decade for Goliad

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	11,526	39,501	71,432	85,190	94,332	104,319
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.9.3 Irrigation, Goliad

Irrigation, Goliad is projected to have adequate water supplies available from the Gulf Coast Aquifer and run-of-river rights to meet the WUG's projected demand during the planning period.

5.3.9.4 Livestock, Goliad

Livestock, Goliad is projected to have adequate water supplies available from local sources to meet the WUG's projected demand during the planning period.

5.3.9.5 Manufacturing, Goliad

Manufacturing, Goliad is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the WUG's projected demand during the planning period.

5.3.9.6 Mining, Goliad

Mining, Goliad is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the WUG's projected demand during the planning period.

5.3.9.7 Steam-Electric Power, Goliad

Current water supply for Steam-Electric Power, Goliad is obtained from the Gulf Coast Aquifer and Coleto Creek Reservoir. Steam-Electric Power, Goliad is projected to have adequate supplies through the planning period.

5.3.10 Gonzales County Water Supply Plan

Table 5.3.10-1 lists each WUG in Gonzales County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.10-1 Gonzales County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED)		COMMENT
	2020 (ACFT/YR)	2070 (ACFT/YR)	
County-Other, Gonzales	554	434	No Projected Needs
Gonzales	3,101	2,136	No Projected Needs
Gonzales County WSC	1,232	253	No Projected Needs
Irrigation, Gonzales	482	482	No Projected Needs
Livestock, Gonzales	0	0	No Projected Needs
Manufacturing, Gonzales	0	0	No Projected Needs
Mining, Gonzales	0	0	No Projected Needs
Nixon	3,233	3,057	No Projected Needs
Smiley	322	267	No Projected Needs
Waelder	417	320	No Projected Needs

5.3.10.1 County-Other, Gonzales

The County-Other, Gonzales are projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet their projected demands during the planning period.

5.3.10.2 Gonzales

The City of Gonzales obtains its supply from the Carrizo-Wilcox Aquifer and run-of-river rights and is projected to have adequate supplies through the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Gonzales implement the following water supply plan (Table 5.3.10-2):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 96 acft/yr by 2020, increasing to 1,081 acft/yr by 2070.

Table 5.3.10-2 Recommended Water Supply Plan for Gonzales

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	3,101	2,937	2,779	2,579	2,364	2,136
Recommended WMS						
Advanced Water Conservation	96	271	465	690	941	1,081
WMS Supply	**96**	**271**	**465**	**690**	**941**	**1,081**

Estimated costs of the recommended plan for Gonzales are shown in Table 5.3.10-3.

Table 5.3.10-3 Recommended Plan Costs by Decade for the City of Gonzales

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	74,026	208,530	357,805	531,188	724,200	832,296
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.10.3 Gonzales County WSC

Current water supply for Gonzales County WSC is obtained from the Carrizo-Wilcox Aquifer and Canyon Reservoir. Gonzales County WSC is projected to have adequate water supply for the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Gonzales County WSC implement the following water supply plan (Table 5.3.10-4):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 109 acft/yr by 2020, increasing to 1,233 acft/yr of supply in 2070.

Table 5.3.10-4 Recommended Water Supply Plan for Gonzales County WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	1,232	1,059	892	691	478	253
Recommended WMS						
Advanced Water Conservation	109	289	490	717	966	1,233
WMS Supply	**109**	**289**	**490**	**717**	**966**	**1,233**

Estimated costs of the recommended plan for the Gonzalez County WSC are shown in Table 5.3.10-5.

Table 5.3.10-5 Recommended Plan Costs by Decade for the Gonzales County WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	83,741	222,838	377,382	552,110	744,202	949,047
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.10.4 Irrigation, Gonzales

Irrigation, Gonzales is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer, Sparta Aquifer, Queen City Aquifer, Gulf Coast Aquifer, Canyon Reservoir, and run-of-river rights to meet the WUG's projected demand during the planning period.

5.3.10.5 Livestock, Gonzales

Livestock, Gonzales is projected to have adequate water supplies available from local sources to meet the WUG's projected demand during the planning period.

5.3.10.6 Manufacturing, Gonzales

Manufacturing, Gonzales is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer and Sparta Aquifer to meet the WUG's projected demand during the planning period.

5.3.10.7 Mining, Gonzales

Mining, Gonzales is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer, Sparta Aquifer, and Queen City Aquifer to meet the WUG's projected demand during the planning period.

5.3.10.8 Nixon

The City of Nixon is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the City's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Nixon implement the following water supply plan (Table 5.3.10-6):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 1 acft/yr by 2020, increasing to 38 acft/yr of supply in 2070.

Table 5.3.10-6 Recommended Water Supply Plan for Nixon

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	3,233	3,204	3,177	3,140	3,100	3,057
Recommended WMS						
Advanced Water Conservation	1	1	3	11	23	38
WMS Supply	**1**	**1**	**3**	**11**	**23**	**38**

Estimated costs of the recommended plan for Nixon are shown in Table 5.3.10-7.

Table 5.3.10-7 Recommended Plan Costs by Decade for Nixon

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	750	818	2,334	8,609	17,855	29,545
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.10.9 Smiley

The City of Smiley is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the City's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Smiley implement the following water supply plan (Table 5.3.10-8):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 5 acft/yr by 2020, increasing to 42 acft/yr of supply in 2070.

Table 5.3.10-8 Recommended Water Supply Plan for Smiley

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	322	313	304	293	280	267
Recommended WMS						
Advanced Water Conservation	5	15	26	31	36	42
WMS Supply	**5**	**15**	**26**	**31**	**36**	**42**

Estimated costs of the recommended plan for the City of Smiley are shown in Table 5.3.10-9.

Table 5.3.10-9 Recommended Plan Costs by Decade for the City of Smiley

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	3,994	11,309	19,982	23,486	28,086	32,674
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.10.10 Waelder

The City of Waelder is projected to have adequate water supplies available from the Queen City Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Waelder implement the following water supply plan (Table 5.3.10-10):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 7 acft/yr by 2020, increasing to 44 acft/yr of supply in 2070.

Table 5.3.10-10 Recommended Water Supply Plan for Waelder

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	417	401	385	365	343	320
Recommended WMS						
Advanced Water Conservation	7	18	21	27	35	44
WMS Supply	**7**	**18**	**21**	**27**	**35**	**44**

Estimated costs of the recommended plan for Waelder are shown in Table 5.3.10-11.

Table 5.3.10-11 Recommended Plan Costs by Decade for Waelder

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	5,222	13,571	16,338	20,721	27,072	34,076
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.11 Guadalupe County Water Supply Plan

Table 5.3.11-1 lists each WUG in Guadalupe County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.11-1 Guadalupe County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED) 2020 (ACFT/YR)	PROJECTED SURPLUS / (NEED) 2070 (ACFT/YR)	COMMENT
Cibolo	1,578	(866)	Projected Needs (2030-2070)
County-Other, Guadalupe	525	525	No Projected Needs
GBRA (WUG data)	0	0	No Projected Needs; WUG and WWP data detailed in Section 5.4
Irrigation, Guadalupe	43	43	No Projected Needs
Livestock, Guadalupe	0	0	No Projected Needs
Manufacturing, Guadalupe	0	(387)	Projected Needs (2030 through 2070)
Marion	72	(131)	Projected Needs (2040 through 2070)
Mining, Guadalupe	0	0	No Projected Needs
Schertz	211	(8,385)	Projected Needs (2040 through 2070)
Seguin	(11)	(331)	Projected Needs (2020, 2050 through 2070)
Springs Hill WSC	3,626	205	No Projected Needs
Steam-Electric Power, Guadalupe	3,915	3,915	No Projected Needs

5.3.11.1 Cibolo

Current water supply for the City of Cibolo is obtained from Canyon Reservoir through CRWA. The City is projected to have a shortage beginning in 2030. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Cibolo implement the following water supply plan (Table 5.3.11-2):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 43 acft/yr by 2040, increasing to 875 acft/yr of supply in 2070.
- CVLGC Carrizo Project is to be implemented prior to 2030. This strategy can provide an additional 5,000 acft/yr for 2030 through 2070.

Table 5.3.11-2 Recommended Water Supply Plan for Cibolo

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	1,578	(40)	(484)	(704)	(813)	(866)
Recommended WMS						
Advanced Water Conservation	-	-	43	267	545	875
CVLGC Carrizo Project	-	5,000	5,000	5,000	5,000	5,000
WMS Supply	**0**	**5,000**	**5,043**	**5,267**	**5,545**	**5,875**

Estimated costs of the recommended plan for the City of Cibolo are shown in Table 5.3.11-3.

Table 5.3.11-3 Recommended Plan Costs by Decade for Cibolo

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	29,473	181,843	371,419	596,201
Unit Cost ($/acft)	-	-	681	681	681	681
CVLGC Carrizo Project						
Annual Cost ($/yr)	-	6,151,000	6,151,000	1,569,500	1,569,500	1,569,500
Unit Cost ($/acft)	-	1,230	1,230	314	314	314

5.3.11.2 County-Other, Guadalupe

Current water supply for the County-Other, Guadalupe is obtained from the Edwards Aquifer, Carrizo-Wilcox Aquifer, Queen City Aquifer, Canyon Reservoir, and run-of-river rights. The County-Other, Guadalupe areas are projected to have adequate water supplies through 2070. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that rural area water supply districts and authorities and individual households and/or businesses not served by public water supply systems implement the following water supply plan (Table 5.3.11-4):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 5 acft/yr by 2060, increasing to 13 acft/yr of supply in 2070.

Table 5.3.11-4 Recommended Water Supply Plan for County-Other, Guadalupe

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	525	525	525	525	525	525
Recommended WMS						
Advanced Water Conservation	-	-	-	-	5	13

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
WMS Supply	**0**	**0**	**0**	**0**	**5**	**13**

Estimated costs of the recommended plan for County-Other are shown in Table 5.3.11-5.

Table 5.3.11-5 Recommended Plan Costs by Decade for County-Other, Guadalupe

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	3,516	9,183
Unit Cost ($/acft)	-	-	-	-	681	681

5.3.11.3 Irrigation, Guadalupe

Irrigation, Guadalupe is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer, Canyon Reservoir, and run-of-river rights to meet the WUG's projected demand during the planning period.

5.3.11.4 Livestock, Guadalupe

Livestock, Guadalupe is projected to have adequate water supplies available from local sources to meet the WUG's projected demand during the planning period.

5.3.11.5 Manufacturing, Guadalupe

Current water supply for Manufacturing, Guadalupe is obtained from the Edwards Aquifer, Carrizo-Wilcox Aquifer, Canyon Reservoir, and run-of-river rights. Manufacturing, Guadalupe is projected to need additional water supplies prior to the year 2030. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual industrial operations implement the following water supply plan to meet the projected needs for industrial (Table 5.3.11-6):

- Purchase from WWP (GBRA) is to be implemented prior to 2030. This strategy can provide an additional 402 acft/yr by 2030 through 2070.

Table 5.3.11-6 Recommended Water Supply Plan for Manufacturing, Guadalupe

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	(387)	(387)	(387)	(387)	(387)
Recommended WMS						
Purchase from WWP (GBRA)	-	402	402	402	402	402
WMS Supply	**0**	**402**	**402**	**402**	**402**	**402**

Estimated costs of the recommended plan to meet Manufacturing projected need are shown in Table 5.3.11-7.

Table 5.3.11-7 Recommended Plan Costs by Decade for Manufacturing, Guadalupe

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Purchase from WWP (GBRA)						
Annual Cost ($/yr)	-	599,739	599,739	177,505	177,505	177,505
Unit Cost ($/acft)	-	1,492	1,492	442	442	442

5.3.11.6 Marion

Current water supply for the City of Marion is obtained from the Edwards Aquifer and Canyon Reservoir through CRWA. Marion is projected to need additional water supplies by the year 2040. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Marion implement the following water supply plan to meet the projected needs for the city (Table 5.3.11-8):

- Purchase from WWP (CRWA) is to be implemented prior to 2040. This strategy can provide an additional 18 acft/yr by 2040, increasing to 146 acft/yr in 2070.

Table 5.3.11-8 Recommended Water Supply Plan for Marion

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	72	35	(3)	(44)	(88)	(131)
Recommended WMS						
Purchase from WWP (CRWA)	-	-	18	59	103	146
WMS Supply	**0**	**0**	**18**	**59**	**103**	**146**

Estimated costs of the recommended plan to meet Marion's projected needs are shown in Table 5.3.11-9.

Table 5.3.11-9 Recommended Plan Costs by Decade for Marion

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Purchase from WWP (CRWA)						
Annual Cost ($/yr)	-	-	5,942,000	5,942,000	5,942,000	5,942,000
Unit Cost ($/acft)	-	-	849	849	849	849

5.3.11.7 Mining, Guadalupe

Mining, Guadalupe is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the WUG's projected demand during the planning period.

5.3.11.8 Schertz

Current water supply for the City of Schertz is obtained from the Edwards Aquifer and Carrizo-Wilcox Aquifer. Schertz is projected to need additional water supplies prior to 2040. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Schertz implement the following water supply plan to meet the projected needs for the city (Table 5.3.11-10):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 242 acft/yr by 2020, increasing to 1,967 acft/yr of supply in 2070.
- CVLGC Carrizo Project is to be implemented prior to 2030. This strategy utilizes new Carrizo supply and can provide an additional 5,000 acft/yr by 2030 through 2070.
- SSLGC Expanded Carrizo Project is to be implemented prior to 2020. This strategy utilizes new Carrizo supply and can provide an additional 3,000 acft/yr by 2020 through 2070.
- SSLGC Expanded Brackish Wilcox Project is to be implemented prior to 2040. This strategy utilizes new Wilcox supply and can provide an additional 2,500 acft/yr by 2040 through 2070.

Table 5.3.11-10 Recommended Water Supply Plan for Schertz

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	211	173	(889)	(3,294)	(5,858)	(8,385)
Recommended WMS						
Advanced Water Conservation	242	375	622	971	1,428	1,967
CVLGC Carrizo Project	-	5,000	5,000	5,000	5,000	5,000
SSLGC Expanded Carrizo Project	3,000	3,000	3,000	3,000	3,000	3,000

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
SSLGC Expanded Brackish Wilcox Project	-	-	2,500	2,500	2,500	2,500
WMS Supply	**3,242**	**8,375**	**11,122**	**11,471**	**11,928**	**12,467**

Estimated costs of the recommended plan to meet Schertz's projected needs are shown in Table 5.3.11-11.

Table 5.3.11-11 Recommended Plan Costs by Decade for Schertz

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	165,003	255,520	423,322	661,256	972,398	1,339,361
Unit Cost ($/acft)	681	681	681	681	681	681
CVLGC Carrizo Project						
Annual Cost ($/yr)	-	6,151,000	6,151,000	1,569,500	1,569,500	1,569,500
Unit Cost ($/acft)	-	1,230	1,230	314	314	314
SSLGC Expanded Carrizo Project						
Annual Cost ($/yr)	3,619,500	3,619,500	962,000	962,000	962,000	962,000
Unit Cost ($/acft)	1,207	1,207	321	321	321	321
SSLGC Expanded Brackish Wilcox Project						
Annual Cost ($/yr)	-	-	1,658,000	1,658,000	534,500	534,500
Unit Cost ($/acft)	-	-	663	663	214	214

5.3.11.9 Seguin

The City of Seguin is projected to need additional water supplies available from the Carrizo-Wilcox Aquifer, Canyon Reservoir, and run-of-river rights to meet the City's projected demands during the planning period except for 2030 and 2040 decades. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Seguin implement the following water supply plan (Table 5.3.11-12):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 59 acft/yr by 2050, increasing to 448 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 228 acft/yr by 2020.
- SSLGC Expanded Carrizo Project is to be implemented prior to 2020. This strategy utilizes new Carrizo supply and can provide an additional 3,000 acft/yr by 2020 through 2070.

- SSLGC Expanded Brackish Wilcox Project is to be implemented prior to 2040. This strategy utilizes new Wilcox supply and can provide an additional 2,500 acft/yr by 2040 through 2070.
- Facilities expansion supply reduction of 2,500 acft/yr through 2070 due to NBU Seguin Interconnect.

Table 5.3.11-12 Recommended Water Supply Plan for Seguin

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(11)	29	18	(93)	(210)	(331)
Recommended WMS						
Advanced Water Conservation	-	-	-	59	232	448
Drought Management	228	-	-	-	-	-
SSLGC Expanded Carrizo Project	3,000	3,000	3,000	3,000	3,000	3,000
SSLGC Expanded Brackish Wilcox Project	-	-	2,500	2,500	2,500	2,500
WMS Supply	**3,228**	**3,000**	**5,500**	**5,559**	**5,732**	**5,948**

Estimated costs of the recommended plan for the City of Seguin are shown in Table 5.3.11-13.

Table 5.3.11-13 Recommended Plan Costs by Decade for Seguin

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	39,948	157,890	305,278
Unit Cost ($/acft)	-	-	-	681	681	681
Drought Management						
Annual Cost ($/yr)	19,898	-	-	-	-	-
Unit Cost ($/acft)	87	-	-	-	-	-
SSLGC Expanded Carrizo Project						
Annual Cost ($/yr)	3,619,500	3,619,500	962,000	962,000	962,000	962,000
Unit Cost ($/acft)	1,207	1,207	321	321	321	321
SSLGC Expanded Brackish Wilcox Project						
Annual Cost ($/yr)	-	-	1,658,000	1,658,000	534,500	534,500
Unit Cost ($/acft)	-	-	663	663	214	214

5.3.11.10 Springs Hill WSC

Springs Hill WSC is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer and Canyon Reservoir to meet the WSC's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Seguin implement the following water supply plan (Table 5.3.11-14):

- Facilities Expansion: Lake Placid WTP Expansion is to be implemented in the 2020 decade. This strategy is anticipated to increase capacity for Springs Hill WSC by 2,200 acft/yr by the decade 2020 through 2070. This is not new water supply. Data shown in Table 5.4-9 represents WMS supply water availability consistent with TWDB data. See Section 5.2.8.2 for more details.
- Facilities Expansion: Bored Pipeline to be implemented in the 2030 decade. This strategy is anticipated to increase capacity for Springs Hill WSC by 5,000 acft/yr by the decade 2030 through 2070. This is not new water supply. Data shown in Table 5.4-9 represents WMS supply water availability consistent with TWDB data. See Section 5.2.8.2 for more details.

Table 5.3.11-14 Recommended Water Supply Plan for Springs Hill WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	3,626	1,968	1,563	1,139	663	205
Recommended WMS						
Facilities Expansion: Lake Placid WTP Expansion	1,394	1,394	1,394	1,394	1,394	1,394
Facilities Expansion: Bored Pipeline	-	100	100	100	100	100
WMS Supply	**1,94**	**1,494**	**1,494**	**1,494**	**1,494**	**1,494**

Estimated costs of the recommended plan to meet Springs Hill WSC projected needs are shown in Table 5.3.11-15.

Table 5.3.11-15 Recommended Plan Costs by Decade for Springs Hill WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Facilities Expansion: Lake Placid WTP Expansion[1]						
Annual Cost ($/yr)	1,682,000	1,682,000	768,000	768,000	768,000	768,000
Unit Cost ($/acft)	1,207	1,207	551	551	551	551
Facilities Expansion: Bored Pipeline[1]						
Annual Cost ($/yr)	-	39,000	39,000	4,000	4,000	4,000
Unit Cost ($/acft)	-	390	390	40	40	40

[1] Facilities Expansion unit costs are representative of WMS supplies detailed in Table 5.4-3; not the anticipated volumes.

5.3.11.11 Steam-Electric Power, Guadalupe

Current water supply for Steam-Electric Power, Guadalupe is obtained from Canyon Reservoir and direct reuse. Steam-Electric Power, Guadalupe is projected to have adequate water supplies through 2070.

5.3.12 Hays County Water Supply Plan

Table 5.3.12-1 lists each WUG in Hays County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.12-1 Hays County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED)		COMMENT
	2020 (ACFT/YR)	2070 (ACFT/YR)	
Buda	1	1	No Projected Needs
County Line SUD	736	(852)	Projected Needs (2050 through 2070)
County Other, Hays	0	(7,220)	Projected Needs (2060 through 2070)
Crystal Clear SUD	(66)	(1,575)	Projected Needs (2020, and 2040 through 2070)
Creedmoor-Maha WSC	--	--	See Caldwell County.
Goforth SUD	3,159	(3,230)	Projected Needs (2050 through 2070)
Irrigation, Hays	349	349	No Projected Needs
Kyle	1,375	(2,831)	Projected Needs (2030 through 2070)
Livestock, Hays	0	0	No Projected Needs
Manufacturing, Hays	502	494	No Projected Needs
San Marcos	2,182	(12,115)	Projected Needs (2040 through 2070)
South Buda WCID 1	436	24	No Projected Needs
Texas State University	202	234	No Projected Needs
Wimberley WSC	137	(2,836)	Projected Needs (2030 through 2070)

5.3.12.1 Buda

The City of Buda obtains water from GBRA, and is split with its primary region, Region K. In Region L, the City of Buda is projected to have adequate water supplies available from GBRA to meet the City's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Buda implement the following water supply plan in Region L (Table 5.3.12-2):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 2 acft/yr by 2020, increasing to 23 acft/yr in 2070.

- ARWA/GBRA Project (Phase 1) is to be implemented by 2020 and can provide an additional 762 acft/yr in 2020 through 2070. Anticipated supply volumes are accessed in Region K.
- ARWA Project (Phase 2) is to be implemented by 2040 and can provide an additional 1,067 acft/yr in 2040 through 2070. Anticipated supply volumes are accessed in Region K.
- ARWA Project (Phase 3) is to be implemented by 2060 and can provide an additional 178 acft/yr in 2060 through 2070. Below details the Region L specific volumes

Table 5.3.12-2 Recommended Water Supply Plan for Buda

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	1	0	0	0	1	1
Recommended WMS*						
Advanced Water Conservation	2	6	9	13	17	23
ARWA/GBRA Project (Phase 1)[1]	-	-	-	-	-	-
ARWA Project (Phase 2)[2]	-	-	-	-	-	-
ARWA Project (Phase 3)[3]	-	-	-	-	21	21
WMS Supply	**2**	**6**	**9**	**13**	**38**	**44**
* The City of Buda is split between Region L and Region K. Volumes shown in this table represent the Region L portion of the water accessed for this WUG.						

Estimated costs of the recommended plan for the Buda are shown in Table 5.3.12-3.

Table 5.3.12-3 Recommended Plan Costs by Decade for Buda

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	1,362	4,086	6,219	8,853	11,577	15,663
Unit Cost ($/acft)	681	681	681	681	681	681
ARWA/GBRA Project (Phase 1)						
Annual Cost ($/yr)	-	-	-	-	-	-
Unit Cost ($/acft)	-	-	-	-	-	-
ARWA Project (Phase 2)						
Annual Cost ($/yr)	-	-	-	-	-	-
Unit Cost ($/acft)	-	-	-	-	-	-
ARWA Project (Phase 3)						
Annual Cost ($/yr)	-	-	-	-	70,035	70,035
Unit Cost ($/acft)	-	-	-	-	2,001	2,001

5.3.12.2 County Line SUD

Current water supply for County Line SUD is obtained from the Edwards Aquifer, Canyon Reservoir, and run-of-river rights. County Line SUD is projected to need additional water supplies prior to 2050. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that County Line SUD implement the following water supply plan to meet the projected needs for the WSC (Table 5.3.12-4):

- ARWA/GBRA Project (Phase 1) is to be implemented by 2020 and can provide an additional 478 acft/yr in 2020 through 2070.
- ARWA Project (Phase 2) is to be implemented by 2040 and can provide an additional 669 acft/yr in 2040 through 2070.
- ARWA Project (Phase 3) is to be implemented by 2060 and can provide an additional 178 acft/yr in 2060 through 2070.
- Recycled Water Strategies: Non-Potable Reuse is to be implemented by 2020 and can provide an additional 560 acft/yr in 2020, increasing to 3,360 acft/yr by 2070.
- County Line SUD Trinity Well Field project is to be implemented prior to 2050. This strategy can provide an additional 500 acft/yr by 2050, increasing to 740 acft/yr by 2060 through 2070.
- County Line SUD Brackish Edwards project is to be implemented prior to 2050. This strategy can provide an additional 500 acft/yr by 2050, increasing to 1,500 acft/yr by 2070.

Table 5.3.12-4 Recommended Water Supply Plan for County Line SUD

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	736	438	115	(207)	(530)	(852)
Recommended WMS						
ARWA/GBRA Project (Phase 1)	478	478	478	478	478	478
ARWA Project (Phase 2)	-	-	669	669	669	669
ARWA Project (Phase 3)	-	-	-	-	178	178
Recycled Water Strategies	560	1,120	1,680	2,240	2,800	3,360
County Line SUD Trinity Well Field	-	-	-	500	740	740
County Line SUD Brackish Edwards Project	-	-	-	500	1,000	1,500
WMS Supply	**1,038**	**1,598**	**2,827**	**4,387**	**5,865**	**6,925**

Estimated costs of the recommended plan to meet County Line SUD's projected needs are shown in Table 5.3.12-5.

Table 5.3.12-5 Recommended Plan Costs by Decade for County Line SUD

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
ARWA/GBRA Project (Phase 1)						
Annual Cost ($/yr)	683,667	683,667	171,156	171,156	171,156	171,156
Unit Cost ($/acft)	1,430	1,430	358	358	358	358
ARWA Project (Phase 2)						
Annual Cost ($/yr)	-	-	426,599	426,599	134,023	134,023
Unit Cost ($/acft)	-	-	635	635	199	199
ARWA Project (Phase 3)						
Annual Cost ($/yr)	-	-	-	-	355,078	355,078
Unit Cost ($/acft)	-	-	-	-	2,001	2,001
Recycled Water Strategies: County Line SUD Non-Potable Reuse						
Annual Cost ($/yr)	555,833	1,111,667	1,667,500	2,223,333	2,779,167	3,335,000
Unit Cost ($/acft)	993	993	401	401	401	401
County Line SUD Trinity Well Field						
Annual Cost ($/yr)	-	-	-	1,444,000	1,540,000	798,000
Unit Cost ($/acft)	-	-	-	2,888	2,081	1,078
County Line SUD Brackish Edwards Project						
Annual Cost ($/yr)	-	-	-	1,805,000	3,011,000	3,452,000
Unit Cost ($/acft)	-	-	-	3,610	3,022	2,301

5.3.12.3 County-Other, Hays

Current water supply for County-Other, Hays is obtained from the Edwards Aquifer and Trinity Aquifer, and is split with its primary region, Region K. In Region L, County-Other, Hays is projected to need additional water supplies prior to 2060. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the Couth-Other area water supply districts and authorities and individual households and/or businesses not served by public water supply systems implement the following water supply plan to meet the projected needs for the County-Other areas in Region L (Table 5.3.12-6):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 232 acft/yr by 2070.
- Purchase from WWP (GBRA) is to be implemented prior the 2060 decade. This strategy can provide an additional 2,029 acft/yr by 2060, increasing to 7,220 acft/yr in 2070.

Table 5.3.12-6 Recommended Water Supply Plan for County-Other, Hays

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	106	0	0	(2,029)	(7,220)
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	232
Purchase from WWP (GBRA)	-	-	-	-	2,029	7,220
WMS Supply	**0**	**0**	**0**	**0**	**2,029**	**7,452**

Estimated costs of the recommended plan to meet County-Other projected needs are shown in Table 5.3.12-7.

Table 5.3.12-7 Recommended Plan Costs by Decade for County-Other, Hays

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	158,242
Unit Cost ($/acft)	-	-	-	-	-	681
Purchase from WWP (GBRA)						
Annual Cost ($/yr)	-	-	-	-	3,027,268	10,772,240
Unit Cost ($/acft)	-	-	-	-	442	442

5.3.12.4 Crystal Clear SUD

Current water supply for Crystal Clear SUD is obtained from the Edwards Aquifer, Canyon Reservoir, and run-of-river rights. Crystal Clear SUD is projected to need additional water supplies for the planning period except for the 2030 decade. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Crystal Clear SUD implement the following water supply plan to meet the projected needs for the WSC (Table 5.3.12-8):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 77 acft/yr by 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 92 acft/yr by 2020.
- ARWA/GBRA Project (Phase 1) is to be implemented by 2020 and can provide an additional 2,560 acft/yr in 2020 through 2070.
- ARWA Project (Phase 2) is to be implemented by 2040 and can provide an additional 3,585 acft/yr in 2040 through 2070.
- ARWA Project (Phase 3) is to be implemented by 2060 and can provide an additional 953 acft/yr in 2060 through 2070.

Table 5.3.12-8 Recommended Water Supply Plan for Crystal Clear SUD

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(66)	305	(106)	(560)	(1,057)	(1,575)
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	77
Drought Management	92	-	-	-	-	-
ARWA/GBRA Project (Phase 1)	2,560	2,560	2,560	2,560	2,560	2,560
ARWA Project (Phase 2)	-	-	3,585	3,585	3,585	3,585
ARWA Project (Phase 3)	-	-	-	-	953	953
WMS Supply	**2,652**	**2,560**	**6,145**	**6,145**	**7,098**	**7,175**

Estimated costs of the recommended plan to meet Crystal Clear SUD's projected needs are shown in Table 5.3.12-9.

Table 5.3.12-9 Recommended Plan Costs by Decade for Crystal Clear

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	59,498
Unit Cost ($/acft)	-	-	-	-	-	770
Drought Management						
Annual Cost ($/yr)	8,176	-	-	-	-	-
Unit Cost ($/acft)	89	-	-	-	-	-
ARWA/GBRA Project (Phase 1)						
Annual Cost ($/yr)	3,661,483	3,661,483	916,651	916,651	916,651	916,651
Unit Cost ($/acft)	1,430	1,430	358	358	358	358
ARWA Project (Phase 2)						
Annual Cost ($/yr)	-	-	2,286,035	2,286,035	718,195	718,195
Unit Cost ($/acft)	-	-	635	635	199	199
ARWA Project (Phase 3)						
Annual Cost ($/yr)	-	-	-	-	1,901,065	1,901,065
Unit Cost ($/acft)	-	-	-	-	2,001	2,001

5.3.12.5 Goforth SUD

Current water supply for Goforth SUD is obtained from the Edwards (Barton Springs) Aquifer, and is split with Region K. Goforth SUD is projected to need additional water supplies prior to 2050. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Goforth SUD implement the following water supply plan to meet the projected needs for the utility in Region L (Table 5.3.12-10):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 50 acft/yr by 2070.
- ARWA/GBRA Project (Phase 1) is to be implemented prior to 2020. This strategy can provide an additional 3,999 acft/yr for the WUG as a whole by 2020 through 2070. Below details the Region L specific volumes.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 103 acft/yr by 2020.

Table 5.3.12-10 Recommended Water Supply Plan for Goforth SUD

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	3,159	1,905	642	(633)	(1,926)	(3,230)
Recommended WMS*						
Advanced Water Conservation	-	-	-	-	-	50
Drought Management	103	-	-	-	-	-
ARWA/GBRA Project (Phase 1)	3,767	3,796	3,804	3,769	3,692	3,609
WMS Supply	**3,870**	**3,796**	**3,804**	**3,769**	**3,692**	**3,659**

* Goforth SUD is split between Region L and Region K. Volumes shown in this table represent the Region L portion of the water accessed for this WUG.

Estimated costs of the recommended plan to meet Goforth SUD's projected needs are shown in Table 5.3.12-11.

Table 5.3.12-11 Recommended Plan Costs by Decade for Goforth SUD

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	34,050
Unit Cost ($/acft)	-	-	-	-	-	681
Drought Management						
Annual Cost ($/yr)	9,656	-	-	-	-	-
Unit Cost ($/acft)	89	-	-	-	-	-
ARWA/GBRA Project (Phase 1)						
Annual Cost ($/yr)	2,714,500	2,735,398	1,076,025	1,066,124	1,044,344	1,020,866
Unit Cost ($/acft)	721	721	283	283	283	283

5.3.12.6 Irrigation, Hays

Irrigation, Hays is projected to have adequate water supplies available from the Edwards Aquifer and run-of-river rights to meet the WUG's projected demand during the planning period.

5.3.12.7 Kyle

Current water supply for the City of Kyle is obtained from the Edwards Aquifer, Edwards (Barton Springs) Aquifer, and Canyon Reservoir. The City of Kyle is projected to need additional water supplies prior to 2030. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Kyle implement the following water supply plan to meet the projected needs for the City (Table 5.3.12-12):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 52 acft/yr by 2050, increasing to 480 acft/yr of supply in 2070.
- ARWA/GBRA Project (Phase 1) is to be implemented by 2020 and can provide an additional 4,225 acft/yr in 2020 through 2070.
- ARWA Project (Phase 2) is to be implemented by 2040 and can provide an additional 5,916 acft/yr in 2040 through 2070.
- ARWA Project (Phase 3) is to be implemented by 2060 and can provide an additional 1,573 acft/yr in 2060 through 2070.

Table 5.3.12-12 Recommended Water Supply Plan for Kyle

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	1,375	(1,407)	(2,860)	(2,845)	(2,835)	(2,831)
Recommended WMS						
Advanced Water Conservation	-	-	-	52	266	480
ARWA/GBRA Project (Phase 1)	4,225	4,225	4,225	4,225	4,225	4,225
ARWA Project (Phase 2)	-	-	5,916	5,916	5,916	5,916
ARWA Project (Phase 3)	-	-	-	-	1,573	1,573
WMS Supply	**4,225**	**4,225**	**10,141**	**10,193**	**11,980**	**12,194**

Estimated costs of the recommended plan to meet Kyle's projected needs are shown in Table 5.3.12-13.

Table 5.3.12-13 Recommended Plan Costs by Decade for Kyle

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	35,115	180,936	327,070
Unit Cost ($/acft)	-	-	-	681	681	681

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
ARWA/GBRA Project (Phase 1)						
Annual Cost ($/yr)	6,042,877	6,042,877	1,512,832	1,512,832	1,512,832	1,512,832
Unit Cost ($/acft)	1,430	1,430	358	358	358	358
ARWA Project (Phase 2)						
Annual Cost ($/yr)	-	-	3,772,436	3,772,436	1,185,172	1,185,172
Unit Cost ($/acft)	-	-	635	635	199	199
ARWA Project (Phase 3)						
Annual Cost ($/yr)	-	-	-	-	3,137,854	3,137,854
Unit Cost ($/acft)	-	-	-	-	2,001	2,001

5.3.12.8 Livestock, Hays

Current water supply for Livestock, Hays is obtained from the Trinity Aquifer and local sources. Livestock, Hays is projected to have adequate water supplies through 2070.

5.3.12.9 Manufacturing, Hays

Manufacturing, Hays is projected to have adequate water supplies available from the Edwards Aquifer and run-of-river rights to meet the WUG's projected demand during the planning period.

5.3.12.10 San Marcos

Current water supply for the City of San Marcos is obtained from the Edwards Aquifer, Canyon Reservoir, and run-of-river rights. San Marcos is projected to need additional water supplies prior to 2040. San Marcos provides potable water to the Texas State University-San Marcos. Texas State University –San Marcos is projected to need additional supply by 2030. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that San Marcos implement the following water supply plan to meet the projected needs for the City (Table 5.3.12-14):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 54 acft/yr by 2040, increasing to 1,706 acft/yr of supply in 2070.
- ARWA/GBRA Project (Phase 1) is to be implemented by 2020 and can provide an additional 2,594 acft/yr in 2020, increasing to 5,380 acft/yr in 2030 through 2070.
- ARWA Project (Phase 2) is to be implemented by the 2040 decade and can provide an additional 7,530 acft/yr in 2040 through 2070.
- ARWA Project (Phase 3) is to be implemented by the 2060 decade and can provide an additional 2,002 acft/yr in 2060 through 2070.
- Recycled Water Strategies: San Marcos Non-Potable Reuse is to be implemented by the 2020 decade and can provide an additional 1,826 acft/yr in 2020, increasing to 1,971 by 2030through 2070.

- Recycled Water Strategies: San Marcos Potable Reuse is to be implemented by the 2050 decade and can provide an additional 4,705 acft/yr through 2070
- Facilities Expansions: CRWA Hays Caldwell WTP Expansion is to be implemented by the 2020 decade. This strategy can provide an additional 1,288 acft/yr through 2070.

Table 5.3.12-14 Recommended Water Supply Plan for San Marcos

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	2,182	369	(1,887)	(4,666)	(8,057)	(12,115)
Recommended WMS						
Advanced Water Conservation	-	-	54	395	949	1,706
Facilities Expansion: CRWA Hays Caldwell WTP Expansion	1,288	1,288	1,288	1,288	1,288	1,288
ARWA/GBRA Project (Phase 1)	2,594	5,380	5,380	5,380	5,380	5,380
ARWA Project (Phase 2)	-	-	7,530	7,530	7,530	7,530
ARWA Project (Phase 3)	-	-	-	-	2,002	2,002
Recycled Water Strategies: San Marcos Non-Potable Reuse	1,826	1,971	1,971	1,971	1,971	1,971
Recycled Water Strategies: San Marcos Potable Reuse	-	-	-	4,705	4,705	4,705
WMS Supply	**5,708**	**8,639**	**16,223**	**20,372**	**22,928**	**23,685**

Estimated costs of the recommended plan to meet San Marcos' projected needs are shown in Table 5.3.12-15.

Table 5.3.12-15 Recommended Plan Costs by Decade for San Marcos

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	32,551	236,919	569,349	1,023,689
Unit Cost ($/acft)	-	-	600	600	600	600
Facilities Expansion: CRWA Hays Caldwell WTP Expansion						
Annual Cost ($/yr)	2,017,008	2,017,008	899,024	899,024	899,024	899,024
Unit Cost ($/acft)	1,566	1,566	698	698	698	698
ARWA/GBRA Project (Phase 1)*						
Annual Cost ($/yr)	4,340,168	8,397,835	2,432,399	2,432,399	2,432,399	2,432,399
Unit Cost ($/acft)	1,430	1,430	358	358	358	358

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
ARWA Project (Phase 2)						
Annual Cost ($/yr)	-	-	4,801,630	4,801,630	1,508,510	1,508,510
Unit Cost ($/acft)	-	-	635	635	199	199
ARWA Project (Phase 3)						
Annual Cost ($/yr)	-	-	-	-	3,993,633	3,993,633
Unit Cost ($/acft)	-	-	-	-	2,001	2,001
Recycled Water Strategies: San Marcos Non-Potable Reuse						
Annual Cost ($/yr)	3,615,347	3,902,437	3,902,437	3,902,437	3,902,437	3,902,437
Unit Cost ($/acft)	1,980	1,980	1,980	1,980	1,980	1,980
Recycled Water Strategies: San Marcos Potable Reuse						
Annual Cost ($/yr)	-	-	-	7,539,563	7,539,563	7,539,563
Unit Cost ($/acft)	-	-	-	1,980	1,980	1,980
* Annual Cost includes San Marcos WTP component of project.						

5.3.12.11 South Buda WCID 1

The South Buda WCID 1 is projected to have adequate water supplies available from GBRA to meet the City's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the South Buda WCID 1 implement the following water supply plan (Table 5.3.12-16).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 4 acft/yr by 2020, increasing to 60 acft/yr of supply in 2070.

Table 5.3.12-16 Recommended Water Supply Plan for South Buda WCID 1

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	436	375	305	241	140	24
Recommended WMS						
Advanced Water Conservation	4	6	12	21	38	60
WMS Supply	**4**	**6**	**12**	**21**	**38**	**60**

Estimated costs of the recommended plan to meet South Buda WCID 1's projected needs are shown in Table 5.3.12-17.

Table 5.3.12-17 Recommended Plan Costs by Decade for South Buda WCID 1

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Annual Cost ($/yr)	2,606	3,843	7,844	14,456	25,595	41,073
Unit Cost ($/acft)	681	681	681	681	681	681

5.3.12.12 Texas State University

Texas State University is projected to have adequate water supplies available from GBRA to meet the University's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the Texas State University implement the following water supply plan (Table 5.3.12-18).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 33 acft/yr by 2020, increasing to 201 acft/yr of supply in 2070.

Table 5.3.12-18 Recommended Water Supply Plan for Texas State University

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	202	219	228	232	233	234
Recommended WMS						
Advanced Water Conservation	33	101	153	167	185	201
WMS Supply	**33**	**101**	**153**	**167**	**185**	**201**

Estimated costs of the recommended plan to meet Texas State University's projected needs are shown in Table 5.3.12-19.

Table 5.3.12-19 Recommended Plan Costs by Decade for Texas State University

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	22,240	68,964	104,141	114,028	125,646	136,959
Unit Cost ($/acft)	681	681	681	681	681	681

5.3.12.13 Wimberley WSC

Current water supply for Wimberley WSC is obtained from the Trinity Aquifer. Wimberley WSC is projected to need additional water supplies prior to 2030. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Wimberley implement the following water supply plan to meet the projected needs for the WSC (Table 5.3.12-20).

- Purchase from WWP (GBRA) to be implemented prior to 2030. This strategy can provide an additional 262 acft/yr of supply in 2030, increasing to 2,851 acft/yr by 2070.

Table 5.3.12-20 Recommended Water Supply Plan for Wimberley WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	137	(247)	(737)	(1,351)	(2,045)	(2,836)
Recommended WMS						
Purchase from WWP (GBRA)	-	262	752	1,366	2,060	2,851
WMS Supply	**0**	**262**	**752**	**1,366**	**2,060**	**2,851**

Estimated costs of the recommended plan to meet Wimberley WSC's projected needs are shown in Table 5.3.12-21.

Table 5.3.12-21 Recommended Plan Costs by Decade for Wimberley WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Purchase from WWP (GBRA)						
Annual Cost ($/yr)	-	390,875	1,121,900	603,165	909,605	1,258,875
Unit Cost ($/acft)	-	1,492	1,492	442	442	442

5.3.13 Karnes County Water Supply Plan

Table 5.3.13-1 lists each WUG in Karnes County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.13-1 Karnes County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED) 2020 (ACFT/YR)	2070 (ACFT/YR)	COMMENT
County-Other, Karnes	41	66	No projected Needs
El Oso WSC	(37)	(185)	Projected Needs (2020 through 2070)
Falls City	79	113	No Projected Needs
Irrigation, Karnes	0	(559)	Projected Needs (2040 through 2070)
Karnes City	(319)	(232)	Projected Needs (2020 through 2070)
Kenedy	427	417	No Projected Needs
Livestock, Karnes	822	558	No Projected Needs
Manufacturing, Karnes	0	(155)	Projected Needs (2040 through 2070)
Mining, Karnes	(1,928)	26	Projected Needs (2020 through 2050)
Runge	0	0	No Projected Needs

5.3.13.1 County-Other, Karnes

County-Other, Karnes is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer and the Gulf Coast Aquifer to meet their projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the Couth-Other area water supply districts and authorities and individual households and/or businesses not served by public water supply systems implement the following water supply plan to meet the projected needs for the County-Other areas (Table 5.3.13-2).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 1 acft/yr by 2050, increasing to 21 acft/yr of supply in 2070.

Table 5.3.13-2 Recommended Water Supply Plan for County-Other

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	41	61	66	66	66	66
Recommended WMS						
Advanced Water Conservation	-	-	-	1	11	21
WMS Supply	**0**	**0**	**0**	**1**	**11**	**21**

Estimated costs of the recommended plan to meet County-Other projected needs are shown in Table 5.3.13-3.

Table 5.3.13-3 Recommended Plan Costs by Decade for County-Other

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	863	8,295	16,294
Unit Cost ($/acft)	-	-	-	770	770	770

5.3.13.2 El Oso WSC

El Oso WSC obtains its supplies from the Carrizo-Wilcox Aquifer and is projected to need additional supplies. The Carrizo-Wilcox Aquifer is MAG limited in Karnes County and El Oso WSC will need to draw additional supplies from the Gulf Coast Aquifer in Bee County – via coordination with Region N. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that El Oso WSC implement the following water supply plan (Table 5.3.13-4).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 29 acft/yr by 2020, increasing to 194 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 19 acft/yr by 2020. Below details the volume that would be accessed in Region L.
- Local Groundwater management is to be implemented or enhanced in the immediate future in Bee County via Region N coordination. This strategy can provide an additional 120 acft/yr by 2020 through 2070. Below details the volume that would be accessed in Region L

Table 5.3.13-4 Recommended Water Supply Plan for El Oso WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(37)	(50)	(26)	(31)	(176)	(185)
Recommended WMS						
Advanced Water Conservation	29	84	138	161	176	194
Drought Management*	14	-	-	-	-	-
Local Groundwater*	12	13	18	20	45	47
WMS Supply	**60**	**97**	**156**	**181**	**221**	**241**

* El Oso WSC is split between Region L and Region N. Volumes shown in this table represent the Region L portion of the water accessed for this WUG.

Estimated costs of the recommended plan for El Oso WSC are shown in Table 5.3.13-5.

Table 5.3.13-5 Recommended Plan Costs by Decade for El Oso WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	22,658	64,895	106,119	123,945	135,904	149,042
Unit Cost ($/acft)	770	770	770	770	770	770
Drought Management						
Annual Cost ($/yr)	1,677	-	-	-	-	-
Unit Cost ($/acft)	88	-	-	-	-	-
Local Groundwater						
Annual Cost ($/yr)	158,000	158,000	101,000	101,000	101,000	101,000
Unit Cost ($/acft)	1,317	1,317	842	842	842	842

5.3.13.3 Falls City

The City of Falls City is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the City's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Falls City implement the following water supply plan (Table 5.3.13-6).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 6 acft/yr by 2020, increasing to 42 acft/yr of supply in 2070.

Table 5.3.13-6 Recommended Water Supply Plan for Falls City

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	79	91	103	109	113	113
Recommended WMS						
Advanced Water Conservation	6	17	26	36	39	42
WMS Supply	**6**	**17**	**26**	**36**	**39**	**42**

Estimated costs of the recommended plan for Falls City are shown in Table 5.3.13-7.

Table 5.3.13-7 Recommended Plan Costs by Decade Falls City

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	4,825	12,834	20,252	27,853	30,391	32,286
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.13.4 Irrigation, Karnes

Current water supply for Irrigation, Karnes is obtained from the Carrizo-Wilcox Aquifer and run-of-river rights and is projected to need additional supplies prior to the 2040 decade. Due to limited economically feasible supplies for irrigation, these needs remain unmet. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual irrigators implement water conservation measures associated with the Advanced Water Conservation WMS (Table 5.3.13-8).

- Irrigation water conservation, while not a recommended strategy, is encouraged and can provide additional supply when possible. The SCTRWPG has determined that it is not economically feasible for agricultural producers to purchase additional supplies to meet projected needs.

Table 5.3.13-8 Recommended Water Supply Plan for Irrigation, Karnes

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	(559)	(559)	(559)	(559)
Recommended WMS						
WMS Supply	**0**	**0**	**0**	**0**	**0**	**0**

5.3.13.5 Karnes City

The City of Karnes City obtains its water supply from the Carrizo-Wilcox Aquifer and is projected to have a shortage prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Karnes City implement the following water supply plan (Table 5.3.13-9):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 21 acft/yr in 2020, increasing to 114 acft/yr in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 23 acft/yr by 2020.
- Local Groundwater management is to be implemented prior to 2020. This strategy can provide an additional 444 acft/yr in 2020 through 2070.

Table 5.3.13-9 Recommended Water Supply Plan for Karnes City

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(319)	(305)	(280)	(267)	(256)	(232)
Recommended WMS						
Advanced Water Conservation	21	63	84	91	102	114
Drought Management	23	-	-	-	-	-
Local Groundwater	444	444	444	444	444	444
WMS Supply	**488**	**507**	**528**	**535**	**546**	**558**

Estimated costs of the recommended plan for Karnes City are shown in Table 5.3.13-10.

Table 5.3.13-10 Recommended Plan Costs by Decade Karnes City

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	16,026	48,829	64,530	69,717	78,511	87,839
Unit Cost ($/acft)	770	770	770	770	770	770
Drought Management						
Annual Cost ($/yr)	2,568	-	-	-	-	-
Unit Cost ($/acft)	112	-	-	-	-	-
Local Groundwater						
Annual Cost ($/yr)	502,000	502,000	215,000	215,000	215,000	215,000
Unit Cost ($/acft)	1,131	1,131	611	611	611	611

5.3.13.6 Kenedy

Current water supply for the City of Kenedy is obtained from the Gulf Coast Aquifer. Kenedy is projected to have adequate water supplies for the planning year. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Kenedy implement the following water supply plan to meet the projected needs for the City (Table 5.3.13-11).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 86 acft/yr by 2020, increasing to 593 acft/yr of supply in 2070.

Table 5.3.13-11 Recommended Water Supply Plan for Kenedy

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	427	402	414	416	417	417
Recommended WMS						
Advanced Water Conservation	86	200	304	409	505	593
WMS Supply	**86**	**200**	**304**	**409**	**505**	**593**

Estimated costs of the recommended plan for rural areas are shown in Table 5.3.13-12.

Table 5.3.13-12 Recommended Plan Costs by Decade for Kenedy

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	66,189	154,185	234,300	315,200	388,987	456,415
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.13.7 Livestock, Karnes

Livestock, Karnes is projected to have adequate water supplies available from local sources to meet the WUG's projected demand during the planning period.

5.3.13.8 Manufacturing, Karnes

Manufacturing, Karnes is projected to have additional water supplies need from the Gulf Coast Aquifer to meet the WUG's projected demand prior to 2040. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that manufacturing in Karnes County follows the following water supply plan to meet their needs (Table 5.3.13-13).

- Local Groundwater management is to be implemented prior to the 2040 decade. This strategy can provide an additional 232 acft/yr in 2020, with variation through the planning period to meet projected needs.

Table 5.3.13-13 Recommended Water Supply Plan for Manufacturing, Karnes

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	(113)	(155)	(155)	(155)
Recommended WMS						
Local Groundwater	-	-	232	231	242	242
WMS Supply	**0**	**0**	**232**	**231**	**242**	**242**

Estimated costs of the recommended plan for manufacturing in Karnes County are shown in Table 5.3.13-14.

Table 5.3.13-14 Recommended Plan Costs by Decade for Manufacturing, Karnes

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Local Groundwater						
Annual Cost ($/yr)	-	-	15,000	15,000	2,000	2,000
Unit Cost ($/acft)	-	-	65	65	8	8

5.3.13.9 Mining, Karnes

Current water supply for Mining, Karnes is obtained from the Carrizo-Wilcox Aquifer and Gulf Coast Aquifer. Mining is projected to need additional water supplies prior to 2020. Due to a lack of supply in the county, these needs remain unmet. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual mining companies implement measures associated with the Advanced Water Conservation WMS to meet the projected needs for Mining, Karnes (Table 5.3.13-15).

- Mining water conservation, while not a recommended strategy, is encouraged and can provide additional supply when possible. The SCTRWPG has determined that it is not economically feasible for mining associations to purchase additional supplies to meet projected needs.

Table 5.3.13-15 Recommended Water Supply Plan for Mining, Karnes

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(1,928)	(1,356)	(764)	(179)	11	26
Recommended WMS						
WMS Supply	**0**	**0**	**0**	**0**	**0**	**0**

5.3.13.10 Runge

The City of Runge is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Runge implement the following water supply plan (Table 5.3.13-16).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 10 acft/yr by 2020, increasing to 64 acft/yr of supply in 2070.

Table 5.3.13-16 Recommended Water Supply Plan for Runge

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	0	0	0	0
Recommended WMS						
Advanced Water Conservation	10	28	46	55	59	64
WMS Supply	**10**	**28**	**46**	**55**	**59**	**64**

Estimated costs of the recommended plan for the City of Runge are shown in Table 5.3.13-17.

Table 5.3.13-17 Recommended Plan Costs by Decade for Runge

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	7,661	21,589	35,511	42,408	45,520	49,305
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.14 Kendall County Water Supply Plan

Table 5.3.14-1 lists each WUG in Kendall County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.14-1 Kendall County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED)		COMMENT
	2020 (ACFT/YR)	2070 (ACFT/YR)	
Fair Oaks Ranch	-	-	See Bexar County
GBRA (WUG data)	-	-	See Calhoun County; WUG and WWP data detailed in Section 5.4
Boerne	2,644	(2,249)	Projected Needs (2050 through 2070)
County-Other, Kendall	1,462	1,399	No Projected Needs
Irrigation, Kendall	16	16	No Projected Needs
Kendall County WCID 1	444	232	No Projected Needs
Kendall West Utility	189	(1,596)	Projected Needs (2030 through 2070)
Livestock, Kendall	0	0	No Projected Needs
Manufacturing, Kendall	0	0	No Projected Needs

5.3.14.1 Fair Oaks Ranch

See Bexar County for more details.

5.3.14.2 Boerne

Current water supply for the City of Boerne is obtained from the Trinity Aquifer, Canyon Reservoir, and Boerne Lake. Boerne is projected to need additional water supplies prior to 2050. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Boerne implement the following water supply plan to meet the projected needs for the city (Table 5.3.14-2).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 139 acft/yr by 2020, increasing to 2,352 acft/yr of supply in 2070.
- Recycled Water Strategies: Boerne Non-Potable Reuse can be implemented in 2020. This strategy can provide an additional 750 acft/yr by 2020, increasing to 1,500 acft/yr in 2030 and continuing through 2070.

Table 5.3.14-2 Recommended Water Supply Plan for Boerne

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	2,644	1,727	746	(236)	(1,250)	(2,249)
Recommended WMS						
Advanced Water Conservation	139	496	1,009	1,551	1,936	2,352
Recycled Water Strategies: Boerne Non-Potable Reuse	750	1,500	1,500	1,500	1,500	1,500
WMS Supply	**889**	**1,996**	**2,509**	**3,051**	**3,436**	**3,852**

Estimated costs of the recommended plan to meet the City of Boerne's projected needs are shown in Table 5.3.14-3.

Table 5.3.14-3 Recommended Plan Costs by Decade for Boerne

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	94,632	338,021	687,296	1,056,238	1,318,098	1,601,782
Unit Cost ($/acft)	681	681	681	681	681	681
Recycled Water Strategies						
Annual Cost ($/yr)	1,337,000	1,337,000	663,000	663,000	663,000	663,000
Unit Cost ($/acft)	1,783	891	442	442	442	442

5.3.14.3 County-Other, Kendall

County-Other, Kendall areas are projected to have adequate water supplies available from the Edwards-Trinity Aquifer, Trinity Aquifer, and Canyon Reservoir during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that County-Other, Kendall areas implement the following water supply plan (Table 5.3.14-4).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 6 acft/yr in 2070.

Table 5.3.14-4 Recommended Water Supply Plan for County-Other, Kendall

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	1,462	1,462	1,462	1,462	1,462	1,399
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	6

WMS Supply	**0**	**0**	**0**	**0**	**0**	**6**

Estimated costs of the recommended plan to meet County-Other, Kendall projected needs are shown in Table 5.3.14-5.

Table 5.3.14-5 Recommended Plan Costs by Decade for County-Other, Kendall

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	4,956
Unit Cost ($/acft)	-	-	-	-	-	770

5.3.14.4 Irrigation, Kendall

Current water supply for Irrigation, Kendall is obtained from the Trinity Aquifer and run-of-river rights. Irrigation is projected to have adequate water supplies through 2070.

5.3.14.5 Kendall County WCID 1

Kendall County WCID 1 is projected to have adequate water supplies available from the Trinity Aquifer and Reuse to meet the WCID's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that WCID implement the following water supply plan (Table 5.3.14-6).

- Recycled Water Strategies: Kendall County WCID 1 is to be implemented in 2020. This strategy will provide a supply of 180 acft/yr in 2020 through 2070.

Table 5.3.14-6 Recommended Water Supply Plan for Kendall County WCID 1

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	444	409	369	326	279	232
Recommended WMS						
Recycled Water Strategies	180	180	180	180	180	180
WMS Supply	**180**	**180**	**180**	**180**	**180**	**180**

Estimated costs of the recommended plan to meet Kendall County WCID 1's projected needs are shown in Table 5.3.14-7.

Table 5.3.14-7 Recommended Plan Costs by Decade for Kendall County WCID 1

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Recycled Water Strategies						
Annual Cost ($/yr)	0	0	0	0	0	0
Unit Cost ($/acft)	0	0	0	0	0	0

5.3.14.6 Kendall West Utility

Current water supply for the Kendell West Utility is obtained from the Trinity Aquifer and Reuse. Kendall West Utility is projected to need additional water supplies prior to 2030. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Kendell West Utility implement the following water supply plan to meet the projected needs (Table 5.3.14-8).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 9 acft/yr in 2070.
- Local Groundwater management can be implemented in 2030. This strategy will provide a supply of 282 acft/yr in 2030, increasing to 1,596 acft/yr in 2070.

Table 5.3.14-8 Recommended Water Supply Plan for Kendall West Utility

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	189	(282)	(561)	(902)	(1,365)	(1,596)
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	9
Local Groundwater	-	282	561	902	1,365	1,596
WMS Supply	**0**	**282**	**561**	**902**	**1,365**	**1,605**

Estimated costs of the recommended plan to meet Kendall West Utility's projected needs are shown in Table 5.3.14-9.

Table 5.3.14-9 Recommended Plan Costs by Decade for Kendall West Utility

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	6,684
Unit Cost ($/acft)	-	-	-	-	-	770
Local Groundwater						
Annual Cost ($/yr)	-	0	0	0	0	0
Unit Cost ($/acft)	-	0	0	0	0	0

5.3.14.7 Livestock, Kendall

Current water supply for Livestock, Kendall is obtained from the Trinity Aquifer and local sources. Livestock is projected to have adequate water supply through 2070.

5.3.14.8 Manufacturing, Kendall

There is no projected Manufacturing, Kendall water demand therefore no WMS are recommended for this water user group.

5.3.15 La Salle County Water Supply Plan

Table 5.3.15-1 lists each WUG in LaSalle County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.15-1 La Salle County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED)		COMMENT
	2020 (ACFT/YR)	2070 (ACFT/YR)	
Cotulla	1,090	570	No Projected Needs
County-Other, La Salle	0	0	No Projected Needs
Encinal WSC	81	0	No Projected Needs
Irrigation, La Salle	(1,184)	(1,294)	Projected Needs (2020 through 2070)
Livestock, La Salle	0	0	No Projected Needs
Mining, La Salle	(4,088)	(147)	Projected Needs (2020 through 2070)

5.3.15.1 Cotulla

The City of Cotulla is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Cotulla implement the following water supply plan (Table 5.3.15-2).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 67 acft/yr by 2020, increasing to 737 acft/yr in 2070.

Table 5.3.15-2 Recommended Water Supply Plan for Cotulla

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	1,090	989	893	776	670	570
Recommended WMS						
Advanced Water Conservation	67	180	303	443	589	737
WMS Supply	**67**	**180**	**303**	**443**	**589**	**737**

Estimated costs of the recommended plan for Cotulla are shown in Table 5.3.15-3.

Table 5.3.15-3 Recommended Plan Costs by Decade for Cotulla

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	51,812	138,541	232,977	340,781	453,604	567,605
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.15.2 County-Other, La Salle

The County-Other, La Salle areas are projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the areas projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that County-Other, La Salle areas implement the following water supply plan (Table 5.3.15-4).

- Advanced Water Conservation is to be implemented or enhanced by the 2070 decade. This strategy can provide an additional 5 acft/yr in 2070.

Table 5.3.15-4 Recommended Water Supply Plan for County-Other, La Salle

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	0	0	0	0
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	5
WMS Supply	**0**	**0**	**0**	**0**	**0**	**5**

Estimated costs of the recommended plan to meet County-Other, La Salle projected needs are shown in Table 5.3.15-5.

Table 5.3.15-5 Recommended Plan Costs by Decade for County-Other, La Salle

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	3,630
Unit Cost ($/acft)	-	-	-	-	-	770

5.3.15.3 Encinal WSC

The City of Encinal is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Encinal implement the following water supply plan (Table 5.3.15-6).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 8 acft/yr by 2020, increasing to 77 acft/yr of supply in 2070.

Table 5.3.15-6 Recommended Water Supply Plan for Encinal WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	81	66	52	34	16	0
Recommended WMS						
Advanced Water Conservation	8	25	44	58	68	77
WMS Supply	**8**	**25**	**44**	**58**	**68**	**77**

Estimated costs of the recommended plan for the City of Encinal are shown in Table 5.3.15-7.

Table 5.3.15-7 Recommended Plan Costs by Decade for Encinal WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	6,300	19,387	33,748	44,776	52,148	59,304
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.15.4 Irrigation, La Salle

Current water supply for Irrigation, La Salle is obtained from the Carrizo-Wilcox Aquifer, Sparta Aquifer, and run-of-river rights. Irrigation, La Salle is projected to need additional water supplies prior to 2020. Due to limited economically feasible supplies for irrigation, these needs remain unmet. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual irrigators implement water conservation measures associated with the Advanced Water Conservation WMS to meet a portion of the projected needs for irrigation (Table 5.3.15-8).

- Irrigation water conservation, while not a recommended strategy, is encouraged and can provide additional supply when possible. The SCTRWPG has determined that it is not economically feasible for agricultural producers to purchase additional supplies to meet projected needs.

Table 5.3.15-8 Recommended Water Supply Plan for Irrigation, La Salle

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(1,184)	(1,203)	(1,223)	(1,248)	(1,271)	(1,294)
Recommended WMS						
WMS Supply	**0**	**0**	**0**	**0**	**0**	**0**

5.3.15.5 Livestock, La Salle

Livestock, La Salle is projected to have adequate water supplies available from local sources to meet the WUG's projected demand during the planning period.

5.3.15.6 Mining, La Salle

Current water supply for Mining, La Salle is obtained from the Carrizo-Wilcox Aquifer. Mining, La Salle is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that mining operations implement the following water supply plan to meet the projected needs (Table 5.3.15-9).

- Mining water conservation, while not a recommended strategy, is encouraged and can provide additional supply when possible. The SCTRWPG has determined that it is not economically feasible for mining associations to purchase additional supplies to meet projected needs.

Table 5.3.15-9 Recommended Water Supply Plan for Mining, La Salle

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(4,088)	(4,243)	(3,734)	(2,290)	(851)	(147)
Recommended WMS						
WMS Supply	**0**	**0**	**0**	**0**	**0**	**0**

5.3.16 Medina County Water Supply Plan

Table 5.3.16-1 lists each WUG in Medina County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.16-1 Medina County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED)		COMMENT
	2020 (ACFT/YR)	2070 (ACFT/YR)	
Benton City WSC	-	-	See Atascosa County
Lytle	-	-	See Atascosa County
SAWS (WUG data)	-	-	See Bexar County; WUG and WWP data detailed in Section 5.4
Castroville	(281)	(270)	Projected Needs (2020 through 2070)
County-Other, Medina	907	907	No Projected Needs
Devine	189	123	No Projected Needs
East Medina County SUD	(140)	(455)	Projected Needs (2020 through 2070)
Hondo	(562)	(1,226)	Projected Needs (2020 through 2070)
Irrigation, Medina	(35,430)	(37,226)	Projected Needs (2020 through 2070)
La Coste	(38)	(92)	Projected Needs (2020 through 2070)
Livestock, Medina	20	20	No Projected Needs
Manufacturing, Medina	1,480	1,476	No Projected Needs
Medina County WCID 2	431	369	No Projected Needs
Medina River West WSC	295	250	No Projected Needs
Mining, Medina	157	157	No Projected Needs
Natalia	(106)	(230)	Projected Needs (2020 through 2070)
West Medina WSC	(48)	(155)	Projected Needs (2020 through 2070)
Yancey WSC	(121)	(423)	Projected Needs (2020 through 2070)

5.3.16.1 Benton City WSC

See Atascosa County for more details.

5.3.16.2 Lytle

See Atascosa County for more details.

5.3.16.3 Castroville

Current water supply for the City of Castroville is obtained from the Edwards Aquifer. Castroville is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Castroville implement the following water supply plan to meet the projected needs for the city (Table 5.3.16-2).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 46 acft/yr by 2020, increasing to 336 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 17 acft/yr in 2020.
- Edwards Transfers are to be implemented prior to 2020. This strategy can provide an additional 300 acft/yr by 2020, decreasing to 100 in 2050.

Table 5.3.16-2 Recommended Water Supply Plan for the City of Castroville

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(281)	(273)	(266)	(264)	(267)	(270)
Recommended WMS						
Advanced Water Conservation	46	109	167	225	283	336
Drought Management	17	-	-	-	-	-
Edwards Transfers	300	200	150	100	0	0
WMS Supply	**363**	**309**	**317**	**325**	**283**	**336**

Estimated costs of the recommended plan to meet the City of Castroville's projected needs are shown in Table 5.3.16-3.

Table 5.3.16-3 Recommended Plan Costs by Decade for the City of Castroville

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	35,323	83,995	128,878	173,548	217,847	258,698
Unit Cost ($/acft)	770	770	770	770	770	770

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Drought Management						
Annual Cost ($/yr)	1,833	-	-	-	-	-
Unit Cost ($/acft)	108	-	-	-	-	-
Edwards Transfers						
Annual Cost ($/yr)	372,749	248,499	186,375	124,250	-	-
Unit Cost ($/acft)	1,242	1,242	1,242	1,242	-	-

5.3.16.4 County-Other, Medina

County-Other, Medina areas have adequate water supplies available from the Edwards Aquifer, Trinity Aquifer, and the Carrizo-Wilcox Aquifer to meet the WUG's projected demand during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that these areas implement the following water supply plan to meet the projected needs (Table 5.3.16-4).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 27 acft/yr in 2070.

Table 5.3.16-4 Recommended Water Supply Plan for County-Other, Medina

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	907	907	907	907	907	907
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	27
WMS Supply	**0**	**0**	**0**	**0**	**0**	**27**

Estimated costs of the recommended plan to meet County-Other projected needs are shown in Table 5.3.16-5.

Table 5.3.16-5 Recommended Plan Costs by Decade for County-Other, Medina

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	21,150
Unit Cost ($/acft)	-	-	-	-	-	770

5.3.16.5 Devine

The City of Devine is projected to have adequate water supplies available from the Edwards Aquifer and the Carrizo-Wilcox Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Devine implement the following water supply plan (Table 5.3.16-6).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 4 acft/yr in 2070.

Table 5.3.16-6 Recommended Water Supply Plan for Devine

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	189	179	170	157	140	123
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	4
WMS Supply	**0**	**0**	**0**	**0**	**0**	**4**

Estimated costs of the recommended plan for the City of Devine are shown in Table 5.3.16-7.

Table 5.3.16-7 Recommended Plan Costs by Decade for Devine

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	2,873
Unit Cost ($/acft)	-	-	-	-	-	770

5.3.16.6 East Medina County SUD

Current water supply for East Medina SUD is obtained from the Edwards Aquifer. East Medina SUD is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that East Medina SUD implement the following water supply plan to meet the projected needs for the SUD (Table 5.3.16-8).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 43 acft/yr in 2020.
- Edwards Transfers are to be implemented prior to 2020. This strategy can provide an additional 150 acft/yr in 2020, increasing to 500 acft/yr of supply in 2070.

Table 5.3.16-8 Recommended Water Supply Plan for East Medina County SUD

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(140)	(212)	(274)	(335)	(398)	(455)
Recommended WMS						
Drought Management	43	-	-	-	-	-
Edwards Transfers	150	250	300	400	450	500
WMS Supply	**193**	**250**	**300**	**400**	**450**	**500**

Estimated costs of the recommended plan for the East Medina County SUD's projected needs are shown in Table 5.3.16-9.

Table 5.3.16-9 Recommended Plan Costs by Decade for East Medina County SUD

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Drought Management						
Annual Cost ($/yr)	3,856	-	-	-	-	-
Unit Cost ($/acft)	90	-	-	-	-	-
Edwards Transfers						
Annual Cost ($/yr)	186,375	310,624	372,749	496,999	559,124	621,249
Unit Cost ($/acft)	1,242	1,242	1,242	1,242	1,242	1,242

5.3.16.7 Hondo

Current water supply for the City of Hondo is obtained from the Edwards Aquifer. Hondo is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Hondo implement the following water supply plan to meet the projected needs for the city (Table 5.3.16-10).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 87 acft/yr by 2020, increasing to 754 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 51 acft/yr in 2020.
- Edwards Transfers are to be implemented prior to 2020. This strategy can provide an additional 500 acft/yr by 2020, with variation through planning period to meet projected needs.

Table 5.3.16-10 Recommended Water Supply Plan for Hondo

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(562)	(721)	(858)	(987)	(1,113)	(1,226)
Recommended WMS						
Advanced Water Conservation	87	260	450	599	675	754
Drought Management	51	-	-	-	-	-
Edwards Transfers	500	500	450	425	500	500
WMS Supply	**638**	**760**	**900**	**1,024**	**1,175**	**1,254**

Estimated costs of the recommended plan to meet Hondo's projected needs are shown in Table 5.3.16-11.

Table 5.3.16-11 Recommended Plan Costs by Decade for Hondo

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	67,323	200,286	346,655	461,556	520,033	580,802
Unit Cost ($/acft)	770	770	770	770	770	770
Drought Management						
Annual Cost ($/yr)	4,519	-	-	-	-	-
Unit Cost ($/acft)	89	-	-	-	-	-
Edwards Transfers						
Annual Cost ($/yr)	621,249	621,249	559,124	528,061	621,249	621,249
Unit Cost ($/acft)	1,242	1,242	1,242	1,242	1,242	1,242

5.3.16.8 Irrigation, Medina

Current water supply for Irrigation, Medina is obtained from the Edwards Aquifer, Carrizo-Wilcox Aquifer, and run-of-river rights. Irrigation, Medina is projected to need additional water supplies prior to 2020. Due to limited economically feasible supplies for irrigation, these needs remain unmet. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual irrigators implement water conservation measures associated with the Advanced Water Conservation WMS to meet a portion of the projected needs for irrigation (Table 5.3.16-12).

- Irrigation water conservation, while not a recommended strategy, is encouraged and can provide additional supply when possible. The SCTRWPG has determined that it is not economically feasible for agricultural producers to purchase for additional supplies to meet projected needs.

Table 5.3.16-12 Recommended Water Supply Plan for Irrigation, Medina

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(35,430)	(35,757)	(35,690)	(36,009)	(36,174)	(37,226)
Recommended WMS						
WMS Supply	**0**	**0**	**0**	**0**	**0**	**0**

5.3.16.9 La Coste

Current water supply for the City of La Coste is obtained from the Edwards Aquifer. La Coste is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that La Coste implement the following water supply plan to meet the projected needs for the city (Table 5.3.16-13).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 8 acft/yr in 2020.
- Edwards Transfers are to be implemented prior to 2020 can provide an additional 100 acft/yr by 2020, continuing through 2070.

Table 5.3.16-13 Recommended Water Supply Plan for La Coste

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(38)	(50)	(60)	(70)	(82)	(92)
Recommended WMS						
Drought Management	8	-	-	-	-	-
Edwards Transfers	100	100	100	100	100	100
WMS Supply	**108**	**100**	**100**	**100**	**100**	**100**

Estimated costs of the recommended plan to meet La Coste's projected needs are shown in Table 5.3.16-14.

Table 5.3.16-14 Recommended Plan Costs by Decade for La Coste

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Drought Management						
Annual Cost ($/yr)	577	-	-	-	-	-
Unit Cost ($/acft)	72	-	-	-	-	-
Edwards Transfers						

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Annual Cost ($/yr)	124,250	124,250	124,250	124,250	124,250	124,250
Unit Cost ($/acft)	1,242	1,242	1,242	1,242	1,242	1,242

5.3.16.10 Livestock, Medina

Livestock, Medina is projected to have adequate water supplies available from local sources to meet the WUG's projected demand during the planning period

5.3.16.11 Manufacturing, Medina

Manufacturing, Medina is projected to have adequate water supplies available from the Edwards Aquifer to meet the WUG's projected demand during the planning period.

5.3.16.12 Medina County WCID 2

The Medina County WCID 1 is projected to have adequate water supplies available from the Edwards Aquifer to meet their projected demands during the planning period.

5.3.16.13 Medina River West WSC

The Medina River West WSC is projected to have adequate water supplies available from the Edwards and Trinity Aquifers to meet their projected demands during the planning period.

5.3.16.14 Mining, Medina

Mining, Medina is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer and the Trinity Aquifer to meet the WUG's projected demand during the planning period.

5.3.16.15 Natalia

Current water supply for Natalia is obtained from the Edwards Aquifer. Natalia is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Natalia implement the following water supply plan to meet the projected needs for the city (Table 5.3.16-15).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 7 acft/yr by 2020, increasing to 55 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 6 acft/yr in 2020.
- Edwards Transfers are to be implemented prior to 2020 can provide an additional 125 acft/yr by 2020, increasing to 200 acft/yr of supply in 2070.

Table 5.3.16-15 Recommended Water Supply Plan for Natalia

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(106)	(136)	(161)	(185)	(209)	(230)
Recommended WMS						
Advanced Water Conservation	7	23	26	33	44	55
Drought Management	6	-	-	-	-	-
Edwards Transfers	125	150	150	200	200	200
WMS Supply	**138**	**173**	**176**	**233**	**244**	**255**

Estimated costs of the recommended plan to meet the City of Natalia's projected needs are shown in Table 5.3.16-16.

Table 5.3.16-16 Recommended Plan Costs by Decade for Natalia

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	5,480	17,923	20,380	25,750	33,903	42,350
Unit Cost ($/acft)	770	770	770	770	770	770
Drought Management						
Annual Cost ($/yr)	689	-	-	-	-	-
Unit Cost ($/acft)	115	-	-	-	-	-
Edwards Transfers						
Annual Cost ($/yr)	155,312	186,375	186,375	248,499	248,499	248,499
Unit Cost ($/acft)	1,242	1,242	1,242	1,242	1,242	1,242

5.3.16.16 West Medina WSC

Current water supply for the West Medina WSC is obtained from the Edwards Aquifer. West Medina WSC is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that WSC implement the following water supply plan to meet the projected needs (Table 5.3.16-17):

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 9 acft/yr by 2020, increasing to 90 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 7 acft/yr in 2020.
- Edwards Transfers are to be implemented prior to 2020 can provide an additional 75 acft/yr by 2020, continuing through 2070.

Table 5.3.16-17 Recommended Water Supply Plan for West Medina WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(48)	(74)	(97)	(118)	(137)	(155)
Recommended WMS						
Advanced Water Conservation	9	30	54	70	79	90
Drought Management	7	-	-	-	-	-
Edwards Transfers	75	75	75	75	75	75
WMS Supply	**91**	**105**	**129**	**145**	**154**	**165**

Estimated costs of the recommended plan to meet the West Medina WSC's projected needs are shown in Table 5.3.16-18.

Table 5.3.16-18 Recommended Plan Costs by Decade for West Medina WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	7,164	22,797	41,438	53,608	60,988	69,530
Unit Cost ($/acft)	770	770	770	770	770	770
Drought Management						
Annual Cost ($/yr)	845	-	-	-	-	-
Unit Cost ($/acft)	121	-	-	-	-	-
Edwards Transfers						
Annual Cost ($/yr)	93,187	93,187	93,187	93,187	93,187	93,187
Unit Cost ($/acft)	1,242	1,242	1,242	1,242	1,242	1,242

5.3.16.17 Yancey WSC

Current water supply for Yancey WSC is obtained from the Edwards Aquifer. Yancey WSC is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Yancey WSC implement the following water supply plan to meet the projected needs for the WSC (Table 5.3.16-19).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 11 acft/yr by 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 40 acft/yr in 2020.
- Edwards Transfers are to be implemented prior to 2020 can provide an additional 100 acft/yr by 2020, increasing to 450 acft/yr of supply in 2070.

Table 5.3.16-19 Recommended Water Supply Plan for Yancey WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(121)	(192)	(256)	(314)	(372)	(423)
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	11
Drought Management	40	-	-	-	-	-
Edwards Transfers	100	225	300	350	400	450
WMS Supply	**140**	**225**	**300**	**350**	**400**	**461**

Estimated costs of the recommended plan to meet Yancey WSC's projected needs are shown in Table 5.3.16-20.

Table 5.3.16-20 Recommended Plan Costs by Decade for Yancey WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	8,376
Unit Cost ($/acft)	-	-	-	-	-	770
Drought Management						
Annual Cost ($/yr)	3,572	-	-	-	-	-
Unit Cost ($/acft)	89	-	-	-	-	-
Edwards Transfers						
Annual Cost ($/yr)	124,250	279,562	372,749	434,874	496,999	559,124
Unit Cost ($/acft)	1,242	1,242	1,242	1,242	1,242	1,242

5.3.17 Refugio County Water Supply Plan

Table 5.3.17-1 lists each WUG in Refugio County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.17-1 Refugio County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED)		COMMENT
	2020 (ACFT/YR)	2070 (ACFT/YR)	
County-Other, Refugio	0	0	No Projected Needs
Irrigation, Refugio	0	0	No Projected Needs
Livestock, Refugio	0	0	No Projected Needs
Mining, Refugio	0	0	No Projected Needs
Refugio	0	0	No Projected Needs
Woodsboro	0	0	No Projected Needs

5.3.17.1 County-Other, Refugio

The County-Other, Refugio areas are projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the city's projected demands during the planning period.

5.3.17.2 Irrigation, Refugio

Irrigation, Refugio is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the WUG's projected demand during the planning period.

5.3.17.3 Livestock, Refugio

Livestock, Refugio is projected to have adequate water supplies available from local sources to meet the WUG's projected demand during the planning period.

5.3.17.4 Mining, Refugio

Mining, Refugio is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the WUG's projected demand during the planning period.

5.3.17.5 Refugio

The City of Refugio is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Refugio implement the following water supply plan (Table 5.3.17-2).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 19 acft/yr by 2020, decreasing to 119 acft/yr of supply in 2070.

Table 5.3.17-2 Recommended Water Supply Plan for the City of Refugio

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	0	0	0	0
Recommended WMS						
Advanced Water Conservation	19	59	85	96	108	119
WMS Supply	**19**	**59**	**85**	**96**	**108**	**119**

Estimated costs of the recommended plan for the City of Refugio are shown in Table 5.3.17-3.

Table 5.3.17-3 Recommended Plan Costs by Decade for the City of Refugio

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	14,862	45,514	65,499	73,950	82,779	91,620
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.17.6 Woodsboro

The City of Woodsboro is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Woodsboro implement the following water supply plan (Table 5.3.17-4).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 6 acft/yr by 2020, decreasing to 27 acft/yr of supply in 2070.

Table 5.3.17-4 Recommended Water Supply Plan for Woodsboro

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	0	0	0	0
Recommended WMS						
Advanced Water Conservation	6	9	8	14	20	27
WMS Supply	**6**	**9**	**8**	**14**	**20**	**27**

Estimated costs of the recommended plan for Woodsboro are shown in Table 5.3.17-5.

Table 5.3.17-5 Recommended Plan Costs by Decade for Woodsboro

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	4,689	6,629	6,238	11,044	15,328	20,755
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.18 Uvalde County Water Supply Plan

Table 5.3.18-1 lists each WUG in Uvalde County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.18-1 Uvalde County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED)		COMMENT
	2020 (ACFT/YR)	2070 (ACFT/YR)	
County-Other, Uvalde	0	20	No Projected Needs
Irrigation, Uvalde	(40,491)	(41,704)	Projected Needs (2020 through 2070)
Knippa WSC	174	121	No Projected Needs
Livestock, Uvalde	0	0	No Projected Needs
Manufacturing, Uvalde	108	108	No Projected Needs
Mining, Uvalde	(102)	(102)	Projected Needs (2020 through 2070)
Sabinal	(146)	(301)	Projected Needs (2020 through 2070)
Uvalde	(2,434)	(3,972)	Projected Needs (2020 through 2070)
Windmill WSC	124	0	No Projected Needs

5.3.18.1 County Other, Uvalde

The County-Other, Uvalde areas are projected to have adequate water supplies available from the Edwards Aquifer and Carrizo-Wilcox Aquifer to meet their projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that these areas implement the following water supply plan (Table 5.3.18-2).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 1 acft/yr by 2070.

Table 5.3.18-2 Recommended Water Supply Plan for County-Other, Uvalde

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	20	20	20	20
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	1
WMS Supply	0	0	0	0	0	1

Estimated costs of the recommended plan for County-Other, Uvalde are shown in Table 5.3.18-3.

Table 5.3.18-3 Recommended Plan Costs by Decade for County-Other, Uvalde

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	-	424
Unit Cost ($/acft)	-	-	-	-	-	770

5.3.18.2 Irrigation, Uvalde

Current water supply for Irrigation, Uvalde is obtained from the Edwards Aquifer and run-of-river rights. Irrigation, Uvalde is projected to need additional water supplies prior to 2020. Due to limited economically feasible supplies for irrigation, these needs remain unmet. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual irrigators implement water conservation measures associated with the Advanced Water Conservation WMS to meet a portion of the projected needs for irrigation (Table 5.3.18-4).

- Project needs for this WUG are decreased due to GW conversion in this county. See Appendix 2-A WUG Supply Balance after WMS.

Table 5.3.18-4 Recommended Water Supply Plan for Irrigation, Uvalde

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(40,491)	(40,746)	(40,867)	(41,109)	(41,394)	(41,704)
Recommended WMS						
WMS Supply	**0**	**0**	**0**	**0**	**0**	**0**

5.3.18.3 Knippa WSC

The Knippa WSC is projected to have adequate water supplies available from the Austin Chalk, Edwards, and Trinity Aquifers to meet projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Knippa WSC implement the following water supply plan to meet the projected needs for the WSC (Table 5.3.3-8).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 6 acft/yr by 2020, increasing to 54 acft/yr of supply in 2070.

Table 5.3.18-5 Recommended Water Supply Plan for Knippa WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	174	163	154	143	132	121
Recommended WMS						
Advanced Water Conservation	6	18	31	42	47	54

WMS Supply	**6**	**18**	**31**	**42**	**47**	**54**

Estimated costs of the recommended plan to meet Knippa WSC's projected needs are shown in Table 5.3.18-6.

Table 5.3.18-6 Recommended Plan Costs by Decade for Knippa WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	4,300	13,921	24,216	32,009	36,499	41,479
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.18.4 Livestock, Uvalde

Livestock, Uvalde is projected to have adequate water supplies available from local sources to meet the WUG's projected demand during the planning period.

5.3.18.5 Manufacturing, Uvalde

Manufacturing, Uvalde is projected to have adequate water supplies available from the Edwards Aquifer to meet the WUG's projected demand during the planning period.

5.3.18.6 Mining, Uvalde

Current water supply for Mining, Uvalde is obtained from the Edwards and Leona Gravel Aquifers. Mining, Uvalde is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Mining operations implement the following water supply plan to meet the projected needs (Table 5.3.18-7).

- Local Groundwater management is to be implemented by the 2020 decade. This strategy can provide an additional 242 acft/yr effective 2020, continuing through 2070.

Table 5.3.18-7 Recommended Water Supply Plan for Mining, Uvalde

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(102)	(102)	(102)	(102)	(102)	(102)
Recommended WMS						
Local Groundwater	242	242	242	242	242	242
WMS Supply	**242**	**242**	**242**	**242**	**242**	**242**

Estimated costs of the recommended plan to meet mining projected needs are shown in Table 5.3.18-8.

Table 5.3.18-8 Recommended Plan Costs by Decade for Mining, Uvalde

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Local Groundwater						
Annual Cost ($/yr)	13,000	13,000	2,000	2,000	2,000	2,000
Unit Cost ($/acft)	54	54	8	8	8	8

5.3.18.7 Sabinal

Current water supply for the City of Sabinal is obtained from the Edwards Aquifer. Sabinal is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Sabinal implement the following water supply plan to meet the projected needs for the city (Table 5.3.18-9).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 20 acft/yr by 2020, increasing to 203 acft/yr of supply in 2070.
- Edwards Transfers are to be implemented prior to 2020 can provide an additional 150 acft/yr by 2020, decreasing to 125 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 14 acft/yr by 2020.

Table 5.3.18-9 Recommended Water Supply Plan for Sabinal

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(146)	(178)	(205)	(237)	(269)	(301)
Recommended WMS						
Advanced Water Conservation	20	57	96	141	182	203
Drought Management	14	-	-	-	-	-
Edwards Transfers	150	150	150	125	125	125
WMS Supply	**184**	**207**	**246**	**266**	**307**	**328**

Estimated costs of the recommended plan to meet Sabinal's projected needs are shown in Table 5.3.18-10.

Table 5.3.18-10 Recommended Plan Costs by Decade for Sabinal

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	15,656	43,801	74,155	108,559	140,473	156,164
Unit Cost ($/acft)	770	770	770	770	770	770

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Drought Management						
Annual Cost ($/yr)	657	-	-	-	-	-
Unit Cost ($/acft)	47	-	-	-	-	-
Edwards Transfers						
Annual Cost ($/yr)	138,747	150,486	135,053	119,297	107,561	122,000
Unit Cost ($/acft)	1,242	1,242	1,242	1,242	1,242	1,242

5.3.18.8 Uvalde

Current water supply for the City of Uvalde is obtained from the Edwards Aquifer. Uvalde is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Uvalde implement the following water supply plan to meet the projected needs for the city (Table 5.3.18-11).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 193 acft/yr by 2020, increasing to 1,942 acft/yr of supply in 2070.
- Edwards Transfers are to be implemented prior to 2020 can provide an additional 2,138 acft/yr by 2020, decreasing to 2,030 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 103 acft/yr by 2020.

Table 5.3.18-11 Recommended Water Supply Plan for Uvalde

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(2,434)	(2,747)	(3,019)	(3,331)	(3,655)	(3,972)
Recommended WMS						
Advanced Water Conservation	193	552	945	1,384	1,744	1,942
Drought Management	103	-	-	-	-	-
Edwards Transfers	2,138	2,195	2,074	1,947	1,911	2,030
WMS Supply	**2,434**	**2,747**	**3,019**	**3,331**	**3,655**	**3,972**

Estimated costs of the recommended plan to meet the City of Uvalde's projected needs are shown in Table 5.3.18-12.

Table 5.3.18-12 Recommended Plan Costs by Decade for Uvalde

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	148,301	424,734	727,640	1,065,867	1,342,727	1,495,517
Unit Cost ($/acft)	770	770	770	770	770	770
Drought Management						
Annual Cost ($/yr)	4,500	-	-	-	-	-
Unit Cost ($/acft)	44	-	-	-	-	-
Edwards Transfers						
Annual Cost ($/yr)	2,656,958	2,727,775	2,576,955	2,418,841	2,374,659	2,521,984
Unit Cost ($/acft)	1,242	1,242	1,242	1,242	1,242	1,242

5.3.18.9 Windmill WSC

The Windmill WSC is projected to have adequate water supplies available from the Austin Chalk Aquifer to meet the WSC projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Windmill WSC implement the following water supply plan to meet the projected needs for the WSC (Table 5.3.18-13).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 15 acft/yr by 2020, increasing to 141 acft/yr of supply in 2070.

Table 5.3.18-13 Recommended Water Supply Plan for Windmill WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	124	99	77	52	26	0
Recommended WMS						
Advanced Water Conservation	15	43	75	111	125	141
WMS Supply	**15**	**43**	**75**	**111**	**125**	**141**

Estimated costs of the recommended plan to meet Windmill WSC projected needs are shown in Table 5.3.18-14.

Table 5.3.18-14 Recommended Plan Costs by Decade for Windmill WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	11,176	33,256	57,809	85,114	96,072	108,313
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.19 Victoria County Water Supply Plan

Table 5.3.19-1 lists each WUG in Victoria County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.19-1 Victoria County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED) 2020 (ACFT/YR)	2070 (ACFT/YR)	COMMENT
County-Other, Victoria	(831)	(1,151)	Projected Needs (2020 through 2070)
Irrigation, Victoria	0	0	No Projected Needs
Livestock, Victoria	0	0	No Projected Needs
Manufacturing, Victoria	(7,641)	(8,762)	Projected Needs (2020 through 2070)
Mining, Victoria	0	0	No Projected Needs
Quail Creek MUD	1,043	1,017	No Projected Needs
Steam-Electric Power, Victoria	(18,925)	(18,925)	Projected Needs (2020 through 2070)
Victoria	(8,935)	(12,295)	Projected Needs (2020 through 2070)
Victoria County WCID 1	117	85	No Projected Needs

5.3.19.1 County Other, Victoria

Current water supply for the County Other, Victoria areas is obtained from the Gulf Coast Aquifer. The County Other areas are projected to need additional water supplies immediately starting in 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the County Other areas implement the following water supply plan to meet the projected needs (Table 5.3.19-2).

- Purchase from WWP (GBRA) is to be implemented prior to 2020. This strategy can provide an additional supply of 846 acft/yr by 2020 increasing to 1,166 in 2070.

Table 5.3.19-2 Recommended Water Supply Plan for County-Other, Victoria

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(831)	(891)	(936)	(1,000)	(1,080)	(1,151)
Recommended WMS						
Purchase from WWP (GBRA)	846	906	951	1,015	1,095	1,166
WMS Supply	**846**	**906**	**951**	**1,015**	**1,095**	**1,166**

Estimated costs of the recommended plan to meet County-Other projected needs are shown in .

Table 5.3.19-3.

Table 5.3.19-3 Recommended Plan Costs by Decade for County-Other, Victoria

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Purchase from WWP (GBRA)						
Annual Cost ($/yr)	6,603,000	6,603,000	4,486,000	4,486,000	2,949,000	2,949,000
Unit Cost ($/acft)	110	110	81	81	49	49

5.3.19.2 Irrigation, Victoria

Irrigation, Victoria is projected to have adequate water supplies available from the Gulf Coast Aquifer, and run-of-river rights to meet the projected water supply demand during the planning period.

5.3.19.3 Livestock, Victoria

Livestock, Victoria is projected to have adequate water supplies available from local sources to meet the WUG's projected demand during the planning period.

5.3.19.4 Manufacturing, Victoria

Current water supply for Manufacturing, Victoria is obtained from the Gulf Coast Aquifer. Manufacturing, Victoria is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual manufacturing operations implement the following water supply plan to meet the projected needs for manufacturing (Table 5.3.3-8).

- GBRA Lower Basin New Appropriation is to be implemented to provide 16,575 acft/yr from 2030 through 2070.

Table 5.3.19-4 Recommended Water Supply Plan for Manufacturing, Victoria

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(7,641)	(8,762)	(8,762)	(8,762)	(8,762)	(8,762)
Recommended WMS						
GBRA Lower Basin New Appropriation	-	16,575	16,575	16,575	16,575	16,575
WMS Supply	**0**	**16,575**	**16,575**	**16,575**	**16,575**	**16,575**

Estimated costs of the recommended plan to meet Manufacturing projected needs are shown in

Table 5.3.19-5 Recommended Plan Costs by Decade for Manufacturing, Victoria

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
GBRA Lower Basin New Appropriation						
Annual Cost ($/yr)	-	10,905,941	10,905,941	5,750,911	5,750,911	1,861,720
Unit Cost ($/acft)	-	658	658	347	347	112

5.3.19.5 Mining, Victoria

Mining, Victoria is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the WUG's projected demand during the planning period.

5.3.19.6 Quail Creek MUD

Quail Creek MUD is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet the Quail Creek MUD projected demands during the planning period.

5.3.19.7 Steam-Electric Power, Victoria

Current water supply for Steam-Electric Power, Victoria is obtained from the Gulf Coast Aquifer and run-of-river rights. Steam-Electric Power, Victoria is projected to need additional water supplies prior to 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Steam-Electric Power implement the following water supply plan to meet the projected needs (Table 5.3.19-6).

- GBRA Victoria County Steam-Electric Project is to be implemented to provide 23,925 acft/yr from 2030 through 2070.

Table 5.3.19-6 Recommended Water Supply Plan for Steam-Electric Power, Victoria

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(18,925)	(18,925)	(18,925)	(18,925)	(18,925)	(18,925)
Recommended WMS						
GBRA Victoria County Steam-Electric Project*	-	23,925	23,925	23,925	23,925	23,925
WMS Supply	**0**	**23,925**	**23,925**	**23,925**	**23,925**	**23,925**
* Indicates WMS obtains its water supply from the GBRA Lower Basin New Appropriation Project						

Estimated costs of the recommended plan to meet Steam-Electric Power projected needs are shown in Table 5.3.19-7.

Table 5.3.19-7 Recommended Plan Costs by Decade for Steam-Electric Power, Victoria

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
GBRA Victoria County Steam-Electric Project						
Annual Cost ($/yr)	-	13,196,000	13,196,000	4,946,000	4,946,000	4,946,000
Unit Cost ($/acft)	-	552	552	207	207	207

5.3.19.8 Victoria

Current water supply for the City of Victoria is obtained from the Gulf Coast Aquifer and run-of-river rights. The City of Victoria is projected to need additional water supplies starting in the planning year 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Victoria implement the following water supply plan (Table 5.3.19-8).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 809 acft/yr by 2020, increasing to 7,516 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 490 acft/yr by 2020.
- Victoria County ASR is to be implemented by 2020 can provide an additional supply of 7,900 acft, continuing through 2070.
- The Groundwater-Surface Water Exchange WMS is to be implemented by 2020 can provide an additional 8,544 ac/ft of water by 2020, continuing on through 2070.

Table 5.3.19-8 Recommended Water Supply Plan for Victoria

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(8,935)	(9,790)	(10,454)	(11,124)	(11,755)	(12,295)
Recommended WMS						
Advanced Water Conservation	809	2,199	3,642	5,158	6,705	7,516
Drought Management	490	-	-	-	-	-
City of Victoria ASR	7,900	7,900	7,900	7,900	7,900	7,900
City of Victoria Groundwater-Surface Water Exchange	8,544	8,544	8,544	8,544	8,544	8,544
WMS Supply	**17,743**	**18,643**	**20,086**	**21,602**	**23,149**	**23,960**

Estimated costs of the recommended plan for Victoria are shown in Table 5.3.19-9.

Table 5.3.19-9 Recommended Plan Costs by Decade for Victoria

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	485,612	1,319,337	2,185,029	3,094,669	4,022,992	4,509,802
Unit Cost ($/acft)	600	600	600	600	600	600
Drought Management						
Annual Cost ($/yr)	29,970	-	-	-	-	-
Unit Cost ($/acft)	61	-	-	-	-	-
City of Victoria ASR						
Annual Cost ($/yr)	3,042,000	3,042,000	370,000	370,000	370,000	370,000
Unit Cost ($/acft)	385	385	47	47	47	47
City of Victoria Groundwater-Surface Water Exchange						
Annual Cost ($/yr)	0	0	0	0	0	0
Unit Cost ($/acft)	0	0	0	0	0	0

5.3.19.9 Victoria County WCID 1

Victoria County WCID 1 is projected to have adequate water supplies available from the Gulf Coast Aquifer to meet their projected demands during the planning period.

5.3.20 Wilson County Water Supply Plan

Table 5.3.20-1 lists each WUG in Wilson County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.20-1 Wilson County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED) 2020 (ACFT/YR)	PROJECTED SURPLUS / (NEED) 2070 (ACFT/YR)	COMMENT
McCoy WSC	-	-	See Atascosa County
East Central SUD	-	-	See Bexar County
Elmendorf	-	-	See Bexar County
Nixon	-	-	See Gonzalez County
El Oso WSC	-	-	See Karnes County
County-Other, Wilson	600	1,304	No projected shortage
Floresville	553	(1,281)	Projected shortage (2040 through 2070)
Irrigation, Wilson	39	(453)	Projected shortage (2060 through 2070)
La Vernia	690	302	No projected shortage
Livestock, Wilson	0	0	No projected shortage
Manufacturing, Wilson	0	0	No projected shortage
Mining, Wilson	0	0	No projected shortage
Oak Hills WSC	(468)	(1,338)	Projected shortage (2020 through 2070)
Picosa WSC	66	(137)	Projected shortage (2040 through 2070)
Poth	249	(97)	Projected shortage (2060 through 2070)
SS WSC	(425)	(4,133)	Projected shortage (2020 through 2070)
Steam-Electric Power, Wilson	0	0	No projected shortage
Stockdale	529	164	No projected shortage
Sunko WSC	806	171	No projected shortage

5.3.20.1 McCoy WSC

See Atascosa County for more details.

5.3.20.2 East Central SUD

See Bexar County for more details.

5.3.20.3 Elmendorf

See Bexar County for more details.

5.3.20.4 Nixon

See Gonzales County for more details.

5.3.20.5 El Oso WSC

See Karnes County for more details.

5.3.20.6 County-Other, Wilson

The County-Other, Wilson areas are projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet their projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that these areas implement the following water supply plan (Table 5.3.20-2).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 4 acft/yr of supply in 2070.

Table 5.3.20-2 Recommended Water Supply Plan for County-Other, Wilson

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	600	660	772	938	1,304	1,304
Recommended WMS						
Advanced Water Conservation	-	-	-	-	-	4
WMS Supply	**0**	**0**	**0**	**0**	**0**	**4**

Estimated costs of the recommended plan to meet County-Other projected needs are shown in Table 5.3.20-3.

Table 5.3.20-3 Recommended Plan Costs by Decade for County-Other, Wilson

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	149	3,334
Unit Cost ($/acft)	-	-	-	-	770	770

5.3.20.7 Floresville

Current water supply for the City of Floresville is obtained from the Carrizo-Wilcox Aquifer. Floresville is projected to need additional water supplies prior to 2040. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Floresville implement the following water supply plan to meet the projected needs for the city (Table 5.3.20-4).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 79 acft/yr by 2020, increasing to 1,283 acft/yr of supply in 2070.
- Local Groundwater is to be implemented prior to 2040 and can provide an additional 828 acft/yr by 2040 increasing to 1,656 acft/yr by 2070.

Table 5.3.20-4 Recommended Water Supply Plan for Floresville

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	553	151	(245)	(608)	(961)	(1,281)
Recommended WMS						
Advanced Water Conservation	79	270	523	819	1,118	1,283
Local Groundwater	-	-	828	828	1,654	1,656
WMS Supply	**79**	**270**	**1,351**	**1,647**	**2,772**	**2,939**

Estimated costs of the recommended plan to meet Floresville's projected needs are shown in Table 5.3.20-5.

Table 5.3.20-5 Recommended Plan Costs by Decade for Floresville

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	61,152	208,104	402,338	630,909	860,542	988,234
Unit Cost ($/acft)	770	770	770	770	770	770
Local Groundwater						
Annual Cost ($/yr)	-	-	429,000	429,000	665,500	665,500
Unit Cost ($/acft)	-	-	518	518	402	402

5.3.20.8 Irrigation, Wilson

Irrigation, Wilson is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer, Sparta Aquifer, Queen City Aquifer, and run-of-river rights to meet the needs prior to 2050. Due to limited economically feasible supplies for irrigation, these needs remain unmet. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual irrigators implement water conservation measures associated with the Advanced Water Conservation WMS to meet a portion of the projected needs for irrigation (Table 5.3.20-6).

- Project needs for this WUG are decreased due to GW conversion in this county. See Appendix 2-A WUG Supply Balance after WMS.

Table 5.3.20-6 Recommended Water Supply Plan for Irrigation, Wilson

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	39	24	12	1	(153)	(453)
Recommended WMS						
WMS Supply	**0**	**0**	**0**	**0**	**0**	**0**

5.3.20.9 La Vernia

Current water supply for the City of La Vernia is obtained from the Carrizo-Wilcox Aquifer. La Vernia is projected to have adequate water supplies through the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that La Vernia implement the following water supply plan (Table 5.3.20-7).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 15 acft/yr by 2020, increasing to 219 acft/yr of supply in 2070.

Table 5.3.20-7 Recommended Water Supply Plan for La Vernia

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	690	605	521	444	369	302
Recommended WMS						
Advanced Water Conservation	15	55	109	157	188	219
WMS Supply	**15**	**55**	**109**	**157**	**188**	**219**

Estimated costs of the recommended plan for La Vernia are shown in Table 5.3.20-8.

Table 5.3.20-8 Recommended Plan Costs by Decade for La Vernia

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	11,687	42,605	83,796	120,876	144,854	168,897
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.20.10 Livestock, Wilson

Livestock, Wilson is projected to have adequate water supplies available from local sources to meet the WUG's projected needs during the planning period.

5.3.20.11 Manufacturing, Wilson

Manufacturing, Wilson is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the WUG's projected demand during the planning period.

5.3.20.12 Mining, Wilson

Mining, Wilson is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the WUG's projected demand during the planning period.

5.3.20.13 Oak Hills WSC

Current water supply for Oak Hills WSC is obtained from the Carrizo-Wilcox Aquifer. Oak Hills WSC is projected to have an immediate need starting in 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Oak Hills WSC implement the following water supply plan to meet the projected needs for the WSC (Table 5.3.20-9).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 30 acft/yr by 2020, increasing to 248 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 28 acft/yr by 2020.
- Local Groundwater management is to be implemented immediately can provide an additional 475 acft/yr by 2020, increasing to 1,350 acft/yr by 2070.

Table 5.3.20-9 Recommended Water Supply Plan for Oak Hills WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(468)	(658)	(846)	(1,019)	(1,186)	(1,338)
Recommended WMS						
Advanced Water Conservation	30	72	101	142	192	248
Drought Management	28	-	-	-	-	-
Local Groundwater	475	675	875	1,050	1,200	1,350
WMS Supply	**533**	**747**	**976**	**1,192**	**1,392**	**1,598**

Estimated costs of the recommended plan to meet Oak Hills WSC's projected needs are shown in Table 5.3.20-10.

Table 5.3.20-10 Recommended Plan Costs by Decade for Oak Hills WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	20,430	49,371	68,883	96,465	130,526	168,762
Unit Cost ($/acft)	681	681	681	681	681	681
Drought Management						
Annual Cost ($/yr)	2,470	-	-	-	-	-
Unit Cost ($/acft)	88	-	-	-	-	-
Local Groundwater						
Annual Cost ($/yr)	0	0	0	0	0	0
Unit Cost ($/acft)	0	0	0	0	0	0

5.3.20.14 Picosa WSC

Current water supply for the Picosa WSC is obtained from the Carrizo-Wilcox Aquifer. The WSC is projected to need additional water supplies prior to 2040. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the WSC implement the following water supply plan to meet the projected needs for the city (Table 5.3.20-11).

- Local Groundwater management is to be implemented prior to 2020 can provide an additional 19 acft/yr by 2040, increasing to 137 acft/yr by 2070.

Table 5.3.20-11 Recommended Water Supply Plan for Picosa WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	66	23	(19)	(58)	(99)	(137)
Recommended WMS						
Local Groundwater	-	-	19	58	99	137
WMS Supply	**0**	**0**	**19**	**58**	**99**	**137**

Estimated costs of the recommended plan for the City of Poth are shown in Table 5.3.20-12.

Table 5.3.20-12 Recommended Plan Costs by Decade for Picosa WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Local Groundwater						
Annual Cost ($/yr)	-	-	0	0	0	0

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Unit Cost ($/acft)	-	-	0	0	0	0

5.3.20.15 Poth

Current water supply for the City of Poth is obtained from the Carrizo-Wilcox Aquifer. The City of Poth is projected to need an additional water supply by 2060. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Poth implement the following water supply plan (Table 5.3.20-13).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 7 acft/yr by 2020, increasing to 64 acft/yr of supply in 2070.
- Local Groundwater management is to be implemented prior to 2060 can provide an additional 35 acft/yr by 2060, increasing to 97 acft/yr by 2070.

Table 5.3.20-13 Recommended Water Supply Plan for Poth

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	249	175	101	33	(35)	(97)
Recommended WMS						
Advanced Water Conservation	7	9	14	25	43	64
Local Groundwater	-	-	-	-	35	97
WMS Supply	**7**	**9**	**14**	**25**	**78**	**161**

Estimated costs of the recommended plan for Poth are shown in Table 5.3.20-14.

Table 5.3.20-14 Recommended Plan Costs by Decade for Poth

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	5,189	6,691	10,884	19,533	33,200	49,105
Unit Cost ($/acft)	770	770	770	770	770	770
Local Groundwater						
Annual Cost ($/yr)	-	-	-	-	0	0
Unit Cost ($/acft)	-	-	-	-	0	0

5.3.20.16 SS WSC

Current water supply for SS WSC is obtained from the Carrizo-Wilcox Aquifer. SS WSC is projected to have an immediate shortage starting in 2020. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that SS WSC implement the following water supply plan to meet the projected needs for the WSC (Table 5.3.20-15).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 16 acft/yr by 2060, increasing to 159 acft/yr of supply in 2070.
- Drought Management is to be implemented or enhanced in the immediate future. This strategy can provide an additional 95 acft/yr in 2020.
- Purchase from WWP (CRWA) is to be implemented prior to 2020. This strategy can provide an additional supply of 345 acft/yr by 2020 increasing to 2,869 in 2070.
- Brackish Carrizo-Wilcox groundwater for SS WSC with conversions is to be implemented by 2060 if conversions are applied. This strategy can provide an additional 1,120 acft/yr starting in 2060.

Table 5.3.20-15 Recommended Water Supply Plan for SS WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(425)	(1,108)	(1,867)	(2,640)	(3,600)	(4,133)
Recommended WMS						
Advanced Water Conservation	-	-	-	-	16	159
Drought Management	95	-	-	-	-	-
Purchase from WWP (CRWA)	345	1,123	1,882	2,655	2,479	2,869
SS WSC Brackish Carrizo-Wilcox Project	-	-	-	-	1,120	1,120
WMS Supply	**440**	**1,123**	**1,882**	**2,655**	**3,615**	**4,148**

Estimated costs of the recommended plan to meet SS WSC's projected needs are shown in Table 5.3.20-16.

Table 5.3.20-16 Recommended Plan Costs by Decade for SS WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	-	-	-	-	12,337	122,154
Unit Cost ($/acft)	-	-	-	-	770	770
Drought Management						
Annual Cost ($/yr)	8,404	-	-	-	-	-
Unit Cost ($/acft)	88	-	-	-	-	-
Purchase from WWP (CRWA)						
Annual Cost ($/yr)	9,308,000	9,308,000	5,942,000	5,942,000	5,942,000	5,942,000
Unit Cost ($/acft)	1,330	1,330	849	849	849	849
SS WSC Brackish Carrizo-Wilcox Project						

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Annual Cost ($/yr)	0	0	0	0	3,260,000	3,260,000
Unit Cost ($/acft)	0	0	0	0	2,911	2,911

5.3.20.17 Steam-Electric Power, Wilson

There is no projected needs for Steam-Electric Power, Wilson and therefore no WMS are recommended for this water user group.

5.3.20.18 Stockdale

The City of Stockdale is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Stockdale implement the following water supply plan (Table 5.3.20-17).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 13 acft/yr by 2020, increasing to 210 acft/yr of supply in 2070.

Table 5.3.20-17 Recommended Water Supply Plan for the Stockdale

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	529	450	371	299	228	164
Recommended WMS						
Advanced Water Conservation	13	49	98	143	171	201
WMS Supply	**13**	**49**	**98**	**143**	**171**	**201**

Estimated costs of the recommended plan for Stockdale are shown in Table 5.3.20-18.

Table 5.3.20-18 Recommended Plan Costs by Decade for Stockdale

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	9,743	37,454	75,701	109,758	132,032	154,723
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.20.19 Sunko WSC

The Sunko WSC is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the WSC projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that Sunko WSC implement the following water supply plan to meet the projected needs for the WSC (Table 5.3.20-19).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 17 acft/yr by 2020, increasing to 145 acft/yr of supply in 2070.

Table 5.3.20-19 Recommended Water Supply Plan for Sunko WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	806	668	532	407	283	171
Recommended WMS						
Advanced Water Conservation	17	32	47	71	106	145
WMS Supply	**17**	**32**	**47**	**71**	**106**	**145**

Estimated costs of the recommended plan to meet Sunko WSC's projected needs are shown in Table 5.3.20-20.

Table 5.3.20-20 Recommended Plan Costs by Decade for Sunko WSC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	13,216	24,816	35,960	54,363	81,514	111,681
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.21 Zavala County Water Supply Plan

Table 5.3.21-1 lists each WUG in Zavala County and its corresponding management supply or shortage in years 2020 and 2070. For each WUG with a projected shortage, or need, a water supply plan has been developed and is presented in the following subsections.

Table 5.3.21-1 Zavala County Management Supply/Shortage by Water User Group

WATER USER GROUP	PROJECTED SURPLUS / (NEED) 2020 (ACFT/YR)	2070 (ACFT/YR)	COMMENT
Batesville WSC	0	0	No projected shortage
County-Other, Zavala	117	9	No projected shortage
Crystal City	753	0	No projected shortage
Irrigation, Zavala	(21,235)	(19,865)	Projected shortage (2020 through 2070)
Livestock, Zavala	0	0	No projected shortage
Loma Alta Chula Vista Water System	0	0	No projected shortage
Manufacturing, Zavala	0	0	No projected shortage
Mining, Zavala	0	0	No projected shortage
Zavala County WCID 1	860	639	No projected shortage

5.3.21.1 Batesville WSC

The Batesville WSC is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the city's projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the Batesville WSC implement the following water supply plan (Table 5.3.21-2).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 5 acft/yr by 2020, increasing to 37 acft/yr of supply in 2070.

Table 5.3.21-2 Recommended Water Supply Plan for Batesville WSC

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	0	0	0	0
Recommended WMS						
Advanced Water Conservation	5	13	16	22	29	37
WMS Supply	**5**	**13**	**16**	**22**	**29**	**37**

Estimated costs of the recommended plan for Batesville WSC are shown in Table 5.3.21-3.

Table 5.3.21-3 Recommended Plan Costs by Decade for Batesville

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	3,938	10,302	12,045	16,556	22,668	28,744
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.21.2 County-Other, Zavala

The County-Other, Zavala areas are projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet their projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that these areas implement the following water supply plan (Table 5.3.21-4).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 4 acft/yr by 2020, increasing to 42 acft/yr of supply in 2070.

Table 5.3.21-4 Recommended Water Supply Plan for County-Other, Zavala

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	117	98	75	51	30	9
Recommended WMS						
Advanced Water Conservation	4	9	15	24	32	42
WMS Supply	4	9	15	24	32	42

Estimated costs of the recommended plan for County-Other are shown in Table 5.3.21-5.

Table 5.3.21-5 Recommended Plan Costs by Decade for County-Other, Zavala

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	3,451	7,083	11,684	18,161	24,368	32,167
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.21.3 Crystal City

The City of Crystal City is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the city’s projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the City of Crystal City implement the following water supply plan (Table 5.3.21-6).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 60 acft/yr by 2020, increasing to 654 acft/yr of supply in 2070.

Table 5.3.21-6 Recommended Water Supply Plan for the City of Crystal City

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	753	598	456	296	143	0
Recommended WMS						
Advanced Water Conservation	60	196	353	496	573	654
WMS Supply	**60**	**196**	**353**	**496**	**573**	**654**

Estimated costs of the recommended plan for the City of Crystal City are shown in Table 5.3.21-7.

Table 5.3.21-7 Recommended Plan Costs by Decade for the City of Crystal City

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	46,296	150,541	272,176	382,073	441,417	503,328
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.21.4 Irrigation, Zavala

Current water supply for Irrigation, Zavala is obtained from the Carrizo-Wilcox Aquifer. Irrigation, Zavala is projected to need additional water supplies prior to 2020. Due to limited economically feasible supplies for irrigation, these needs remain unmet. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that individual irrigators implement water conservation measures associated with the Advanced Water Conservation WMS to meet a portion of the projected needs for irrigation (Table 5.3.21-8).

Table 5.3.21-8 Recommended Water Supply Plan for Irrigation, Zavala

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	(21,235)	(21,350)	(21,109)	(20,733)	(20,148)	(19,865)
Recommended WMS						
WMS Supply	**0**	**0**	**0**	**0**	**0**	**0**

5.3.21.5 Livestock, Zavala

Livestock, Zavala is projected to have adequate water supplies available from local sources to meet the WUG's projected demand during the planning period.

5.3.21.6 Loma Alta Chula Vista Water System

Loma Alta Chula Vista Water System is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet their projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that the Loma Alta Chula Vista Water System implement the following water supply plan (Table 5.3.21-9).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 12 acft/yr by 2020, increasing to 140 acft/yr of supply in 2070.

Table 5.3.21-9 Recommended Water Supply Plan for Loma Alta Chula Vista Water System

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	0	0	0	0	0	0
Recommended WMS						
Advanced Water Conservation	12	34	57	84	112	140
WMS Supply	**12**	**34**	**57**	**84**	**112**	**140**

Estimated costs of the recommended plan for Loma Alta Chula Vista Water System are shown in Table 5.3.21-10.

Table 5.3.21-10 Recommended Plan Costs by Decade for Loma Alta Chula Vista Water System

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	9,530	26,051	43,920	64,935	86,127	107,975
Unit Cost ($/acft)	770	770	770	770	770	770

5.3.21.7 Manufacturing, Zavala

Manufacturing, Zavala is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the WUG's projected demand during the planning period.

5.3.21.8 Mining, Zavala

Mining, Zavala is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet the WUG's projected demand during the planning period.

5.3.21.9 Zavala County WCID 1

The Zavala County WCID 1 is projected to have adequate water supplies available from the Carrizo-Wilcox Aquifer to meet their projected demands during the planning period. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that WCID implement the following water supply plan (Table 5.3.21-11).

- Advanced Water Conservation is to be implemented or enhanced in the immediate future. This strategy can provide an additional 24 acft/yr by 2020, increasing to 283 acft/yr of supply in 2070.

Table 5.3.21-11 Recommended Water Supply Plan for Zavala County WCID 1

	2020 (ACFT/YR)	2030 (ACFT/YR)	2040 (ACFT/YR)	2050 (ACFT/YR)	2060 (ACFT/YR)	2070 (ACFT/YR)
Projected Surplus (Needs)	860	813	770	724	680	639
Recommended WMS						
Advanced Water Conservation	24	65	113	168	225	283
WMS Supply	**24**	**65**	**113**	**168**	**225**	**283**

Estimated costs of the recommended plan to meet Zavala County WCID 1 projected needs are shown in

Table 5.3.3-3 Recommended Water Supply Plan for Aqua WSC

Table 5.3.21-12 Recommended Plan Costs by Decade for Zavala County WCID 1

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	18,192	50,216	86,756	129,128	173,386	218,148
Unit Cost ($/acft)	770	770	770	770	770	770

FINAL PLAN

SECTION 5.4: WATER SUPPLY PLANS FOR WHOLESALE WATER PROVIDERS

South Central Texas Regional Water Plan

B&V PROJECT NO. 192335

PREPARED FOR

South Central Texas Regional Water Planning Group

5 NOVEMBER 2020

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5.4 WATER SUPPLY PLANS FOR WHOLESALE WATER PROVIDERS

A water supply plan has been developed for each WWP that includes, if applicable, WUG data and sales of water to customer WUGs. For the following WWPs, all associated WMS projects in Section 5.2 were identified as recommended strategies for Region L. Recommended WMS to meet the projected needs of each WUG, and WWP in Region L are summarized in tables generated by the TWDB Regional Water Planning Database (DB22) in Appendix 2-A. WMS purchases (i.e. sales or transfers) in the proceeding tables include WUGs from other regions to account for all of each WWP's supply distribution as required by the TWDB.

5.4.1 Alliance Regional Water Authority

ARWA currently has permits for the Carrizo-Wilcox Aquifer in Caldwell County, but has no infrastructure in place to access the groundwater. As such, there is no current supply for ARWA. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that ARWA implement the following water supply plan to meet the projected needs of its planned customers (Table 5.4-1). Cost estimates are summarized in Table 5.4-2.

- ARWA/GBRA Project (Phase 1) – To be implemented in the 2020 decade. This strategy can provide an additional estimated 15,000 acft/yr of supply from 2020 through 2070.
- ARWA Project (Phase 2) – To be implemented by 2040. This strategy can provide an additional estimated 21,000 acft/yr of supply from 2040 through 2070.
- ARWA Project (Phase 3) – To be implemented by 2060. This strategy can provide an additional estimated 5,584 acft/yr of supply from 2060 through 2070.

Table 5.4-1 Projected Supply Plan for ARWA (acft/yr)

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Projected WWP Contract Demands and Supplies						
WWP Contract Demands	0	0	0	0	0	0
WWP Contract Supplies	0	0	0	0	0	0
Total System Management Supplies/(Needs)	**0**	**0**	**0**	**0**	**0**	**0**
WMS Supplies						
ARWA/GBRA Project (Phase 1)	15,000	15,000	15,000	15,000	15,000	15,000
ARWA Project (Phase 2)	0	0	20,999	20,999	20,999	20,999
ARWA Project (Phase 3)	0	0	0	0	5,584	5,584
Total Management and WMS Supplies	**15,000**	**15,000**	**35,999**	**35,999**	**41,583**	**41,583**
WMS Purchases[1]						
City of Buda	762	762	1,829	1,829	2,113	2,113
County Line SUD	478	478	1,147	1,147	1,325	1,325

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Crystal Clear SUD	2,560	2,560	6,145	6,145	7,098	7,098
Green Valley SUD	1,595	1,595	3,827	3,827	4,421	4,421
City of Kyle	4,225	4,225	10,141	10,141	11,714	11,714
Manufacturing, Comal	2,786	0	0	0	0	0
City of San Marcos	2,594	5,380	12,910	12,910	14,912	14,912
Total Purchases	15,000	15,000	35,999	35,999	41,583	41,583
Total System Management Supplies After WMS Purchases						
Projected Total System Supplies After WMS Purchases	0	0	0	0	0	0

[1] WMS Purchases include total volumes purchased by WUGs regardless of region splits.

Table 5.4-2 Recommended Plan Costs by Decade for ARWA

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
ARWA/GBRA Project (Phase 1)						
Annual Cost ($/yr)	$21,454,000	$21,454,000	$5,371,000	$5,371,000	$5,371,000	$5,371,000
Unit Cost ($/acft)	$1,430	$1,430	$358	$358	$358	$358
ARWA Project (Phase 2)						
Annual Cost ($/yr)	--	--	$13,391,000	$13,391,000	$4,207,000	$4,207,000
Unit Cost ($/acft)	--	--	$635	$635	$199	$199
ARWA Project (Phase 3)						
Annual Cost ($/yr)	--	--	--	--	$11,171,000	$11,171,000
Unit Cost ($/acft)	--	--	--	--	$2,001	$2,001

5.4.2 Canyon Regional Water Authority

The current water supply for CRWA is obtained from GBRA, various existing surface water rights and leases, and the Carrizo-Wilcox Aquifer. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that CRWA implement the following water supply plan to meet the projected needs of its customers (Table 5.4-3). Cost estimates are summarized in Table 5.4-4.

- Facilities Expansion: Lake Dunlap WTP Expansion – To be implemented in the 2020 decade. This strategy is anticipated to provide an additional 2,300 acft/yr. However, due to MAG limitations, WMS supply is expected to provide up to 1,040 acft/yr. This is not new water supply. See Section 5.2.8.2 for more details.

- Facilities Expansion: Hays Caldwell WTP Expansion – To be implemented in the 2020 decade. This strategy is anticipated to provide an additional 2,300 acft/yr. However, due to MAG limitations, WMS supply is expected to provide up to 1,543 acft/yr; with WMS supplies currently allocated for Martindale WSC and San Marcos. See Section 5.2.8.2 for strategy details and Section 5.3 for WMS supplies for Martindale WSC and San Marcos.
- CRWA Wells Ranch Project (Phase 3) – To be implemented in the 2020 decade. This strategy can provide an additional 3,500 acft/yr of supply for the 2020 decade, increasing to 7,000 acft/yr of supply from 2030 through 2070.
- CRWA Siesta Project – To be implemented in the 2060 decade. This strategy can provide an additional 5,042 acft/yr of supply from 2060 through 2070.
- CRWA Brackish Wilcox Project – To be implemented in the 2030 decade. This strategy can provide an additional 14,700 acft/yr of supply from 2030 through 2070.

Table 5.4-3 Projected Supply Plan for CRWA (acft/yr)

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Projected WWP Contract Demands and Supplies						
WWP Contract Demands	26,817	26,817	26,817	26,817	26,817	26,817
WWP Contract Supplies	26,817	26,817	26,817	26,817	26,817	26,817
Total System Management Supplies/(Needs)[1]	**0**	**0**	**0**	**0**	**0**	**0**
WMS Supplies						
Facilities Expansion: Lake Dunlap WTP Expansion[1]	1,040	1,040	1,040	1,040	1,040	1,040
Facilities Expansion: Hays Caldwell WTP Expansion[2]	1,543	1,543	1,543	1,543	1,543	1,543
Wells Ranch Phase 3	3,500	7,000	7,000	7,000	7,000	7,000
Siesta Project	-	-	-	-	5,042	5,042
Brackish Wilcox Project	-	14,700	14,700	14,700	14,700	14,700
Total New Supplies	**6,083**	**24,283**	**24,283**	**24,283**	**29,325**	**29,325**
Total System Management and WMS Supplies						
Projected System and WMS Supplies	6,083	24,283	24,283	24,283	29,325	29,325
WMS Purchases						
City of Converse	264	575	762	736	730	720
City of Marion	--	--	18	59	103	146
Martindale WSC	255	320	395	505	785	1,109
S S WSC	345	1,123	1,882	2,655	2,479	2,869
City of San Marcos	1,288	1,288	1,288	1,288	1,288	1,288
Total Purchases	**2,152**	**3,306**	**4,345**	**5,243**	**5,385**	**6,132**
Total System Management Supplies After WMS Purchases						

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Projected Total System Supplies After WMS Purchases	3,931	20,977	19,938	19,040	23,940	23,193

[1] Anticipated capacity for Facilities Expansion: Lake Dunlap WTP Expansion is 2,300 acft/yr through the planning period. Volumes shown are based on water availability consistent with TWDB data. See Section 5.2.8.2 for more details.

[2] Anticipated capacity for Facilities Expansion: Hays Caldwell WTP Expansion is 2,300 acft/yr through the planning period. Volumes shown are based on water availability consistent with TWDB data. See Section 5.2.8.2 for more details.

Table 5.4-4 Recommended Plan Costs by Decade for CRWA

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Facilities Expansion: Lake Dunlap WTP Expansion[1]						
Annual Cost ($/yr)	$2,417,000	$2,417,000	$1,077,000	$1,077,000	$1,077,000	$1,077,000
Unit Cost ($/acft)	$2,324	$2,324	$1,036	$1,036	$1,036	$1,036
Facilities Expansion: Hays Caldwell WTP Expansion[1]						
Annual Cost ($/yr)	$2,417,000	$2,417,000	$1,077,000	$1,077,000	$1,077,000	$1,077,000
Unit Cost ($/acft)	$1,566	$1,566	$698	$698	$698	$698
Wells Ranch Phase 3						
Annual Cost ($/yr)	$9,308,000	$9,308,000	$5,942,000	$5,942,000	$5,942,000	$5,942,000
Unit Cost ($/acft)	$1,330	$1,330	$849	$849	$849	$849
Siesta Project						
Annual Cost ($/yr)	--	--	--	--	$12,456,000	$12,456,000
Unit Cost ($/acft)	--	--	--	--	$2,470	$2,470
Brackish Wilcox						
Annual Cost ($/yr)	--	$23,451,000	$23,451,000	$10,931,000	$10,931,000	$10,931,000
Unit Cost ($/acft)	--	$1,595	$1,595	$744	$744	$744

[1] Facilities Expansion unit costs are representative of WMS supplies detailed in Table 5.4-3; not the anticipated volumes.

5.4.3 Cibolo Valley Local Government Corporation

CVLGC is seeking water permits for the Carrizo-Wilcox Aquifer in Wilson County. There is no infrastructure in place yet, and as such, no current supply for CVLGC. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that CVLGC implement the following water supply plan to meet the projected needs for its customers (Table 5.4-5). Cost estimates are summarized in Table 5.4-6.

- CVLGC Carrizo Project in Wilson County with Transfers – To be implemented by the 2030 decade. This strategy can provide an additional 10,000 acft/yr of supply from 2030 through 2070.

Table 5.4-5 Projected Supply Plan for CVLGC (acft/yr)

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Projected WWP Contract Demands and Supplies						
WWP Contract Demands	0	0	0	0	0	0
WWP Contract Supplies	0	0	0	0	0	0
Total System Management Supplies/(Needs)	0	0	0	0	0	0
WMS Supplies						
CVLGC Carrizo Project	-	10,000	10,000	10,000	10,000	10,000
Total System Management and WMS Supplies	0	10,000	10,000	10,000	10,000	10,000
WMS Purchases						
City of Cibolo	-	5,000	5,000	5,000	5,000	5,000
City of Schertz	-	5,000	5,000	5,000	5,000	5,000
Total Purchases	-	10,000	10,000	10,000	10,000	10,000
Total System Management Supplies After WMS Purchases						
Projected Total System Supplies After WMS Purchases	0	0	0	0	0	0

Table 5.4-6 Recommended Plan Costs by Decade for CVLGC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
CVLGC Carrizo Project						
Annual Cost ($/yr)	--	$12,302,000	$12,302,000	$3,139,000	$3,139,000	$3,139,000
Unit Cost ($/acft)	--	$1,230	$1,230	$314	$314	$314

5.4.4 Guadalupe-Blanco River Authority

The current water supply for GBRA is obtained from the Canyon Reservoir and run-of-river rights. GBRA is projected to need additional water supplies by 2020 to meet projected demands. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that GBRA implement the following water supply plan to meet the projected needs for its customers (Table 5.4-7). Cost estimates are summarized in Table 5.4-8.

- Facilities Expansion: GBRA Western Canyon WTP Expansion – To be implemented in the 2060 decade. This strategy is anticipated to provide an additional 5,600 acft/yr. However, due to MAG limitations, WMS supply is expected to provide up to 1,725 acft/yr. See Section 5.2.8.2 for more details.
- Facilities Expansion: Hays County Pipeline – To be implemented in the 2020 decade. This strategy is anticipated to increase capacity by 15,400 acft/yr. However, due to MAG limitations, WMS supply capacity varies through the planning period. This is not new water supply. See Section 5.2.8.2 for more details
- ARWA/GBRA Project (Phase 1) – To be implemented in the 2020 decade. This strategy can provide an additional estimated 15,000 acft/yr of supply for 2020 through 2070.
- GBRA Mid-Basin Project (Phase 2) – To be implemented in the 2020 decade. This strategy can provide an additional 27,000 acft/yr of supply for 2020 through 2070.
- GBRA Lower Basin Storage – To be implemented in the 2020 decade. This strategy can provide an additional 59,780 acft/yr of supply for 2020 through 2070.
- GBRA Lower Basin New Appropriation – To be implemented in the 2030 decade. This strategy can provide an additional 40,500 acft/yr of supply for 2030 through 2070. As described in WMS Subsections 5.2.17 and 5.2.18, 16,575 acft/yr is allocated to Manufacturing, Victoria and 23,925 acft/yr is effectively sold to the GBRA Victoria County Steam-Electric Power WMS.
- GBRA Victoria County Steam-Electric Project – To be implemented in the 2020 decade in coordination with the Lower Basin New Appropriation WMS. As described above and in the associated WMS subsections, this strategy includes the purchase of 23,925 acft/yr from the Lower Basin New Appropriation Project, which is then allocated to Victoria County Steam-Electric Power uses. This WMS is not included in Total New Supplies in Table 5.4-7 (i.e., it is not double counted).

Table 5.4-7 Projected Supply Plan for GBRA (acft/yr)

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Projected WUG Demands and Supplies						
WUG Demands	325	343	363	387	417	447
WUG Supplies	325	343	363	387	417	447
WUG Management Supplies/(Needs)	0	0	0	0	0	0
Projected WWP Contract Demands and Supplies						
WWP Contract Demands	122,332	122,332	118,332	118,332	118,332	118,332
WWP Contract Supplies	118,005	117,283	114,190	114,784	117,230	117,215
WWP Management Supplies/(Needs)	(4,327)	(5,049)	(4,142)	(3,548)	(1,102)	(1,117)
Total System Management Supplies/(Needs)[1]	(4,327)	(5,049)	(4,142)	(3,548)	(1,102)	(1,117)
WMS Supplies[2]						
Facilities Expansion: GBRA Western Canyon WTP Expansion[3]	--	--	--	--	1,725	1,566
Facilities Expansion: Hays County Pipeline[4]	--	2,179	5,108	4,345	0	0
ARWA/GBRA Project (Phase 1)	14,999	14,999	14,999	14,999	14,999	14,999
GBRA Mid-Basin Project Phase 2	27,000	27,000	27,000	27,000	27,000	27,000
GBRA Lower Basin Storage	59,780	59,780	59,780	59,780	59,780	59,780
GBRA Lower Basin New Appropriation	--	40,500	40,500	40,500	40,500	40,500
GBRA Victoria County Steam-Electric[5]	--	*23,925*	*23,925*	*23,925*	*23,925*	*23,925*
Total New Supplies	101,779	144,458	147,387	146,624	144,004	143,845
Total System Management and WMS Supplies						
Projected System and WMS Supplies	97,452	139,409	143,245	143,076	142,902	142,728
WMS Purchases						
Canyon Lake Water Service	--	--	--	--	--	177
County-Other, Hays	--	1,000	1,000	1,000	3,029	8,220

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
County-Other, Victoria	846	906	951	1,015	1,095	1,166
Goforth SUD	3,999	3,999	3,999	3,999	3,999	3,999
City of Lockhart	3,000	3,000	3,000	3,000	3,000	3,000
Manufacturing, Comal	--	3,783	3,783	3,783	3,783	3,783
Manufacturing, Guadalupe	--	402	402	402	402	402
Manufacturing, Victoria	--	16,575	16,575	16,575	16,575	16,575
New Braunfels Utilities	8,000	8,000	8,000	8,000	8,000	8,000
Steam-Electric Power, Victoria	--	23,925	23,925	23,925	23,925	23,925
West Travis County Public Utility Agency[6]	--	*3,000*	*3,000*	*3,000*	*3,000*	*3,000*
Wimberley WSC	--	262	752	1,366	2,060	2,851
Total Purchases	**15,845**	**64,852**	**65,387**	**66,065**	**68,868**	**75,098**
Total System Management Supplies After WMS Purchases						
Projected Total System Supplies After WMS Purchases	81,607	74,557	77,858	77,011	74,034	67,630

[1] Total System Management Supplies/(Needs) is the summation of WUG and WWP water supply data.

[2] WMS Purchases include total volumes purchased by WUGs regardless of region splits.

[3] Anticipated capacity for Facilities Expansion: Western Canyon WTP Expansion is 5,600 acft/yr from 2060 through 2070. Volumes shown are based on water availability consistent with TWDB data. See Section 5.2.8.2 for more details.

[4] Anticipated capacity for Facilities Expansion: Hays County Pipeline is 15,400 acft/yr through the planning period. Volumes shown are based on water availability consistent with TWDB data. See Section 5.2.8.2 for more details.

[5] The GBRA Victoria County Steam-Electric Project WMS purchases its supplies via the GBRA Lower Basin New Appropriation WMS; the listed GBRA Victoria County Steam-Electric supplies are not accounted for in the Total New Supplies row.

[6] West Travis County Public Utility Agency is a Region K WUG and the data shown is to account for GBRA's WWP sales/transfers as required by the TWDB

Table 5.4-8 Recommended Plan Costs by Decade for GBRA

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Facilities Expansion: GBRA Western Canyon WTP Expansion[1]						
Annual Cost ($/yr)	--	--	--	--	$2,854,000	$2,854,000
Unit Cost ($/acft)	--	--	--	--	$1,654	$1,822
Facilities Expansion: Hays County Pipeline[1]						
Annual Cost ($/yr)	--	$1,998,000	$1,998,000	$205,000	$205,000	$205,000

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Unit Cost ($/acft)	--	$917	$391	$47	$0	$0
ARWA/GBRA Project (Phase 1)						
Annual Cost ($/yr)	$10,809,000	$10,809,000	$4,243,000	$4,243,000	$4,243,000	$4,243,000
Unit Cost ($/acft)	$721	$721	$283	$283	$283	$283
GBRA Mid-Basin Project Phase 2						
Annual Cost ($/yr)	--	$6,603,000	$2,949,000	$2,949,000	$2,949,000	$2,949,000
Unit Cost ($/acft)	--	$110	$49	$49	$49	$49
GBRA Lower Basin Storage						
Annual Cost ($/yr)	$6,603,000	$6,603,000	$4,846,000	$4,846,000	$2,949,000	$2,949,000
Unit Cost ($/acft)	$110	$110	$81	$81	$49	$49
GBRA Victoria County Steam-Electric Project						
Annual Cost ($/yr)	$13,196,000	$13,196,000	$4,946,000	$4,946,000	$4,946,000	$4,946,000
Unit Cost ($/acft)	$552	$552	$207	$207	$207	$207
GBRA Lower Basin New Appropriation						
Annual Cost ($/yr)	--	$26,648,000	$26,648,000	$14,052,000	$14,052,000	$4,549,000
Unit Cost ($/acft)	--	$658	$658	$347	$347	$112
GBRA Victoria County Steam-Electric						
Annual Cost ($/yr)	--	$13,196,000	$13,196,000	$4,946,000	$4,946,000	$4,946,000
Unit Cost ($/acft)	--	$552	$552	$207	$207	$207
[1] Facilities Expansion unit costs are representative of WMS supplies detailed in Table 5.4-7; not the anticipated volumes.						

5.4.5 San Antonio Water System

The current water supply for SAWS is obtained from the Carrizo-Wilcox Aquifer, Edwards Aquifer, Trinity Aquifer, Canyon Reservoir, ASR, and direct reuse. SAWS is projected to need additional water supplies by the 2030 decade according to its WUG supply balance. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that SAWS implement the following water supply plan to meet the projected needs for SAWS and its customers (Table 5.4-9). Estimated costs are summarized in Table 5.4-10.

- Advanced Water Conservation – To be implemented or enhanced in the immediate future. This strategy has been assigned to each applicable WUG based on the Advanced Water Conservation WMS by the SCTRWPG. Current data provided by SAWS.

- Advanced Meter Infrastructure – To be implemented in the 2020 decade. This strategy can provide an additional 426 acft/yr, 606 acft/yr, and 510 acft/yr of supply for the 2020, 2030, and 2040 decades, respectively.
- Drought Management – To be implemented in the 2020 decade. This strategy can provide an additional 11,951 acft/yr of supply for the decade 2020, increasing to 56,588 acft/yr by 2070. Current data provided by SAWS.
- Facilities Expansion: ASR WTP Expansion – To be implemented in the 2030 decade. This strategy increases capacity for SAWS by 33,600 acft/yr by the decade 2030 through 2070. This is not new water supply. Data shown in Table 5.4-9 represents WMS supply water availability consistent with TWDB data. See Section 5.2.8.2 for more details.
- Facilities Expansion: Western Integration Pipeline Phase 2 – To be implemented in the 2020 decade. This strategy increases capacity for SAWS by 84,100 acft/yr by the 2020 decade through 2070. This is not new water supply. Data shown in Table 5.4-9 represents WMS supply water availability consistent with TWDB data. See Section 5.2.8.2 for more details.
- Direct Recycled Water Programs – To be to be implemented in the 2030 decade. This strategy can provide an additional 5,000 acft/yr of supply by the decade 2030, increasing to 40,000 acft/yr by 2070.
- Expanded Local Carrizo Project – To be implemented by 2040. This strategy can provide an additional 21,000 acft/yr of supply for the decades 2040 through 2070.
- Expanded Brackish Groundwater Project – To be implemented by 2040. This strategy can provide an additional 20,160 acft/yr of supply for the decade 2040, increasing to 70,160 acft/yr of supply by 2060.

Table 5.4-9 Projected Supply Plan for SAWS (acft/yr)

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Projected WUG Demands and Supplies						
WUG Demands	239,028	262,301	285,481	308,607	331,930	353,673
WUG Supplies	247,047	247,833	250,701	254,138	256,049	256,049
WUG Management Supplies/(Needs)	8,019	(14,468)	(34,780)	(54,469)	(75,881)	(97,624)
Projected WWP Contract Demands and Supplies						
WWP Contract Demands	7,330	6,830	6,830	6,830	6,830	6,830
WWP Contract Supplies	7,330	6,830	6,830	6,830	6,830	6,830
WWP Management Supplies/(Needs)	0	0	0	0	0	0
Total System Management Supplies/(Needs)[1]	**8,019**	**(14,468)**	**(34,780)**	**(54,469)**	**(75,881)**	**(97,624)**
WMS Supplies						
Advanced Water Conservation	24,367	50,667	74,313	89,629	102,682	115,929
Advanced Meter Infrastructure	426	606	510	--	--	--

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Drought Management	11,951	31,476	45,677	49,377	53,109	56,588
Facilities Expansion: ASR WTP Expansion[2]	--	33,600	33,600	33,600	33,600	33,600
Facilities Expansion: Western Integration Pipeline Phase 2[3]	1,406	4,000	4,000	4,000	4,000	4,000
Direct Recycled Water Programs	--	5,000	5,000	15,000	25,000	40,000
SAWS Expanded Local Carrizo Project	--	--	21,000	21,000	21,000	21,000
SAWS Expanded Brackish Groundwater Project	--	--	20,160	20,160	70,160	70,160
Total New Supplies	**38,150**	**125,349**	**204,260**	**232,766**	**309,551**	**341,277**
Total System Management and WMS Supplies						
Projected System and WMS Supplies	45,263	110,881	169,480	178,297	233,670	243,653
WMS Purchases						
Air Force Village II Inc.	107	114	114	97	81	74
Bexar County Steam-Electric	2,797	2,797	2,797	2,797	2,797	2,797
Bexar County WCID 10	348	312	243	197	199	198
Elmendorf	46	133	214	292	350	399
Fort Sam Houston	1,716	1,315	927	557	207	0
Kirby	174	275	249	240	238	237
Live Oak	392	333	297	261	226	192
The Oaks WSC	132	170	208	242	271	294
Total Purchases	**5,712**	**5,449**	**5,049**	**4,683**	**4,369**	**4,191**
Total System Management Supplies after WMS Purchases						
Projected Total System Supplies After WMS Purchases	39,551	105,432	164,431	173,614	229,301	239,462

[1] Total System Management Supplies/(Needs) is the summation of WUG and WWP water supply data.

[2] Anticipated capacity for Facilities Expansion: ASR WTP Expansion is 33,600 acft/yr from 2030 through 2070. Volumes shown are based on water availability consistent with TWDB data. See Section 5.2.8.2 for more details.

[3] Anticipated capacity for Facilities Expansion: Western Integration Pipeline Phase 2 is 84,100 acft/yr from 2020 through 2070. Volumes shown are based on water availability consistent with TWDB data. See Section 5.2.8.2 for more details.

Table 5.4-10 Recommended Plan Costs by Decade for SAWS

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Advanced Water Conservation						
Annual Cost ($/yr)	$14,620,200	$30,400,200	$44,587,800	$53,777,400	$61,609,200	$69,557,400

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Unit Cost ($/acft)	$600	$600	$600	$600	$600	$600
Advanced Meter Infrastructure						
Annual Cost ($/yr)	$22,388,000	$22,388,000	$2,081,000	--	--	--
Unit Cost ($/acft)	$52,554	$36,944	$4,080	--	--	--
Drought Management						
Annual Cost ($/yr)	$1,183,149	$8,057,856	$16,352,366	$17,676,966	$19,013,022	$20,258,504
Unit Cost ($/acft)	$99	$256	$358	$358	$358	$358
Direct Recycled Water Programs						
Annual Cost ($/yr)	$26,648,000	$26,648,000	$14,052,000	$14,052,000	$14,052,000	$14,052,000
Unit Cost ($/acft)	$658	$658	$347	$347	$347	$347
Facilities Expansion: ASR WTP Expansion[1]						
Annual Cost ($/yr)	$0	$6,631,000	$6,631,000	$3,851,000	$3,851,000	$3,851,000
Unit Cost ($/acft)	$0	$197	$197	$115	$115	$115
Facilities Expansion: Western Integration Pipeline Phase 2[1]						
Annual Cost ($/yr)	$9,124,000	$9,124,000	$1,170,000	$1,170,000	$1,170,000	$1,170,000
Unit Cost ($/acft)	$2,281	$2,281	$293	$293	$293	$293
SAWS Expanded Local Carrizo Project						
Annual Cost ($/yr)	--	--	$2,632,000	$2,632,000	$884,000	$884,000
Unit Cost ($/acft)	--	--	$125	$125	$42	$42
SAWS Expanded Brackish Groundwater Project						
Annual Cost ($/yr)	--	--	$14,124,000	$14,124,000	$102,642,000	$102,642,000
Unit Cost ($/acft)	--	--	$701	$701	$1,463	$1,463

[1] Facilities Expansion unit costs are representative of WMS supplies detailed in Table 5.4-9; not the anticipated volumes (unless they fit within the MAG – e.g. ASR WTP Expansion).

5.4.6 Schertz-Seguin Local Government Corporation

The current water supply for SSLGC is obtained from the Carrizo-Wilcox Aquifer. Working within the planning criteria established by the SCTRWPG and the TWDB, it is recommended that SSLGC implement the following water supply plan to meet the projected needs for SSLGC (Table 5.4-11). Cost estimates are summarized in Table 5.4-12.

- SSLGC Expanded Carrizo Project – To be implemented in the 2020 decade. This strategy can provide an additional 6,000 acft/yr of supply from 2020 through 2070.

- SSLGC Brackish Wilcox Project – To be implemented by 2040. This strategy can provide an additional 5,000 acft/yr of supply from 2040 through 2070.

Table 5.4-11 Projected Supply Plan for SSLGC (acft/yr)

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
Projected WWP Contract Demands and Supplies						
WWP Contract Demands	17,039	16,644	17,039	17,039	17,039	17,039
WWP Contract Supplies	17,039	16,644	17,039	17,039	17,039	17,039
Total System Management Supplies/(Needs)	**0**	**0**	**0**	**0**	**0**	**0**
WMS Supplies						
SSLGC Expanded Carrizo Project	6,000	6,000	6,000	6,000	6,000	6,000
SSLGC Brackish Wilcox Project	-	-	5,000	5,000	5,000	5,000
Total Management and WMS Supplies	**6,000**	**6,395**	**11,000**	**11,000**	**11,000**	**11,000**
WMS Purchases						
City of Schertz	3,000	3,000	5,500	5,500	5,500	5,500
City of Seguin	3,000	3,000	5,500	5,500	5,500	5,500
Total Purchases	**6,000**	**6,000**	**11,000**	**11,000**	**11,000**	**11,000**
Total System Management Supplies After WMS Purchases						
Projected Total System Supplies After WMS Purchases	0	0	0	0	0	0

Table 5.4-12 Recommended Plan Costs by Decade for SSLGC

PLAN ELEMENTS	2020	2030	2040	2050	2060	2070
SSLGC Expanded Carrizo Project						
Annual Cost ($/yr)	$7,239,000	$7,239,000	$1,924,000	$1,924,000	$1,924,000	$1,924,000
Unit Cost ($/acft)	$1,207	$1,207	$321	$321	$321	$321
SSLGC Brackish Wilcox Project						
Annual Cost ($/yr)	--	--	$3,316,000	$3,316,000	$1,069,000	$1,069,000
Unit Cost ($/acft)	--	--	$663	$663	$214	$214

5.4.7 Management Supply Factors

Assuming all recommended WMSs are implemented, Table 5.4-13 summarizes the calculated management supply factor for each WWP as well as the entities identified as MWPs. The formula for management supply factors equates to: the total existing supplies, plus all water supplies from recommended WMSs; divided by the entity's total projected Water Demand, within each planning decade [31 TAC § 357.35(g)(2)].

Table 5.4-13 Summary of Management Supply Factors for WWPs and MWPs

ENTITY	2020	2030	2040	2050	2060	2070
ARWA	0	0	0	0	0	0
CRWA	1.2	1.9	1.9	1.9	2.1	2.1
CVLGC	0	0	0	0	0	0
GBRA	1.9	2.1	2.2	2.2	2.2	2.2
New Braunfels	2.2	2	1.8	1.6	1.4	1.3
SAWS	1.2	1.6	1.8	1.7	1.8	1.8
San Marcos	1.7	1.7	2	1.9	1.7	1.5
SSLGC	1.4	1.4	1.6	1.6	1.6	1.6
Victoria	1.5	1.5	1.5	1.5	1.6	1.6

FINAL PLAN

SECTION 5.5: WATER CONSERVATION RECOMMENDATIONS

South Central Texas Regional Water Plan

B&V PROJECT NO. 123456

PREPARED FOR

South Central Texas Regional Water Planning Group

5 NOVEMBER 2020

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5.5 WATER CONSERVATION RECOMMENDATIONS

The SCTRWPG strongly supports water conservation, and has recommended the Advanced Water Conservation WMS (See Section 5.2.1) for the 2021 SCTRWP. Water conservation is recommended for all WUGs in every use category, including irrigation, livestock, manufacturing, mining, municipal, and steam-electric power. The following section consolidates the SCTRWPG's recommendations regarding water conservation for municipal and non-municipal WUGs.

5.5.1 Water Conservation in the 2021 South Central Texas Regional Water Plan

Water conservation is incorporated into the 2021 SCTRWP in the form of passive conservation approaches in the TWDB water demand projections, and also as active approaches in the Advanced Water Conservation WMS.

5.5.1.1 Water Conservation in Water Demand Projections

Expected water-efficiency savings are incorporated into the current TWDB municipal water demand projections (See Chapter 2) and include estimated or anticipated savings due to state and federal specifications for fixture and appliance design. The savings projected by the TWDB includes complete replacement of existing plumbing fixtures to water-efficient fixtures by the year 2045. The projections also assume that all new construction includes water-efficient plumbing fixtures.

5.5.1.2 Advanced Water Conservation

The Advanced Water Conservation WMS (See Section 5.2.1) includes information, recommendations, and BMPs for all use types. For municipal conservation, WUG-specific demand reductions and cost estimates were developed. The following sub-section summarizes the municipal water conservations aspects of the Advanced Water Conservation WMS.

Municipal Water Conservation

The SCTRWPG established the following Advanced Water Conservation goals for the 2021 SCTRWP:

- Advanced Water Conservation is recommended for every municipal WUG in the South Central Texas Region.
- For municipal WUGs with water use of 140 GPCD or greater, the goal is to reduce per capita water use by 1 percent per year until 140 GPCD is reached; after which, the goal is to reduce per capita water use by 1/4 percent per year (0.25 percent per year) for the remainder of the planning period; and
- For municipal WUGs having year 2011 water use of less than 140 GPCD, the goal is to reduce per capita water use by 1/4 percent per year for the remainder of the planning period.

Beginning in 2004, the Water Conservation Implementation Task Force developed a BMP guide for municipal users[1]. In 2007, the Task Force was succeeded by the Water Conservation Advisory Council (WCAC), enacted by the 80th Texas Legislature with the passage of SB 3 and HB 4. The council's primary

[1] Water Conservation Implementation Task Force. Report to the 79th Legislature, Texas Water Development Board, Special Report. Austin, Texas. November 2004.

roles include monitoring trends in water conservation implementation and technologies for potential inclusion as BMPs. Since its inception, WCAC has continually worked with TWDB and TCEQ to update the "Best Management Practices Guide." The municipal-based water conservation WMSs included in the 2006, 2011, 2016, and 2021 Regional Water Plans have been based upon the most-recent BMP guide.

A variety of conservation measures are recommended as described in the WCAC Municipal BMP Guide[2], any combination of which can be used to meet the specific goals for a municipality or utility. Conservation can be achieved using a variety of strategies, including the following:

- **Conservation Analysis and Planning**
  - Conservation Coordinator
  - Cost-Effectiveness Analysis
  - Water Survey for Single-Family and Multi-Family Customers
  - Customer Characterization
- **Financial**
  - Water Conservation Pricing
  - Wholesale Agency Assistance Programs
- **System Operations**
  - Metering of all New Connections and Retrofitting of Existing Connections
  - System Water Audit and Water Loss
- **Landscaping**
  - Athletic Field Conservation
  - Golf Course Conservation
  - Landscape Irrigation Conservation and Incentives
  - Park Conservation
  - Residential Landscape Irrigation Evaluations
  - Outdoor Watering Schedule
- **Education and Public Awareness**
  - Public Information
  - School Education
  - Public Outreach and Education
  - Partnerships with Nonprofit Organizations
- **Rebate, Retrofit, and Incentive Programs**

[2] "Best Management Practices for Municipal Water Users." Texas Water Development Board. Austin, Texas. May 2019.

- Conservation Programs for Industrial, Commercial, and Institutional Accounts
- Residential Clothes Washer Incentive Program
- Residential Toilet Replacement Programs
- Showerhead, Aerator, and Toilet Flapper Retrofit Program
- Water-Wise Landscape Design and Conversion Programs
- Customer Conservation Rebates
- Plumbing Assistance Programs for Economically Disadvantaged Customers

- **Conservation Technology**
  - New Construction Graywater
  - Rainwater Harvesting and Condensate Reuse[3]
  - Reuse of Reclaimed Water[3]
- **Regulatory Enforcement**
  - Prohibition of Wasting Water
  - Conservation Ordinance Planning and Development

Outdoor Water Use

As described in the Advanced Water Conservation WMS in Section 5.2.1, Texas Living Waters published in 2018 the "Water Conservation by the Yard: A Statewide Analysis of Outdoor Water Savings Potential," which detailed regional and statewide projected conservation savings using effective outdoor watering education, technology, and restrictions. According to Texas Living Waters, effectively implementing outdoor watering restrictions can achieve much of the projected conservation savings identified in the 2017 State Water Plan (SWP).

Texas Living Waters calculated WUG-level estimated savings potential resulting from no more than twice per week outdoor watering restrictions for each regional water planning region. The estimated potential savings is based on the level of effort (low and high) expended to educate and enforce outdoor watering restrictions. For Region L, the potential savings percentage ranges from 3.5 percent (low effort education/enforcement) to 8.5 percent (high effort education/enforcement) of the total municipal demand. Texas Living Waters' research indicates that education and enforcement have a direct impact on the effectiveness of outdoor watering restrictions. If no more than twice per week watering restrictions were implemented in Region L with a high level of education and enforcement effort, 39,871 acft/yr could be conserved relative to the projected 2020 municipal demands. More details can be found in the Advanced Water Conservation WMS in Section 5.2.1.

[3] While Rainwater Harvesting, Condensate Reuse, and Reuse of Reclaimed Water are included in the WCAC Municipal BMP Guide as water conservation measures, they are not classified as water conservation measures by the TWDB for regional water planning purposes or in DB22.

Advanced Water Conservation WMS Summary

The SCTRWPG acknowledges and supports the creation and activities of the WCAC created by HB 4 and SB 3 of the 80th Texas Legislature. In addition, the SCTRWPG acknowledges and supports the implementation of HB 2667 of the 81st Texas Legislature relating to performance standards for plumbing fixtures sold in Texas.

The Advanced Water Conservation WMS includes retrofit of plumbing fixtures, adoption and use of efficient clothes washers, and significant reduction of lawn and landscape watering. The combined plumbing fixtures, clothes washers, and lawn watering water conservation practices would reduce municipal water demand by an estimated 4,607 acft/yr in 2020; 22,021 acft/yr in 2040; and 51,685 acft/yr in 2070 (Section 5.2.1).

Total cost for implementation and administration of the Advanced Water Conservation WMS to meet the Region L goals in 2020 is estimated as $3,153,545 ($684 per acft per year), increasing to $15,018,844 ($682 per acft/yr) in 2040, and to $35,158,582 in 2070 ($680 per acft/yr). As the quantity of water conservation (demand reduction) increases, the unit cost decreases from $684 per acft in 2020, to $682 per acft in 2040, and to $680 per acft in 2070.

Irrigation Water Conservation

Due to gaps in irrigation data for Region L WUGs, irrigation demand reduction volumes and costs associated with those reductions cannot be quantified precisely. While the SCTRWPG recommends water conservation measures for all Region L WUGs including irrigation WUGs, for the purposes of the 2021 SCTRWP and DB22, the Advanced Water Conservation WMS is a recommended strategy for municipal WUGs only. The SCTRWPG further supports and recommends the implementation of water conservation measures included in the WCAC Agricultural BMP Guide.[4] The list of agricultural BMPs is as follows:

- **Information Gathering and Education Practices**
  - Cost Effectiveness Analysis
  - On-Farm Irrigation Audit
- **Cropping and Management Practices**
  - Crop Residue Management and Conservation Tillage
  - Irrigation Scheduling
  - Volumetric Measurement of Irrigation Water Use
- **Land Management Systems**
  - Brush Control/Management[5]

[4] "Best Management Practices for Agricultural Water Users." Texas Water Development Board. Austin, Texas. November 2013.
[5] While brush control/management is included in the WCAC Agricultural BMP Guide, it is not classified as a water conservation measure by the TWDB for regional water planning purposes or in DB22.

- Contour Farming
- Furrow Dikes
- Land Leveling

- **On Farm Water Delivery Systems**
  - Drip/Micro-Irrigation System
  - Gated and Flexible Pipe for Field Water Distribution Systems
  - Linear Move Sprinkler Irrigation Systems
  - Lining of On-Farm Irrigation Ditches
  - Low Pressure Center Pivot Sprinkler Irrigation Systems
  - Replacement of On-Farm Irrigation Ditches with Pipelines
  - Surge Flow Irrigation for Field Water Distribution Systems
- **Water District Delivery Systems**
  - Lining of District Irrigation Canals
  - Replacement of Irrigation District Canals and Lateral Canals with Pipelines
- **Miscellaneous Systems**
  - Nursery Production Systems
  - Tailwater Recovery and Reuse System[6]

Manufacturing, Steam-Electric Power, and Mining Water Conservation

Similar to irrigation use, sufficient data are not available for manufacturing, steam-electric power, and mining use categories for the South Central Texas Region to enable accurate demand reduction volumes and costs. However, the SCTRWPG supports and recommends the implementation of the Advanced Water Conservation WMS, which incorporates the WCAC Industrial BMP Guide.[7] The list of WCAC Industrial BMPs is as follows:

- **Conservation Analysis and Planning**
  - Cost Effectiveness Analysis
  - Industrial Site Specific Conservation
  - Industrial Water Audit
- **Educational Practices**
  - Management and Employee Programs
- **System Operations**

[6] While Tailwater Recovery and Reuse System is included in the WCAC Agricultural BMP Guide, it is not classified as a water conservation measure by the TWDB for regional water planning purposes or in DB22.
[7] "Best Management Practices for Industrial Water Users." Texas Water Development Board. Austin, Texas. February 2013.

- Boiler and Steam Systems
- Industrial Alternative Sources and Reuse of Process Water[8]
- Industrial Submetering
- Industrial Water Waste Reduction
- Refrigeration
- Rinsing/Cleaning
- Water Treatment

Cooling Systems Management

- Cooling Systems (other than Cooling Towers)
- Cooling Towers
- Once-Through Cooling

Landscaping

- Industrial Facility Landscaping

5.5.2 Model Water Conservation Plans

Pursuant to TWDB Exhibit C, model water conservation plans are available on the TCEQ website:

- Municipal Water Use by Public Water Supplier (TCEQ-10218): http://www.tceq.texas.gov/assets/public/permitting/forms/10218.docx
- Wholesale Public Water Suppliers (TCEQ-20162): http://www.tceq.texas.gov/assets/public/permitting/forms/20162.docx
- Manufacturing/Industrial Use (TCEQ-20839): http://www.tceq.texas.gov/assets/public/permitting/forms/20839.docx
- Mining Use (TCEQ-20840): http://www.tceq.texas.gov/assets/public/permitting/forms/20840.docx
- Agricultural Uses:
  - Agriculture Non-Irrigation (TCEQ-10541): http://www.tceq.texas.gov/assets/public/permitting/watersupply/conservation/10541.docx
  - Individually-Operated Irrigation System (TCEQ-10238): http://www.tceq.texas.gov/assets/public/permitting/watersupply/conservation/10238.docx
  - Agricultural Water Suppliers Providing Water to More Than One User (TCEQ-10244): http://www.tceq.texas.gov/assets/public/permitting/watersupply/conservation/10244.docx

[8] While Reuse of Process Water is included in the WCAC Industrial BMP Guide, it is not classified as a water conservation measure by the TWDB for manufacturing and steam-electric power uses in the regional water plan or in DB22. It is, however, considered by the TWDB as a water conservation measure for mining uses in the regional water plan and DB22.