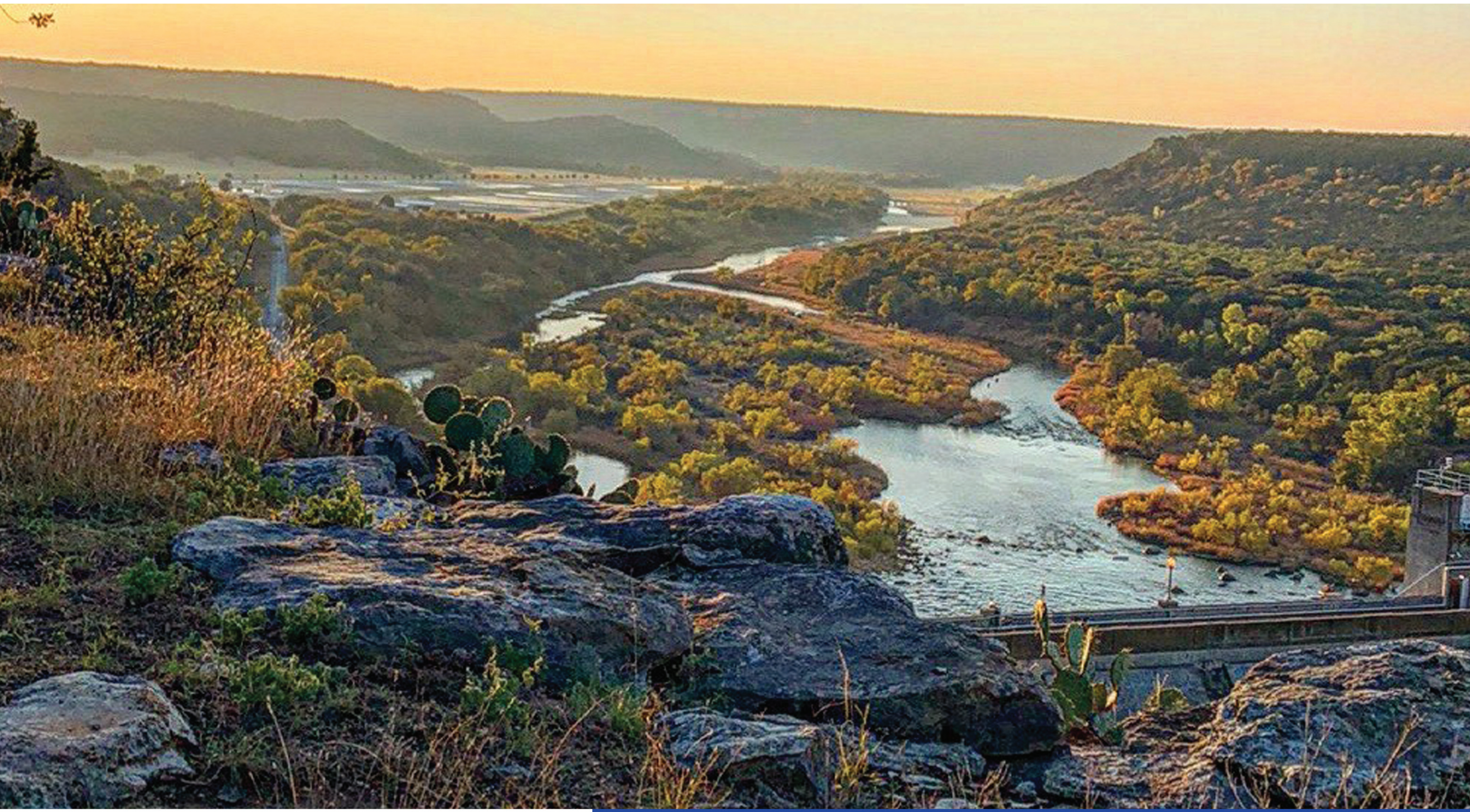

2026 BRAZOS G INITIALLY PREPARED PLAN VOLUME II

Prepared for

The Brazos G Regional Water Planning Group

March 3, 2025

TBPELS NO. F-558

In association with:

Advanced Groundwater Solutions, LLC

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2026 REGION G INITIALLY PREPARED PLAN – VOLUME II

Prepared for

BRAZOS G REGIONAL WATER PLANNING GROUP

March 3, 2025

Carollo Engineers, Inc.

Plummer, Inc.

Advanced Groundwater Solutions, LLC.

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BRAZOS G REGIONAL WATER PLANNING GROUP
Executive Committee

Voting Members

MEMBER	COUNTY	INTEREST
Mr. Wayne Wilson, (Chair)	Brazos	Agriculture
Ms. Gail Peek (Vice-Chair)	McLennan	Small Business
Mr. David Collinsworth (Secretary/Treasurer)	McLennan	River Authorities
Mr. Dirk Aaron	Bell	GMA 8
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Mr. Ryan Bayle	Hood	Electric Generating Utilities
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Ms. Luci Dunn	Taylor	Environmental
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Mr. Alan Gardenhire	Milam	Industries
Mr. Zach Holland	Grimes	GMA 14
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Ms. Jennifer Nations	Brazos	Municipalities
Mr. Gary Newman	Williamson	Public
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Mr. Dale Spurgin	Jones	Agriculture
Ms. Kathy Turner Jones	Johnson	Water Districts
Ms. Lisa Tyer	McLennan	Municipalities
Mr. Patrick Wagner	Erath	Water Districts
Mr. Jerry K. “Kenny”Weldon	Erath	Municipalities
Mr. Gary Westbrook	Milam	GMA 12

Plan Administrator
Brazos River Authority

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Water Resources Regional Planner

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PREPARED BY:

DRAFT DOCUMENTS

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Carollo Engineers, Inc.
TBPELS No. F-882

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Contents

Tables

Figures

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CHAPTER 1 WATER MANAGEMENT STRATEGIES

Title 31 TAC 357.7.34 requires that the regional water planning group evaluate all water management strategies determined to be potentially feasible. The guidelines list multiple types of strategies and numerous subtypes, including water conservation; drought management measures; reuse of wastewater; expanded use of existing facilities including systems optimizations, conjunctive use, reallocation of storage to new uses, interbasin transfers, new supply development, and others. Many of the strategies evaluated are updates from the evaluations performed for the 2021 Plan, with costs and supply typically being the most common items updated. Costs for these strategies as shown in specific Water User Group (WUG) and Wholesale Water Provider (WWP) plans have been updated to reflect September 2023 prices.

1.1 Identification of Potentially Feasible Strategies

TWDB rules require that the process for identifying potentially feasible Water Management Strategies (WMSs) be documented at a public meeting (31 TAC §357.12(b)). This section describes the documented process used by the Brazos G RWPG to identify potentially feasible WMSs. On February 13, 2024, the Brazos G RWPG formally considered the process for identifying, evaluating and selecting WMSs as described below.

Process for identifying, evaluating and selecting WMSs:

1. Include strategies identified in previous plans:
   a. Include recommended and alternative strategies from 2021.
   b. Include strategies evaluated, but not recommended in 2021.
   c. Include strategies evaluated in previous Plans that were not moved forward.
2. Identify draft needs and develop additional ideas to meet those needs.
3. Maintain ongoing communication from local interests through the process.

An investigation is then performed to identify the potential infeasibility of a WMS or WMSP:

- If strategy contemplates permitting and/or construction;
- If strategy is near-term or necessitates significant time for implementation;
- If the potential sponsor(s) have taken, or have indicated they will take, affirmative steps towards the strategy's implementation. Affirmative steps may include, but not be limited to:
- Spending money on the strategy or project;
- Voting to spend money on the strategy or project;
- Applying for a federal or state permit for the strategy or project.

Next, it is identified if the strategy could potentially provide flood mitigation benefits. It is identified if the strategy contemplates use of the Brazos Alluvium, so that interregional coordination may be necessary. Then, an initial list of potentially feasible strategies is determined, and additional WMSs are included if local interests request them and the planning schedule and budget allow for the addition.

The Scope of Work Committee of Brazos G met on September 24, 2024, November 7, 2024, December 20, 2024, and January 23, 2025, to identify potentially feasible WMSs and determine which strategies to recommend evaluating for the 2026 Brazos G Plan.

Seawater desalination was not considered potentially feasible due to distance from the coast. Brackish groundwater was considered utilizing recently identified Brackish Groundwater Production Zones, the supplies from which were considered as separate from the MAG.

The Brazos G RWPG identified the threshold of significant water needs for consideration of aquifer storage and recovery projects to be 10,000 acft/yr or greater. Table 1-1 presents the 15 WUGs having needs exceeding this threshold, and an assessment of ASR potential for each WUG. Aquifer storage and recovery is recommended as a water management strategy for seven of those, either specifically as a strategy where the WUG is the sponsor, or as a strategy for a WWP that provides the WUG supply. In addition, ASR is recommended as a water management strategy for other WUGs with needs less than the 10,000 acft/yr threshold. ASR is not considered as a potential strategy for county-aggregated WUGs such as Irrigation or Steam-Electric unless a specific project sponsor requests it be recommended. None have made the request.

Table 1-1 Assessment of ASR Potential

Water User Group	2080 Need (acft/yr)	Assessment of ASR Potential
Abilene	(10,934)	ASR not identified as potentially feasible; hydrogeology appears unsuitable
Bryan	(35,740)	ASR recommended as a water management strategy
College Station	(17,056)	ASR recommended as a water management strategy
County-Other, Williamson	(29,475)	ASR recommended for WWP (BRA)
Georgetown	(158,402)	ASR recommended as a water management strategy and recommended for WWP (BRA)
Hutto	(12,601)	ASR recommended for WWP (BRA)
Johnson County SUD	(10,616)	ASR recommended for WWP (BRA)
Jonah Water SUD	(19,652)	ASR recommended for WWP (BRA)
Round Rock	(11,775)	ASR recommended for WWP (BRA) (LCRA, Region K)
Temple	(10,887)	ASR recommended for WWP (BRA)
Taylor	(10,996)	ASR recommended for WWP (BRA)
Waco	(26,900)	ASR identified as potentially feasible
Irrigation, Knox	(10,212)	ASR not identified as potentially feasible
Irrigation, Robertson	(13,886)	ASR not identified as potentially feasible
Steam-Electric Power, Somervell	(14,897)	ASR not identified as potentially feasible

Potentially feasible water management strategies evaluated during preparation of the 2026 Plan are listed in Table 1-2.

Table 1-2 Potentially Feasible Water Management Strategies Evaluated for the 2026 Brazos G Regional Water Plan

Chapter (Volume II)	Water Management Strategy and Description
2	**Water Conservation** (implement accelerated use of various water conservation techniques to achieve water savings above what is already included in the TWDB water demand projections)
3	**Wastewater Reuse** (use highly treated wastewater treatment plant effluent to meet non-potable and potable water needs)
4	**New Reservoirs** (new or updated evaluations of the following proposed new reservoirs) ▪ Brushy Creek Reservoir ▪ Cedar Ridge Reservoir ▪ Coryell County Off-Channel Reservoir ▪ City of Groesbeck Off-Channel Reservoir ▪ NCTMWA Lake Creek Reservoir ▪ New Throckmorton Reservoir ▪ Turkey Peak Dam - Lake Palo Pinto Enlargement
5	**Groundwater** ▪ City of Bryan Groundwater Strategies ▪ City of College Station Groundwater Strategies ▪ City of Georgetown Groundwater Strategies
6	**Conjunctive Use** (conjunctively use surface water supplies with available groundwater supplies) ▪ Lake Granger Augmentation ▪ Oak Creek Reservoir and Champion Well Field
7	**Aquifer Storage and Recovery** (Inject or percolate excess surface water into groundwater aquifers, storing for future use) ▪ City of Bryan ASR ▪ City of College Station ASR ▪ Lake Georgetown ASR ▪ Lake Granger ASR ▪ Acton MUD ASR
8	**Regional Water Supply Projects** ▪ Bosque County Regional Project ▪ Rolling Plains GCD Managed Aquifer Recharge ▪ Brushy Creek RUA Water Supply Project ▪ East Williamson County Water Supply Project ▪ Lake Belton to Stillhouse Hollow Pipeline ▪ Lake Whitney Water Supply Project (Cleburne) ▪ Somervell County Water Supply Project ▪ West Texas Water Partnership Supply to Abilene (Region F evaluation)
9	**Augmentation of Existing Reservoir Supplies** ▪ Lake Aquilla Storage Reallocation ▪ Lake Granger Storage Reallocation ▪ Lake Whitney Reallocation ▪ Lake Waco Reallocation

Chapter (Volume II)	Water Management Strategy and Description
10	**Brush Control** (increase deep percolation and discharge to streams by removing unwanted brush
11	**Miscellaneous Strategies** (various pipelines, treatment plants and groundwater wells to meet projected needs of water user groups and wholesale water providers)

1.2 Evaluation and Recommendation of Strategies

The following chapters contain technical evaluations of the potentially feasible water management strategies the Brazos G Regional Water Planning Group (RWPG) wished to consider. Each section is typically divided into five subsections: (1) Description of Option; (2) Available Yield; (3) Environmental Issues; (4) Engineering and Costing; and (5) Implementation Issues. Information in these sections was presented to the Brazos G RWPG and was used in evaluating strategies to meet water needs in the Brazos G region.

Technical evaluations of water management strategies were presented at public meetings of the Brazos G RWPG's Scope of Work Committee over the course of the development of the 2026 Plan. Most strategies are identified as potentially feasible to serve specific WUGs or WWPs and are usually evaluated in coordination with potential sponsors. Other strategies are initially identified as potentially feasible to meet needs for multiple WUGs and/or WWPs. In the case where the preferred strategy for a WUG or WWP has not been communicated, the Brazos G RWPG recommends a strategy based on the WUG's existing sources of supply and the location and sources available to the strategy, with consideration given to the feasibility of the strategy's implementation. These recommendations have been presented and reviewed at three public subregional meetings prior to adoption of the Initially Prepared Plan to provide the opportunity for WUGs to request modification of the recommendations prior to adoption of the Initially Prepared Plan. Where requests have been received for strategies to be included within the Plan, the Brazos G RWPG has worked to incorporate such strategies in a manner consistent with all applicable rules and guidelines for regional water planning. The Brazos G RWPG desires the Brazos G Regional Water Plan to reflect the initiatives of the water providers in the Brazos G Area.

1.3 Plan Development Criteria

It is the goal of the Brazos G RWPG to develop a plan to meet projected water needs within the Brazos G region with feasible recommendations. The Brazos G RWPG has adopted a set of Plan Development Criteria that was used to evaluate whether a given strategy should be used to meet a projected shortage and ultimately be included in the Brazos G Regional Water Plan.

The proposed strategies were developed by evaluating the water management strategies using the Plan Development Criteria and then matching strategies to meet projected shortages. This section discusses the evaluation criteria adopted by the planning group during plan development, and criteria to be met in formulation of the plan. The adopted plan elements will meet these criteria:

- Water Supply – Water supply must be evaluated with respect to quantity, reliability, and cost. The criteria for quantity are that the plan must be sufficient to meet projected needs in the planning period. The criteria for reliability is that it meet municipal, industrial, and agricultural needs 100 percent of the time. The criteria for cost are that the projected cost be reasonable to meet the projected needs.

- Environmental Issues – Environmental considerations must be examined with respect to environmental water needs, wildlife habitat, cultural resources, and bays and estuaries. The criteria for environmental water flows and wildlife habitat are that stream conditions must meet permit requirements for diversions that currently have permits. For projects that require permit acquisition the project will provide adequate environmental instream flows for aquatic habitat. Projects should be sited to avoid known cultural resources, if possible. Flows to bays and estuaries should meet expected permit conditions.
- Impacts on Other State Water Resources – The criteria recommend a follow-up study by the Brazos G RWPG if any significant impacts are anticipated on other state water resources.
- Threats to Agriculture and Natural Resources – The criteria require that the planning group identify any potential impact, compare the impact to the proposed benefit of the plan, and make recommendations. With the exception of large projects that will affect large acreages, such as reservoir projects, the water management strategies evaluated will have no significant impact to the State's Agricultural resources.
- Equitable Comparison of Feasible Strategies – This is achieved by the equal application of criteria across different water management strategies.
- Interbasin Transfers – The planning group may consider interbasin transfers as a supply option. The criteria require that the participating entities recognize and account for Texas Water Code requirements for expected permitting requirements.
- Impacts from Voluntary Redistribution – The criteria require that any potential third party social or economic impacts from voluntary redistribution of water rights be identified and described, although for the purposes of the 2026 Plan the Brazos G RWPG did not prefer making recommendations in this category.
- Other Criteria – TWDB allows the Brazos G RWPG to adopt other criteria. The Brazos G RWPG has not adopted any further criteria.

The following sections discuss the methods and procedures used to develop the information needed to evaluate the strategies and compare them to the criteria.

1.4 Engineering

A procedure was developed to maintain equal and consistent consideration of various design and cost variables across differing water management strategy options. These are planning level estimates only, and do not reflect detailed site-specific design work, nor any extensive optimization and selection of design variables. These procedures standardized the consideration of the following design and costing issues as closely as possible, given the varying scope and magnitude of differing projects. For each option, major cost components were determined at the outset. Estimates of volume of water and rate of delivery needed were developed from the supply-demand comparisons presented in Volume I, Chapter 4, if directly applicable. Volumes necessary to meet shortages were estimated, and both average annual and peak rates of projected delivery were calculated. Average annual rates were adjusted to reflect pump station downtime for maintenance activities. Transmission and treatment facilities were generally sized based on peak rates of delivery.

Water source and delivery locations were determined, considering source and destination elevations, surrounding land use, and other geographic considerations. Further details on engineering factors considered are presented in the discussions of the various water management strategies presented in Volume II, Sections 2 through 11.

1.5 Cost Estimates

The cost estimates of this study are expressed in three major categories: (1) construction costs or capital (structural) costs, (2) other (non-structural) project costs, and (3) annual costs. All costs for these categories were estimated using the TWDB Unified Costing Model as required by the TWDB.

Construction costs are the direct costs incurred in constructing facilities, such as those for materials, labor, and equipment. "Other" project costs include expenses not directly associated with construction activities of the project, such as costs for engineering, legal counsel, land acquisition, contingencies, environmental studies and mitigation, and interest during construction. Capital costs and other project costs comprise the total project cost. Operation and maintenance, energy costs, purchase of wholesale water and debt service payments are examples of annual costs. Major components that may be part of a preliminary cost estimate are listed in Table 1-3. All costs represent September 2023 prices.

Table 1-3 Summary of Major Components Included in Preliminary Cost Estimates of Potential Water Supply Strategies

<table>
<tr><th>Capital Costs (Structural Costs)</th><th>Other Project Costs (Non-Structural Costs)</th></tr>
<tr><td rowspan="3">1. Pump Stations
2. Pipelines
3. Water Treatment Plants
4. Water Storage Tanks
5. Off-Channel Reservoirs
6. Well Fields
7. Dams and Reservoirs
8. Relocations
9. Other Items</td><td>1. Engineering (Design, Bidding and Construction Phase Services, Geotechnical, Legal, Financing, and Contingencies)
2. Land and Easements and Surveying
3. Environmental - Studies and Mitigation
4. Interest During Construction</td></tr>
<tr><th>Annual Project Costs</th></tr>
<tr><td>1. Debt Service
2. Operation and Maintenance (excluding pumping energy)
3. Pumping Energy Costs
4. Purchase Water Cost (if applicable)</td></tr>
</table>

As previously mentioned, "other" (non-structural) project costs are costs incurred in a project that are not directly associated with construction activities. These include costs for engineering, legal counsel, financing, contingencies, land, easements, surveying and legal fees for land acquisition, environmental and archaeology studies, permitting, mitigation, and interest during construction. These costs are added to the capital costs to obtain the total project cost. A standard percentage applied to the capital costs is used to calculate a combined cost that includes engineering, financial, legal services, and contingencies.

Annual costs are those that the project owner can expect to incur if the project is implemented. These costs include repayment of borrowed funds (debt service), operation and maintenance costs of the project facilities, pumping power costs, and water purchase costs, when applicable.

Debt service is the estimated annual payment that can be expected for repayment of borrowed funds based on the total project cost, an assumed finance rate, and the finance period in years. As specified by the TWDB in Exhibit C, Second Amended General Guidelines for Development of the 2026 Regional Water Plans (September 2023)[1], debt service for all projects was calculated assuming an annual interest rate of 3.5 percent and a repayment period of 40 years for large reservoir projects and 20 years for all other projects.

Operation and maintenance costs for dams, pump stations, pipelines, and well fields (excluding pumping power costs) include labor and materials required to operate the facilities and provide for regular repair and/or replacement of equipment. In accordance with TWDB guidelines, unless specific project data are available, operation and maintenance costs are calculated at 1 percent of the total estimated construction costs for pipelines, at 1.5 percent of the total estimated construction costs for dams and reservoirs, and at 2.5 percent for intake and pump stations. Water treatment plant operation and maintenance costs were based on treatment level and plant capacity. The operation and maintenance costs include labor, materials, replacement of equipment, process energy, building energy, chemicals, and pumping energy.

In accordance with TWDB guidelines, power costs are calculated on an annual basis using the appropriate calculated power load and a power rate of $0.09 per kilo-Watt-hour (kWh). The amount of energy consumed is based upon the pumping horsepower required.

The raw water purchase cost, if applicable, is included if the water supply option involves purchase of raw or treated water from an entity. This cost varies by source and by supplier.

A cost estimate summary for each individual option is presented with total capital costs, total project costs, and total annual costs. The level of detail is dependent upon the characteristics of each option. Additionally, the cost per unit of water involved in the option is reported as costs per acft and cost per 1,000 gallons of water developed. The individual option cost tables specify the point within the region at which the cost applies (e.g., raw water at the reservoir, treated water delivered to the WUG or WWP, or elsewhere as appropriate).

Numerous recommended water management strategies are included in plans for individual water user groups that are not analyzed to the exact level of detail as the separate water management strategies described in most of Volume II. These generally involve small interconnections between two neighboring systems or purchases of additional supplies from a wholesale water provider or adjacent water user group. These strategies are referred to as miscellaneous strategies and are summarized in Volume II, Section11.

Note that costs include only those infrastructure elements needed to develop, treat and transmit the water supply to the distribution system of the WUG or WWP. Distribution costs are not included in the cost estimates.

[1] Available for download at: https://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2026/projectdocs/2026RWP_ExhibitC.pdf

1.6 Quantitative Factors Used to Evaluate Environmental and Agricultural Impacts of Potentially Feasible Water Management Strategies

The Regional Water Planning Guidelines (31 TAC 357.7) require that each regional water management strategy includes an evaluation of environmental factors, specifically effects on environmental water needs, wildlife habitat, cultural resources, agricultural resources, upstream development on bays, estuaries, and arms of the Gulf of Mexico. These factors were evaluated for each of the proposed water management strategies according to the level of description and engineering design information provided.

Potential water management strategies were evaluated for potential impacts to the following environmental and agricultural resources.

- **Environmental water needs** – The water necessary to sustain a sound ecological environment. Surface water strategies could potentially utilize this water source. Reuse supplies could potentially use water that would have otherwise been discharged into a surface water body. Groundwater strategies are assumed to not have an impact on surface water needed for environmental needs.
- **Wildlife habitat** – The area disrupted from implementation of a strategy.
- **Threatened and Endangered Species** – The Endangered Species Act of 1973 (et seq.) is designed to protect plant and animal resources from the adverse effects of development. To comply with this act, federal agencies are required to assess a proposed project area to determine if any threatened or endangered species or critical habitats for these species are present. The threated, endangered, candidate and species of greatest conservation need located in a county where a potential strategy is located were identified and used to quantitatively assess potential impacts.
- **Wetlands** – The area classified as wetlands that is disrupted from the implementation of a strategy. Pipelines, wells, pump stations, and water treatment plants are anticipated to be located outside of wetland areas. Therefore, only reservoir footprints and surface water intakes are considered to impact wetlands.
- **Cultural resources** – The physical evidence or place of past human activity that may be disrupted from the implementation of a strategy.
- **Bays and estuaries water needs** – The freshwater inflow necessary to sustain a sound ecological environment in the bays, estuaries, and arms of the Gulf of Mexico. Potential strategies included in the Brazos G Plan are located a substantial distance from the coast and are not anticipated to impact water needs of bays and estuaries.
- **Agricultural resources** – The land required for agricultural production related to farming and ranching. Potential strategies located in rural locations are assumed to impact agricultural resources.

Each impacted resource was quantitatively assessed and scored using the following parameters. The amount of area impacted by the implementation of a strategy is estimated using the following assumptions.

- Reservoir footprint (actual acreage impacted).
- WTP (5 acres).

- Pipeline ROW width of 50 ft.
- Groundwater wells (2 acres):
  - Intakes and pump stations (5 acres).
  - Well field connection pipelines and pipelines less than 24 in diameter are assumed to have negligible impacts and are not included in the total area impacted.

Scoring of the criteria ranges from a value of 1 (highest impacts) to 3 (lowest impacts). The quantitative criteria used to evaluate the impacts of potentially feasible strategies and projects is presented in Table 1-4. A matrix summarizing the impacts of the individual water management strategies can be found in Appendix P.

Table 1-4 Quantitative Criteria Applied to Evaluate Impacts to Environmental and Agricultural Resources of Water Management Strategies and Projects

LEGEND					
Score	Impact	Environmental Water Needs	Wildlife Habitat (total acres impacted)	Threatened and Endangered Species	Cultural Resources (Reservoir Footprint Acres)
1	High	None	>10,000	>100	>1,000
2	Medium	Reuse, Surface Water	1,000 - 10,000	50 - 100	1 - 1,000
3	Low	Conservation, Groundwater	0 - 1,000	0-50	0

1.7 Agricultural Water Management Strategies

New firm water supplies often cannot be developed for irrigated agriculture, because the cost of development usually far exceeds the value of the water in irrigated production. Without any firm supply of water, agricultural producers will have to reduce the irrigation and confined livestock demands through a variety of conservation and other management practices. Conservation practices were evaluated, specifically related to irrigation conservation and the savings of water that can be expected. The evaluation is presented in Volume II, Section 2.

1.8 Water Conservation and Drought Preparation

Water conservation recommendations are included in the plans for individual water user groups. Water conservation as a water management strategy for individual municipal water user groups was evaluated as per the description in Volume II, Section 2. For municipal water user groups, the Brazos G RWPG recommends a goal of a one-percent reduction per year (until the target rate of 140 gpcd is reached) in overall water demands, regardless of whether an entity reports a water supply need or not during the planning period. For conservation for non-municipal use (irrigation, manufacturing, and mining), the Brazos G RWPG has recommended a target reduction in water demand of 3 percent by 2030, 5 percent by 2040, and 7 percent from 2050 to 2080 for entities with a water supply need (shortage) during the planning period. The Brazos G RWPG does not recommend water conservation as a strategy to meet steam-electric needs. The plan presents a list of recommended BMPs in Volume II, Section 2. Costs and savings to be expected from various Best Management Practices (BMPs) are described, and recommended target reductions in per capita water use (gpcd) are presented.

For irrigation conservation, specific costs, expected savings and conservation target recommended by the Brazos G RWPG are described in Volume II, Section 2. Little guidance exists for estimating water savings and costs for BMPs for non-municipal and non-irrigation uses, as water use under each of these categories is facility-specific.

While water conservation is a viable water management strategy that makes more efficient use of available supplies to meet projected water needs, drought management recommendations have not been made by the Brazos G RWPG as a water management strategy for specific WUG needs. The regional water plan is developed to meet projected water demands during a drought of severity equivalent to the drought of record. The purpose of the planning is to ensure that sufficient supplies are available to meet future water demands. Reducing water demands during a drought as a defined water management strategy does not ensure that sufficient supplies will be available to meet the projected water demands; but simply eliminates the demands. While the Brazos G RWPG encourages entities in the Brazos G Area to promote demand management during a drought, it should not be identified as a "new source" of supply. Recommending demand reductions as a water management strategy is antithetical to the concept of planning to meet projected water demands. It does not make more efficient use of existing supplies as does conservation, but instead effectively turns the tap off when the water is needed most. It is planning to not meet future water demands. When considering the costs of demand reduction during drought, the costs for drought management could be considered as the economic costs of not meeting the projected water demands, as will be summarized in the final plan in Appendix G.

1.9 Funding and Permitting by State Agencies of Projects Not in the Regional Water Plan

Senate Bill 1 requires water supply projects to be consistent with approved regional water plans to be eligible for certain types of TWDB funding and to obtain water right permits from the Texas Commission on Environmental Quality (TCEQ). Texas Water Code provides that the TCEQ shall grant an application to appropriate surface water, including amendments to existing permits, only if the proposed action addresses a water supply need in a manner that is consistent with an approved regional water plan. TCEQ may waive this requirement if conditions warrant.

For TWDB funding, the Texas Water Code states that the TWDB may provide financial assistance to a water supply project only after TWDB determines that the needs to be met by the project will be addressed in a manner that is consistent with the appropriate regional water plan. The TWDB may waive this provision if conditions warrant.

The Brazos G RWPG has considered the variety of actions and permit applications that may come before the TCEQ and the TWDB and does not want to unduly constrain projects or applications for small amounts of water that may not be included specifically in the adopted regional water plan. "Small amounts of water" is defined as involving no more than 1,000 acft/yr, regardless of whether the action is temporary or long term. The Brazos G RWPG provides direction to TCEQ and TWDB regarding appropriations, permit amendments, and projects involving small amounts of water that will not have a significant impact on the region's water supply as follows: such projects are consistent with the regional water plan, even though not specifically recommended in the plan. However, many of the projects associated with these "small amounts of water" have been included where possible as miscellaneous strategies in Volume II, Section 11 of this Plan.

The Brazos G RWPG also provides direction to the TWDB regarding financial assistance for repair and replacement of existing facilities, or to develop small amounts of water (less than 1,000 acft/yr). Water supply projects not involving the development of or connection to a new water source or involving development of a new supply less than 1,000 acft/yr, are consistent with the regional water plan, even though not specifically mentioned in the adopted plan.

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CHAPTER 2 WATER CONSERVATION

Chapter 2 provides detailed discussions regarding the municipal, irrigation, and industrial water conservation in the Brazos G area.

2.1 Municipal Water Conservation

Water conservation is defined as those methods and practices that either reduce the demand for water supply or increase the efficiency of the supply. Water facilities are used so that supply is conserved and made available for future use. Water conservation is typically a non-capital-intensive alternative that any water supply entity can pursue.

Water supply entities and major water right holders that meet the following criteria are required by Texas Water Code and Texas Administrative Code statute to submit a Water Conservation Plan to the TCEQ [1]:

- Entities applying for or currently receiving financial assistance of greater than $500,000 from the Texas Water Development Board (TWDB);
- Entities with 3,300 connections or greater; or
- Surface water right holders of:
  - Greater than 1,000 acft/year (non-irrigation).
  - Greater than 10,000 acft/year (irrigation).

The purpose of a water conservation plan is to establish strategies for reducing the volume of water used from a water supply source, reduce loss or waste of water, and maintain and improve the efficiency in the use of water. According to Texas Administrative Code statute, water conservation plans must identify 5- and 10-year targets and goals for water use and water loss, including methods used to track progress in meeting targets and goals. Water conservation plans for Brazos G municipal water user groups, including the most common water conservation best management practices (BMPs) identified in the water conservation plans, are summarized in Volume I, Chapter 7.

The TWDB guidance and Texas Administrative Code 357.34 requires Regional Water Planning Groups to consider water conservation practices, including potentially applicable BMPs, for each water user group with an identified water need (shortage) in the regional water plan. For the 2026 Regional Water Plans, the TWDB requires water conservation content to be included in the Plans including directives for regional water planning groups to assess the highest level of water conservation and efficiencies achievable, report the resulting projected water use savings in gallons per capita per day, and develop conservation strategies based on this information.

[1] The TWDB also requests the entities to submit the WCPs and the annual water conservation reports to TWDB. See the TWDB website for details: https://www.twdb.texas.gov/conservation/municipal/plans/index.asp

Furthermore, water conservation strategies should identify capital or other costs for best management practices that result in an immediate, quantifiable increase in water savings or decrease in system water use or water losses, including active plumbing retrofit programs, replacement of portions of an existing leaking water transmission or distribution network, and/or meter replacement/SCADA installation (where applicable). This section addresses the TWDB directives related to water conservation.

There are several water conservation resources that have been developed for use in developing the Regional Water Plans. The Water Conservation Implementation Task Force, created by Senate Bill 1094, provided guidance on Water Conservation Best Management Practices (BMPs)[2]. The Task Force summarized their recommendations in a Report to the 79th Legislature[3], which included Task Force recommendations of gpcd targets and goals that should be considered by retail public water suppliers when developing water conservation plans required by the state, 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.

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 1 percent in total gpcd, until such time as the entity achieves a total gpcd of 140 gpcd or less, or municipal water use (gpcd) goals approved by regional water planning groups.

In 2007, the 80th Texas Legislature, via the passage of Senate Bill 3 and House Bill 4, directed the TWDB to appoint the members of the newly-created Water Conservation Advisory Council (WCAC), which was established to continue the work initiated by the Water Conservation Implementation Task Force. The WCAC has submitted a Report and Recommendations to the 88th Texas Legislature[4] with the following updates:

Recent trends indicate that regional water planning groups should eliminate the 140 gpcd target.

A recommended methodology is to reduce the planning year per capita water use by one percent each year. However, the Council acknowledges that the cumulative reduction might not be feasible beyond 2040. [5]

The TWDB has continued the work of the Task Force by providing additional resources for municipal water users to assist water utilities with water conservation, including:

- Water Conservation Best Management Practice Guides
  - Municipal Water Providers, May 2019

[2] Texas Water Development Board, Water Conservation Implementation Task Force, Water Conservation Best Management Practices Guide, November 2004.
[3] Texas Water Development Board, Water Conservation Implementation Task Force Report to the 79th Legislature, November 2004. https://www.twdb.texas.gov/conservation/resources/doc/WCITF_Leg_Report.pdf
[4] Water Conservation Advisory Council, Progress Made in Water Conservation in Texas: Report and Recommendations to the 88th Texas Legislature, December 1, 2022. https://savetexaswater.org/resources/doc/2022%20WCAC%20Report_Final.pdf
[5] In light of the limitations of the recommended methodology, the Brazos G Scope of Work Committee decided to keep the 140 GPCD as the planning target until new information becomes available in the next cycle, as discussed in their November 7th, 2024, meeting.

- » Wholesale Water Providers, October 2017
- Water Conservation Plan Guidance for Utilities, developed in January 2013
  - » Water Conservation Plan Checklist
  - » How to Develop a Water Conservation Plan
  - » Identifying Water Conservation Targets and Goals

The TWDB provided tools for Regional Water Planning Groups to consider during development of municipal water conservation recommendations for the 2026 Regional Water Plans. These resources were considered during development of the 2026 Brazos G Regional Water Plan, with Brazos G-specific results summarized below in sub-bullets.

- Annual Water Conservation Report Data (Years 2016 and 2022)
- 82 Brazos G municipal entities submitted annual reports on implementation of their water conservation plan (entities range in population from 524 to 152,631 in 2020)
- Table 2-1 presents the number of entities who reported implementation of BMPs from 2016 to 2022, which indicates that three of the most popular BMPs are Metering New Connections & Retrofitting Existing Connections, Public Information, and Utility Water Audit & Water Loss, respectively.
- Municipal Water Conservation Planning Tool
- The Municipal Water Conservation Planning Tool was developed by the TWDB in the previous cycle of regional planning to assist individual water utilities with planning conservation programs. The tool allows the user to include a mix of BMPs, and produces the expected annual conservation savings and associated capital and annual costs. The tool comes with population and water demand projections (and other data such as number of connections) for many municipal water user groups. The tool includes user-based functionality to load baseline demand projections, select conservation measures (plan or single-year savings) based on implementation activity, manage scenarios (to evaluate various BMP combinations) and use this information to calculate water savings and costs. The tool was not updated for this planning cycle, and therefore, it does not contain updated population and water demand projections.

Table 2-1 Summary of BMP Implementation by Brazos G Entities

BMP	2016	2017	2018	2019	2020	2021	2022	Average
Athletic Fields Conservation	9	10	5	8	7	7	10	**8**
Conservation Coordinator	12	17	26	26	26	24	29	**23**
Conservation Ordinance Planning & Development	N/A	N/A	N/A	N/A	5	6	8	**6**
Conservation Programs for ICI Accounts	1	2	1	1	1	1	1	**1**
Cost Effective Analysis	1	1	1	3	2	3	5	**2**
Custom Conservation Rebates	N/A	1	1	1	1	1	1	**1**
Customer Characterization	N/A	N/A	N/A	N/A	3	3	3	**3**
Enforcement of Irrigation Standards	N/A	N/A	N/A	N/A	6	7	8	**7**

BMP	2016	2017	2018	2019	2020	2021	2022	Average
Golf Course Conservation	8	9	10	13	11	12	11	**11**
Landscape Irrigation Conservation & Incentives	4	4	5	7	7	6	8	**6**
Metering New Connections & Retrofitting Existing Connections	42	47	44	43	41	41	41	**43**
New Construction Graywater	1	1	1	2	N/A	1	N/A	**1**
Other	5	3	5	4	5	6	4	**5**
Outdoor Watering Schedule	N/A	N/A	N/A	N/A	7	11	16	**11**
Park Conservation	8	7	7	10	8	10	9	**8**
Partnerships with Nonprofit Organizations	3	6	5	7	4	3	6	**5**
Prohibition on Wasting Water	19	19	20	21	17	16	19	**19**
Public Information	46	47	38	41	33	33	36	**39**
Public Outreach & Education	3	3	5	4	13	16	17	**9**
Rainwater Harvesting & Condensate Reuse	3	4	4	2	2	2	3	**3**
Residential Clothes Washer Incentive Program	2	1	1	1	1	1	1	**1**
Residential Landscape Irrigation Evaluation	5	5	6	6	7	7	7	**6**
Residential Toilet Replacement Programs	2	2	2	N/A	1	1	1	**2**
Reuse for Agriculture	3	3	4	3	7	5	6	**4**
Reuse for Chlorination/Dechlorination	9	6	6	5	4	4	4	**5**
Reuse for Industry	6	6	7	4	5	5	5	**5**
Reuse for On-site Irrigation	11	10	10	11	6	8	7	**9**
Reuse for Plant Washdown	17	16	13	16	16	19	17	**16**
School Education	18	19	19	20	9	9	9	**15**
Showerhead, Aerator, & Toilet Flapper Retrofit	1	1	2	1	2	2	3	**2**
Utility Water Audit & Water Loss	35	39	36	32	39	34	41	**37**
Water Conservation Pricing	27	29	30	26	29	27	30	**28**

BMP	2016	2017	2018	2019	2020	2021	2022	Average
Water Survey for Single Family & Multi-family Customers	N/A	1	N/A	1	3	2	1	**2**
Water Wise Landscape Design & Conversion Programs	2	2	2	2	2	2	2	**2**
Wholesale Agency Assistance Programs	N/A	1	1	1	1	1	1	**1**

Note: Cells with "N/A" indicate that no data are available for these BMPs for the given year, as reported in the TWDB annual water conservation report.

2.1.1 Description of Strategy

For regional water planning purposes, municipal water use is defined as residential and commercial water use. Municipal water is primarily for drinking, sanitation, cleaning, cooling, fire protection, and landscape watering for residential, commercial, and institutional establishments. A key parameter for assessing 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 water conservation is to decrease the amount of water – measured in gallons per capita per day (gpcd) – that a typical utility uses.

The current TWDB municipal water demand projections account for expected water savings due to implementation of the 1991 State Water-Efficient Plumbing Act. However, any projected water savings due to conservation programs over and above the savings associated with the 1991 Plumbing Act must be listed as a separate water management strategy. The projections assume that 100 percent of new construction includes water-efficient plumbing fixtures. Consequently, any water management strategy intended to replace inefficient plumbing fixtures installed prior to 1995 would constitute an acceleration of the effects of the 1991 Plumbing Act, but provide no additional long-term savings. Including a retrofit program as a water management strategy without first discounting the TWDB per capita water use reductions would double-count water savings, since those savings due to retrofits are already included in the base water demand projections.

In 2009, the Texas Legislature enacted House Bill (HB) 2667 establishing new minimum standards for plumbing fixtures sold in Texas beginning in 2014. HB 2667 clarifies and sets out the national standards of the American Society of Mechanical Engineers and American National Standards Institute by which plumbing fixtures will be produced and tested. This bill establishes a phase-in of high efficiency plumbing fixtures brought into Texas, which will allow manufacturers the time to change their production, at the same time allowing retailers the opportunity to turn over their inventory. HB 2667 creates an exemption for those manufacturers that volunteer to register their products with the United States Environmental Protection Agency's WaterSense Program, which should result in additional water savings. This bill also repeals the TCEQ certification process for plumbing fixtures since the plumbing fixtures must meet national certification and testing procedures.

The TCEQ has promulgated rules to reflect this new change in law. The 2009 law requires that by January 2014, all toilets use no more than 1.28 gallons per flush (20% savings from the 1991 1.6 gallons per flush standard). As of June 2021, the 2018 edition of the Uniform Plumbing Code (UPC) and the 2018 edition of the International Code Council's International Plumbing Code have been adopted by the State Board of

Plumbing Examiners' Rule 367.2 in Title 22 of the Texas Administrative Code. These codes increase the efficiency of shower heads and faucet aerators, as shown in Table 2-2 below. The 2024 UPC, released in January 2024, is consistent with Table 2-2.

Table 2-2 Standards for Plumbing Fixtures

Fixture	Standard
Toilets	1.28 gallons per flush
Shower Heads	2.5 gallons per minute at 80 psi
Urinals	0.5 gallon per flush
Faucet Aerators	1.5 gallons per minute at 60 psi
Drinking Water Fountains	Shall be self-closing

The TWDB has projected municipal water savings that are expected to result from passive water conservation measures, including low flow plumbing fixture rules, efficient new residential clothes washer standards, and efficient new residential dishwasher standards. Water savings from these measures will occur naturally, and no WUG actions are needed to realize the savings. Another notable update by the TWDB regarding the plumbing code savings is the inclusion of passive savings from the commercial sector. The water demand projections presented in Chapter 2 are the baseline water demand projections minus the projected water savings from passive measures. Therefore, the projected water savings from passive measures are built into the Brazos G water demand projections. The projected passive water conservation savings for the region represent 2.4 to 2.8 percent of the baseline water demand, depending on the planning decade.

2.1.2 Brazos G Municipal Water Conservation Approach

In the 2026 Regional Water Planning effort, a new requirement distinguishes water conservation strategies into two separate categories:

Water Use Reduction Strategy: This category focuses on measures that directly reduce water consumption by end users.

Water Loss Mitigation Strategy: This category addresses the reduction of water loss within the distribution system.

2.1.2.1 Water Use Reduction Strategy

The Brazos G Regional Water Planning Group (Brazos G RWPG) recommends additional water conservation beyond the Plumbing Act savings for all municipal water user groups with per capita use above 140 gpcd in the TWDB base gpcd [6], regardless of whether or not the entity has needs. For these entities, the goal is to reduce per capita use by 1% [7] annually until the target is met, and then hold the 140 gpcd rate constant throughout the remainder of the planning period.

[6] Typically based on 2011 water use or a different year based on revisions.

[7] It should be noted that a 1% reduction is applied to the baseline GPCD, which includes the passive savings projected by TWDB. However, the conservation savings presented in this chapter exclude passive savings, as these will be realized at no cost to entities through the natural replacement of water-efficient fixtures.

The Brazos G RWPG recognizes that the WCAC recommended eliminating the 140 gpcd targets and using the 1% per year reduction over the fifty-year planning horizon. However, a constant 1% per year reduction might not be feasible for WUGs beyond 2040, as noted by the WCAC. Thus, the Brazos G RWPG decided to continue with the 140 gpcd target until new information comes to light in the next planning cycle. The savings from these targets are incorporated into the total conservation savings presented in Section 2.1.3.

Municipal water conservation can be achieved in a variety of ways, including using BMPs identified by the TWDB[8]:

System Water Audit and Water Loss,

Water Conservation Pricing,

Prohibition on Wasting Water,

Conservation Ordinance Planning and Development,

Showerhead, Aerator, and Toilet Flapper Retrofit,

Residential Toilet Replacement Programs with Ultra-Low-Flow toilets,

Residential Clothes Washer Incentive Program,

School Education,

Water Survey for Single-Family and Multi-Family Customers,

Landscape Irrigation Conservation and Incentives,

Water-Wise Landscape Design and Conversion Programs,

Athletic Field Conservation,

Golf Course Conservation,

Metering of all New Connections and Retrofitting of Existing Connections,

Wholesale Agency Assistance Programs,

Conservation Coordinator (updated 2019),

Water Reuse[9],

Public Information,

Rainwater Harvesting and Condensate Reuse[6],

New Construction Greywater,

Park Conservation,

Conservation Programs for Industrial, Commercial, and Institutional Accounts,

Residential Landscape Irrigation Evaluation,

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[8] https://www.twdb.texas.gov/conservation/BMPs/Mun/index.asp
[9] Reuse and Rainwater Harvesting are considered separate sources for purposes of regional water planning and are not classified as "conservation" in the regional water planning process.

Outdoor Watering Schedule (adopted 2019),

Custom Characterization (adopted 2019),

Public Outreach and Education (adopted 2019),

Partnerships with Nonprofit Organizations,

Custom Conservation Rebates (adopted 2019),

Plumbing Assistance for Economically Disadvantaged Customers (adopted 2019)

The Brazos G RWPG does not recommend specific conservation BMPs for municipal entities, as each entity should choose those conservation strategies that best fit their individual situation.

2.1.2.2 Water Loss Mitigation Strategy

The TWDB compiled the 2022 Water Loss Audit for regional water planning groups to consider when developing the regional water plans (Texas Administrative Code §357.34 (f)(2)D). Furthermore, water management strategy evaluations for the 2026 Brazos G Plan are to take into account anticipated water losses associated with each strategy when calculating the quantity of water delivered and treated, according to TWDB guidelines (Texas Administrative Code §357.34 (d)(3)A). The reported water losses include both real and apparent losses. Real Loss is water lost through distribution system leakage and line breaks; Apparent Loss includes water that was not read accurately by a meter, unauthorized consumption, including water taken by theft, and data analysis errors. The best opportunity for water savings for Brazos G entities is by implementing water management strategies to reduce real loss.

Municipal water entities seeking infrastructure replacement programs to reduce water loss may be eligible for state supported programs, including State Water Implementation Fund for Texas (SWIFT), which has been allocated $11.5 billion to make financing of water projects more affordable and provide consistent state financial assistance for development of water supply projects identified in the State Water Plan per the TWDB website as of January 2025.

The Brazos G RWPG considered TWDB-provided water loss information for Brazos G entities and water conservation BMP for pipeline replacement for municipal entities that report real losses greater than 15% of water system input volume. In the Brazos G Area in 2022, 109 public water suppliers submitted a water loss audit to TWDB. Of the 109 submitted audits, 60 public water suppliers reported a water loss greater than the key performance targets developed by AWWA, which is as follows (1) retail public utilities located in less dense communities (less than 32 connections per mile), for which the threshold or median is 57 gallons per connection per day, and (2) retail public utilities locating in more dense communities (32 or more connections per mile), for which the threshold or median is 30 gallons per connection per day. Of those 60, about 48 exceeded a real water loss of 15%. These entities were then matched with the WUGs in the Brazos area for further water loss mitigation strategy analysis.

The savings for WUGs with real water losses greater than 15% were estimated as the difference between their current water loss (2022) and the target of 15%.

The savings from the water loss mitigation are incorporated into the total conservation savings presented in Section 2.1.3.

2.1.3 Available Supply

Per capita water use was provided by the TWDB for 2026 Regional Water Planning purposes for each municipal WUG based on TWDB-approved population and water demand estimates for each decade from 2030 to 2080 (summarized in Volume I Chapter 2, Table 2.5). The historical per capita water use[10] in 2011, adjusted for passive savings that might be expected with implementation of low flow plumbing fixtures, was used as a basis for projected per capita water use in decades from 2030 to 2080. However, about 280 out of 360 of the municipal WUGs received a baseline per capita water use revision based on their recent trends. The available supply attributed to implementation of the advanced conservation strategy is a 1% annual reduction in demand over and above that assumed in the TWDB water demand projections attributable to low flow plumbing code implementation.

Table 2-3 shows a comparison of TWDB baseline per capita demand for the 2026 Brazos G Plan to per capita goals with advanced conservation for Brazos G entities with per capita demand greater than 140 gpcd (or 120 gpcd for most Williamson WUGs).

Table 2-4 lists the additional water savings attributable to the Brazos G RWPG conservation recommendations[11]. The projected savings attributed to advanced conservation by Brazos G primary municipal WUGs is 36,810 ac-ft/yr in 2030 and increases to 186,034 ac-ft/yr by 2080, shown by WUG in Table 2-4. All entities, in order to be in line with projections, will need to verify that their conservation planning measures are consistent with TCEQ standards and the TWDB projections. Beyond that, some communities with projected needs may be able to reduce or eliminate those needs with stronger conservation planning.

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[10] Based on water user surveys provided voluntarily by water provider to the TWDB.
[11] Additional savings represents savings beyond the plumbing code savings that are already incorporated in the demand projection, including water savings from both water use reduction and water loss mitigation strategies.

Table 2-3 Comparison of TWDB Baseline Per Capita Rates for the 2026 Brazos G Plan and Per Capita Rates With Advanced Conservation

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
WUG	COUNTY		2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
439 WSC	Bell	172	168	168	168	168	168	168	155	140	140	140	140	140
Abilene	Taylor	183	178	178	178	178	178	178	165	146	140	140	140	140
Acton MUD	Hood	185	180	180	180	180	180	180	167	148	140	140	140	140
Acton MUD	Johnson	185	180	180	180	180	180	180	167	148	140	140	140	140
Albany	Shackelford	276	271	271	271	271	271	271	248	221	193	166	140	140
Alvarado	Johnson	125	120	120	120	120	120	120	120	120	120	120	120	120
Anson	Jones	139	134	134	134	134	134	134	134	134	134	134	134	134
Armstrong WSC	Bell	159	155	155	155	155	155	155	140	140	140	140	140	140
Aspermont	Stonewall	331	326	326	326	326	326	326	298	265	232	199	166	140
Axtell WSC	McLennan	157	153	153	153	153	153	153	140	140	140	140	140	140
Baird	Callahan	196	191	191	191	191	191	191	176	157	140	140	140	140
Bartlett	Bell	183	178	178	178	178	178	178	165	146	128	120	120	120
Bartlett	Williamson	183	178	178	178	178	178	178	165	146	128	120	120	120
Bell County WCID 1	Bell	338	333	333	333	333	333	333	304	270	237	203	169	140
Bell County WCID 2	Bell	175	171	171	171	171	171	171	158	140	140	140	140	140
Bell County WCID 3	Bell	161	157	157	157	157	157	157	145	140	140	140	140	140
Bell Milam Falls WSC	Bell	162	157	157	157	157	157	157	146	140	140	140	140	140
Bell Milam Falls WSC	Falls	162	157	157	157	157	157	157	146	140	140	140	140	140
Bell Milam Falls WSC	Milam	162	157	157	157	157	157	157	146	140	140	140	140	140
Bell Milam Falls WSC	Williamson	162	157	157	157	157	157	157	146	140	140	140	140	140
Bellmead	McLennan	120	115	115	115	115	115	115	115	115	115	115	115	115
Belton	Bell	157	153	153	153	153	153	153	140	140	140	140	140	140

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
Benjamin	Knox	277	272	272	272	272	272	272	249	222	194	166	140	140
Bethany SUD	Johnson	127	122	122	122	122	122	122	122	122	122	122	122	122
Bethesda WSC	Tarrant	188	184	184	184	184	184	184	169	150	140	140	140	140
Bethesda WSC	Johnson	188	184	184	184	184	184	184	169	150	140	140	140	140
Birome WSC	Hill	137	133	133	133	133	133	133	133	133	133	133	133	133
Birome WSC	Limestone	137	133	133	133	133	133	133	133	133	133	133	133	133
Birome WSC	McLennan	137	133	133	133	133	133	133	133	133	133	133	133	133
Bistone Municipal Water Supply District	Limestone	419	415	415	415	415	415	415	377	335	293	251	210	168
Block House MUD	Williamson	130	126	126	126	126	126	126	120	120	120	120	120	120
Bold Springs WSC	Hill	135	130	130	130	130	130	130	130	130	130	130	130	130
Bold Springs WSC	McLennan	135	130	130	130	130	130	130	130	130	130	130	130	130
Brandon Irene WSC	Navarro	249	244	244	244	244	244	244	224	199	174	149	140	140
Brandon Irene WSC	Hill	249	244	244	244	244	244	244	224	199	174	149	140	140
Breckenridge	Stephens	161	156	156	156	156	156	156	145	140	140	140	140	140
Bremond	Robertson	183	178	178	178	178	178	178	165	146	140	140	140	140
Brenham	Washington	230	225	225	225	225	225	225	207	184	161	140	140	140
Bruceville Eddy	Falls	245	240	240	240	240	240	240	221	196	172	147	140	140
Bruceville Eddy	McLennan	245	240	240	240	240	240	240	221	196	172	147	140	140
Brushy Creek MUD	Williamson	185	181	181	181	181	181	181	167	148	130	120	120	120
Bryan	Brazos	169	164	164	164	164	164	164	152	140	140	140	140	140
Burleson	Tarrant	143	139	139	139	139	139	139	140	140	140	140	140	140
Burleson	Johnson	143	139	139	139	139	139	139	140	140	140	140	140	140
Cade Lakes WSC	Burleson	230	225	225	225	225	225	225	207	184	161	140	140	140
Caldwell	Burleson	196	191	191	191	191	191	191	176	157	140	140	140	140

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
Callahan County WSC	Callahan	78	74	74	74	74	74	74	74	74	74	74	74	74
Calvert	Robertson	235	230	230	230	230	230	230	212	188	165	140	140	140
Cameron	Milam	217	212	212	212	212	212	212	195	174	152	140	140	140
Cedar Park	Williamson	191	187	187	187	187	187	187	172	153	134	120	120	120
Cedar Park	Travis	191	187	187	187	187	187	187	172	153	134	120	120	120
Cego-Durango WSC	Falls	159	154	154	154	154	154	154	140	140	140	140	140	140
Central Bosque WSC	McLennan	161	156	156	156	156	156	156	145	140	140	140	140	140
Central Texas College District	Bell	283	280	280	280	280	280	280	255	226	198	170	140	140
Central Texas College District	Coryell	283	280	280	280	280	280	280	255	226	198	170	140	140
Central Washington County WSC	Washington	123	118	118	118	118	118	118	118	118	118	118	118	118
Chalk Bluff WSC	McLennan	147	142	142	142	142	142	142	140	140	140	140	140	140
Chappell Hill WSC	Washington	198	193	193	193	193	193	193	178	158	140	140	140	140
Chatt WSC	Hill	162	157	157	157	157	157	157	146	140	140	140	140	140
Childress Creek WSC	Bosque	230	225	225	225	225	225	225	207	184	161	140	140	140
Childress Creek WSC	McLennan	230	225	225	225	225	225	225	207	184	161	140	140	140
Cisco	Eastland	170	165	165	165	165	165	165	153	140	140	140	140	140
Cleburne	Johnson	192	187	187	187	187	187	187	173	154	140	140	140	140
Clifton	Bosque	201	196	196	196	196	196	196	181	161	140	140	140	140
Clyde	Callahan	96	91	91	91	91	91	91	91	91	91	91	91	91
College Station	Brazos	177	172	172	172	172	172	172	159	140	140	140	140	140
Comanche	Comanche	113	108	108	108	108	108	108	108	108	108	108	108	108
Coolidge	Limestone	174	170	170	170	170	170	170	157	140	140	140	140	140
Copperas Cove	Coryell	119	115	115	115	115	115	115	115	115	115	115	115	115
Copperas Cove	Lampasas	119	115	115	115	115	115	115	115	115	115	115	115	115

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
Corix Utilities Texas Inc	Mitchell	170	165	165	165	165	165	165	153	140	140	140	140	140
Corix Utilities Texas Inc	Lampasas	170	165	165	165	165	165	165	153	140	140	140	140	140
Corix Utilities Texas Inc	Washington	170	165	165	165	165	165	165	153	140	140	140	140	140
Corix Utilities Texas Inc	Blanco	170	165	165	165	165	165	165	153	140	140	140	140	140
Corix Utilities Texas Inc	Burnet	170	165	165	165	165	165	165	153	140	140	140	140	140
Corix Utilities Texas Inc	Colorado	170	165	165	165	165	165	165	153	140	140	140	140	140
Corix Utilities Texas Inc	Llano	170	165	165	165	165	165	165	153	140	140	140	140	140
Corix Utilities Texas Inc	Matagorda	170	165	165	165	165	165	165	153	140	140	140	140	140
Corix Utilities Texas Inc	Mills	170	165	165	165	165	165	165	153	140	140	140	140	140
Corix Utilities Texas Inc	San Saba	170	165	165	165	165	165	165	153	140	140	140	140	140
Coryell City Water Supply District	Coryell	163	159	159	159	159	159	159	147	140	140	140	140	140
Coryell City Water Supply District	Hamilton	163	159	159	159	159	159	159	147	140	140	140	140	140
Coryell City Water Supply District	McLennan	163	159	159	159	159	159	159	147	140	140	140	140	140
County-Other, Bell	Bell	151	147	147	147	147	147	147	140	140	140	140	140	140
County-Other, Bosque	Bosque	125	120	120	120	120	120	120	120	120	120	120	120	120
County-Other, Brazos	Brazos	132	125	125	125	125	125	125	125	125	125	125	125	125
County-Other, Burleson	Burleson	104	99	99	99	99	99	99	99	99	99	99	99	99
County-Other, Callahan	Callahan	72	67	67	67	67	67	67	67	67	67	67	67	67
County-Other, Comanche	Comanche	95	90	90	90	90	90	90	90	90	90	90	90	90
County-Other, Coryell	Coryell	106	101	101	101	101	101	101	101	101	101	101	101	101
County-Other, Eastland	Eastland	82	77	77	77	77	77	77	77	77	77	77	77	77
County-Other, Erath	Erath	126	121	121	121	121	121	121	121	121	121	121	121	121
County-Other, Falls	Falls	114	109	109	109	109	109	109	109	109	109	109	109	109
County-Other, Fisher	Fisher	104	99	99	99	99	99	99	99	99	99	99	99	99

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
County-Other, Grimes	Grimes	127	122	122	122	122	122	122	122	122	122	122	122	122
County-Other, Hamilton	Hamilton	112	107	107	107	107	107	107	107	107	107	107	107	107
County-Other, Haskell	Haskell	120	115	115	115	115	115	115	115	115	115	115	115	115
County-Other, Hill	Hill	100	95	95	95	95	95	95	95	95	95	95	95	95
County-Other, Hood	Hood	94	90	90	90	90	90	90	90	90	90	90	90	90
County-Other, Johnson	Johnson	96	91	91	91	91	91	91	91	91	91	91	91	91
County-Other, Jones	Jones	113	108	108	108	108	108	108	108	108	108	108	108	108
County-Other, Kent	Kent	109	104	104	104	104	104	104	104	104	104	104	104	104
County-Other, Knox	Knox	93	88	88	88	88	88	88	88	88	88	88	88	88
County-Other, Lampasas	Lampasas	121	115	115	115	115	115	115	115	115	115	115	115	115
County-Other, Lee	Lee	94	89	89	89	89	89	89	89	89	89	89	89	89
County-Other, Limestone	Limestone	86	81	81	81	81	81	81	81	81	81	81	81	81
County-Other, McLennan	McLennan	115	110	110	110	110	110	110	110	110	110	110	110	110
County-Other, Milam	Milam	111	106	106	106	106	106	106	106	106	106	106	106	106
County-Other, Nolan	Nolan	105	99	99	99	99	99	99	99	99	99	99	99	99
County-Other, Palo Pinto	Palo Pinto	84	79	79	79	79	79	79	79	79	79	79	79	79
County-Other, Robertson	Robertson	102	97	97	97	97	97	97	97	97	97	97	97	97
County-Other, Shackelford	Shackelford	90	85	85	85	85	85	85	85	85	85	85	85	85
County-Other, Somervell	Somervell	109	105	105	105	105	105	105	105	105	105	105	105	105
County-Other, Stephens	Stephens	97	91	91	91	91	91	91	91	91	91	91	91	91
County-Other, Stonewall	Stonewall	107	102	102	102	102	102	102	102	102	102	102	102	102
County-Other, Taylor	Taylor	104	97	97	97	97	97	97	97	97	97	97	97	97
County-Other, Throckmorton	Throckmorton	86	81	81	81	81	81	81	81	81	81	81	81	81
County-Other, Washington	Washington	116	111	111	111	111	111	111	111	111	111	111	111	111

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
County-Other, Williamson	Williamson	140	136	136	136	136	136	136	126	120	120	120	120	120
County-Other, Young	Young	110	105	105	105	105	105	105	105	105	105	105	105	105
Crawford	McLennan	212	207	207	207	207	207	207	191	170	148	140	140	140
Cross Country WSC	Bosque	178	173	173	173	173	173	173	160	140	140	140	140	140
Cross Country WSC	McLennan	178	173	173	173	173	173	173	160	140	140	140	140	140
Cross Plains	Callahan	210	205	205	205	205	205	205	189	168	147	140	140	140
De Leon	Comanche	99	94	94	94	94	94	94	94	94	94	94	94	94
Deanville WSC	Burleson	175	170	170	170	170	170	170	158	140	140	140	140	140
Dog Ridge WSC	Bell	172	168	168	168	168	168	168	155	140	140	140	140	140
Double Diamond Utilities	Hill	1023	1019	1019	1019	1019	1019	1019	921	818	716	614	512	409
Double Diamond Utilities	Johnson	1023	1019	1019	1019	1019	1019	1019	921	818	716	614	512	409
Double Diamond Utilities	Palo Pinto	1023	1019	1019	1019	1019	1019	1019	921	818	716	614	512	409
Dublin	Erath	105	100	100	100	100	100	100	100	100	100	100	100	100
East Bell WSC	Bell	155	150	150	150	150	150	150	140	140	140	140	140	140
East Bell WSC	Falls	155	150	150	150	150	150	150	140	140	140	140	140	140
East Crawford WSC	McLennan	304	300	300	300	300	300	300	274	243	213	182	152	140
Eastland	Eastland	160	155	155	155	155	155	155	140	140	140	140	140	140
Elm Creek WSC	Bell	143	139	139	139	139	139	139	140	140	140	140	140	140
Elm Creek WSC	Coryell	143	139	139	139	139	139	139	140	140	140	140	140	140
Elm Creek WSC	McLennan	143	139	139	139	139	139	139	140	140	140	140	140	140
EOL WSC	McLennan	113	109	109	109	109	109	109	109	109	109	109	109	109
Eula WSC	Callahan	85	85	85	85	85	85	85	85	85	85	85	85	85
Fern Bluff MUD	Williamson	194	190	190	190	190	190	190	175	155	136	120	120	120
Files Valley WSC	Ellis	179	175	175	175	175	175	175	161	140	140	140	140	140

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
Files Valley WSC	Hill	179	175	175	175	175	175	175	161	140	140	140	140	140
Flat WSC	Coryell	258	254	254	254	254	254	254	232	206	181	155	140	140
Florence	Williamson	136	131	131	131	131	131	131	120	120	120	120	120	120
Fort Belknap WSC	Stephens	124	119	119	119	119	119	119	119	119	119	119	119	119
Fort Belknap WSC	Throckmorton	124	119	119	119	119	119	119	119	119	119	119	119	119
Fort Belknap WSC	Young	124	119	119	119	119	119	119	119	119	119	119	119	119
Fort Gates WSC	Coryell	187	182	182	182	182	182	182	168	150	140	140	140	140
Fort Griffin SUD	Shackelford	171	166	166	166	166	166	166	154	140	140	140	140	140
Fort Griffin SUD	Stephens	171	166	166	166	166	166	166	154	140	140	140	140	140
Fort Griffin SUD	Throckmorton	171	166	166	166	166	166	166	154	140	140	140	140	140
Fort Hood	Bell	215	210	210	210	210	210	210	194	172	151	140	140	140
Fort Hood	Coryell	215	210	210	210	210	210	210	194	172	151	140	140	140
Franklin	Robertson	133	128	128	128	128	128	128	128	128	128	128	128	128
Gatesville	Coryell	246	241	241	241	241	241	241	221	197	172	148	140	140
Georgetown	Bell	173	169	169	169	169	169	169	180	176	171	160	150	140
Georgetown	Williamson	173	169	169	169	169	169	169	180	176	171	160	150	140
Georgetown	Burnet	173	169	169	169	169	169	169	180	176	171	160	150	140
Gholson WSC	Hill	127	123	123	123	123	123	123	123	123	123	123	123	123
Gholson WSC	McLennan	127	123	123	123	123	123	123	123	123	123	123	123	123
Giddings	Lee	188	183	183	183	183	183	183	169	150	140	140	140	140
Glen Rose	Somervell	199	194	194	194	194	194	194	179	159	140	140	140	140
Godley	Johnson	116	111	111	111	111	111	111	111	111	111	111	111	111
Gordon	Erath	230	225	225	225	225	225	225	207	184	161	140	140	140
Gordon	Palo Pinto	230	225	225	225	225	225	225	207	184	161	140	140	140

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
Gorman	Eastland	109	104	104	104	104	104	104	104	104	104	104	104	104
Graham	Young	302	297	297	297	297	297	297	272	242	211	181	151	140
Granbury	Hood	175	170	170	170	170	170	170	158	140	140	140	140	140
Grandview	Johnson	153	148	148	148	148	148	148	140	140	140	140	140	140
Granger	Williamson	145	140	140	140	140	140	140	131	120	120	120	120	120
Groesbeck	Limestone	167	162	162	162	162	162	162	150	140	140	140	140	140
H & H WSC	McLennan	125	121	121	121	121	121	121	121	121	121	121	121	121
Hamby WSC	Callahan	116	111	111	111	111	111	111	111	111	111	111	111	111
Hamby WSC	Jones	116	111	111	111	111	111	111	111	111	111	111	111	111
Hamby WSC	Shackelford	116	111	111	111	111	111	111	111	111	111	111	111	111
Hamby WSC	Taylor	116	111	111	111	111	111	111	111	111	111	111	111	111
Hamilton	Hamilton	179	174	174	174	174	174	174	161	140	140	140	140	140
Hamlin	Jones	187	182	182	182	182	182	182	168	150	140	140	140	140
Harker Heights	Bell	178	174	174	174	174	174	174	160	140	140	140	140	140
Haskell	Haskell	174	169	169	169	169	169	169	157	140	140	140	140	140
Hawley WSC	Jones	109	104	104	104	104	104	104	104	104	104	104	104	104
Hawley WSC	Taylor	109	104	104	104	104	104	104	104	104	104	104	104	104
Hearne	Robertson	152	147	147	147	147	147	147	140	140	140	140	140	140
Hewitt	McLennan	176	171	171	171	171	171	171	158	140	140	140	140	140
Hico	Hamilton	134	129	129	129	129	129	129	129	129	129	129	129	129
Highland Park WSC	Bosque	264	259	259	259	259	259	259	238	211	185	158	140	140
Highland Park WSC	McLennan	264	259	259	259	259	259	259	238	211	185	158	140	140
Hilco United Services	Ellis	187	182	182	182	182	182	182	168	150	140	140	140	140
Hilco United Services	Bosque	187	182	182	182	182	182	182	168	150	140	140	140	140

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
Hilco United Services	Hill	187	182	182	182	182	182	182	168	150	140	140	140	140
Hill County WSC	Hill	131	127	127	127	127	127	127	127	127	127	127	127	127
Hillsboro	Hill	211	206	206	206	206	206	206	190	169	148	140	140	140
Hilltop WSC	McLennan	143	138	138	138	138	138	138	140	140	140	140	140	140
Hog Creek WSC	Bosque	962	957	957	957	957	957	957	866	770	673	577	481	385
Hog Creek WSC	McLennan	962	957	957	957	957	957	957	866	770	673	577	481	385
Holland	Bell	105	100	100	100	100	100	100	100	100	100	100	100	100
Hubbard	Hill	132	127	127	127	127	127	127	127	127	127	127	127	127
Hutto	Williamson	107	103	103	103	103	103	103	103	103	103	103	103	103
Itasca	Hill	110	105	105	105	105	105	105	105	105	105	105	105	105
Jarrell-Schwertner	Bell	125	120	120	120	120	120	120	120	120	120	120	120	120
Jarrell-Schwertner	Williamson	125	120	120	120	120	120	120	120	120	120	120	120	120
Jayton	Kent	180	175	175	175	175	175	175	162	140	140	140	140	140
Johnson County SUD	Tarrant	123	119	119	119	119	119	119	119	119	119	119	119	119
Johnson County SUD	Johnson	123	119	119	119	119	119	119	119	119	119	119	119	119
Jonah Water SUD	Williamson	188	184	184	184	184	184	184	169	150	132	120	120	120
Keene	Johnson	130	128	128	128	128	128	128	128	128	128	128	128	128
Kempner WSC	Bell	176	172	172	172	172	172	172	158	140	140	140	140	140
Kempner WSC	Coryell	176	172	172	172	172	172	172	158	140	140	140	140	140
Kempner WSC	Lampasas	176	172	172	172	172	172	172	158	140	140	140	140	140
Kempner WSC	Burnet	176	172	172	172	172	172	172	158	140	140	140	140	140
Killeen	Bell	125	121	121	121	121	121	121	121	121	121	121	121	121
Knox City	Knox	224	219	219	219	219	219	219	202	179	157	140	140	140
Lacy Lakeview	McLennan	125	120	120	120	120	120	120	120	120	120	120	120	120

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
Lake Palo Pinto Area WSC	Palo Pinto	112	107	107	107	107	107	107	107	107	107	107	107	107
Lampasas	Lampasas	167	162	162	162	162	162	162	150	140	140	140	140	140
Lawn	Taylor	178	173	173	173	173	173	173	160	140	140	140	140	140
Leander	Williamson	124	124	124	124	124	124	124	120	120	120	120	120	120
Leander	Travis	124	124	124	124	124	124	124	120	120	120	120	120	120
Lee County WSC	Lee	129	125	125	125	125	125	125	125	125	125	125	125	125
Lee County WSC	Washington	129	125	125	125	125	125	125	125	125	125	125	125	125
Lee County WSC	Bastrop	129	125	125	125	125	125	125	125	125	125	125	125	125
Lee County WSC	Fayette	129	125	125	125	125	125	125	125	125	125	125	125	125
Leroy Tours Gerald WSC	McLennan	115	111	111	111	111	111	111	111	111	111	111	111	111
Levi WSC	Falls	238	234	234	234	234	234	234	214	190	167	140	140	140
Levi WSC	McLennan	238	234	234	234	234	234	234	214	190	167	140	140	140
Lexington	Lee	177	172	172	172	172	172	172	159	140	140	140	140	140
Liberty Hill	Williamson	111	107	107	107	107	107	107	107	107	107	107	107	107
Lipan	Hood	143	139	139	139	139	139	139	140	140	140	140	140	140
Little Elm Valley WSC	Bell	171	167	167	167	167	167	167	154	140	140	140	140	140
Little Elm Valley WSC	Falls	171	167	167	167	167	167	167	154	140	140	140	140	140
Lorena	McLennan	171	166	166	166	166	166	166	154	140	140	140	140	140
Marlin	Falls	267	262	262	262	262	262	262	240	214	187	160	140	140
Mart	McLennan	233	228	228	228	228	228	228	210	186	163	140	140	140
McGregor	McLennan	238	233	233	233	233	233	233	214	190	167	140	140	140
McLennan County WCID 2	McLennan	172	167	167	167	167	167	167	155	140	140	140	140	140
Meridian	Bosque	145	140	140	140	140	140	140	140	140	140	140	140	140
Merkel	Taylor	117	112	112	112	112	112	112	112	112	112	112	112	112

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
Mexia	Limestone	133	132	132	132	132	132	132	132	132	132	132	132	132
Milano WSC	Burleson	167	162	162	162	162	162	162	150	140	140	140	140	140
Milano WSC	Milam	167	162	162	162	162	162	162	150	140	140	140	140	140
Mineral Wells	Parker	180	175	175	175	175	175	175	162	140	140	140	140	140
Mineral Wells	Palo Pinto	180	175	175	175	175	175	175	162	140	140	140	140	140
Moffat WSC	Bell	167	162	162	162	162	162	162	150	140	140	140	140	140
Moody	McLennan	135	130	130	130	130	130	130	130	130	130	130	130	130
Morgans Point Resort	Bell	135	130	130	130	130	130	130	130	130	130	130	130	130
Mountain WSC	Coryell	157	153	153	153	153	153	153	140	140	140	140	140	140
Multi County WSC	Coryell	93	88	88	88	88	88	88	88	88	88	88	88	88
Multi County WSC	Hamilton	93	88	88	88	88	88	88	88	88	88	88	88	88
Multi County WSC	Lampasas	93	88	88	88	88	88	88	88	88	88	88	88	88
Munday	Knox	180	175	175	175	175	175	175	162	144	140	140	140	140
Mustang Valley WSC	Bosque	215	211	211	211	211	211	211	194	172	151	140	140	140
Mustang Valley WSC	Coryell	215	211	211	211	211	211	211	194	172	151	140	140	140
Navasota	Grimes	183	178	178	178	178	178	178	165	146	140	140	140	140
Noack WSC	Williamson	189	184	184	184	184	184	184	170	151	132	120	120	120
North Bosque WSC	McLennan	279	275	275	275	275	275	275	251	223	195	167	140	140
North Milam WSC	Falls	173	168	168	168	168	168	168	156	140	140	140	140	140
North Milam WSC	Milam	173	168	168	168	168	168	168	156	140	140	140	140	140
North Rural WSC	Parker	100	95	95	95	95	95	95	95	95	95	95	95	95
North Rural WSC	Palo Pinto	100	95	95	95	95	95	95	95	95	95	95	95	95
Oglesby	Coryell	74	69	69	69	69	69	69	69	69	69	69	69	69
Palo Pinto WSC	Palo Pinto	127	122	122	122	122	122	122	122	122	122	122	122	122

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
Paloma Lake MUD 1	Williamson	139	139	139	139	139	139	139	125	120	120	120	120	120
Paloma Lake MUD 2	Williamson	139	139	139	139	139	139	139	125	120	120	120	120	120
Parker WSC	Hill	147	142	142	142	142	142	142	140	140	140	140	140	140
Parker WSC	Johnson	147	142	142	142	142	142	142	140	140	140	140	140	140
Pendleton WSC	Bell	169	165	165	165	165	165	165	152	140	140	140	140	140
Possum Kingdom WSC	Palo Pinto	384	379	379	379	379	379	379	346	307	269	230	192	154
Possum Kingdom WSC	Stephens	384	379	379	379	379	379	379	346	307	269	230	192	154
Post Oak SUD	Navarro	205	200	200	200	200	200	200	185	164	144	140	140	140
Post Oak SUD	Hill	205	200	200	200	200	200	200	185	164	144	140	140	140
Post Oak SUD	Limestone	205	200	200	200	200	200	200	185	164	144	140	140	140
Potosi WSC	Callahan	139	134	134	134	134	134	134	134	134	134	134	134	134
Potosi WSC	Taylor	139	134	134	134	134	134	134	134	134	134	134	134	134
Prairie Hill WSC	Limestone	183	178	178	178	178	178	178	165	146	140	140	140	140
Prairie Hill WSC	McLennan	183	178	178	178	178	178	178	165	146	140	140	140	140
Ranger	Eastland	166	161	161	161	161	161	161	149	140	140	140	140	140
Riesel	McLennan	118	113	113	113	113	113	113	113	113	113	113	113	113
Rio Vista	Hill	159	154	154	154	154	154	154	143	127	140	140	140	140
Rio Vista	Johnson	159	154	154	154	154	154	154	143	127	140	140	140	140
Rising Star	Eastland	171	166	166	166	166	166	166	154	140	140	140	140	140
Robertson County WSC	Robertson	143	138	138	138	138	138	138	140	140	140	140	140	140
Robinson	McLennan	200	195	195	195	195	195	195	180	160	140	140	140	140
Roby	Fisher	207	202	202	202	202	202	202	186	166	145	140	140	140
Rockdale	Milam	198	193	193	193	193	193	193	178	158	140	140	140	140
Rogers	Bell	164	159	159	159	159	159	159	148	140	140	140	140	140

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
Roscoe	Nolan	186	181	181	181	181	181	181	167	149	140	140	140	140
Rosebud	Falls	114	109	109	109	109	109	109	109	109	109	109	109	109
Ross WSC	McLennan	140	135	135	135	135	135	135	135	135	135	135	135	135
Rotan	Fisher	165	160	160	160	160	160	160	149	140	140	140	140	140
Round Rock	Williamson	139	139	139	139	139	139	139	125	120	120	120	120	120
Round Rock	Travis	139	139	139	139	139	139	139	125	120	120	120	120	120
S U N WSC	Fisher	97	92	92	92	92	92	92	92	92	92	92	92	92
S U N WSC	Jones	97	92	92	92	92	92	92	92	92	92	92	92	92
S U N WSC	Taylor	97	92	92	92	92	92	92	92	92	92	92	92	92
Salado WSC	Bell	296	292	292	292	292	292	292	266	237	207	178	148	140
Salem Elm Ridge WSC	Milam	175	171	171	171	171	171	171	158	140	140	140	140	140
Santo SUD	Parker	125	120	120	120	120	120	120	120	120	120	120	120	120
Santo SUD	Hood	125	120	120	120	120	120	120	120	120	120	120	120	120
Santo SUD	Palo Pinto	125	120	120	120	120	120	120	120	120	120	120	120	120
SLC WSC	Limestone	95	90	90	90	90	90	90	90	90	90	90	90	90
Smith Bend WSC	Bosque	133	128	128	128	128	128	128	128	128	128	128	128	128
Snook	Burleson	318	313	313	313	313	313	313	286	254	223	191	159	140
Somervell County Water District	Somervell	240	236	236	236	236	236	236	216	192	168	144	140	140
Somerville	Burleson	187	182	182	182	182	182	182	168	150	140	140	140	140
Sonterra MUD	Williamson	108	105	105	105	105	105	105	105	105	105	105	105	105
Southwest Milam WSC	Burleson	190	185	185	185	185	185	185	171	152	140	140	140	140
Southwest Milam WSC	Lee	190	185	185	185	185	185	185	171	152	140	140	140	140
Southwest Milam WSC	Milam	190	185	185	185	185	185	185	171	152	140	140	140	140
Southwest Milam WSC	Williamson	190	185	185	185	185	185	185	171	152	140	140	140	140

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
Sportsmans World MUD	Palo Pinto	890	884	884	884	884	884	884	801	712	623	534	445	356
Spring Valley WSC	McLennan	160	156	156	156	156	156	156	140	140	140	140	140	140
Staff WSC	Eastland	143	139	139	139	139	139	139	140	140	140	140	140	140
Staff WSC	Stephens	143	139	139	139	139	139	139	140	140	140	140	140	140
Stamford	Jones	233	228	228	228	228	228	228	210	186	163	140	140	140
Steamboat Mountain WSC	Taylor	123	119	119	119	119	119	119	119	119	119	119	119	119
Stephens Regional SUD	Stephens	178	173	173	173	173	173	173	160	140	140	140	140	140
Stephens Regional SUD	Throckmorton	178	173	173	173	173	173	173	160	140	140	140	140	140
Stephenville	Erath	136	131	131	131	131	131	131	131	131	131	131	131	131
Strawn	Palo Pinto	207	202	202	202	202	202	202	186	166	145	140	140	140
Sturdivant Progress WSC	Parker	97	93	93	93	93	93	93	93	93	93	93	93	93
Sturdivant Progress WSC	Palo Pinto	97	93	93	93	93	93	93	93	93	93	93	93	93
Sweetwater	Nolan	144	139	139	139	139	139	139	140	140	140	140	140	140
Taylor	Williamson	120	115	115	115	115	115	115	120	120	120	120	120	120
TDCJ Luther Units	Grimes	247	243	243	243	243	243	243	222	198	173	148	140	140
TDCJ W Pack Unit	Grimes	245	240	240	240	240	240	240	221	196	172	147	140	140
Temple	Bell	227	222	222	222	222	222	222	204	182	159	140	140	140
Texas A&M University	Brazos	477	472	472	472	472	472	472	429	382	334	286	239	191
Texas State Technical College	McLennan	1804	1800	1800	1800	1800	1800	1800	1624	1443	1263	1082	902	722
The Bitter Creek WSC	Fisher	140	135	135	135	135	135	135	135	135	135	135	135	135
The Bitter Creek WSC	Nolan	140	135	135	135	135	135	135	135	135	135	135	135	135
The Grove WSC	Bell	139	135	135	135	135	135	135	135	135	135	135	135	135
The Grove WSC	Coryell	139	135	135	135	135	135	135	135	135	135	135	135	135
Thorndale	Milam	138	133	133	133	133	133	133	133	133	133	133	133	133

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
Throckmorton	Throckmorton	216	211	211	211	211	211	211	194	173	151	140	140	140
Tolar	Hood	148	144	144	144	144	144	144	140	140	140	140	140	140
Tri County SUD	Limestone	116	112	112	112	112	112	112	112	112	112	112	112	112
Troy	Bell	119	115	115	115	115	115	115	115	115	115	115	115	115
Twin Creek WSC	Robertson	223	218	218	218	218	218	218	201	178	156	140	140	140
Tye	Taylor	143	138	138	138	138	138	138	140	140	140	140	140	140
Valley Mills	Bosque	179	174	174	174	174	174	174	161	140	140	140	140	140
Valley Mills	McLennan	179	174	174	174	174	174	174	161	140	140	140	140	140
Venus	Johnson	168	163	163	163	163	163	163	151	140	140	140	140	140
View Caps WSC	Taylor	150	145	145	145	145	145	145	140	140	140	140	140	140
Vista Oaks MUD	Williamson	139	139	139	139	139	139	139	125	120	120	120	120	120
Waco	McLennan	222	217	217	217	217	217	217	200	178	155	140	140	140
Walsh Ranch MUD	Williamson	139	139	139	139	139	139	139	125	120	120	120	120	120
Wellborn SUD	Brazos	188	184	184	184	184	184	184	169	150	140	140	140	140
Wellborn SUD	Robertson	188	184	184	184	184	184	184	169	150	140	140	140	140
West	McLennan	165	160	160	160	160	160	160	149	140	140	140	140	140
West Bell County WSC	Bell	166	161	161	161	161	161	161	149	140	140	140	140	140
West Brazos WSC	Falls	159	155	155	155	155	155	155	140	140	140	140	140	140
West Brazos WSC	McLennan	159	155	155	155	155	155	155	140	140	140	140	140	140
Westbound WSC	Callahan	73	68	68	68	68	68	68	68	68	68	68	68	68
Westbound WSC	Eastland	73	68	68	68	68	68	68	68	68	68	68	68	68
White Rock Water SUD	Limestone	101	96	96	96	96	96	96	96	96	96	96	96	96
Whitney	Hill	172	167	167	167	167	167	167	155	140	140	140	140	140
Wickson Creek SUD	Brazos	139	135	135	135	135	135	135	135	135	135	135	135	135

			GPCD Board Projections without Advanced Conservation						GPCD Board Projections with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
Wickson Creek SUD	Grimes	139	135	135	135	135	135	135	135	135	135	135	135	135
Wickson Creek SUD	Robertson	139	135	135	135	135	135	135	135	135	135	135	135	135
Williamson County MUD 10	Williamson	139	139	139	139	139	139	139	125	120	120	120	120	120
Williamson County MUD 11	Williamson	139	139	139	139	139	139	139	125	120	120	120	120	120
Williamson County WSID 3	Williamson	184	179	179	179	179	179	179	166	147	129	120	120	120
Williamson County WSID 3	Travis	184	179	179	179	179	179	179	166	147	129	120	120	120
Williamson Travis Counties MUD 1	Williamson	141	136	136	136	136	136	136	127	120	120	120	120	120
Williamson Travis Counties MUD 1	Travis	141	136	136	136	136	136	136	127	120	120	120	120	120
Windsor Water	McLennan	148	144	144	144	144	144	144	140	140	140	140	140	140
Woodrow Osceola WSC	Hill	176	172	172	172	172	172	172	158	140	140	140	140	140
Woodway	McLennan	351	346	346	346	346	346	346	316	281	246	211	176	140

Table 2-4 Estimated Annual Water Savings for WUGs with Recommended Conservation

WUG	Additional Water Saved - W/ Advanced Conservation (ac-ft)					
	2030	2040	2050	2060	2070	2080
439 WSC	113	286	324	356	381	393
Abilene	1,995	5,139	6,489	6,866	7,285	7,756
Acton MUD	170	443	603	655	711	771
Albany	168	198	220	240	248	212
Armstrong WSC	52	57	62	65	69	73
Aspermont	21	42	60	77	90	97
Axtell WSC	25	27	30	34	38	41
Baird	26	58	86	86	84	83
Bartlett	121	152	183	198	195	196
Bell County WCID 1	8	18	28	38	48	57
Bell County WCID 2	25	64	67	68	70	72
Bell County WCID 3	242	355	457	560	583	608
Bell Milam Falls WSC	219	257	261	264	267	271
Belton	402	466	546	619	680	722
Benjamin	5	10	14	19	21	18
Bethesda WSC	592	1,533	2,265	2,510	2,784	3,092
Bistone Municipal Water Supply District	23	45	66	86	102	117
Block House MUD	35	30	29	28	28	26
Brandon Irene WSC	45	104	167	231	260	268
Breckenridge	69	91	83	79	74	66
Bremond	12	27	31	30	29	28
Brenham	342	778	1,217	1,622	1,624	1,626
Bruceville Eddy	142	344	570	833	956	1,021
Brushy Creek MUD	298	704	1,101	1,321	1,321	1,321
Bryan	1,410	3,253	3,853	4,568	5,753	7,243
Cade Lakes WSC	60	72	82	91	91	89
Caldwell	73	162	244	243	241	239
Calvert	22	47	71	94	90	86
Cameron	103	221	338	393	380	365
Cedar Park	1,690	3,859	6,106	7,745	7,745	7,745
Cego-Durango WSC	19	21	24	26	29	34
Central Bosque WSC	10	15	15	15	17	17
Central Texas College District	25	52	80	109	138	138
Central Washington County WSC	46	48	46	49	52	56
Chalk Bluff WSC	10	9	9	11	12	13

WUG	Additional Water Saved - W/ Advanced Conservation (ac-ft)					
	2030	2040	2050	2060	2070	2080
Chappell Hill WSC	9	19	30	29	28	28
Chatt WSC	42	50	51	52	52	55
Childress Creek WSC	122	153	182	207	201	196
Cisco	54	110	114	115	115	117
Cleburne	572	1,483	2,360	2,574	2,815	3,084
Clifton	60	146	253	272	292	315
College Station	1,837	4,993	5,873	6,904	6,781	6,673
Comanche	67	66	65	65	64	64
Coolidge	10	23	23	22	21	20
Corix Utilities Texas Inc	278	590	611	624	643	662
Coryell City Water Supply District	85	135	136	135	137	135
County-Other, Bell	37	38	40	37	32	24
County-Other, Eastland	33	31	28	26	22	18
County-Other, Erath	439	474	517	568	625	690
County-Other, Falls	178	160	141	122	98	64
County-Other, Haskell	109	106	102	101	99	97
County-Other, Lee	7	7	6	5	5	5
County-Other, Williamson	590	1,788	2,237	2,778	3,433	4,255
Crawford	16	41	72	91	100	111
Cross Country WSC	50	137	151	165	182	201
Cross Plains	16	37	58	65	64	63
Deanville WSC	26	64	64	63	62	62
Dog Ridge WSC	263	388	421	444	470	497
Double Diamond Utilities	314	690	1,110	1,574	2,096	2,693
East Bell WSC	29	25	23	22	21	21
East Crawford WSC	29	65	104	147	194	219
Eastland	59	50	46	42	40	37
Eula WSC	136	140	144	149	153	159
Fern Bluff MUD	90	220	356	463	464	464
Files Valley WSC	69	183	193	203	214	227
Flat WSC	17	37	58	77	88	88
Florence	18	18	20	21	23	25
Fort Belknap WSC	159	160	164	167	169	173
Fort Gates WSC	38	85	114	113	112	111
Fort Griffin SUD	16	33	34	37	33	33
Fort Hood	661	1,585	2,565	3,161	3,274	3,386
Gatesville	1,014	1,451	1,929	2,369	2,521	2,532

WUG	Additional Water Saved - W/ Advanced Conservation (ac-ft)					
	2030	2040	2050	2060	2070	2080
Georgetown	0	0	0	6,865	18,497	33,224
Giddings	88	204	262	258	252	245
Glen Rose	46	111	173	173	172	171
Gordon	30	46	62	78	78	76
Graham	209	449	674	905	1,130	1,202
Granbury	225	626	703	787	880	986
Grandview	16	17	19	21	24	25
Granger	13	29	32	34	36	39
Groesbeck	48	80	78	76	74	71
Hamilton	169	229	229	226	222	218
Hamlin	24	48	56	48	43	39
Harker Heights	563	1,577	1,786	1,852	1,852	1,852
Haskell	43	100	97	97	96	95
Hearne	43	39	37	36	35	32
Hewitt	258	592	592	592	592	592
Hico	2	2	2	2	2	2
Highland Park WSC	12	27	42	55	63	63
Hilco United Services	106	245	333	344	357	372
Hillsboro	273	635	1,016	1,180	1,204	1,233
Hog Creek WSC	37	77	118	155	192	229
Jarrell-Schwertner	597	605	631	660	689	719
Jayton	8	19	20	21	21	21
Jonah Water SUD	673	1,855	3,681	5,731	7,157	8,761
Kempner WSC	821	1,203	1,213	1,203	1,194	1,181
Knox City	74	100	124	143	140	141
Lampasas	157	274	300	321	331	325
Lawn	4	7	7	6	5	4
Leander	756	958	1,009	1,008	1,009	1,009
Levi WSC	49	114	192	285	301	320
Lexington	29	71	69	68	66	65
Liberty Hill	64	93	128	165	207	255
Little Elm Valley WSC	67	106	114	121	128	135
Lorena	162	213	223	230	240	250
Marlin	114	231	344	448	524	531
Mart	37	79	116	143	128	111
McGregor	214	502	808	1,188	1,243	1,304
McLennan County WCID 2	16	32	30	27	23	19

WUG	Additional Water Saved - W/ Advanced Conservation (ac-ft)					
	2030	2040	2050	2060	2070	2080
Mexia	220	213	205	198	190	182
Milano WSC	38	68	67	67	66	65
Mineral Wells	1,190	1,728	1,817	1,908	1,908	1,908
Moffat WSC	81	91	81	73	64	58
Moody	77	87	97	107	118	128
Mountain WSC	27	27	28	28	27	27
Munday	17	41	47	47	48	50
Mustang Valley WSC	34	77	116	133	127	121
Navasota	179	358	426	436	449	461
Noack WSC	11	28	45	58	59	61
North Bosque WSC	55	133	231	351	492	552
North Milam WSC	13	30	28	27	26	26
Paloma Lake MUD 1	54	74	74	74	74	74
Paloma Lake MUD 2	39	53	53	53	53	53
Parker WSC	4	3	4	4	4	4
Pendleton WSC	31	66	69	70	73	76
Possum Kingdom WSC	51	113	169	228	286	342
Post Oak SUD	25	60	93	97	94	96
Prairie Hill WSC	21	53	65	71	74	78
Ranger	31	48	46	45	43	43
Riesel	19	20	21	22	24	25
Rio Vista	14	37	21	24	28	31
Rising Star	10	19	18	17	17	16
Robinson	234	605	1,086	1,238	1,413	1,614
Roby	10	20	31	34	33	33
Rockdale	128	292	446	449	452	456
Rogers	50	55	54	52	50	48
Roscoe	18	37	46	45	45	44
Rosebud	38	35	33	30	28	27
Rotan	18	31	30	30	29	28
Round Rock	2,320	3,887	4,617	4,775	4,921	5,049
Salado WSC	216	512	892	1,344	1,906	2,257
Salem Elm Ridge WSC	13	29	28	27	26	25
Snook	35	77	117	158	198	221
Somervell County Water District	125	282	444	598	619	614
Somerville	20	47	60	61	60	60
Southwest Milam WSC	140	331	475	499	527	560

WUG	Additional Water Saved - W/ Advanced Conservation (ac-ft)					
	2030	2040	2050	2060	2070	2080
Sportsmans World MUD	7	14	22	29	36	43
Spring Valley WSC	43	49	53	59	66	72
Stamford	304	349	379	394	339	274
Stephens Regional SUD	42	106	107	109	114	121
Strawn	32	44	56	59	58	58
Sweetwater	15	15	14	14	14	14
Taylor	289	413	555	687	835	1,001
TDCJ Luther Units	28	59	91	124	135	135
TDCJ W Pack Unit	36	81	126	173	186	186
Temple	2,375	5,762	9,836	13,473	14,215	15,045
Texas A&M University	957	1,979	3,037	4,095	5,131	6,189
Texas State Technical College	197	399	600	803	1,005	1,206
The Bitter Creek WSC	120	124	129	136	142	151
Throckmorton	12	24	36	39	38	35
Tolar	5	5	6	6	8	8
Tri County SUD	43	42	40	38	37	35
Twin Creek WSC	17	40	60	73	69	66
Valley Mills	18	48	49	50	52	51
Venus	33	57	53	50	46	43
View Caps WSC	11	10	11	12	13	13
Vista Oaks MUD	44	59	59	59	59	59
Waco	3,008	7,396	12,685	16,949	18,261	19,732
Walsh Ranch MUD	13	17	17	17	17	17
Wellborn SUD	504	1,264	1,919	2,268	2,659	3,098
West	36	64	66	68	70	73
West Bell County WSC	59	108	113	117	120	125
West Brazos WSC	37	39	39	42	45	48
Whitney	33	75	76	77	79	80
Williamson County MUD 10	60	81	81	81	81	81
Williamson County MUD 11	93	181	245	315	394	483
Williamson County WSID 3	74	225	444	646	779	933
Williamson Travis Counties MUD 1	51	88	89	90	89	90
Windsor Water	3	2	2	2	2	3
Woodrow Osceola WSC	43	102	104	106	108	111
Woodway	348	744	1,145	1,547	1,948	2,361
Total	**36,810**	**76,095**	**106,066**	**136,075**	**159,347**	**186,034**

2.1.4 Environmental Issues

No substantial environmental impacts are anticipated, as water conservation is typically a non-capital intensive alternative that is not associated with direct physical impacts to the natural environment. A summary of the few potential environmental issues that might arise for this alternative are presented in Table 2-5.

Table 2-5 Environmental Issues: Municipal Water Conservation

Issue	Description
Implementation Measures	Voluntary reduction, reduced diversions, changing water pricing, mandatory restrictions (landscaping ordinances, watering days), reducing unaccounted for water
Environmental Water Needs / Instream Flows	No substantial impact identified, assuming relatively low reduction in diversions and return flows; substantial reductions in municipal and industrial diversions from water conservation would potentially result in low to moderate positive impacts as more stream flow would be available for environmental water needs and instream flows
Bays and Estuaries	No substantial impact identified, assuming relatively low reduction in diversions and return flows
Fish and Wildlife Habitat	No substantial impact identified, assuming relatively low reductions in diversions and return flows; potential low to moderate positive impact to aquatic and riparian habitats with substantial reductions as more stream flow would be available to these habitats; potential moderate positive benefits from implementation of site-specific xeriscape landscaping
Cultural Resources	No substantial impacts anticipated.
Threatened and Endangered Species	No substantial impact identified, assuming relatively low reduction in diversions and return flows; potential low to moderate positive impact to aquatic and riparian threatened and endangered species (where they occur) with substantial diversion reductions
Comments	Assumes no substantial change in infrastructure with attendant landscape impacts; further assumes that infrastructure improvements which do occur will largely be in urbanized settings

2.1.5 Engineering and Costing

The TWDB requires that costs and water supply estimates be developed for each recommended water management strategy. For the BMPs listed above in Section 2.1.2, water savings (yield) and costs to implement these strategies reported in TWDB guidance documents are summarized in Table 2-6. Costs and savings presented are general and often sparse, based on a range of variables affecting implementation and level of success.

Table 2-6 Costs and Savings of Municipal Water Conservation Techniques (BMPs)

BMPs	Water Savings Estimate				Costs Estimate				Note
	Min	Max	Average	Saving Metric	Min	Max	Average	Cost Metric	
2.3 Water Survey for Single-Family and Multi-Family Customers	Showerhead and Aerators: 5.5 gpd per person. Single-Family Home Irrigation Audit: 26 gallons per day (gpd) per house. Multi-Family Community Irrigation Audit: 15% of outdoor water use or 208 gpd.				The labor costs range from $50 to $150 for a SF survey and start at $100 for a MF survey. Fixture Giveaways: -Showerheads: <$2 each. -Aerators: <$1 each. -Flappers: $3–$10 each. -Additional one-time costs: leak detection equipment and meters. -Marketing/outreach: $5–$15 per survey. -Administrative/overhead: 10–20% of labor costs.				
3.1 Water Conservation Pricing	1	3	2	%	Cost to utilities should be negligible				Elasticity studies have shown an average reduction in water use of 1 to 3 percent for every 10 percent increase in the average monthly water bill.
5.1 Athletic Field Conservation 5.2 Golf Course Conservation 5.4 Park Conservation	15	25	20	%	Labor: $250 - $1,000, Marketing and outreach: $5 -$15, Admin: 10% - 20%				Irrigation surveys: Athletic fields without CCIS: 15%–25% savings if efficiency measures are implemented. Cost and savings of other measures should be evaluated in a case-by-case basis.

BMPs	Water Savings Estimate				Costs Estimate				Note
	Min	Max	Average	Saving Metric	Min	Max	Average	Cost Metric	
5.3 Landscape Irrigation Conservation and Incentives	15% savings per TWDB Guidance			%	Labor Costs: - Single-Family (SF): $50–$100 per survey. - Industrial, Commercial, Institutional (ICI): $100+ per survey (varies by size and scope). One-Time Costs: Leak detection equipment and meters. Marketing/Outreach: $5–$15 per survey. Admin: 10%–20% of labor costs.				
5.6 Outdoor Watering Schedule	2	11	6.5	%	Cost to utilities should be negligible				Estimated savings from no more than twice per week outdoor watering schedules per a 2018 Texas Study
6.1 Public Information	Hard to quantify				$ 0.50	$ 3	$ 1.75	$/customer	
6.2 School Education	Hard to quantify				$ 1	$ 35	$ 18	$/student	Curriculum Units: $1–$3 per student. Educational Entertainment: $2–$5 per student. Prepackaged Programs: Up to $35 per student. Additional Costs: Utility staff oversight and outreach to schools/students.
6.3 Public Outreach and Education	Hard to quantify				0.25	Several dollars	n/a	$/student	

BMPs	Water Savings Estimate				Costs Estimate				Note
	Min	Max	Average	Saving Metric	Min	Max	Average	Cost Metric	
7.2 Residential Clothes Washer Incentive Program	n/a				Rebate: $50-$100 Labor: $15 - $35 Marketing and outreach: $5 - $10 Admin: 10% - 20%				
7.3 Residential Toilet Replacement Program	n/a				Toilet Bulk Purchase: $50 - $70 Labor: $10-$40 Marketing and outreach: $5-$10 Admin: 10%-20%				
7.4 Showerhead, Aerator, and Toilet Flapper Retrofit Program	Showerheads and Faucet Aerators -Initial Savings: 5.5 gpd -Device Life Span: Permanent Device: Toilet Flapper -Initial Savings: Up to 12.8 gpd -Device Life Span: 5 years				Device Costs: -Showerheads: <$2 each. -Aerators: <$1 each. -Toilet Flappers: $3–$10 each. Labor Costs: -Installation (SF): $10–$30 per showerhead/aerator. -$5–$20 per toilet. Marketing/Outreach: $5–$10 per SF customer. Admin: 10%–20% of labor costs.				
7.5 Water Wise Landscape Design and Conversion Programs	Hard to quantify				Rebate: $0.05 -$1/sq ft Staff labor: $50-$100/conversion Marketing and Outreach: $20-$50 Admin: 10%-20%				
7.7 Plumbing Assistance for Economically Disadvantaged Customers	Residential end use data: 12% EPA estimates of leak waste levels: savings vary depending on the types of leaks				Hard to quantify				

Source: TWDB, February 2020. Best Management Practices for Municipal Water User.

2.1.5.1 Water Use Reduction Strategy

Municipal water conservation costs for this strategy were developed using the TWDB Municipal Water Conservation Planning Tool with an inflation adjustment (i.e., 22% from November 2018 to September 2023). The tool allows the user to include a mix of BMPs, and produces the expected annual conservation savings and associated capital and annual costs. The tool came with population and water demand projections (and other data such as number of connections) for municipal water user groups. The tool includes user-based functionality to load baseline demand projections, select conservation measures (plan or single-year savings) based on implementation activity, manage scenarios (to evaluate various BMP combinations) and use this information to calculate water savings and costs. The tool includes the following pre-defined BMPs:

- High Efficiency (HE) Toilet Rebate
- Bathroom Retrofit
- Showerhead and Aerator Kit
- Clothes Washer Rebate
- Home Water Reports
- Irrigation Audits- High Users
- High Efficiency Sprinkler Nozzle Rebate
- Smart Irrigation Controller Rebate
- WaterWise Landscape Rebate
- Rainwater Harvesting Rebate, and
- Rain Barrel

The costs to implement these BMPs ranges from $331 to $1,658 per acft saved, with the showerhead kit being the most economical ($331 per acft saved) and clothes washer rebates and rain barrels being the most expensive at $1,658 and $1,545 per acft in September 2023 dollars, respectively. Since the TWDB tool only included 75 of the 246 Brazos G individual discrete municipal water user groups from the previous cycle, three Brazos G water user groups were selected to represent a range of Small, Medium and Large utilities for costing purposes.

The City of Hico records in the TWDB tool were considered representative of “Small” Brazos G municipal water users; the City of Taylor was considered representative of “Medium” Brazos G municipal water users; and the City of Waco was considered representative of “Large.” Although the TWDB tool does not present costs for the most common water conservation BMPs from local water conservation plans in the Brazos G Area, the following BMPs from the TWDB tool were selected to estimate a unit cost for municipal water conservation: HE Toilet Rebate, Bathroom Retrofit, Showerhead and Aerator Kit, Home Water Reports, and WaterWise Landscape Rebate. The costs to implement these BMPs was $684 per acft water saved in September 2023 dollars and did not vary much amongst small, medium, and large users.

2.1.5.2 Water Loss Mitigation Strategy

The cost estimates for the Water Loss Mitigation Strategy were calculated using the following methodology:

Capital cost: Water Main Replacements

The length of water main replacement is assumed to be 10% of the real water loss percentage, minus the target of 15%. This calculation assumes that Brazos G WUGs will focus on replacing the top 10% of the most leaking pipes compared to the average length of mains required to achieve the desired savings. For example, if a system has a water loss of 100 gallons per mile per year and aims to reduce the loss by half, with a total real water loss of 100,000 gallons per year, it would need to replace:

$$\frac{1}{2} \times \frac{100{,}000\,\mathrm{gallons/year}}{100\,\mathrm{gallons/mile/year}} = 50\,\mathrm{miles}$$

This suggests that, on average, this system needs to replace 50 miles of main. However, the Brazos G RWPG recognizes that entities are likely to target the most leaking pipes, achieving similar savings with fewer replacements. Therefore, a factor of 10% is used to represent targeted water main replacement.

The unit cost of main replacement is derived from the TWDB UCM model for an 8-inch PVC pipe: $198 per linear foot in rural rocky areas and $287 per linear foot in urban rocky areas.

An interest rate of 3.5% and a 20-year term are assumed.

Annual O&M Cost: Leak Detection And Management Program

To achieve and maintain the projected water loss reduction, entities are expected to spend $300 per acre-foot per year (ac-ft/yr) to achieve a 34.7% reduction in water loss from their baseline year and $600/ac-ft/yr to achieve additional savings beyond the 34.7%. These cost estimates are based on a 2022 water loss study that analyzed data from over 800 utilities in California, Texas, and Georgia. The study found that it is economically efficient for a median utility to reduce water losses by 34.7% at a cost of $277/ac-ft/yr. Adjusted for inflation, the rounded cost of $300/ac-ft/yr was adopted. Achieving savings beyond 34.7% is expected to be significantly more challenging, warranting a doubled cost factor to reflect the increased difficulty and expense.

2.1.5.3 Summary

The total program costs for municipal entities having per capita use greater than 140 gpcd and/or with a water loss mitigation strategies are presented in Table 2-7. Total conservation potential costs for Brazos G are estimated at around 33.5 million in 2030 and increasing to $125 million by 2080. The BGRWPG has expressed a desire to offer BMPs to encourage conservation while maintaining flexibility for municipal users to adopt strategies that suit them the best.

Table 2-7 Estimated Cost of Conservation to Achieve Water Savings Identified in Table 2-4

WUG	Annual Cost ($)						Capital Cost ($)
	2030	2040	2050	2060	2070	2080	
439 WSC	$77,292	$195,624	$221,616	$243,504	$260,604	$268,812	$0
Abilene	$1,364,580	$3,515,076	$4,438,476	$4,696,344	$4,982,940	$5,305,104	$0
Acton MUD	$116,280	$303,012	$412,452	$448,020	$486,324	$527,364	$0
Albany	$190,250	$213,868	$125,697	$141,442	$149,496	$127,712	$1,514,686
Armstrong WSC	$35,568	$38,988	$42,408	$44,460	$47,196	$49,932	$0
Aspermont	$14,364	$28,728	$41,040	$52,668	$61,560	$66,348	$0
Axtell WSC	$17,100	$18,468	$20,520	$23,256	$25,992	$28,044	$0
Baird	$17,784	$39,672	$58,824	$58,824	$57,456	$56,772	$0
Bartlett	$143,020	$164,466	$102,490	$112,750	$111,180	$111,623	$1,185,617
Bell County WCID 1	$5,472	$12,312	$19,152	$25,992	$32,832	$38,988	$0
Bell County WCID 2	$17,100	$43,776	$45,828	$46,512	$47,880	$49,248	$0
Bell County WCID 3	$141,773	$208,697	$240,012	$293,952	$306,228	$319,488	$317,286
Bell Milam Falls WSC	$764,026	$789,165	$133,622	$135,674	$137,157	$139,041	$9,343,620
Belton	$274,968	$318,744	$373,464	$423,396	$465,120	$493,848	$0
Benjamin	$3,420	$6,840	$9,576	$12,996	$14,364	$12,312	$0
Bethesda WSC	$404,928	$1,048,572	$1,549,260	$1,716,840	$1,904,256	$2,114,928	$0
Bistone Municipal Water Supply District	$15,732	$30,780	$45,144	$58,824	$69,768	$80,028	$0
Block House MUD	$23,940	$20,520	$19,836	$19,152	$19,152	$17,784	$0
Brandon Irene WSC	$30,780	$71,136	$114,228	$158,004	$177,840	$183,312	$0
Breckenridge	$47,196	$62,244	$56,772	$54,036	$50,616	$45,144	$0
Bremond	$8,208	$18,468	$21,204	$20,520	$19,836	$19,152	$0
Brenham	$233,928	$532,152	$832,428	$1,109,448	$1,110,816	$1,112,184	$0
Bruceville Eddy	$97,128	$235,296	$389,880	$569,772	$653,904	$698,364	$0
Brushy Creek MUD	$203,832	$481,536	$753,084	$903,564	$903,564	$903,564	$0

WUG	Annual Cost ($)						Capital Cost ($)
	2030	2040	2050	2060	2070	2080	
Bryan	$964,440	$2,225,052	$2,635,452	$3,124,512	$3,935,052	$4,954,212	$0
Cade Lakes WSC	$97,495	$105,703	$44,766	$51,144	$51,144	$49,998	$963,268
Caldwell	$49,932	$110,808	$166,896	$166,212	$164,844	$163,476	$0
Calvert	$15,048	$32,148	$48,564	$64,296	$61,560	$58,824	$0
Cameron	$70,452	$151,164	$231,192	$268,812	$259,920	$249,660	$0
Cedar Park	$1,155,960	$2,639,556	$4,176,504	$5,297,580	$5,297,580	$5,297,580	$0
Cego-Durango WSC	$12,996	$14,364	$16,416	$17,784	$19,836	$23,256	$0
Central Bosque WSC	$6,840	$10,260	$10,260	$10,260	$11,628	$11,628	$0
Central Texas College District	$17,100	$35,568	$54,720	$74,556	$94,392	$94,392	$0
Central Washington County WSC	$95,606	$96,272	$15,314	$16,312	$17,311	$18,643	$1,141,145
Chalk Bluff WSC	$6,840	$6,156	$6,156	$7,524	$8,208	$8,892	$0
Chappell Hill WSC	$6,156	$12,996	$20,520	$19,836	$19,152	$19,152	$0
Chatt WSC	$94,385	$99,857	$26,016	$26,700	$26,700	$28,118	$1,054,675
Childress Creek WSC	$443,723	$465,172	$102,515	$120,103	$116,487	$113,800	$5,446,554
Cisco	$36,936	$75,240	$77,976	$78,660	$78,660	$80,028	$0
Cleburne	$391,248	$1,014,372	$1,614,240	$1,760,616	$1,925,460	$2,109,456	$0
Clifton	$41,040	$99,864	$173,052	$186,048	$199,728	$215,460	$0
College Station	$1,256,508	$3,415,212	$4,017,132	$4,722,336	$4,638,204	$4,564,332	$0
Comanche	$44,878	$44,503	$24,353	$24,353	$23,979	$23,979	$281,057
Coolidge	$6,840	$15,732	$15,732	$15,048	$14,364	$13,680	$0
Corix Utilities Texas Inc	$190,152	$403,560	$417,924	$426,816	$439,812	$452,808	$0
Coryell City Water Supply District	$58,140	$92,340	$93,024	$92,340	$93,708	$92,340	$0
County-Other, Bell	$25,308	$25,992	$27,360	$25,308	$21,888	$16,416	$0
County-Other, Eastland	$92,091	$91,338	$10,535	$9,782	$8,277	$6,772	$1,132,368
County-Other, Erath	$193,383	$207,657	$210,848	$231,647	$254,893	$281,402	$203,892
County-Other, Falls	$96,876	$89,280	$59,502	$51,484	$41,356	$27,008	$309,262

WUG	Annual Cost ($)						Capital Cost ($)
	2030	2040	2050	2060	2070	2080	
County-Other, Haskell	$57,983	$56,619	$46,398	$45,943	$45,033	$44,124	$119,400
County-Other, Lee	$2,985	$2,985	$1,800	$1,500	$1,500	$1,500	$12,571
County-Other, Williamson	$403,560	$1,222,992	$1,530,108	$1,900,152	$2,348,172	$2,910,420	$0
Crawford	$10,944	$28,044	$49,248	$62,244	$68,400	$75,924	$0
Cross Country WSC	$34,200	$93,708	$103,284	$112,860	$124,488	$137,484	$0
Cross Plains	$10,944	$25,308	$39,672	$44,460	$43,776	$43,092	$0
Deanville WSC	$17,784	$43,776	$43,776	$43,092	$42,408	$42,408	$0
Dog Ridge WSC	$216,065	$295,212	$226,028	$238,320	$252,398	$266,896	$1,236,358
Double Diamond Utilities	$214,776	$471,960	$759,240	$1,076,616	$1,433,664	$1,842,012	$0
East Bell WSC	$19,836	$17,100	$15,732	$15,048	$14,364	$14,364	$0
East Crawford WSC	$19,836	$44,460	$71,136	$100,548	$132,696	$149,796	$0
Eastland	$40,356	$34,200	$31,464	$28,728	$27,360	$25,308	$0
Eula WSC	$446,477	$448,345	$67,263	$69,599	$71,467	$74,270	$5,442,644
Fern Bluff MUD	$61,560	$150,480	$243,504	$316,692	$317,376	$317,376	$0
Files Valley WSC	$47,196	$125,172	$132,012	$138,852	$146,376	$155,268	$0
Flat WSC	$11,628	$25,308	$39,672	$52,668	$60,192	$60,192	$0
Florence	$12,312	$12,312	$13,680	$14,364	$15,732	$17,100	$0
Fort Belknap WSC	$1,814,157	$1,814,603	$73,008	$74,343	$75,234	$77,014	$24,777,555
Fort Gates WSC	$25,992	$58,140	$77,976	$77,292	$76,608	$75,924	$0
Fort Griffin SUD	$10,944	$22,572	$23,256	$25,308	$22,572	$22,572	$0
Fort Hood	$452,124	$1,084,140	$1,754,460	$2,162,124	$2,239,416	$2,316,024	$0
Gatesville	$715,700	$1,011,438	$1,122,930	$1,423,602	$1,526,994	$1,533,653	$3,017,166
Georgetown	$0	$0	$0	$4,695,660	$12,651,948	$22,725,216	$0
Giddings	$60,192	$139,536	$179,208	$176,472	$172,368	$167,580	$0
Glen Rose	$31,464	$75,924	$118,332	$118,332	$117,648	$116,964	$0
Gordon	$25,856	$36,800	$36,865	$47,809	$47,809	$46,441	$154,621

WUG	Annual Cost ($)						Capital Cost ($)
	2030	2040	2050	2060	2070	2080	
Graham	$142,956	$307,116	$461,016	$619,020	$772,920	$822,168	$0
Granbury	$153,900	$428,184	$480,852	$538,308	$601,920	$674,424	$0
Grandview	$10,944	$11,628	$12,996	$14,364	$16,416	$17,100	$0
Granger	$8,892	$19,836	$21,888	$23,256	$24,624	$26,676	$0
Groesbeck	$37,357	$59,245	$51,432	$50,064	$48,696	$46,644	$91,604
Hamilton	$174,367	$215,659	$124,398	$122,850	$120,617	$118,385	$1,297,035
Hamlin	$16,416	$32,832	$38,304	$32,832	$29,412	$26,676	$0
Harker Heights	$385,092	$1,078,668	$1,221,624	$1,266,768	$1,266,768	$1,266,768	$0
Haskell	$29,412	$68,400	$66,348	$66,348	$65,664	$64,980	$0
Hearne	$29,412	$26,676	$25,308	$24,624	$23,940	$21,888	$0
Hewitt	$176,472	$404,928	$404,928	$404,928	$404,928	$404,928	$0
Hico	$3,602	$3,602	$600	$600	$600	$600	$42,673
Highland Park WSC	$8,208	$18,468	$28,728	$37,620	$43,092	$43,092	$0
Hilco United Services	$72,504	$167,580	$227,772	$235,296	$244,188	$254,448	$0
Hillsboro	$186,732	$434,340	$694,944	$807,120	$823,536	$843,372	$0
Hog Creek WSC	$25,308	$52,668	$80,712	$106,020	$131,328	$156,636	$0
Jarrell-Schwertner	$305,484	$293,676	$189,300	$198,000	$206,700	$215,700	$1,594,296
Jayton	$5,472	$12,996	$13,680	$14,364	$14,364	$14,364	$0
Jonah Water SUD	$494,111	$1,276,487	$2,398,380	$3,766,404	$4,703,772	$5,757,900	$1,364,209
Kempner WSC	$841,602	$1,098,353	$666,653	$660,947	$656,209	$649,018	$6,208,534
Knox City	$65,074	$82,858	$70,654	$83,650	$81,855	$82,539	$406,761
Lampasas	$114,506	$192,998	$186,768	$199,980	$206,052	$202,332	$319,468
Lawn	$2,736	$4,788	$4,788	$4,104	$3,420	$2,736	$0
Leander	$517,104	$655,272	$690,156	$689,472	$690,156	$690,156	$0
Levi WSC	$33,516	$77,976	$131,328	$194,940	$205,884	$218,880	$0
Lexington	$19,836	$48,564	$47,196	$46,512	$45,144	$44,460	$0

WUG	Annual Cost ($)						Capital Cost ($)
	2030	2040	2050	2060	2070	2080	
Liberty Hill	$64,891	$73,907	$39,794	$51,297	$64,354	$79,276	$639,482
Little Elm Valley WSC	$108,296	$133,672	$62,372	$66,185	$70,323	$73,811	$1,072,621
Lorena	$166,925	$200,526	$118,426	$122,188	$127,490	$132,791	$1,242,192
Marlin	$77,976	$158,004	$235,296	$306,432	$358,416	$363,204	$0
Mart	$25,308	$54,036	$79,344	$97,812	$87,552	$75,924	$0
McGregor	$146,376	$343,368	$552,672	$812,592	$850,212	$891,936	$0
McLennan County WCID 2	$10,944	$21,888	$20,520	$18,468	$15,732	$12,996	$0
Mexia	$286,599	$283,639	$86,673	$83,714	$80,331	$76,949	$2,751,288
Milano WSC	$25,992	$46,512	$45,828	$45,828	$45,144	$44,460	$0
Mineral Wells	$1,543,936	$1,899,886	$989,207	$1,038,657	$1,038,657	$1,038,657	$13,633,428
Moffat WSC	$122,719	$131,369	$43,039	$38,773	$33,824	$30,926	$1,179,591
Moody	$82,047	$86,453	$42,733	$47,139	$51,985	$56,390	$683,973
Mountain WSC	$18,468	$18,468	$19,152	$19,152	$18,468	$18,468	$0
Munday	$11,628	$28,044	$32,148	$32,148	$32,832	$34,200	$0
Mustang Valley WSC	$23,256	$52,668	$79,344	$90,972	$86,868	$82,764	$0
Navasota	$125,008	$246,292	$266,040	$272,496	$280,620	$288,060	$369,460
Noack WSC	$7,524	$19,152	$30,780	$39,672	$40,356	$41,724	$0
North Bosque WSC	$37,620	$90,972	$158,004	$240,084	$336,528	$377,568	$0
North Milam WSC	$8,892	$20,520	$19,152	$18,468	$17,784	$17,784	$0
Paloma Lake MUD 1	$36,936	$50,616	$50,616	$50,616	$50,616	$50,616	$0
Paloma Lake MUD 2	$26,676	$36,252	$36,252	$36,252	$36,252	$36,252	$0
Parker WSC	$2,736	$2,052	$2,736	$2,736	$2,736	$2,736	$0
Pendleton WSC	$21,204	$45,144	$47,196	$47,880	$49,932	$51,984	$0
Possum Kingdom WSC	$34,884	$77,292	$115,596	$155,952	$195,624	$233,928	$0
Post Oak SUD	$17,100	$41,040	$63,612	$66,348	$64,296	$65,664	$0
Prairie Hill WSC	$14,364	$36,252	$44,460	$48,564	$50,616	$53,352	$0

WUG	Annual Cost ($)						Capital Cost ($)
	2030	2040	2050	2060	2070	2080	
Ranger	$21,204	$32,832	$31,464	$30,780	$29,412	$29,412	$0
Riesel	$20,937	$21,304	$7,688	$8,054	$8,786	$9,152	$198,711
Rio Vista	$9,576	$25,308	$14,364	$16,416	$19,152	$21,204	$0
Rising Star	$6,840	$12,996	$12,312	$11,628	$11,628	$10,944	$0
Robinson	$160,056	$413,820	$742,824	$846,792	$966,492	$1,103,976	$0
Roby	$6,840	$13,680	$21,204	$23,256	$22,572	$22,572	$0
Rockdale	$87,552	$199,728	$305,064	$307,116	$309,168	$311,904	$0
Rogers	$59,036	$62,711	$27,768	$26,655	$25,542	$24,683	$490,520
Roscoe	$12,312	$25,308	$31,464	$30,780	$30,780	$30,096	$0
Rosebud	$57,993	$56,686	$14,376	$13,069	$12,198	$11,762	$588,945
Rotan	$12,312	$21,204	$20,520	$20,520	$19,836	$19,152	$0
Round Rock	$1,586,880	$2,658,708	$3,158,028	$3,266,100	$3,365,964	$3,453,516	$0
Salado WSC	$147,744	$350,208	$610,128	$919,296	$1,303,704	$1,543,788	$0
Salem Elm Ridge WSC	$8,892	$19,836	$19,152	$18,468	$17,784	$17,100	$0
Snook	$23,940	$52,668	$80,028	$108,072	$135,432	$151,164	$0
Somervell County Water District	$85,500	$192,888	$303,696	$409,032	$423,396	$419,976	$0
Somerville	$13,680	$32,148	$41,040	$41,724	$41,040	$41,040	$0
Southwest Milam WSC	$95,760	$226,404	$324,900	$341,316	$360,468	$383,040	$0
Sportsmans World MUD	$4,788	$9,576	$15,048	$19,836	$24,624	$29,412	$0
Spring Valley WSC	$29,412	$33,516	$36,252	$40,356	$45,144	$49,248	$0
Stamford	$240,299	$275,533	$210,939	$226,357	$194,833	$157,407	$1,276,312
Stephens Regional SUD	$28,728	$72,504	$73,188	$74,556	$77,976	$82,764	$0
Strawn	$69,128	$77,336	$32,223	$34,275	$33,867	$33,867	$757,819
Sweetwater	$13,156	$13,156	$4,200	$4,200	$4,200	$4,200	$123,017
Taylor	$201,364	$239,039	$168,628	$208,734	$253,701	$304,137	$1,613,904
TDCJ Luther Units	$19,152	$40,356	$62,244	$84,816	$92,340	$92,340	$0

WUG	Annual Cost ($)						Capital Cost ($)
	2030	2040	2050	2060	2070	2080	
TDCJ W Pack Unit	$24,624	$55,404	$86,184	$118,332	$127,224	$127,224	$0
Temple	$1,624,500	$3,941,208	$6,727,824	$9,215,532	$9,723,060	$10,290,780	$0
Texas A&M University	$654,588	$1,353,636	$2,077,308	$2,800,980	$3,509,604	$4,233,276	$0
Texas State Technical College	$134,748	$272,916	$410,400	$549,252	$687,420	$824,904	$0
The Bitter Creek WSC	$3,295,627	$3,297,483	$59,855	$63,103	$65,887	$70,063	$46,047,450
Throckmorton	$8,208	$16,416	$24,624	$26,676	$25,992	$23,940	$0
Tolar	$3,420	$3,420	$4,104	$4,104	$5,472	$5,472	$0
Tri County SUD	$302,519	$302,183	$13,456	$12,783	$12,447	$11,774	$4,093,943
Twin Creek WSC	$11,628	$27,360	$41,040	$49,932	$47,196	$45,144	$0
Valley Mills	$12,312	$32,832	$33,516	$34,200	$35,568	$34,884	$0
Venus	$22,572	$38,988	$36,252	$34,200	$31,464	$29,412	$0
View Caps WSC	$7,524	$6,840	$7,524	$8,208	$8,892	$8,892	$0
Vista Oaks MUD	$30,096	$40,356	$40,356	$40,356	$40,356	$40,356	$0
Waco	$2,057,472	$5,058,864	$8,676,540	$11,593,116	$12,490,524	$13,496,688	$0
Walsh Ranch MUD	$8,892	$11,628	$11,628	$11,628	$11,628	$11,628	$0
Wellborn SUD	$344,736	$864,576	$1,312,596	$1,551,312	$1,818,756	$2,119,032	$0
West	$24,624	$43,776	$45,144	$46,512	$47,880	$49,932	$0
West Bell County WSC	$40,356	$73,872	$77,292	$80,028	$82,080	$85,500	$0
West Brazos WSC	$25,308	$26,676	$26,676	$28,728	$30,780	$32,832	$0
Whitney	$22,572	$51,300	$51,984	$52,668	$54,036	$54,720	$0
Williamson County MUD 10	$41,040	$55,404	$55,404	$55,404	$55,404	$55,404	$0
Williamson County MUD 11	$63,612	$123,804	$167,580	$215,460	$269,496	$330,372	$0
Williamson County WSID 3	$50,616	$153,900	$303,696	$441,864	$532,836	$638,172	$0
Williamson Travis Counties MUD 1	$34,884	$60,192	$60,876	$61,560	$60,876	$61,560	$0
Windsor Water	$2,052	$1,368	$1,368	$1,368	$1,368	$2,052	$0
Woodrow Osceola WSC	$29,412	$69,768	$71,136	$72,504	$73,872	$75,924	$0

WUG	Annual Cost ($)						Capital Cost ($)
	2030	2040	2050	2060	2070	2080	
Woodway	$238,032	$508,896	$783,180	$1,058,148	$1,332,432	$1,614,924	$0
Total	**$33,532,287**	**$60,263,780**	**$70,362,063**	**$90,741,624**	**$106,528,565**	**$124,635,337**	**$145,740,981**
Note: capital costs are associated with main replacement, and the annual costs from 2030 to 2049 reflect the payback period.							

2.1.6 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 2-8, and the option meets each criterion.

Table 2-8 Comparison of Municipal Water Conservation Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Variable, dependent on current per capita rate
2. Reliability	2. Variable, dependent on public acceptance
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. None or low impact
2. Habitat	2. No apparent negative impact
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None or low impact
5. Threatened and Endangered Species	5. None or low impact
6. Wetlands	6. None or low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Not applicable

2.2 Irrigation Water Conservation

2.2.1 Description of Strategy

Irrigation water use is the use of freshwater that is pumped from aquifers and/or diverted from streams and reservoirs of the planning area and applied directly to grow crops, orchards, and hay and pasture in the study area. Irrigation water is typically applied to land by: (1) flowing or flooding water down furrows; and (2) the use of sprinklers. When groundwater is used, irrigation wells are usually located within the fields to be irrigated. For surface water supplies, typically water is diverted from the source and conveyed by canals and pipelines to the fields. For both groundwater and surface water, the conservation objective is to reduce the quantity of water that is lost to deep percolation and evaporation between the originating points (wells in the case of groundwater, and stream diversion points in the case of surface water), and the irrigated crops in the fields. Thus, the focus is upon investments in irrigation application equipment, instruments, and conveyance facility improvements (canal lining and pipelines) to reduce seepage losses, deep percolation, and evaporation of water, and management of the irrigation processes to improve efficiencies of irrigation water use and reduce the quantities of water needed to accomplish irrigation.

2.2.2 Available Yield

All irrigators in the Brazos G Region are encouraged to conserve water.

The Brazos G RWPG recommends conservation for irrigation WUGs with projected irrigation water needs during the planning period from 2030 to 2080. A voluntary target is recommended for these irrigation entities with needs to reduce water demands by 3% by 2030, 5% by 2040, and 7% from 2050-2080. In the Brazos G Area, 19 counties are projected to have irrigation needs (shortages) during the 2030 to 2080 planning period.

This conservation can be achieved in a variety of ways, including using BMPs identified by the TWDB[12], such as:

1. Irrigation Scheduling;
2. Volumetric Measurement of Irrigation Water Use;
3. Crop Residue Management and Conservation Tillage;
4. On-farm Irrigation audit;
5. Furrow Dikes;
6. Land Leveling;
7. Contour Farming;
8. Conservation of Supplemental Irrigated Farmland to Dry-Land Farmland;
9. Brush Control/Management;
10. Lining of On-Farm Irrigation ditches;
11. Replacement of On-/farm Irrigation Ditches with Pipelines;
12. Low Pressure Center Pivot Sprinkler Irrigation Systems;
13. Drip/Micro-Irrigation System;
14. Gated and Flexible Pipe for Field Water Distribution Systems;
15. Surge Flow Irrigation for Field Water Distribution Systems;

[12] TWDB website: https://www.twdb.texas.gov/conservation/BMPs/Ag/index.asp

16. Linear Move Sprinkler Irrigation Systems;
17. Lining of District Irrigation Canals;
18. Replacement of District Irrigation canals and Lateral canals with Pipelines;
19. Tailwater Recovery and Use System; and
20. Nursery Production Systems.

For the BMPs listed above, water savings (yield) and costs to implement these strategies reported in TWDB guidance documents are summarized in Table 2-9. The TWDB describes how the BMPs reduce irrigation water use, however information regarding specific water savings and costs to install irrigation water saving systems is generally unavailable.

The Brazos G RWPG does not recommend specific conservation BMPs for irrigation entities, as each entity should choose those conservation strategies that best fit their individual situation.

Water savings and costs for three irrigation water conservation BMPs are presented: 1) furrow dikes; 2) low-pressure sprinklers (LESA); and 3) low-energy precision application systems (LEPA). These major irrigation water conservation techniques applicable in the Brazos G are described briefly below and used to estimate costs to implement irrigation water conservation programs to achieve target savings.

2.2.2.1 Furrow Dikes

Furrow dikes are small mounds of soil mechanically installed a few feet apart in the furrow. These mounds of soil create small reservoirs that capture precipitation and hold it until it soaks into the soil instead of running down the furrow and out the end of the field. This practice can conserve (capture) as much as 100 percent of rainfall runoff, and furrow dikes are used to prevent irrigation runoff under sprinkler systems. This maintains high irrigation uniformity and increases irrigation application efficiencies. Capturing and holding precipitation that would have drained from the fields replaces required irrigation water on irrigated fields; and furrow dikes have been demonstrated to be useful management tools on both irrigated and non-irrigated cropland.

Use of furrow dikes can have water savings up to 12 percent gross quantity of water applied using sprinkler irrigation. Furrow dikes require special equipment and cost about $7 to $40 per acre in September 2023 dollars.

Table 2-9 Cost and Savings of Possible Irrigation Water Conservation Techniques (BMPs)

Best Management Practices	Water Savings Estimates				Cost Estimates				Assumptions/Notes
	Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric	
Irrigation Scheduling	0.3	0.5	0.4	acft/ac/yr	-	-	-	-	Verification of estimated savings attempted by Pacific NW Lab (1994), results inconclusive.
Volumetric Measurement of Irrigation Water Use	0.0	0.0	0.0	-	-	-	-	-	Helps inform conservation efforts, but does not directly lead to conservation savings. Cost varies.
Crop Residue Management and Conservation Tillage	0.3	1.0	0.6	acft/ac/yr	-	-	-	-	Cost varies, some conservation tillage programs are less expensive than conventional tillage.
On-farm Irrigation audit	-	-	-	-	-	-	-	-	No quantifiable savings or costs. Site and crop use specific.
Furrow Dikes	-	-	0.3	acft/ac/yr	5	30	18	per acre/yr	
Land Leveling	-	-	0.3	acft/ac/yr	150	500	325	per acre	Savings based on leveled rice fields near the Texas Gulf Coast. Costs reflect initial costs (touch-up costs are much less)
Contour Farming	-	-	-	-	5	10	8	per acre	
Conservation of Supplemental Irrigated Farmland to Dry-Land	-	-	-	-	-	-	-	-	
Brush Control/Management	0.3	0.6	0.5	acft/ac/yr	36	203	119	acre/10 yrs	Cost estimates are per a Texas A&M study; county average costs range from $150 to $200
Lining of On-Farm Irrigation ditches	-	-	-	-	3	4	3	per sq ft	Concrete lining saves about 80% (conservative estimate) of original seepage. Cost is for concrete lining.
Replacement of On-/farm Irrigation Ditches with Pipelines	-	-	-	-	-	-	-	-	
Low Pressure Center Pivot Sprinkler Irrigation Systems	0.3	0.7	0.5	acft/yr	300	500	400	per acre	Savings based on fraction. "Min" water savings estimate based on fair conditions.
Drip/Micro-Irrigation System	-	-	-	-	800	1,200	1,000	per acre	Costs reflect installation costs only (no O&M)
Gated and Flexible Pipe for Field Water Distribution Systems	-	-	-	-	20	25	23	per acft/yr	*Assuming that 0.25 acft/ac/yr of water is saved
Surge Flow Irrigation for Field Water Distribution Systems	0.1	0.4	0.3	acft/yr	20	25	23	per acft/yr	Savings based on a percentage. Cost estimates assume that 0.25 acft/ac/yr of water is saved by using a surge valve
Linear Move Sprinkler Irrigation Systems	0.3	0.7	0.5	acft/yr	300	700	500	per acre	Savings based on fraction. "Min" water savings estimate based on fair conditions.
Lining of District Irrigation Canals	-	-	-	-	3	4	3	per sq ft	Cost of concrete lining
Replacement of District Irrigation canals and Lateral canals with Pipelines	-	-	-	-	-	-	-	-	
Tailwater Recovery and Use System	0.5	1.5	1.0	acft/ac/yr	-	-	-	-	Cost Varies widely
Nursery Production Systems	-	-	-	-	-	-	-	-	

Source: TWDB Best Management Practices for Agricultural Water Users, 2013.
https://www.twdb.texas.gov/conservation/BMPs/Ag/index.asp

2.2.2.2 Low Elevation Spray Application (LESA) and Low Energy Precision Application (LEPA)

Low Elevation Spray Application (LESA) with 75 to 90 percent application efficiency improve irrigation application efficiency in comparison to conventional furrow irrigation by reducing water requirements per acre by 15 percent. Low Energy Precision Application (LEPA) systems involve a sprinkler system that has been modified to discharge water directly into furrows at low pressure, thus reducing evaporation losses. When used in conjunction with furrow dikes, which hold both precipitation and sprinkler applied water behind small mounds of earth within the furrows, LEPA systems can accomplish the irrigation objective with less water than is required for the furrow irrigation and pressurized sprinkler methods.

If LEPA is used with furrow dike systems an expected efficiency of 80 to 95 percent is expected. Use of LEPA and furrow dikes allows irrigation farmers to produce equivalent yields per acre at lower energy and labor costs of irrigation. It has been demonstrated that LEPA systems improve production and profitability of irrigation farming. The barriers to installation are high capital costs; with no assurance (at the present time) that the water saved would be available to the irrigation farmer who incurred the costs.

To determine the potential water savings (acft/acre) and cost per acft saved, a five year average of the irrigated acres and water use from 2013-2017 was calculated for each county based on information provided by the USDA National Agricultural Statistics Service.[13] Based on information shown in Table 2-10 for low pressure center pivot sprinkler irrigation systems and linear move sprinkler irrigation systems, an average cost of $550[14] per acre to implement LESA/LEPA technologies was assumed. As a conservative estimate, the amount of water saved (acft/acre) assumed 80 percent application efficiency achieved by LESA or LEPA as compared to traditional non-BMP system with 60% efficiency. As shown in Table 2-10, this conversion to higher efficiency BMP is expected to save between 0.21 to 0.66 acft/acre at a cost of $833 to $2,619 per acft of water saved.

A 15 percent reduction in irrigation water demand by 2080 for irrigation counties with needs results in a water savings of up to 15,469 acft/yr in 2080 for the region as seen in Table 2-11.

Table 2-10 Costs and Savings by Implementing LESA/LEPA Water Conservation Techniques (BMPs)

Water User Group	Irrigated Acreage (5 yr avg 2013-2017), acres	Irrigation Water Use (5 yr avg 2013-2017), ac-ft	Cost per acre ($)	Water Saved (acft/acre)*	$ per acft
BELL COUNTY-IRRIGATION	2,008	2,732	550	0.34	1,618
BOSQUE COUNTY-IRRIGATION	1,406	2,610	550	0.46	1,196
BURLESON COUNTY-IRRIGATION	16,909	19,307	550	0.33	1,667
COMANCHE COUNTY-IRRIGATION	20,428	26,087	550	0.33	1,667
GRIMES COUNTY-IRRIGATION	358	468	550	0.33	1,667
HASKELL COUNTY-IRRIGATION	41,460	46,148	550	0.28	1,964
HILL COUNTY-IRRIGATION	548	1,450	550	0.66	833

[13] As of December 2024, it appears that the USDA has published the irrigated acres by counties from a recent year (2022) but the estimated water consumption was not provided. Thus, this analysis was not updated in the 2026 RWP. https://www.nass.usda.gov/Publications/AgCensus/2022/Full_Report/Volume_1,_Chapter_2_County_Level/Texas/

[14] Adjusted for inflation from the 2021 RWP cost, which is $450 per acre.

Water User Group	Irrigated Acreage (5 yr avg 2013-2017), acres	Irrigation Water Use (5 yr avg 2013-2017), ac-ft	Cost per acre ($)	Water Saved (acft/acre)*	$ per acft
JOHNSON COUNTY-IRRIGATION	1,530	1,570	550	0.6	917
JONES COUNTY-IRRIGATION	1,944	2,484	550	0.32	1,719
KNOX COUNTY-IRRIGATION	30,756	33,302	550	0.27	2,037
LAMPASAS COUNTY-IRRIGATION	348	488	550	0.32	1,719
MILAM COUNTY-IRRIGATION	4,850	5,660	550	0.33	1,667
NOLAN COUNTY-IRRIGATION	10,334	12,452	550	0.45	1,222
PALO PINTO COUNTY-IRRIGATION	958	1,497	550	0.43	1,279
ROBERTSON COUNTY-IRRIGATION	32,424	68,119	550	0.53	1,038
STEPHENS COUNTY-IRRIGATION	110	133	550	0.34	1,618
TAYLOR COUNTY-IRRIGATION	1,610	1,914	550	0.32	1,719
THROCKMORTON COUNTY-IRRIGATION	60	121	550	0.21	2,619
WILLIAMSON COUNTY-IRRIGATION	288	369	550	0.36	1,528
YOUNG COUNTY-IRRIGATION	343	641	550	0.47	1,170
Total Region G	**167,540**	**227,416**	**-**	**-**	**-**
Average Region G					**1,543**

Notes: TWDB BMPs for Agricultural Water Users include Low-Pressure Center Pivot and Linear Move Sprinkler Irrigation Systems, with costs ranging from $300 to $700 per acre. An average cost of $450 per acre was used in the 2021 RWP, which is $550 per acre in the September 2023 dollars with inflation adjustment. Water savings assume 60% efficiency for non-BMP systems and 80% efficiency for LEPA/LESA systems, providing a conservative estimate.

Table 2-11 Projected Irrigation Water Savings (acft/yr) with Conservation

Water User Group	Water Use Reduction Yields (ac-ft/yr)					
	2030	2040	2050	2060	2070	2080
Bell County	93	155	218	218	218	218
Bosque County	90	150	210	210	210	210
Comanche County	788	1,314	1,839	1,839	1,839	1,839
Grimes County	21	36	49	49	49	49
Hamilton County	34	57	80	80	80	80
Haskell County	1,493	2,488	3,483	3,483	3,483	3,483
Hill County	28	46	64	64	64	64
Johnson County	16	28	38	38	38	38
Jones County	81	135	189	189	189	189
Knox County	1,111	1,851	2,592	2,592	2,592	2,592
Lampasas County	13	22	31	31	31	31
McLennan County	154	256	359	359	359	359

Water User Group	Water Use Reduction Yields (ac-ft/yr)					
	2030	2040	2050	2060	2070	2080
Nolan County	389	648	880	863	852	852
Palo Pinto County	65	108	152	152	152	152
Robertson County	2,198	3,664	5,129	5,129	5,129	5,129
Stephens County	5	8	11	11	11	11
Taylor County	42	72	100	100	100	100
Williamson County	12	20	28	28	28	28
Young County	19	32	45	45	45	45
Total Region G:	**6,652**	**11,090**	**15,497**	**15,480**	**15,469**	**15,469**

2.2.3 Environmental Issues

The irrigation water conservation methods described above have been developed and tested through public and private sector research, and have been adopted and applied within the region. Hundreds of LEPA systems have been installed and are in operation today, and experience has revealed no significant environmental issues associated with this water management strategy. This method improves water use efficiency without making significant changes to wildlife habitat. This method of application, when coupled with furrow dikes, reduces runoff of both applied irrigation water and rainfall. These actions result in the reduced transport of sediment, fertilizers, pesticides and other chemicals tat have been applied to the crops. Thus, the proposed conservation practices are not anticipated to have significant potential adverse environmental effects and may have potentially beneficial environmental effects.

2.2.4 Engineering and Costing

The Brazos G RWPG recommended irrigation water conservation as a water management strategy for irrigation needs, resulting in a total water savings of 6,652 acft/yr beginning in 2030, 15,497 acft/yr in 2050 and 15,469 acft/yr in 2080 as shown in Table 2-11. Brazos G recommends the use of furrow, LESA, and LEPA systems described above but supports flexibility for each WUG to voluntarily decide which of these or other options might serve them best. An average cost of implementing furrow dikes, LESA, and LEPA programs of $550 per acre in September 2024 dollars and water savings rate shown in Table 2-9 were used to calculate a cost per acft of water saved. This was then used to calculate a total estimated cost based on water saved in Table 2-11. The total cost of implementing these three BMPs for Brazos G entities is estimated to cost $10 million in 2030 and 24 million in 2050 as shown in Table 2-12.

Each of the three irrigation water conservation strategies described (furrow dikes, LESA, and LEPA) have the potential to increase water savings beyond the minimum recommended by the Brazos G RWPG; however, none of the strategies can accomplish water savings sufficient to meet all of the projected needs. Further studies are needed to consider other irrigation water conservation BMPs that can be applied to surface applications to increase their application efficiencies.

Table 2-12 Brazos G Irrigation Water Savings and Estimated Costs

Water User Group	Water Use Reduction Yields (ac-ft/yr)						$ per ac-ft water saved	Costs of Water Savings ($)					
	2030	2040	2050	2060	2070	2080		2030	2040	2050	2060	2070	2080
Irrigation, Bell	93	155	218	218	218	218	1,618	$ 150,441	$ 250,735	$ 352,647	$ 352,647	$ 352,647	$ 352,647
Irrigation, Bosque	90	150	210	210	210	210	1,196	$ 107,609	$ 179,348	$ 251,087	$ 251,087	$ 251,087	$ 251,087
Irrigation, Comanche	788	1,314	1,839	1,839	1,839	1,839	1,667	$ 1,313,333	$ 2,190,000	$ 3,065,000	$ 3,065,000	$ 3,065,000	$ 3,065,000
Irrigation, Grimes	21	36	49	49	49	49	1,667	$ 35,000	$ 60,000	$ 81,667	$ 81,667	$ 81,667	$ 81,667
Irrigation, Hamilton	34	57	80	80	80	80	1,543	$ 52,464	$ 87,955	$ 123,445	$ 123,445	$ 123,445	$ 123,445
Irrigation, Haskell	1,493	2,488	3,483	3,483	3,483	3,483	1,964	$ 2,932,679	$ 4,887,143	$ 6,841,607	$ 6,841,607	$ 6,841,607	$ 6,841,607
Irrigation, Hill	28	46	64	64	64	64	833	$ 23,333	$ 38,333	$ 53,333	$ 53,333	$ 53,333	$ 53,333
Irrigation, Johnson	16	28	38	38	38	38	917	$ 14,667	$ 25,667	$ 34,833	$ 34,833	$ 34,833	$ 34,833
Irrigation, Jones	81	135	189	189	189	189	1,719	$ 139,219	$ 232,031	$ 324,844	$ 324,844	$ 324,844	$ 324,844
Irrigation, Knox	1,111	1,851	2,592	2,592	2,592	2,592	2,037	$ 2,263,148	$ 3,770,556	$ 5,280,000	$ 5,280,000	$ 5,280,000	$ 5,280,000
Irrigation, Lampasas	13	22	31	31	31	31	1,719	$ 22,344	$ 37,813	$ 53,281	$ 53,281	$ 53,281	$ 53,281
Irrigation, McLennan	154	256	359	359	359	359	1,543	$ 237,632	$ 395,024	$ 553,959	$ 553,959	$ 553,959	$ 553,959
Irrigation, Nolan	389	648	880	863	852	852	1,222	$ 475,444	$ 792,000	$ 1,075,556	$ 1,054,778	$ 1,041,333	$ 1,041,333
Irrigation, Palo Pinto	65	108	152	152	152	152	1,279	$ 83,140	$ 138,140	$ 194,419	$ 194,419	$ 194,419	$ 194,419
Irrigation, Robertson	2,198	3,664	5,129	5,129	5,129	5,129	1,038	$ 2,280,943	$ 3,802,264	$ 5,322,547	$ 5,322,547	$ 5,322,547	$ 5,322,547
Irrigation, Stephens	5	8	11	11	11	11	1,618	$ 8,088	$ 12,941	$ 17,794	$ 17,794	$ 17,794	$ 17,794
Irrigation, Taylor	42	72	100	100	100	100	1,719	$ 72,188	$ 123,750	$ 171,875	$ 171,875	$ 171,875	$ 171,875
Irrigation, Williamson	12	20	28	28	28	28	1,528	$ 18,333	$ 30,556	$ 42,778	$ 42,778	$ 42,778	$ 42,778
Irrigation, Young	19	32	45	45	45	45	1,170	$ 22,234	$ 37,447	$ 52,660	$ 52,660	$ 52,660	$ 52,660
Total Region G	**6,652**	**11,090**	**15,497**	**15,480**	**15,469**	**15,469**		**$ 10,252,239**	**$ 17,091,701**	**$ 23,893,332**	**$ 23,872,554**	**$ 23,859,110**	**$ 23,859,110**

2.2.5 Implementation Issues

Irrigation demand reduction through water conservation is being implemented throughout the Brazos G Area and the State of Texas. The rate of adoption of efficient water-use practices is dependent upon public knowledge of the benefits, information about how to implement water conservation measures, and financing.

There is widespread public support for irrigation water conservation and it is being implemented at a steady pace, and as water markets for conserved water expand, this practice will likely reach its maximum potential. A major barrier to implementation of water conservation is financing. The TWDB has irrigation conservation programs that may provide funding to irrigators to implement irrigation BMPs that increase water use efficiency. Future planning efforts should consider the use of detailed studies to fully determine the maximum potential benefits of additional irrigation conservation.

This option is compared to the plan development criteria in Table 2-13 and meets most criteria.

Table 2-13 Comparison of Irrigation Conservation to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Firm Yield: Variable according to BMP selected.
2. Reliability	2. High reliability
3. Cost	3. High for internal use (based on BMP selected)
B. Environmental factors	
1. Environmental Water Needs	1. None or low impact
2. Habitat	2. None or low impact
3. Cultural Resources	3. No apparent negative impact
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. None
6. Wetlands	6. No cultural resources affected
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Feasible Strategies	Standard analyses and methods used
F. Requirements for Interbasin Transfers	None
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

2.3 Industrial Water Conservation

2.3.1 Description of Strategy

Water uses for industrial purposes (manufacturing, steam-electric power generation, and mining) are primarily associated with manufacturing products, cleaning and waste removal, waste heat removal, dust control, landscaping, and mine dewatering.

Manufacturing is an important part of the Brazos G Area's economy, and industries use water as a component of the final product, for cooling, and cleaning/wash-down of parts and/or products. Regional industries that are major water users include food and kindred products, apparel, fabricated metal, machinery, and stone and concrete production. There are 28 counties in the Brazos G Area with projected manufacturing needs: Bell, Bosque, Brazos, Burleson, Comanche, Coryell, Eastland, Erath, Fisher, Grimes, Hamilton, Haskell, Hill, Hood, Johnson, Lampasas, Lee, Limestone, McLennan, Nolan, Palo Pinto, Robertson, Somervell, Stephens, Taylor, Washington, Williamson, and Young. In 2080, the estimated manufacturing water needs for the Brazos G Region are 4,374 acft/yr, which is 22% of the manufacturing water demand for the Region.

In the Brazos G Area, the trends for steam-electric water demands are projected to be 158,660 acft/yr from 2030 through 2080. Limestone, Robertson, and Somervell Counties comprise over 80 percent of the projected regional steam-electric water demand in 2080. There are twelve (12) counties in the Brazos G Area with projected steam-electric needs: Bell, Bosque, Brazos, Grimes, Hood, Johnson, Limestone, McLennan, Palo Pinto, Robertson, Somervell, and Young. In 2080, the estimated water needs are 28,280 acft/yr, which is 18% of the steam-electric water demand for the Brazos G Area.

In the Brazos G Area, the mining water demands are expected to decrease 4% between 2030 and 2080, from 26,355 acft to 25,188 acft. Brazos, Burleson, Hood, Limestone, and Somervell counties account for 74 percent of total mining water use in 2080.

2.3.2 Available Yield

All mining entities in the Brazos G Region are encouraged to conserve water.

The Brazos G RWPG recommends that counties with projected needs (shortages) for industrial users (manufacturing or mining) reduce those water demands by 3 percent by 2030, 5 percent by 2040, and 7 percent from 2050 to 2080 by using BMPs identified by the TWDB.

The Brazos G RWPG considered water conservation as a water management strategy for steam-electric users, but opted not to recommend water conservation due to variability in processes and water use practices.

The TWDB lists the following industrial BMPs that may be used to achieve the recommended water savings[15]:

- Industrial Water Audit
- Industrial Water Waste Reduction
- Industrial Submetering
- Cooling Towers
- Cooling Systems (other than Cooling Towers)
- Industrial Alternative Sources and Reuse and Recirculation of Process Water
- Rinsing/Cleaning
- Water Treatment

[15] TWDB website: https://www.twdb.texas.gov/conservation/BMPs/Ind/index.asp

- Boiler and Steam Systems
- Refrigeration (including Chilled Water)
- Once-Through Cooling
- Management and Employee Programs
- Industrial Facility Landscaping
- Industrial Site-Specific Conservation

For the BMPs listed above, water savings (yield) and costs to implement these strategies reported in TWDB guidance documents are summarized in Table 2-14. The TWDB describes how the BMPs reduce water use, however information regarding specific water savings and costs to implement conservation programs is generally unavailable. Conservation savings and costs are facility and process specific. Since mining entities are presented on a county-wide basis and are not individually identified, identification and quantifying of savings of specific water management strategies are not reasonable expectations.

For the fifteen (15) manufacturing users with projected needs, the total manufacturing water savings in 2080 is 974 acft/yr, which amounts to a 22% reduction in total regional manufacturing shortages.

For the thirteen (13) mining users with projected needs, the total mining water savings in 2080 is 1,516 acft/yr, which amounts to a 10% reduction in total regional mining shortages.

Table 2-14 Cost and Savings of Possible Industrial Water Conservation Techniques (BMPs)

Best Management Practices	Water Savings Estimates				Cost Estimates				Assumptions/Notes
	Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric	
Industrial Water Audit	10.0	35.0	22.5	%	-	-	-	-	-
Industrial Water Waste Reduction	-	-	-	-	-	-	-	-	-
Industrial Sub-metering	-	-	-	-	-	-	-	-	-
Cooling Towers	-	-	-	-	-	-	-	-	Highly variable. Savings due to increased concentration ratio and implemented changes in operating procedures. TWDB guidance available for calculating water savings.
Cooling Systems (other than Cooling Towers)	-	90.0	-	%	-	-	-	-	Estimated that retrofitting of single-pass cooling equipment such as x-rays to recirculating water systems can cut water use by up to 90%.
Industrial Alternative Sources and Reuse and Recirculation of Process Water	-	-	-	-	-	-	-	-	-
Rinsing/Cleaning	-	-	-	-	-	-	-	-	-
Water Treatment	10.0	85.0	47.5	%	-	-	-	-	Water savings range widely based on specific updates - from process adjustments to reclaim systems.
Boiler and Steam Systems	-	-	-	-	-	-	-	-	Highly variable. Savings due to increased condensate return and increased concentration ratios. TWDB guidance available for calculating water savings.
Refrigeration (including Chilled Water)	-	-	-	-	-	-	-	-	-
Once-Through Cooling	-	-	-	-	-	-	-	-	-
Management and Employee Programs	-	-	-	-	-	-	-	-	-
Industrial Facility Landscaping	-	-	15.0	%	-	-	-	-	-
Industrial Site Specific Conservation	10.0	95.0	52.5	%	-	-	-	-	Savings vary widely - from water audits to changing from potable to recycled water.

Source: TWDB Best management Practices for Industrial Water Users, February 2013.

https://www.twdb.texas.gov/conservation/BMPs/Ind/index.asp

Table 2-15 Projected Water Savings for Manufacturing and Mining Water User Groups Considering up to a 7 Percent Demand Reduction by 2040

Projected Water Savings for Manufacturing and Mining Water User Groups						
WUG	2030	2040	2050	2060	2070	2080
Manufacturing						
Bell County	29	50	73	75	78	81
Burleson County	4	7	10	11	11	12
Comanche County	1	1	2	2	2	2
Eastland County	2	3	4	5	5	5
Erath County	3	5	7	7	7	8
Hamilton County	1	1	2	2	2	2
Lampasas County	7	12	18	18	19	20
Limestone County	7	13	19	19	21	22
McLennan County	172	298	433	449	465	483
Nolan County	16	28	41	42	44	45
Palo Pinto County	1	1	2	2	2	2
Taylor County	22	37	54	56	58	61
Washington County	21	36	52	54	56	59
Williamson County	58	101	147	152	158	164
Young County	3	5	7	8	8	8
Total Savings	347	598	871	902	936	974
Mining						
Brazos County	80	135	191	192	194	196
Burleson County	167	278	390	390	390	390
Eastland County	10	16	23	23	23	23
Grimes County	7	11	16	16	16	16
Hood County	131	237	356	375	389	399
Limestone County	106	181	262	268	204	209
Milam County	25	42	58	59	59	59
Nolan County	2	4	5	5	5	5
Palo Pinto County	1	1	2	2	2	2
Somervell County	41	73	107	112	115	118
Taylor County	15	27	38	39	39	40
Throckmorton County	3	6	8	8	8	8
Washington County	22	36	51	51	51	51
Total Savings	610	1,047	1,507	1,540	1,495	1,516

2.3.3 Environmental Issues

The Task Force BMPs have been developed and tested through public and private sector research, and have been applied within the region. Such programs have been installed, and are in operation today, and are not expected to have significant environmental issues associated with implementation. For example, most BMPs improve water use efficiency without making significant changes to wildlife habitat. Thus, the proposed conservation practices are not anticipated to have significant potential adverse environmental effects, and may have potentially beneficial environmental effects.

2.3.4 Engineering and Costing

Costs to implement BMPs vary from site to site and the Brazos G RWPG recognizes that industries will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing industrial water conservation strategies.

2.3.5 Implementation Issues

Demand reduction through water conservation is being implemented throughout the Brazos G Area. The rate of adoption of efficient water-using practices is dependent upon public knowledge of the benefits, information about how to implement water conservation measures, and financing.

There is public support for industrial water conservation and it is being implemented at a steady pace. As water markets for conserved water expand, this practice will likely reach greater potentials. The TWDB has industrial water conservation programs including presentations and workshops for utilities who wish to train staff to develop local programs including water use site surveys, publications on industrial water reuse potential, and information on tax incentives for industries that conserve or reuse water. Future planning efforts should consider the use of detailed studies to fully determine the maximum potential benefits of mining conservation.

This option is compared to the plan development criteria in Table 2-16 and the option meets each criterion.

Table 2-16 Comparison of Industrial Conservation to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Manufacturing Firm Yield: up to 1,688 acft/yr (2070) Steam-Electric Firm Yield: up to 14,307 acft/yr (2070) Mining Firm Yield: up to 5,680 acft/yr (2070)
2. Reliability and Cost	2. Good reliability.
3. Cost	3. Cost: Highly variable based on BMP selected and facility specifics.
B. Environmental factors	
1. Instream flows	1. None or low impact.
2. Bay and Estuary Inflows	2. None or low impact.
3. Wildlife Habitat	3. None or low impact.
4. Wetlands	4. None or low impact.

5. Threatened and Endangered Species	5. None.
6. Cultural Resources	6. No cultural resources affected.
7. Water Quality	7. None or low impact.
C. Impacts to State water resources	No apparent negative impacts on water resources
D. Threats to agriculture and natural resources in region	None
E. Recreational impacts	None
F. Equitable Comparison of Strategies	Standard analyses and methods used
G. Interbasin transfers	None
H. Third party social and economic impacts from voluntary redistribution of water	None
I. Efficient use of existing water supplies and regional opportunities	Improvement over current conditions by reducing the rate of decline of local groundwater levels.
J. Effect on navigation	None
K. Consideration of water pipelines and other facilities used for water conveyance	None

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3.1 Wastewater Reuse

3.1.1 Overview

Wastewater reuse is defined as the types of projects that utilize treated wastewater effluent as a replacement for freshwater supply, reducing the overall demand for freshwater supply. Wastewater reuse typically involves a capital project connecting the wastewater 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 or public lands and specific industries or industrial use areas. Few entities are presently capable of utilizing their entire effluent capacity for reuse, but in the long term it is likely that increased pressure on water supplies will result in increased emphasis on reuse, with reused water approaching the quantity of effluent available. Virtually any water supply entity with a wastewater treatment plant could pursue a reuse alternative. Current examples of existing reuse systems in the Brazos G Area include those of the cities of Abilene, Cleburne, Georgetown, Killeen and Round Rock. Many other smaller communities make their effluent available for irrigation and/or energy development purposes.

Wastewater reuse can be classified into two forms, defined by how the reuse water is handled:

1. **Direct Reuse** – Pipe treated wastewater directly from wastewater plant to place of use (often referred to as “flange-to-flange”).
2. **Indirect Reuse** – Discharge treated wastewater to river, stream, or lake for subsequent diversion downstream (often referred to as “bed and banks”).

3.1.2 Direct Reuse

All direct reuse water supply options assume that treated wastewater remains under the control, i.e., in pipelines or storage tanks, of the entity treating the wastewater and/or supplying reuse water, at all times from treatment to point of use.

Wastewater reuse quality and system design requirements are regulated by TCEQ by 30 TAC §210. TCEQ allows two types of reuse 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 reuse water; and
- **Type 2** – Public or food crops cannot come in contact with reuse water.

Current TCEQ criteria for reuse water are shown in Table 3.1-1. Trends across the country indicate that criteria for unrestricted reuse water will likely tend to become more stringent over time. The water quality criteria for Type 1 reuse water are more stringent with lower numerical limits for oxygen demand (BOD_5 or $CBOD_5$), turbidity, and fecal coliform levels.

Table 3.1-1 TCEQ Quality Standards for Reuse Water

Parameter	Allowable Level
Type 1 Reuse	
BOD_5 or $CBOD_5$	5 mg/L
Turbidity	3 NTU
Fecal Coliform	20 CFU / 100 ml (1)
Fecal Coliform (not to exceed)	75 CFU / 100 ml (2)
Type 2 Reuse For a system other than a pond system	
BOD_5	20 mg/L
or $CBOD_5$	15 mg/L
Fecal Coliform	200 CFU / 100 ml (1)
Fecal Coliform (not to exceed)	800 CFU / 100 ml (2)
Type 2 Reuse For a pond system	
BOD_5	30 mg/L
Fecal Coliform	200 CFU / 100 ml (1)
Fecal Coliform (not to exceed)	800 CFU / 100 ml (2)
[1] geometric mean [2] single grab sample	

Notes:
(1) Geometric mean.
(2) Single grab sample.

Two approaches were utilized to evaluate a broad range of potential reuse water supplies:

1. General evaluation of wastewater reuse for multiple water user groups with needs and potential wastewater sources.
2. Specific supply options for water user groups with defined wastewater sources and identified needs.

The following potential wastewater reuse projects were evaluated as specific management strategies:

1. City of College Station;
2. City of Bryan;
3. City of Cleburne;
4. Waco WMARSS:
   a. Waco East;
   b. Bellmead/Lacy-Lakeview;
   c. Bull Hide Creek;
   d. Flat Creek; and
   e. Waco North.

5. Bell County WCID No.1 (cities of Killeen and Harker Heights);
6. City of Cedar Park;
7. City of Liberty Hill; and
8. City of Georgetown.

3.1.3 Indirect Reuse

Indirect reuse is the discharge of treated wastewater to rivers, streams, or lakes for subsequent diversion downstream (also called "bed and banks"). Several water user groups within the Brazos G Area have applied for or have plans to apply for indirect reuse of municipal wastewater flows. For these entities, indirect reuse may be more economical than direct reuse options and/or enable a greater quantity of treated wastewater flows to be utilized as a replacement for potable water supplies.

3.1.4 Direct and Indirect Potable Reuse

Reclaimed water can either be used for potable or non-potable purposes. Reuse applications typically refer to non-potable reuse where the reclaimed water does not get used for potable purposes from the drinking water system. With advanced water treatment methods available there are two options for potable use of reclaimed water. The two options are Indirect Potable Reuse and Direct Potable Reuse. Indirect potable Reuse is defined as "the use of reclaimed water for potable purposes by discharging to a water supply source, such as surface water or ground water." The mixed reclaimed and natural waters then get additional treatment at a water treatment plant before entering the drinking water distribution system. Direct Potable reuse is defined as "the introduction of advanced treated reclaimed water either directly into the potable water system or into the raw water supply entering the water treatment plant." Under these definitions, aquifer storage and recovery may be considered to be a type of indirect potable reuse.

Potable reclaimed water supplied to consumers is held to stricter standards than non-potable reclaimed water use and is required to meet federal and state drinking water standards.

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3.2 General Evaluation of Direct Reuse Potential for Multiple Water User Groups

3.2.1 Description of Option

Many water user groups with projected needs have the potential to develop wastewater reuse projects, and a general evaluation of wastewater reuse potential was conducted for these entities based on wastewater flows used to determine currently available surface water supplies.

3.2.2 Available Supply

The water supply from reuse that would be potentially available for any entity would be that portion of their wastewater effluent stream that is over and above any currently planned reuse and any commitments made to downstream water rights and environmental flows. Of this potential, the amount that can actually be recognized depends on the availability of suitable uses within an economical distance from the treatment plant. If individual high water use industrial plants or open land that benefits from irrigation, such as golf courses, are located relatively close to the plant, then reuse can provide a substantial benefit to water supplies.

In order to identify those communities that may potentially benefit from a reuse program, information regarding each of the communities with both a projected need for additional water supply and a wastewater treatment plant (WWTP) proximate to need was gathered. Table 3.2-1 lists these water user groups, their projected need, approximate average effluent, and an assumed portion of the effluent that may be recoverable. If a WWTP with discharge over 1 million gallons day (mgd) is proximate to the need, it is listed in the table. The portion of effluent that may be recoverable was estimated as 25 percent of the monthly minimum effluent discharge for 2018 through 2022 plus 50 percent of estimated future effluent. A relatively low recoverable percentage was used because of the variability in effluent flows, variability in demand, and the large storage volumes that would likely be needed to match availability with demand.

Several water user groups show a potential reuse amount greater than the projected need and could possibly meet their need in this manner. Utilization of this water source is contingent on whether a potential use for the wastewater effluent exists within an economical distance from the treatment plant.

Table 3.2-1 General Wastewater Reuse Potential in the Brazos G Area

WUG	County	Proximate WW Treatment Facility Over 1 mgd	2080 Projected Need (acft/yr)	2080 Projected Need Percent of Demand	Current Reuse	2080 Maximum Available WWTP Effluent (acft/yr)	2080 Estimated Reuse (acft/yr)
Killeen	Bell	Bell County WCID#1	6,217	16%	N	1,021	410
Elm Creek WSC	Bell	City of Temple	271	31%	N	5,138	2,065
Bell County-Other	Bell	Bell County WCID#1	299	54%	N	1,021	410
Harker Heights	Bell	Bell County WCID#1	2,443	25%	N	1,021	410
Cedar Park	Bell	Cedar Park	5,000	27%	Y	9,276	3,999
Manufacturing	Bell	City of Temple	661	57%	N	5,138	2,065
Irrigation	Bell	Bell County WCID#1	964	31%	N	1,021	410
Temple	Bell	BRA TBRSS	10,887	27%	N	17,382	6,986
Bryan	Brazos	City of Bryan	35,740	71%	Y	14,986	14,986
College Station	Brazos	City of College Station	17,056	47%	Y	20,409	20,406
College Station	Brazos	Texas A&M University	17,056	47%	Y	4,641	4,637
Gatesville	Coryell	City of Gatesville	2,026	46%	N	1,850	726
Cleburne	Johnson	City of Cleburne	6,060	49%	N	10,128	4,157
Steam-Electric	Johnson	City of Cleburne	571	30%	N	10,128	4,157
Mart	McLennan	WMARSS	98	34%	N	47,912	47,914
North Bosque WSC	McLennan	WMARSS	370	33%	N	47,912	47,914
Robinson	McLennan	WMARSS	2,623	46%	N	47,912	47,914
Manufacturing	McLennan	WMARSS	747	11%	N	47,912	47,914
Sweetwater	Nolan	City of Sweetwater	1	0%	Y	1,742	642.94
Steam-Electric	Robertson	City of Hearne	8,038	18%	N	850	307.83
Abilene	Taylor	City of Abilene	10,934	30%	Y	17,494	17,494
Mining	Taylor	City of Abilene	308	75%	Y	17,494	17,494
Georgetown	Williamson	City of Georgetown	158,402	80%	Y	5,217	2,249
Granger	Williamson	City of Georgetown	26	9%	Y	5,217	2,249
Hutto	Williamson	BRA/LCRA BCRWSS West	12,601	91%	N	6,896	2,973
Leander	Williamson	City of Leander	4,763	19%	N	4,227	1,823
Mining	Williamson	City of Georgetown	2,521	77%	N	5,217	2,249
Round Rock	Williamson	BRA/LCRA BCRWSS East	10,205	29%	N	63,454	27,359
Williamson C-O	Williamson	City of Leander	29,475	86%	N	4,227	1,823
Irrigation	Williamson	BRA/LCRA BCRWSS East	226	57%	N	63,454	27,359
Florence	Williamson	BRA TBRSS	209	69%	N	17,382	6,986

3.2.3 Environmental Issues

A summary of environmental issues is presented in Table 3.2-2.

3.2.4 Engineering and Costing

The required improvements to implement a wastewater reuse supply would be expected to vary considerably between entities based on the upgrades required both in treatment and distribution. Therefore, general cost estimates were developed for varying wastewater reuse scenarios as described in Table 3.2-3.

To provide more flexibility in the types of wastewater reuse applications possible, the scenarios assume the use of a Type 1 quality wastewater effluent.

Table 3.2-2 Environmental Issues: General Wastewater Reuse

Issue	Description
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows.
Bays and Estuaries	Possible low negative impact.
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible high negative impact to fish and wildlife habitat with substantially reduced stream flows.
Cultural Resources	Possible low impact.
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas.

Table 3.2-3 Wastewater Reuse Scenarios

Scenario #	Treatment	Distribution
1	Existing WWTP is achieving treatment that meets the Type 1 effluent requirements. Treatment upgrade includes only the addition of chlorine for distribution.	Treated wastewater is supplied to demand location(s) from central WWTP by addition of piping and pump station.
2	Existing WWTP is nearly achieving treatment that meets the Type 1 effluent requirements. Treatment upgrade includes tertiary treatment and chlorine.	Treated wastewater is supplied to demand location(s) from central WWTP by addition of piping and pump station.

Scenarios 1 and 2 include central storage at the wastewater plant with reuse water delivered to the demand location on an as-needed basis. An alternative delivery option not included here is a more decentralized reuse system with storage located at the point of use. Providing storage at the point of use may decrease the necessary pipeline and pump station size because the water can be transported at a more uniform rate to fill storage tanks at the point of use. However, installation of storage tanks at the point of use may be problematic in highly urbanized areas or undesirable near high public use areas.

Cost estimates were developed for each of these scenarios with required facilities for each scenario shown in Table 3.2-4. The demand for reuse water used for irrigation of golf courses, parks, schools, crops, or other landscapes will vary seasonally. For planning purposes, the application rates in Table 3.2-5 are assumed to determine the available project yield for varying sizes of wastewater reuse facilities. Reuse facilities are sized for the peak usage periods, and consequently, the average annual rate of usage may be considerably lower than the peak usage. For a reuse system with typical application rates, as shown in Table 3.2-5, the annual available project yield is 57 percent of the reuse system capacity. Available project yield may be greater than 57 percent of maximum capacity for systems supplying a large portion of the reuse water to industrial, non-municipal or other users that have a more uniform seasonal demand pattern.

Table 3.2-4 Required Distribution Facilities for Generalized Wastewater Reuse Scenarios

Facility	Maximum Capacity (mgd)				Description
	0.5	1	5	10	
Pump Station, HP	127	248	1,209	2,332	Capacity to deliver maximum daily demand in 6 hours
Storage Tank, MG	0.5	1	5	10	Store one days treated reuse water at WWTP
Pipeline, Size in Inches (Length in Miles)	12 (2)	16 (2)	30 (3) 18 (2) 12 (1)	48 (4) 18 (3) 12 (2)	Capacity to deliver maximum daily demand in 6 hours
Available Project Yield, acft/yr (mgd)	319 (0.28)	638 (0.57)	3,193 (2.85)	6,385 (5.7)	Yield is 57 percent of maximum treatment capacity based on seasonal use

Table 3.2-5 Wastewater Reuse Irrigation Application Rate

Use Level	Application Rate	Duration
Peak	1.25 in/week	4 months
Normal	0.75 in/week	3 months
Below Normal	0.25 in/week	5 months
Average	0.71 in/week	weighted
Average/Peak	0.71 / 1.25 = 0.57	

Irrigation water for landscapes such as golf courses and parks will generally be applied during periods when these areas are not being utilized, typically at night. Therefore, the distribution facilities are sized to deliver the total daily demand in a 6-hour period. Pumping facilities are sized to provide a residual pressure of 60 psi at the delivery point.

Table 3.2-6 shows annual cost of reuse water per 1,000 gallons for a range of project scenarios and capacities. Figure 3.2-1 expresses those costs graphically as an annual cost per acft. These costs are for general planning purposes and will vary significantly depending on the specific circumstances of an individual water user group. Table 3.2-7 and Table 3.2-8 show the total project capital costs and total operations and maintenance costs for reuse water supplies, respectively.

Table 3.2-6 General Wastewater Reuse Annual Cost of Water ($ per 1,000 gal available project yield)

Scenario	Capacity (mgd)			
	0.5	1	5	10
1	$9.98	$6.46	$4.71	$5.19
2	$15.46	$10.46	$7.09	$7.26
Debt Service (3.5 percent for 20 years)				

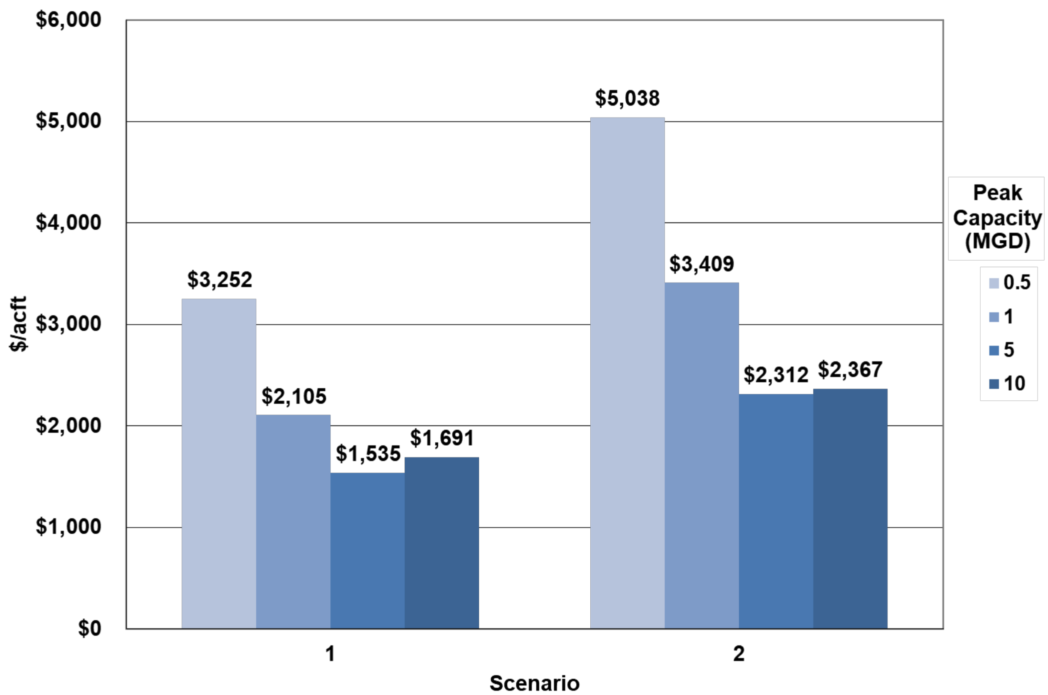


Figure 3.2-1 General Wastewater Reuse Annual Cost of Water ($ per acft available project yield

Table 3.2-7 General Wastewater Reuse Total Project Capital Cost ($ per gallon maximum capacity)

Scenario	Maximum Capacity (mgd)			
	0.5	1	5	10
1	$21.41	$13.46	$9.70	$4.85
2	$25.90	$16.67	$11.44	$5.72

Table 3.2-8 General Wastewater Reuse Total Operations and Maintenance Cost ($ per 1,000 gallons)

Scenario	Maximum Capacity (mgd)			
	0.5	1	5	10
1	$1.36	$1.04	$0.81	$0.81
2	$5.04	$3.75	$2.49	$2.31

The general wastewater reuse costs are utilized to develop the cost estimates for individual water user groups shown in Table 3.2-9. The reuse project maximum capacity (mgd) for each water user group was developed based on the "2080 Projected Need" and "2080 Potential Reuse," as shown in Table 3.2-1. A reuse scenario, as shown in Table 3.2-1, was applied to each water user group based on available information about existing wastewater treatment facilities proximate to the need.

Information for individual water user groups that have specific reuse water supply options are not included in Table 3.2-9; the individual options should be referenced for information on reuse options for these water user groups.

Table 3.2-9 Cost Estimate Summaries: Reuse as a Water Management Strategy for Multiple Water User Group

WUG	County	Reuse Maximum Capacity (mgd)	Available Project Yield (mgd)	Scenario	Annual Cost ($/1000 gal)	Project Capital Cost ($/gal)	Project Cost ($)
Killeen	Bell	See Individual Option					
Elm Creek WSC	Bell	0.35	0.2	2	$15.46	$25.90	$9,063,814
Bell C-O	Bell	0.5	0.3	2	$15.46	$25.90	$12,948,306
Harker Heights	Bell	See Individual Option					
Cedar Park	Bell	See Individual Option					
Manufacturing	Bell	0.2	0.2	2	$15.46	$25.90	$5,179,322
Irrigation	Bell	1	1	2	$10.46	$16.67	$16,672,739
Mining	Bell	5	5	2	$7.09	$11.44	$57,208,858
Temple	Bell	10	5.7	2	$7.26	$5.72	$57,208,858
Bryan	Brazos	See Individual Option					
College Station	Brazos	See Individual Option					
Gatesville	Coryell	7.5	4.3	2	$7.26	$5.72	$42,906,643
Cleburne	Johnson	See Individual Option					
Steam-Electric	Johnson	5	5	2	$7.09	$11.44	$57,208,858
Mining	Jones	0.1	0.1	2	$15.46	$25.90	$2,589,661
Mining	Lee	0.5	0.5	2	$15.46	$25.90	$12,948,306
North Bosque WSC	McLennan	0.8	0.5	1	$6.46	$13.46	$10,769,719
Robinson	McLennan	0.35	0.2	1	$9.98	$21.41	$7,495,213
Manufacturing	McLennan	1	1	1	$6.46	$13.46	$13,462,148
Sweetwater	Nolan	2.8	1.6	1	$4.71	$9.70	$27,173,009
Steam-Electric	Robertson	0.2	0.2	2	$15.46	$25.90	$5,179,322
Abilene	Taylor	See WWP plan in Section 4C.38					
Merkel	Taylor	0.1	0.1	2	$15.46	$25.90	$2,589,661
Mining	Taylor	0.2	0.2	2	$15.46	$25.90	$5,179,322
Georgetown	Williamson	See Individual Option					
Granger	Williamson	0.15	0.1	2	$15.46	$25.90	$3,884,492
Hutto	Williamson	10	5.7	2	$7.26	$5.72	$57,208,858

WUG	County	Reuse Maximum Capacity (mgd)	Available Project Yield (mgd)	Scenario	Annual Cost ($/1000 gal)	Project Capital Cost ($/gal)	Project Cost ($)
Leander	Williamson	10	5.7	2	$7.26	$5.72	$57,208,858
Mining	Williamson	5	5.0	2	$7.09	$7.15	$35,750,000
Round Rock	Williamson	10	5.7	2	$7.26	$5.72	$57,208,858
Williamson C-O	Williamson	10	5.7	2	$7.26	$5.72	$57,208,858
Irrigation	Williamson	0.1	0.1	2	$15.46	$25.90	$2,589,661
Florence	Williamson	0.2	0.1	2	$15.46	$25.90	$5,179,322

3.2.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.2-10, and the option meets each criterion. Each community that pursues wastewater reuse will need to investigate concerns that would include at a minimum:

- 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 reuse.

Table 3.2-10 Comparison of General Wastewater Reuse 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

Impact Category	Comment(s)
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

Reuse of reclaimed wastewater requires a TCEQ authorization. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water customers may include:

- U.S. Army Corps of Engineers 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.
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds.
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

3.3 Bell County WCID No.1 Reuse Projects

3.3.1 Description of Option

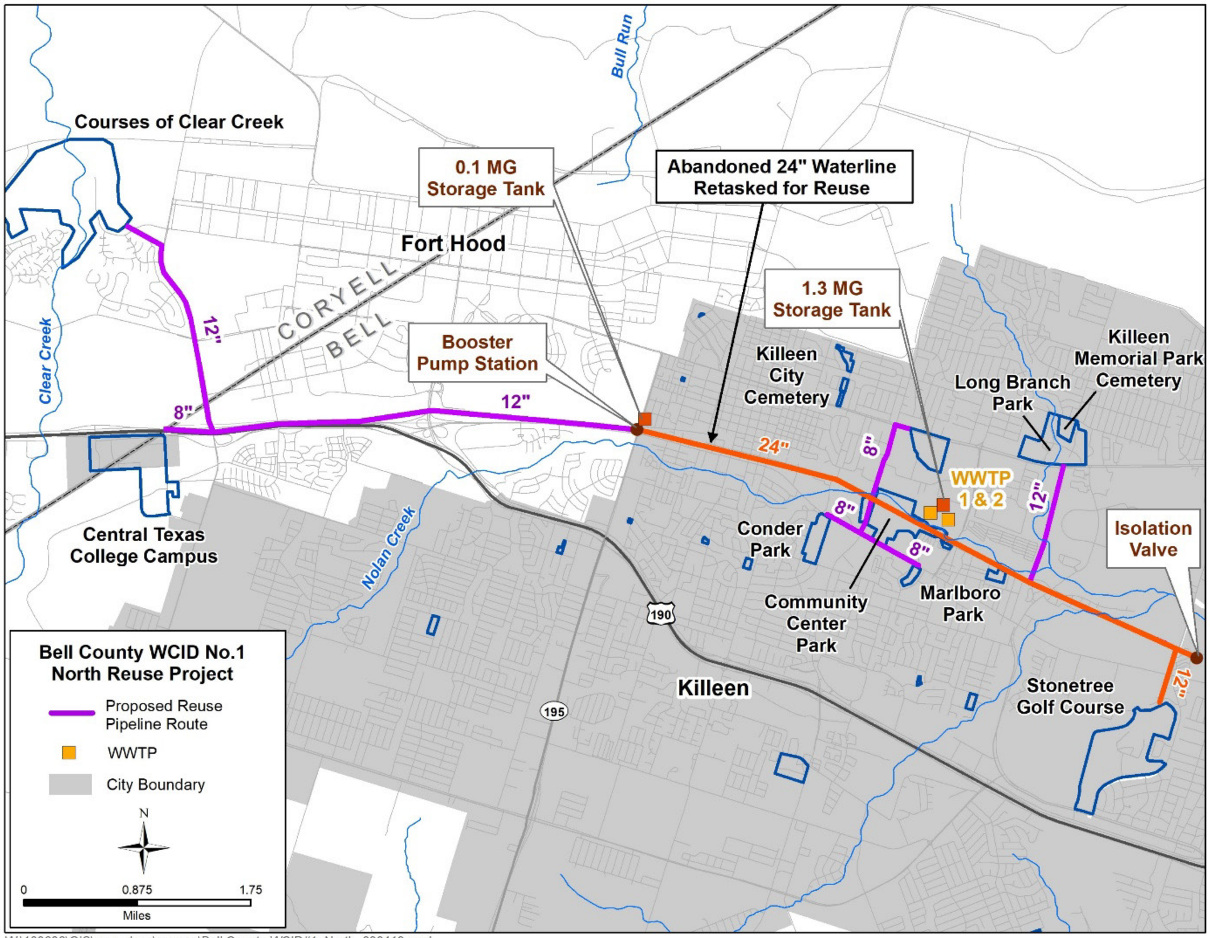
Bell County WCID No. 1 has evaluated several wastewater reuse options as part of its Master Plan update. The reuse portion of the Master Plan identifies both near-term potential customers as well as other future customers that would utilize the total available reuse supply generated through the District's regional wastewater system. The near-term potential projects are those that the District and the cities of Killeen and Harker Heights have identified for implementation within the next 20 years. Other potential demands are associated with future reuse projects at Fort Cavazos (formerly Hood), and additional projects for Killeen, Harker Heights, and other communities in the US Highway 190 corridor.

The near-term potential customers will be served through two projects identified as the North Reuse Project and the South Reuse Project. The North Reuse Project consists of supplying treated wastewater from WWTPs 1 and 2 to potential customers for irrigation use at several municipal parks, two cemeteries in Killeen, golf courses including the Courses of Clear Creek near Fort Cavazos, Stonetree Golf Course, and the Central Texas College campus. Irrigation demands for the North project are shown in Table 3.3-1. An abandoned 24-inch diameter water line will be placed back into service as the main transmission of the North Reuse Project. The locations of the WWTPs, potential customers, and proposed North Reuse Project facilities are shown in Figure 3.3-1. Although average annual demands total approximately 1,925 acft/yr (1.72 million gallons per day [mgd] annual average), the reuse system must be sized to meet the peak irrigation demand during the summer months, which is about 3.03 mgd.

Table 3.3-1 Water Reuse Demands for Bell County WCID No. 1 North Reuse Project

Reuse Customer	Average Demand (mgd)	Peak Demand (mgd)
Courses at Clear Creek	0.47	0.82
Stonetree Golf Course	0.44	0.78
Community Center Ball Park	0.25	0.44
Long Branch Park	0.21	0.38
Central Texas College	0.11	0.19
Killeen City Cemetery	0.11	0.19
Conder Park	0.07	0.13
Memorial Park Cemetery	0.03	0.06
Marlboro Park	0.02	0.03
Total	**1.72**	**3.03**

Figure 3.3-1 Bell County WCID No. 1 North Reuse Project



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The South project includes potential irrigation customers to be supplied from WWTP 3. A portion of the existing effluent discharge line will be used to deliver a portion of the reuse supply. The locations of the WWTP, potential customers and proposed South Reuse Project facilities are shown in Figure 3.3-2. Average annual demand for the South project is approximately 748 acft/yr, and peak irrigation demand is about 1.18 mgd. Irrigation demands for the South project are shown in Table 3.3-2.

The long-term need for reuse supply is anticipated by the District to increase greatly in the future. Future reuse demands are associated with Fort Cavazos, and municipalities along the US Highway 190 corridor such as Harker Heights, Nolanville, Copperas Cove, and others. The North Reuse System would be expanded with new reuse transmission mains to serve these areas. Table 3.3-3 shows the future potential reuse demands.

3.3.2 Available Supply

The water supply that would be potentially available for the District would be that portion of their wastewater effluent stream that has suitable uses within an economical distance from the treatment plant. The District's three WWTP have a total rated capacity of 30 mgd. The average daily effluent flow from WWTP 1 and 2 is about 12 mgd (13,440 acft/yr) of Type 1 effluent. The South WWTP facility is rated for 6 mgd capacity and average about 3.5 mgd (3,920 acft/yr) of Type 1 effluent for use in unrestricted areas.

Figure 3.3-2 Bell County WCID No. 1 South Reuse Project

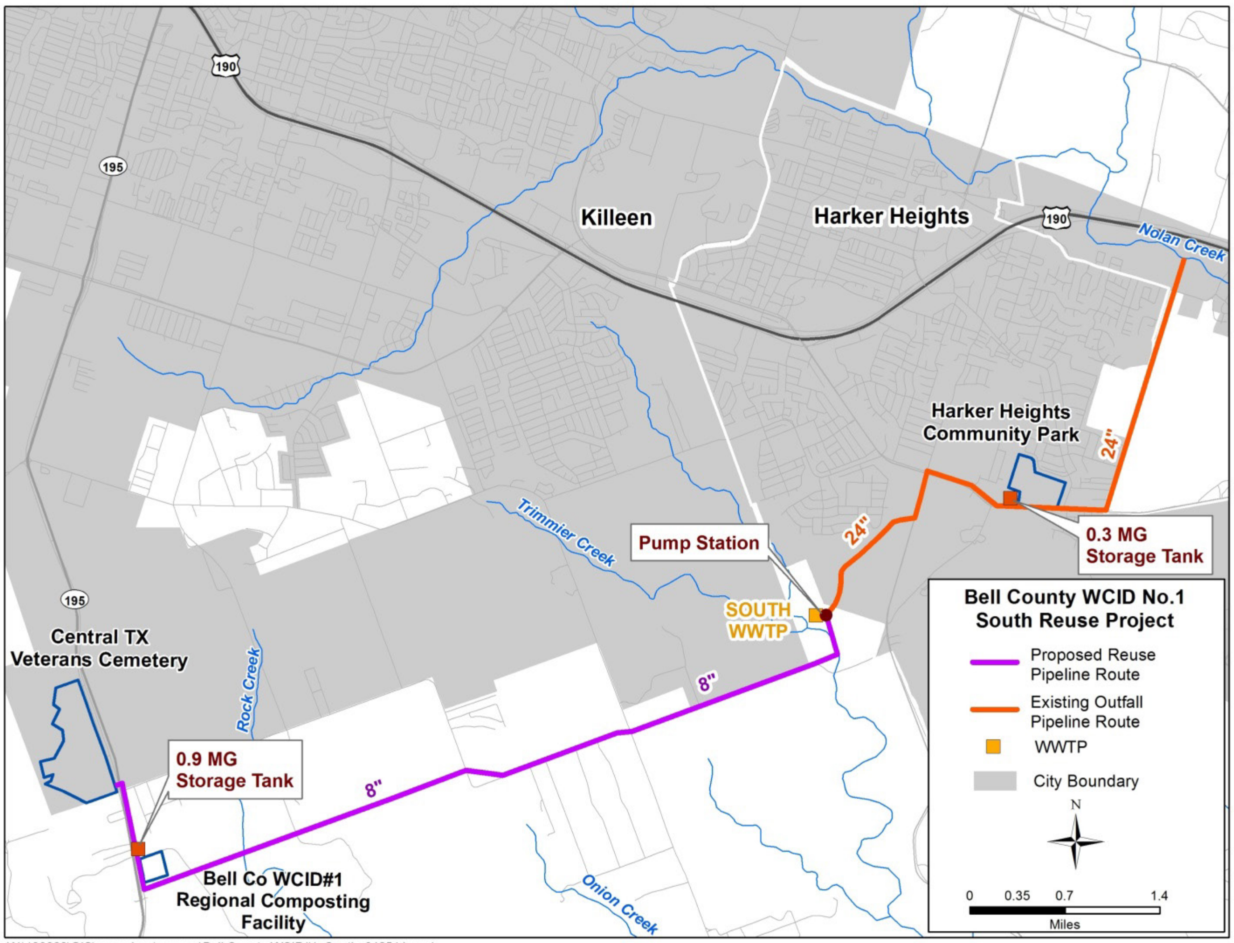

Table 3.3-2 Water Reuse Demands for Bell County WCID No. 1 South Reuse Project

Reuse Customer	Average Demand (mgd)	Peak Demand (mgd)
Central Texas State Veteran's Cemetery	0.48	0.85
Harker Heights Community Park	0.17	0.29
Composting Facility	0.02	0.03
Total	0.67	1.18

The Year 2080 Estimated WWTP Effluent for WWTP 1 and 2 is 25,830 acft/yr (23 mgd) and 7,760 acft/yr (6.9 mgd) for WWTP 3. Since there is no current reuse, potentially all of this volume would be available for direct reuse. The currently proposed near term and future reuse projects could potentially use most of the year 2080 estimated WWTP effluent for the District.

Table 3.3-3 Other Potential Future Water Reuse Demands for Bell County WCID No. 1 Reuse System

Reuse Customer	Average Demand (mgd)	Peak Demand (mgd)
Fort Cavazos		
Vehicle Wash	5.00	5.00
Dust Control	1.20	1.20
Irrigation	6.25	11.06
Site Cooling	0.50	0.50
Future Development (Stillhouse Hollow Lake residential and recreational areas)	0.75	1.33
Nolanville Irrigation	0.50	0.89
Lions Club Park	0.45	0.80
Bacon Ranch Park	0.38	0.67
Camacho Park	0.22	0.39
Timber Ridge Park	0.15	0.27
Maxdale Park	0.15	0.27
AA Lane Park	0.06	0.11
Stewart Park	0.05	0.09
Fowler Park	0.04	0.07
Phyllis Park	0.03	0.05
Fox Creek Park	0.03	0.05
Lions Neighborhood Park	0.02	0.04
Home and Hope Park	0.02	0.04
Pershing	0.02	0.04
Santa Rosa Park	0.02	0.04
Ira Cross Park	0.02	0.04
Other Killeen Areas	1.50	2.66
Other Harker Heights Areas	1.20	2.12
Total	**18.6**	**27.7**

3.3.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible negative impact to fish and wildlife habitat with reduced stream flows; and

- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.3-4.

Table 3.3-4 Environmental Issues: Bell County WCID No. 1 North and South Reuse Projects

Issue	Description
Implementation Measures	Development of additional distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible high negative impact to fish and wildlife habitat with substantially reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species
Comments	Assumes needed infrastructure for the North project will be in urbanized areas and mostly rural areas for the South project

3.3.4 Engineering and Costing

The North Reuse Project will make use of an abandoned 24-inch diameter transmission line to convey treated reuse water to potential customers. New facilities will include storage at the WWTP, a pump station, booster station and branch pipelines. Irrigation water for golf courses, parks, ball fields and cemeteries will generally be applied during periods when these areas are not being utilized, typically at night. Existing storage at the golf courses will be used for irrigation. For reuse customers without storage, water will be delivered on an as needed basis. Therefore, facilities are sized to deliver the total daily demand in a 6-hour period for the customers without existing storage. Providing storage at the point of use may decrease the required pipeline and pump station size because the water can be transported at a more uniform rate to fill storage tanks at the point of use.

The required improvements to implement a wastewater reuse supply for the North Reuse Project are summarized in Table 3.3-5.

Table 3.3-5 Required Facilities – Bell County WCID No. 1 North Reuse Project

Facility	Description
Treatment Upgrade	Existing WWTP meets Type 2 reuse standards, basic treatment chorine disinfection included.
Pump Station(s)	Two pump stations - 339 hp and 143 HP to deliver peak demand of 3.9 mgd (Total pump capacity of 7.82 mgd to deliver portion for two golf courses with on-site storage in 18 hours and in 6 hours for other demand locations).
Storage Tank	1.3 MG at WWTP. 0.1 MG storage at booster station. Utilize existing storage at golf courses.
Pipeline	11,724 ft of 8-inch pipe; 32,216 ft of 12-inch pipe.

Estimated costs for the North Reuse Project are summarized in Table 3.3-6. Total costs for the project are $33,258,000 with annual costs of $3,060,000. Annual costs include debt service estimated at 3.5 percent for 20 years, O&M for pipelines and pump stations and pumping energy. Annual unit costs are estimated to be $1,590/acft or $4.88/thousand gallons. The unit cost of a reuse water supply could potentially be decreased by the addition of other users within an economical distance from the WWTP(s).

The South Reuse Project will make use of a portion of the pressurized pipeline to the Nolan Creek outfall to convey treated reuse water to potential customers east of the South WWTP. New facilities will include a pump station, booster station and branch pipelines. Pumping facilities are sized to deliver the water to ground storage tanks near the irrigation demand. Distribution pumps and pipelines would draw water from the storage tanks as needed. The improvements required to implement a wastewater reuse supply for the South Reuse Project are summarized in Table 3.3-7.

Estimated costs for the South Reuse Project are summarized in Table 3.3-8. Total project costs for the project are $20,221,000 with annual costs of $1,707,000. Annual costs include debt service estimated at 3.5 percent for 20 years, O&M for pipeline and pump station and pumping energy. Annual unit costs are estimated at $382/acft or $7.00/thousand gallons. The unit cost of a reuse water supply could potentially be decreased by the addition of other users within an economical distance from the WWTPs.

Table 3.3-6 Cost Estimate Summary: Bell County WCID No. 1 North Reuse Project

Cost Estimate Summary Water Supply Project Option September 2023 Prices Bell County WCID#1 - North Reuse Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Transmission Pipeline (8-12 in. dia., 8.3 miles)	$15,330,000
Transmission Pump Station(s) & Storage Tank(s)	$6,379,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,100,000
Water Treatment Plant (9 mgd)	$621,000
Integration, Relocations, Backup Generator & Other	$28,000
TOTAL COST OF FACILITIES	**$23,458,000**
Planning (3%)	$704,000
Design (7%)	$1,642,000
Construction Engineering (1%)	$235,000
Legal Assistance (2%)	$469,000
Fiscal Services (2%)	$469,000
Pipeline Contingency (15%)	$2,300,000
All Other Facilities Contingency (20%)	$1,626,000
Environmental & Archaeology Studies and Mitigation	$540,000
Land Acquisition and Surveying (52 acres)	$769,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,046,000
TOTAL COST OF PROJECT	**$33,258,000**
ANNUAL COST	

Cost Estimate Summary Water Supply Project Option September 2023 Prices Bell County WCID#1 - North Reuse Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Debt Service (3.5 percent, 20 years)	$2,338,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$176,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$131,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$373,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (467344 kW-hr @ 0.09 $/kW-hr)	$42,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$3,060,000**
Available Project Yield (acft/yr)	1,925
Annual Cost of Water ($ per acft), based on PF=1	$1,590
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$375
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$4.88
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.15
JS	*2/4/2025*

Table 3.3-7 Required Facilities – Bell County WCID No. 1 South Reuse Project

Facility	Description
Treatment Upgrade	Existing WWTP meets Type 1 reuse standards, add chlorine disinfection to the western pipeline and at the Harker Heights Community Park storage tank.
Pump Station	Transmission and booster pump station - 134 hp to deliver peak demand of 0.9 mgd to a terminal storage tank.
Storage Tanks	0.9 MG tank near the Veterans Cemetery and 0.3 MG tank near Harker Heights Community Park to store one day of treated reuse water.
Pipeline	35,187 ft of 8-inch pipe.

Table 3.3-8 Cost Estimate Summary: Bell County WCID No. 1 South Reuse Project

Cost Estimate Summary Water Supply Project Option September 2023 Prices Bell County WCID#1 - South Reuse Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (0.9 mgd)	$1,256,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices Bell County WCID#1 - South Reuse Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Transmission Pipeline (8 in. dia., 6.7 miles)	$6,391,000
Transmission Pump Station(s) & Storage Tank(s)	$2,138,000
Storage Tanks (Other Than at Booster Pump Stations)	$4,035,000
Two Water Treatment Plants (0.9 mgd and 0.3 mgd)	$141,000
Integration, Relocations, Backup Generator & Other	$19,000
TOTAL COST OF FACILITIES	**$13,980,000**
Planning (3%)	$419,000
Design (7%)	$979,000
Construction Engineering (1%)	$140,000
Legal Assistance (2%)	$280,000
Fiscal Services (2%)	$280,000
Pipeline Contingency (15%)	$959,000
All Other Facilities Contingency (20%)	$1,518,000
Environmental & Archaeology Studies and Mitigation	$424,000
Land Acquisition and Surveying (41 acres)	$606,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$636,000
TOTAL COST OF PROJECT	**$20,221,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,421,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$115,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$58,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$85,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (311116 kW-hr @ 0.09 $/kW-hr)	$28,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,707,000**
Available Project Yield (acft/yr)	748
Annual Cost of Water ($ per acft), based on PF=1.73	$2,282
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.73	$382
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.73	$7.00
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.73	$1.17

Cost Estimate Summary Water Supply Project Option September 2023 Prices Bell County WCID#1 - South Reuse Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
JS	*2/4/2025*

As identified in Table 3.3-9, the combined yield of the North and South Reuse Projects are 2,673 acft/yr with annual unit costs of $1,783/acft or $5.47 per thousand gallons.

Table 3.3-9 Total Yield and Cost for North and South Reuse Projects

Project	Average Yield (acft/yr)	Unit Cost	
		($/acft)	($/kgal)
North Reuse Project	1,925	$1,590	$4.88
South Reuse Project	748	$2,282	$7.00
Total	2,673	$1,783	$5.47

3.3.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.3-10, and the option meets each criterion. Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- U.S. Army Corps of Engineers 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;
- TPWD Sand, Shell, Gravel, and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Table 3.3-10 Comparison of Bell County WCID No.1 North and South Reuse Projects to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Potentially important source reducing demand for potable supplies
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Reduces 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. Potential impact
6. Wetlands	6. None or low impact

Impact Category	Comment(s)
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 Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

3.4 City of Bryan Lake Bryan Reuse

3.4.1 Description of Option

The City of Bryan currently irrigates the Traditions Golf Course with Type 2 treated wastewater effluent from Thompson's Creek WWTP, a small package treatment plant located near the golf course with a capacity of 2.0 million gallons per day (mgd). The City has two other WWTPs, Burton Creek and Still Creek, that produce effluent requiring additional treatment to meet Type 1 reuse water requirements. There are several parks, ball fields, and other green spaces dispersed throughout the City that could be irrigated with reuse water if the wastewater could be treated and distributed economically. However, these green spaces do not individually have large irrigation water demands and are located a significant distance from the existing wastewater treatment plants. Therefore, irrigation reuse options were not evaluated.

The City is considering two alternate reuse projects using treated supplies from Still Creek WWTP to either offset potable demand (Option 1) or as indirect potable reuse (Option 2). Option 1 consists of a reuse project to deliver Type 1 treated wastewater to Bryan Utilities Lake, a small lake associated with a power generation plant (Figure 3.4-1). The City has periodically supplied potable water to this lake for extended periods at a rate of up to 3,000 gpm (4.32 mgd). This option will replace a portion of this potable water demand with a wastewater reuse supply having a peak capacity of 1,500 gpm (2.16 mgd). Since Bryan Utilities Lake is used for recreational purposes, this option includes additional treatment at Still Creek WWTP to supply Type 1 reuse water to the lake. The reuse water supply will be delivered at a continuous daily rate during periods of demand, so no storage is required. The project yield is based on an average demand of 2.16 mgd for 3 months during each year.

Option 2 utilizes similar infrastructure to deliver treated effluent to Bryan Utilities Lake for blending and subsequent treatment to drinking water standards and combining it with existing groundwater supply. However, reuse supplies will be delivered at a uniform rate of 2.16 mgd. An advanced water treatment facility consisting of low-pressure membranes, reverse osmosis and advanced oxidation would be constructed nearby to treat blended supplies from Bryan Utilities Lake. The location of the WTP has not been selected and would be subject to availability of land.

3.4.2 Available Supply

The water supply that would be potentially available for Bryan would be that portion of their wastewater effluent stream that has suitable uses within an economical distance from the treatment plant. The annual average effluent flow from the Still Creek and Burton Creek WWTPs for the year 2022 was 5,396 acft/yr (4.81 mgd) and 1,606 acft/yr (1.43 mgd), respectively.

The City of Bryan has confirmed that it plans to reuse all treated wastewater by 2080. Based on water demand projections for 2080, the future combined Year 2080 estimated WWTP effluent discharge is 19,110 acft/yr (17.1 mgd).

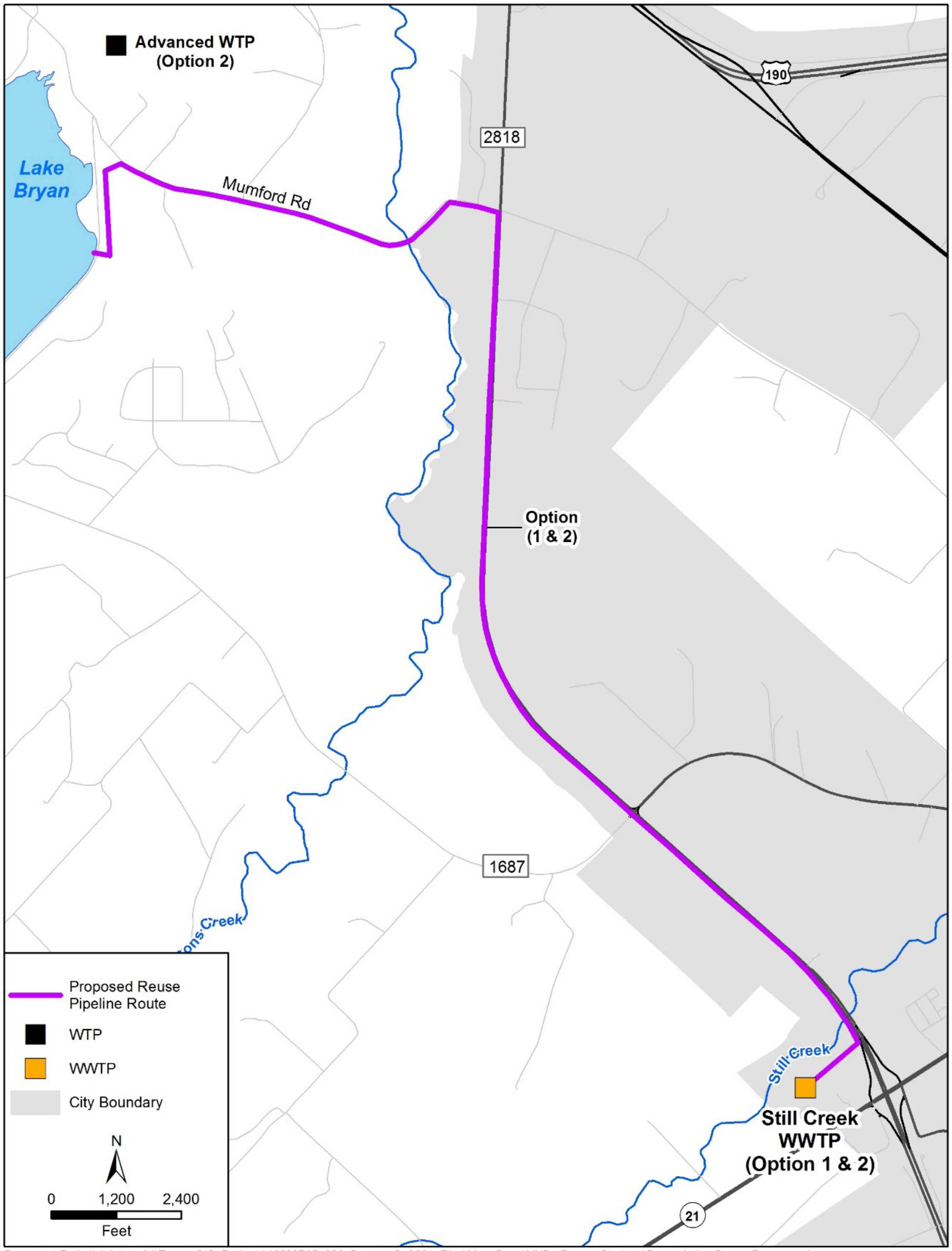

Figure 3.4-1 Bryan Reuse Option 1 and Option 2

3.4.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates.
- Possible impact to water quality in Bryan Utilities Lake and potential for release downstream of reuse water from Bryan Utilities Lake.
- Possible increased water quality to remaining stream flows.
- Possible high negative impact to fish and wildlife habitat with substantially reduced stream flows.
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.4-1.

Table 3.4-1 Environmental Issues: Bryan Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible high negative impact to fish and wildlife habitat with substantially reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

3.4.4 Engineering and Costing

The required improvements to implement a wastewater reuse supply for Bryan's Option 1 are summarized in Table 3.4-2. Costs presented in Table 3.4-3 provide the total Option 1 costs for developing a wastewater reuse supply to Bryan Utilities Lake. The required improvements to implement an indirect potable reuse supply for Bryan's Option 2 are summarized in Table 3.4-4. Costs presented in Table 3.4-5 provide the total Option 2 costs for developing an indirect potable reuse supply. System integration costs are not included in the estimate.

Table 3.4-2 Required Facilities – Bryan Reuse Option 1

Facility	Description
Treatment Upgrade	2.16 mgd, Scenario 2; existing WWTP requires additional tertiary treatment to meet type 1 standards and addition of chlorine for distribution
Pump Station	174 hp (Booster); 2.16 mgd capacity to deliver peak capacity at uniform rate
Storage Tank	None
Pipeline	29,000 ft of 12-inch pipe
Available Project Yield	0.54 mgd (605 acft/yr), yield is 3 months per year of peak demand supplied to lake

Table 3.4-3 Cost Estimate Summary: Option 1 Reuse for Bryan Utilities Lake Supply

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
City of Bryan - Direct Potable Reuse	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	**Estimated Costs for Facilities**
Intake Pump Stations (2.2 mgd)	$2,065,000
Transmission Pipeline (12 in. dia., 5.5 miles)	$7,575,000
Transmission Pump Station(s) & Storage Tank(s)	$1,191,000
Two Water Treatment Plants (2.2 mgd and 2.2 mgd)	$4,168,000
Integration, Relocations, Backup Generator & Other	$7,000
TOTAL COST OF FACILITIES	**$15,006,000**
Planning (3%)	$450,000
Design (7%)	$1,050,000
Construction Engineering (1%)	$150,000
Legal Assistance (2%)	$300,000
Fiscal Services (2%)	$300,000
Pipeline Contingency (15%)	$1,136,000
All Other Facilities Contingency (20%)	$1,486,000
Environmental & Archaeology Studies and Mitigation	$241,000
Land Acquisition and Surveying (34 acres)	$1,084,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$689,000
TOTAL COST OF PROJECT	**$21,892,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,540,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$88,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$52,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$765,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (122540 kW-hr @ 0.09 $/kW-hr)	$11,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$2,456,000**
Available Project Yield (acft/yr)	**605**
Annual Cost of Water ($ per acft), based on PF=4	**$4,060**

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Annual Cost of Water After Debt Service ($ per acft), based on PF=4	**$1,514**
Annual Cost of Water ($ per 1,000 gallons), based on PF=4	**$12.46**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=4	**$4.65**
Note: One or more cost element has been calculated externally.	
JMP	2/1/2025

Table 3.4-4 Required Facilities – Bryan Indirect Potable Reuse Option 2

Facility	Description
Treatment Upgrade	2.16 mgd, Scenario 2; existing WWTP requires additional tertiary treatment to meet type 1 standards and addition of chlorine for distribution
New WTP	2.2 mgd Advanced WTP (low pressure membranes, RO, advanced oxidation)
Pump Station	174 hp (Booster); 2.16 mgd capacity to deliver peak capacity at uniform rate
Intake & Pump Station	43 hp; 2.3 mgd capacity to deliver from Lake Bryan to Advanced WTP
Storage Tank	None
Pipeline	31,000 ft of 12-inch pipe
Available Project Yield	2.19 mgd (2,419 acft/yr)

Table 3.4-5 Cost Estimate Summary: Option 2 Indirect Potable Reuse for Bryan

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
City of Bryan - Indirect Potable Reuse	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	**Estimated Costs for Facilities**
Intake Pump Stations (2.3 mgd)	$6,924,000
Transmission Pipeline (12 in. dia., 5.9 miles)	$8,217,000
Transmission Pump Station(s) & Storage Tank(s)	$1,199,000
Two Water Treatment Plants (0 mgd and 2.2 mgd)	$3,988,000
Advanced Water Treatment Facility (2.2 mgd)	$21,200,000
Integration, Relocations, Backup Generator & Other	$81,000
TOTAL COST OF FACILITIES	**$41,609,000**
Planning (3%)	$1,248,000
Design (7%)	$2,913,000
Construction Engineering (1%)	$416,000
Legal Assistance (2%)	$832,000
Fiscal Services (2%)	$832,000
Pipeline Contingency (15%)	$1,232,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
All Other Facilities Contingency (20%)	$6,678,000
Environmental & Archaeology Studies and Mitigation	$305,000
Land Acquisition and Surveying (41 acres)	$1,855,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,880,000
TOTAL COST OF PROJECT	**$59,800,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$4,202,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$95,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$173,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$657,000
Advanced Water Treatment Facility	$2,674,000
Pumping Energy Costs (1325808 kW-hr @ 0.09 $/kW-hr)	$119,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$7,920,000**
Available Project Yield (acft/yr)	2,419
Annual Cost of Water ($ per acft), based on PF=1	$3,274
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$1,537
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$10.05
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$4.72
Note: One or more cost element has been calculated externally.	
JMP	*2/1/2025*

3.4.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.4-6, and the option meets each criterion. The City of Bryan might select Option 1 or Option 2 as a reuse strategy.

Before pursuing wastewater reuse Option 1, Bryan will need to investigate concerns that would include at a minimum:

- 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);

- Capital costs of constructing needed distribution systems connecting the treatment facilities to the areas of reuse; and
- Regulatory approval of a new discharge (permit) into Bryan Utilities Lake.

Before pursuing indirect potable reuse Option 2, Bryan will need to investigate concerns that would include at a minimum:

- Amount of treated effluent available, taking into consideration downstream water commitments and discharge permit restrictions;
- Capital costs of constructing needed distribution systems connecting the treatment facilities to the areas of reuse;
- Public acceptance and regulatory approval of this water management strategy; and
- Integration of surface water source into a groundwater system which may affect water quality and disinfection compatibility.

Table 3.4-6 Comparison of Bryan Reuse Options 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. Potentially 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. Potential 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 Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

Supply of indirect potable reuse would require a TCEQ discharge permit for returning treated effluent to Bryan Utilities Lake, as well as TCEQ approval of the new surface water supply from the lake. Approval of a TCEQ discharge permit would likely require water quality modeling of Bryan Utilities Lake to help determine effluent limits for dissolved oxygen, biochemical oxygen demand, ammonia-nitrogen and potentially other constituents. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- U.S. Army Corps of Engineers 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;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

3.5 City of Bryan – Miramont Reuse

3.5.1 Description of Option

In addition to the Lake Bryan reuse project options, the City of Bryan is also considering a reuse project to meet summer peaking needs of the Miramont Country Club from the Burton Creek WWTP. The Burton Creek WWTP is currently permitted for 8 mgd with average daily flow of 4.8 mgd in 2022 that can meet Type II reuse requirements. Miramont Country Club uses three wells on the property to pump to onsite ponds which are used to irrigate the golf course, rights of way and landscaping. In the peak irrigation months, Miramont Country Club is using approximately 1.6 mgd to irrigate and maintain pond levels. Miramont Country Club's irrigation supply is currently backed up by the City's potable water system. Figure 3.5-1 shows the potential route for reuse water to the Miramont Country Club.

If Type I effluent is required for the golf course, the Burton Creek WWTP would require tertiary treatment.

3.5.2 Available Supply

The City of Bryan has confirmed that it plans to reuse all treated wastewater by 2080. The Burton Creek WWTP Year 2070 estimated WWTP effluent discharge is 14,200 acft/yr (12.67 mgd).

3.5.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible negative impact to fish and wildlife habitat with reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.5-1.

3.5.4 Engineering and Costing

The required improvements to implement a wastewater reuse supply for the Miramont Country Club are summarized in Table 3.5-2. Project and annual costs are included in Table 3.5-3. The total project cost is estimated at $10,184,000 with an average annual cost of $716,000.

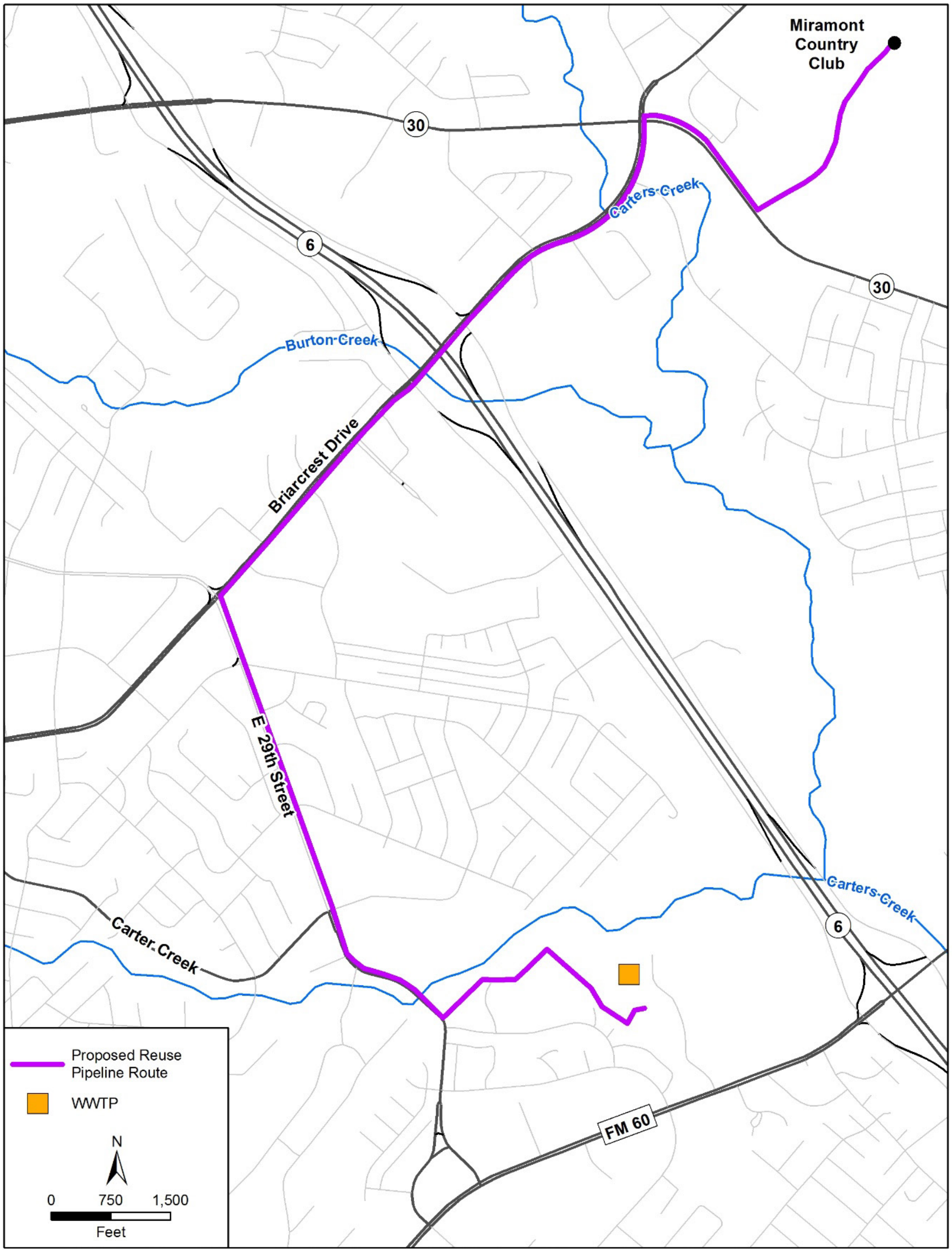

Figure 3.5-1 Bryan Miramont Reuse

Table 3.5-1 Environmental Issues: Bryan Miramont Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible high negative impact to fish and wildlife habitat with substantially reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

Table 3.5-2 Required Facilities – Bryan Miramont Reuse

Facility	Description
Treatment Upgrade	Additional chlorine for distribution
Pump Station	56 hp pump station
Storage Tank	None
Pipeline	18,600 ft of 12-inch pipe
Available Project Yield	0.54 mgd (600 acft/yr), yield is 4 months per year of peak demand

Table 3.5-3 Cost Estimate Summary: Bryan Miramont Reuse Project

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
City of Bryan - Miramont Reuse	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	**Estimated Costs for Facilities**
Intake Pump Stations (0 mgd)	$706,000
Transmission Pipeline (12 in. dia., 3.5 miles)	$6,532,000
Integration, Relocations, Backup Generator & Other	$4,000
TOTAL COST OF FACILITIES	**$7,242,000**
Planning (3%)	$217,000
Design (7%)	$507,000
Construction Engineering (1%)	$72,000
Legal Assistance (2%)	$145,000
Fiscal Services (2%)	$145,000
Pipeline Contingency (15%)	$980,000
All Other Facilities Contingency (20%)	$142,000
Environmental & Archaeology Studies and Mitigation	$158,000
Land Acquisition and Surveying (22 acres)	$255,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$321,000
TOTAL COST OF PROJECT	**$10,184,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$716,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$65,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$18,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (58345 kW-hr @ 0.09 $/kW-hr)	$5,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$804,000**
Available Project Yield (acft/yr)	**600**
Annual Cost of Water ($ per acft), based on PF=3	**$1,340**
Annual Cost of Water After Debt Service ($ per acft), based on PF=3	**$147**
Annual Cost of Water ($ per 1,000 gallons), based on PF=3	**$4.11**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=3	**$0.45**
Note: One or more cost element has been calculated externally.	
JMP	2/1/2025

3.5.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.5-4, and the option meets each criterion. Before pursuing wastewater reuse, the City of Bryan will need to investigate concerns that would include at a minimum:

- Amount of treated effluent available, taking into consideration downstream water commitments and discharge permit requirements.
- Capital costs of constructing needed distribution systems connecting the treatment facilities to the areas of reuse.
- Public acceptance of this water management strategy.

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- U.S. Army Corps of Engineers 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;
- TPWD Sand, Shell, Gravel, and Marl permit for construction in state-owned streambeds; and

- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Table 3.5-4 Comparison of Bryan Miramont Reuse 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. Potential 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 Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

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3.6 Cedar Park Reuse

3.6.1 Description of Option

The City of Cedar Park WWTP has a permitted average effluent discharge of 2.5 million gallons per day (mgd). Cedar Park is currently applying reuse as a water supply to Brushy Creek Sports Park through indirect reuse. Reuse supply available to the Sports Park is on average 32 acft/year (0.03 mgd). During peak demand the supply requirement to the Sports Park and other Public Works can be as great as 0.35 mgd. The City also has a contract with Avery Ranch golf course to provide up to 1 mgd of reuse water. The City operates a Water Reclamation Facility that treats water to Type 1 standards. The City can accommodate another 1 mgd of treated water for additional reuse applications. Two parks, Milburn Park and Fenway Park, have been identified as potential locations for additional reuse supply.

Locations of the Cedar Park WWTP plant, water reclamation facility, and proposed transmission pipelines, ground storage tanks, and pump stations are shown in Figure 3.6-1.

3.6.2 Available Supply

The planned capacity of the Cedar Park Reuse project is 1 mgd (1,120 acft/yr).

3.6.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible negative impact to fish and wildlife habitat with substantially reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.6-1.

Figure 3.6-1 Cedar Park Reuse

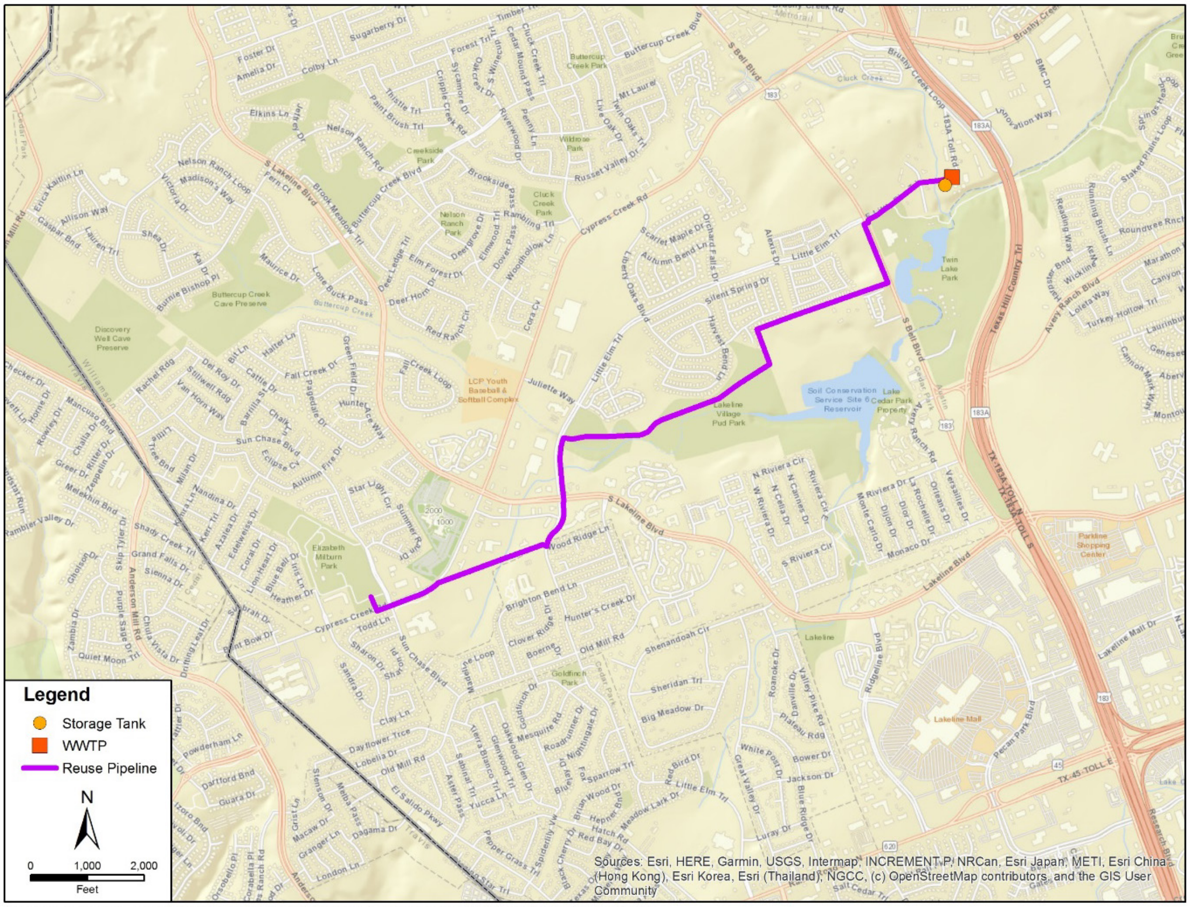

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Table 3.6-1 Environmental Issues: Cedar Park Reuse

Issue	Description
Implementation Measures	Development of additional water transmission pipelines, ground storage tanks and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Edwards Aquifer	Possible increased water quality to stream flows and Edwards Aquifer recharge zone. Possible low impact on recharge rates due to decreased effluent flow from the contributing zone.
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible negative impact to fish and wildlife habitat due to reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

3.6.4 Engineering and Costing

The required improvements to implement a wastewater reuse supply Cedar Park are summarized in Table 3.6-2. The project requires a 1 mgd pump station along with a 1 MG storage tank located at the Cedar Park WWTP. A 2.84 mile, 14-inch diameter pipe would deliver the reuse supply to Fenway Park and Milburn Park. Distribution lines not included in this cost estimate would deliver irrigation supply to both parks.

Table 3.6-2 Required Facilities – Cedar Park Reuse

Facility	Description
Pump Stations	300 HP at Cedar Park WWTP; 1 mgd capacity for peak deliver at uniform rate to Fenway and Milburn Parks
Storage Tanks	1 MG; balancing storage at Cedar Park WWTP
Pipelines	15,000 ft of 14-inch pipe; from Cedar Park WWTP to Fenway and Milburn Park
Available Project Yield	1.0 mgd (1,140 acft/yr)

The total costs for developing a wastewater reuse supply for Fenway Park and Milburn Park are shown in Table 3.6-3. The project will have an estimated total capital cost of $15,412,000 and an annual cost of $1,267,000. This cost translates to a $1,111 per acft or $3.41 per 1,000 gallons unit cost of the reuse water.

Table 3.6-3 Cost Estimate Summary: Cedar Park Reuse

Cost Estimate Summary Water Supply Project Option September 2023 Prices Cedar Park - Cedar Park Reuse Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (0 mgd)	$3,348,000
Transmission Pipeline (14 in. dia., 2.8 miles)	$5,615,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,784,000
Integration, Relocations, Backup Generator & Other	$18,000
TOTAL COST OF FACILITIES	**$10,765,000**
Planning (3%)	$323,000
Design (7%)	$754,000
Construction Engineering (1%)	$108,000
Legal Assistance (2%)	$215,000
Fiscal Services (2%)	$215,000
Pipeline Contingency (15%)	$842,000
All Other Facilities Contingency (20%)	$1,030,000
Environmental & Archaeology Studies and Mitigation	$224,000
Land Acquisition and Surveying (21 acres)	$451,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$485,000
TOTAL COST OF PROJECT	**$15,412,000**
ANNUAL COST	

Cost Estimate Summary Water Supply Project Option September 2023 Prices Cedar Park - Cedar Park Reuse Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Debt Service (3.5 percent, 20 years)	$1,083,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$74,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$84,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (289495 kW-hr @ 0.09 $/kW-hr)	$26,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,267,000**
Available Project Yield (acft/yr)	1,140
Annual Cost of Water ($ per acft), based on PF=4	$1,111
Annual Cost of Water After Debt Service ($ per acft), based on PF=4	$161
Annual Cost of Water ($ per 1,000 gallons), based on PF=4	$3.41
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=4	$0.50
JMP	*1/31/2025*

Table 3.6-4 Comparison of Cedar Park Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient for intended uses
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Reduces instream flows—possible low impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. 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

Impact Category	Comment(s)
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- TCEQ authorization to reuse domestic wastewater under 30 TAC Chapter 210 (“210 authorization”);
- U.S. Army Corps of Engineers 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;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

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3.7 City of Cleburne Reuse

3.7.1 Description of Option

The City of Cleburne obtains its water supply from Lake Pat Cleburne, Lake Aquilla, and groundwater from the Trinity Aquifer. Lake Pat Cleburne, which is owned and operated by the City, impounds runoff from Nolan Creek for storage and use. The city also has contracted with the Brazos River Authority (BRA) for water supply from Lake Aquilla (5,300 acft/yr), from the BRA System (4,700 acft/yr), and from the BRA System with a Lake Whitney diversion (5,000 acft/yr). The city owns and operates six wells that produce water from the Trinity Aquifer.

The City of Cleburne has embraced the beneficial use of reuse water as a viable water management strategy to meet anticipated future shortages. The city plans to reuse available wastewater supplies to help meet its water supply needs and has received an authorization from TCEQ for 8,440 acre feet (7.5 mgd) to allow reuse of all authorized discharges.

3.7.2 Available Supply

The City currently supplies 1.2 mgd (1,344 acft/yr) of reuse water directly to a Brazos Electric Power Cooperative power plant located north of the city for use as cooling water. The City of Cleburne owns and operates the existing reuse water treatment facility located on the City's wastewater treatment plant site. The facility is rated for 2.5 mgd capacity and utilizes inclined plate clarification technology to produce a Type 1 effluent. A 16-inch diameter reuse water transmission line exists along the east side of the city to convey reuse water from the wastewater facility to the power plant and for irrigation of a sports complex.

The City has completed Phase 1 of the West Loop Reclaimed Water Line and Pump Station project. They now operate a 20-inch diameter reclaimed water pipeline on the west side of the city (Figure 3.7-1), which carries water from the existing treatment facility to Lake Pat Cleburne functioning as a form of indirect potable reuse (IPR). The pipeline has a capacity of 6 mgd, however it currently only conveys 2 mgd due to high TDS levels in the wastewater treatment plant's influent.

The City plans to construct a small, 1.25 mgd industrial wastewater treatment plant in the north of the city, which will supply direct reuse to its industrial customers. This new treatment facility will also reduce the TDS levels in the existing WWTP's influent allowing the city to capitalize on the West Loop's full 6 mgd capacity. Due to treatment losses, it is estimated that this 1.25 mgd treatment facility will provide 0.80 mgd to the city's industrial customers. A 16-inch diameter extension of the West Loop that would carry water north of Lake Pat Cleburne is also being considered by the city but has not been decided on. Coupled with a booster pump station and treatment plant expansion, this extension could convey an additional 2.5 mgd to potential reuse customers.

3.7.3 Environmental Issues

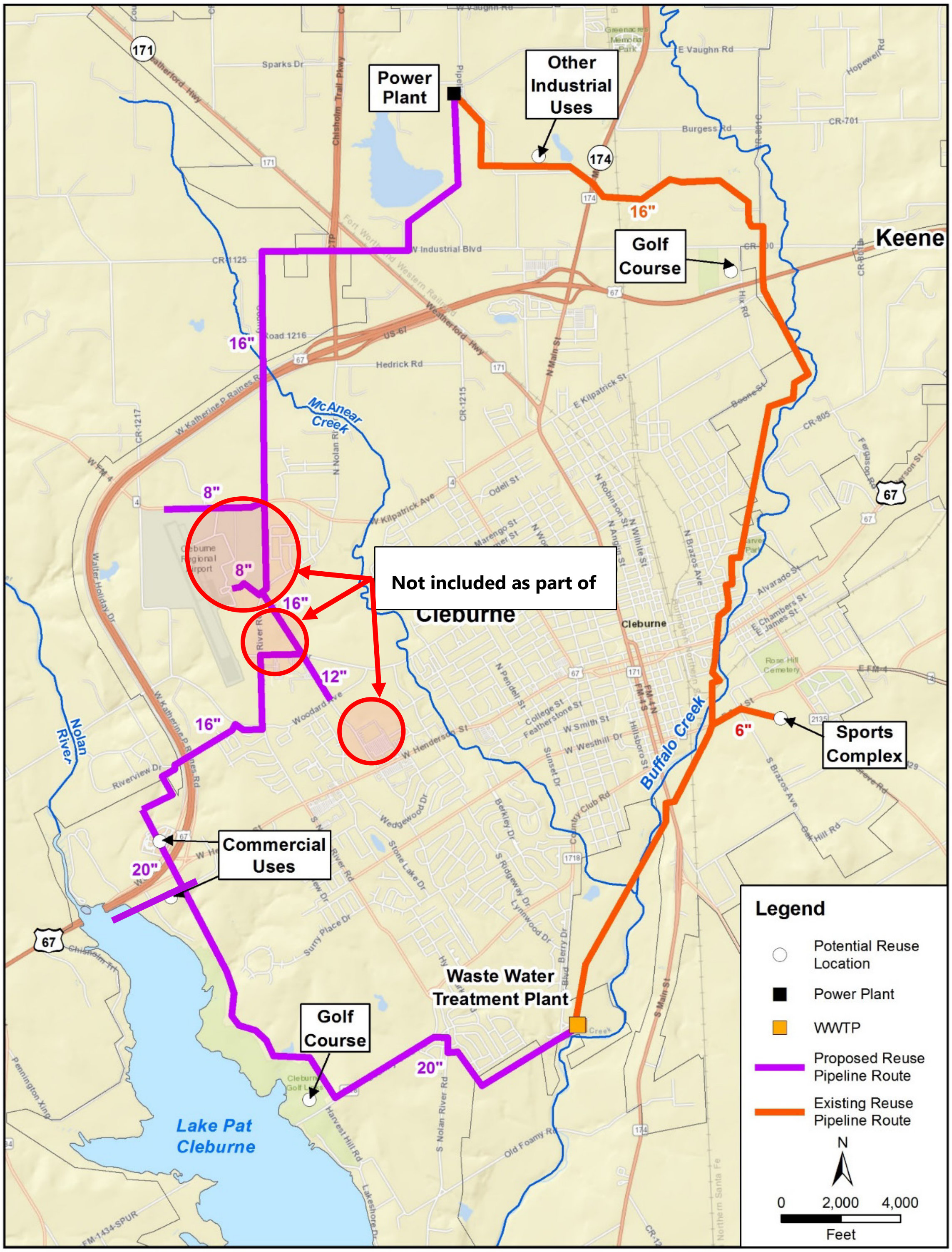
The City of Cleburne has filed for, and received, an authorization from TCEQ to reuse all effluent discharged pursuant to TPDES Permit No. 10006-001 and new outfall 003. The city is also in the process of amending its Chapter 210 Use of Reclaimed Water authorization to supply reuse water for irrigation to the sports complex facility planned east of the city, and to supplement industrial scenarios for fracking. Additional future reuse will require further amendment of the city's reuse authorization.

Expansion of the reuse water treatment facilities would involve relatively low environmental impacts:

- Reduced effluent discharges to the wastewater outfall could have a low impact on environmental water needs and instream flows.
- For potential future reuse within areas a reasonable distance from the existing reclaimed water pipeline, pipeline construction would be limited since available capacity in the existing 16-inch reclaimed water pipeline is currently underutilized.
- Reduced effluent discharges would reduce the BOD stream loading.

A summary of environmental issues is presented in Table 3.7-1.

Figure 3.7-1 Cleburne Reuse



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Note: Costs do not include the two 8-inch lines and one 12-inch line shown above, but they are shown for completeness for City of Cleburne's information.

Table 3.7-1 Environmental Issues: Cleburne Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible high negative impact to fish and wildlife habitat with substantially reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

3.7.4 Engineering and Costing

The facilities needed to provide reuse water for the proposed expansion of the existing reuse water system and the new west loop include the following:

- Expanded reuse water pump station; and
- Construction of north industrial wastewater desalination plant.

As uses of reuse water increase over time, booster pump stations may also be required along the existing 16-inch reuse water line to allow for increased conveyance capacity. Estimated costs to expand the reuse water system as described above are summarized in Table 3.7-2. Phase One has been implemented and constructed. Phase Two total capital costs are $25,807,000 with annual costs of $3,724,000 and unit costs $693/acft or $2.13/thousand gallons.

3.7.4.1 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.7-3, and the option meets each criterion. Implementation of this strategy is relatively straightforward and will include the required permit and reuse authorization amendments mentioned previously in addition to right-of-way and easement acquisition for reuse water piping, authorization for creek and river crossings, and financing.

Table 3.7-2 Cost Estimate Summary Cleburne Reuse Phase 2

Cost Estimate Summary Water Supply Project Option September 2023 Prices City of Cleburne - Cleburne Reuse P2 Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (0 mgd)	$2,924,000
Transmission Pump Station(s) & Storage Tank(s)	$1,504,000
Advanced Water Treatment Facility (1.25 mgd)	$13,898,000
Integration, Relocations, Backup Generator & Other	$91,000
TOTAL COST OF FACILITIES	**$18,417,000**

Cost Estimate Summary Water Supply Project Option September 2023 Prices City of Cleburne - Cleburne Reuse P2 Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
- Planning (3%)	$552,000
- Design (7%)	$1,289,000
- Construction Engineering (1%)	$184,000
Legal Assistance (2%)	$368,000
Fiscal Services (2%)	$368,000
All Other Facilities Contingency (20%)	$3,683,000
Environmental & Archaeology Studies and Mitigation	$136,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$810,000
TOTAL COST OF PROJECT	**$25,807,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,810,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$16,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$73,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$1,691,000
Pumping Energy Costs (1485685 kW-hr @ 0.09 $/kW-hr)	$134,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$3,724,000**
Available Project Yield (acft/yr)	**5,377**
Annual Cost of Water ($ per acft), based on PF=1	**$693**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$356**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$2.13**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$1.09**
Note: One or more cost element has been calculated externally	
J. Stovall	*2/3/2025*

Table 3.7-3 Comparison of Cleburne Reuse 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. Potential 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 Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

3.8 City of College Station Non-Potable Reuse

3.8.1 Description of Option

The City of College Station is currently applying reuse as a water supply from the Carters Creek WWTP for irrigation at Veterans Park and other customers. The City has obtained TCEQ Reclaimed Water Type 1 permits to utilize treated wastewater from the Lick Creek and Carters Creek WWTPs. The City is considering expanding the reuse system and is conducting a strategy study to determine the most cost-effective system. One option (called the Irrigation Option) is to provide 103 acft/yr irrigation supply to Post Oak Mall, Central Park and a planned Industrial Park located to the west of Carters Creek WWTP. Although average annual demand for these three facilities totals approximately 103 acft/yr, the reuse system must be sized to meet the peak irrigation demand during the summer months, which is about 0.25 mgd or 282 acft/yr.

The location of the current system and possible future expansion is shown in Figure 3.8-1. As shown on the map, Veterans Park and Crescent Pointe are north of Carters Creek WWTP within the current service area; and, the Post Oak Mall, Central Park and a planned Industrial Park are to the west of Carters Creek WWTP. A summary of irrigation demand for existing and planned customers is included in Table 3.8-1.

3.8.2 Available Supply

The water supply that would be potentially available for College Station would be that portion of their wastewater effluent stream that has suitable uses within an economical distance from the treatment plant. For the 5-year period from 2018 through 2022, the average effluent discharges from Carters Creek WWTP and Lick Creek WWTP were 6.7 and 1.7 million gallons per day (mgd), respectively, for a combined discharge of 9,409 acft/yr. The combined Year 2080 Estimated WWTP Effluent for these WWTP plants is 24,351 acft/yr (21.74 mgd). The WWTPs combined permitted discharge volumes is 14.5 mgd.

Figure 3.8-1 College Station Non-Potable Reuse

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Table 3.8-1 Water Reuse Demands for College Station Non-Potable Reuse Project

Reuse Customer	Current (acft/yr)	Proposed (acft/yr)
Veteran's Park	141	
Crescent Pointe	13	
Central Park		57
Post Oak Mall		33
Planned Industrial Park		13
Total	**154**	**103**

3.8.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible high negative impact to fish and wildlife habitat with substantially reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.8-2.

Table 3.8-2 Environmental Issues: College Station Non-Potable Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, reuse storage tanks, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible high negative impact to fish and wildlife habitat with substantially reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

3.8.4 Engineering and Costing

The irrigation option will include a pump station at the wastewater treatment plant, a pipeline for customers west of Texas Hwy 6, and ground storage at the end of the pipeline to balance the daily supply and hourly demand. The distribution facilities are sized to deliver the total daily demand in a 12-hour period. Pumping facilities are sized to deliver the water to a ground storage tank near the irrigation demand. Distribution pumps and pipelines would draw water from the storage tank as needed. The required improvements to implement a wastewater reuse supply for College Station are summarized in Table 3.8-3. The total costs for expanding the reuse system are shown in Table 3.8-4. The unit cost of a reuse supply could potentially be decreased by the addition of other users within an economical distance from the WWTP(s).

Table 3.8-3 Required Facilities – College Station Reuse for Veterans Park Irrigation

Facility	Description
Treatment Upgrade	0.09 mgd, Scenario 1; existing WWTP meets type 1 reuse standards, requiring only the addition of chlorine for distribution
Pump Station(s)	Expansion of existing reuse pump station with dedicated pumps - 5 HP to deliver average demand of 0.09 mgd in 12 hours
Storage Tank	0.18; Store one days treated reuse water at the end of the pipeline
Pipeline	11,278 ft of 6-inch pipe
Available Project Yield	0.09 mgd (103 acft/yr)

Table 3.8-4 Cost Estimate Summary: College Station Non-Potable Reuse

Cost Estimate Summary Water Supply Project Option September 2023 Prices College Station - Reuse for Non Potable Purposes Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (0.2 mgd)	$656,000
Transmission Pipeline (6 in. dia., 2.1 miles)	$2,490,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,161,000
Water Treatment Plant (0.1 mgd)	$31,000
Integration, Relocations, Backup Generator & Other	$1,000
TOTAL COST OF FACILITIES	**$4,339,000**
- Planning (3%)	$130,000
- Design (7%)	$304,000
- Construction Engineering (1%)	$43,000
Legal Assistance (2%)	$87,000
Fiscal Services (2%)	$87,000
Pipeline Contingency (15%)	$374,000
All Other Facilities Contingency (20%)	$370,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices College Station - Reuse for Non Potable Purposes Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Environmental & Archaeology Studies and Mitigation	$64,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$189,000
TOTAL COST OF PROJECT	**$5,987,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$421,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$37,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$16,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$18,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (11693 kW-hr @ 0.09 $/kW-hr)	$1,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$493,000**
Available Project Yield (acft/yr)	**103**
Annual Cost of Water ($ per acft), based on PF=2	**$4,786**
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	**$699**
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	**$14.69**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	**$2.14**
JMP	*2/2/2025*

3.8.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.8-5 and the option meets each criterion. Before pursuing wastewater reuse, College Station will need to investigate concerns that would include at a minimum:

- Amount of treated effluent that is available and not committed under separate contracts;
- Potential other 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 reuse.

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- U.S. Army Corps of Engineers Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the United States for construction; and other activities;
- Texas Pollutant Discharge Elimination System (TPDES) Storm Water Pollution Prevention Plan;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Table 3.8-5 Comparison of College Station Non-Potable Reuse 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 Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

3.9 College Station Direct Potable Reuse

3.9.1 Description

The City of College Station is considering two options to utilize its treated wastewater for potable uses. One option that is described in Chapter 8.2 purifies the city's treated effluent and utilizes an aquifer storage and recovery (ASR) wellfield to store potable supplies for peaking demands. The second option described in this section, purifies the supplies and blends it back with the City's treated water sources for subsequent distribution. The concept for the City of College Station (College Station) Direct Potable Reuse project is to:

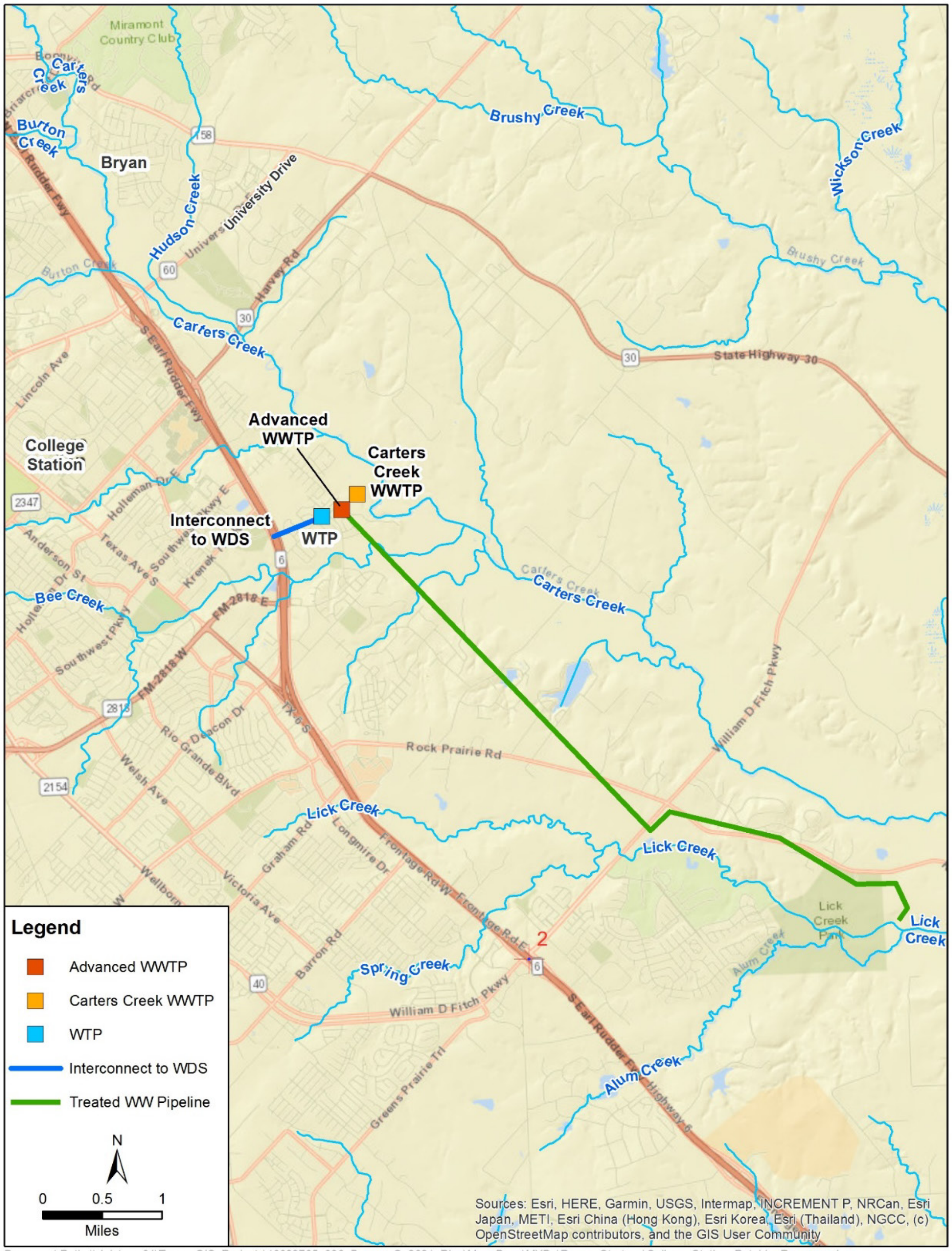
- Utilize existing wastewater effluent as the source of water for direct potable reuse and ASR. For the 5-year period from 2018 through 2022, the average effluent discharges from Carters Creek WWTP and Lick Creek WWTP were 6.7 and 1.7 million gallons per day (mgd), respectively.
- A new Water Treatment Plant and Advance Wastewater Treatment Plant (AWWTP) would be located near the Carters Creek WWTP. Effluent from the much smaller Lick Creek WWTP would be transported to the AWWTP through a new pipeline.
- The AWWTP would treat the treated wastewater effluent with: (1) Low Pressure Membrane, (2) Reverse Osmosis, and (3) Oxidation before sending the water through a WTP as additional buffer and credit toward required log removal.

A schematic showing the location of the project is shown in Figure 3.9-1. New facilities required for this option are the pump station and wastewater transmission pipeline from Lick Creek WTP and Carters Creek WTP, advanced water treatment plant, interconnects between AWWTP, WTP and College Station's distribution system.

3.9.2 Available Yield

College Station wastewater treatment plants include Carters Creek and Lick Creek WWTPs. As of 2024, combined WWTP discharges are greater than 8.6 mgd, thus, an assumed supply of 7.0 mgd (7,842 acft/yr) of treated wastewater would be made available for direct potable reuse. The combined Year 2080 Estimated WWTP Effluent for these WWTP plants is 24,351 acft/yr (21.74 mgd).

Figure 3.9-1 Location of College Station's Direct Potable Reuse Project



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3.9.3 Environmental Issues

A summary of environmental issues is presented in Table 3.9-1.

Table 3.9-1 Environmental Issues: College Station Direct Potable Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment and advanced water treatment plant facilities, transmission and distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low to moderate impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible high negative impact to fish and wildlife habitat with substantially reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

3.9.4 Engineering and Costing

The major facilities required for these projects include:

- Pump station and transmission pipeline from Lick Creek WWTP;
- Advanced Wastewater Treatment Plant;
- Water Treatment Plant; and
- Transmission pipeline and interconnect between AWWTP and distribution system.

Estimates were prepared for capital and project costs, annual debt service, operation and maintenance, power, land, and environmental mitigation. These costs are summarized in Table 3.9-2. The annual costs, including debt service, operation and maintenance, and power, is estimated to be $2,022 per acft for the College Station project.

3.9.5 Implementation

Implementation of the DPR water management strategy for College Station includes the following issues:

- Close coordination with TCEQ to define treatment criteria for expected 5.5 log removal cryptosporidium, 6 log removal giardia, 8 log removal virus after secondary/tertiary WWTP;
- Acquiring permits from TCEQ for the Water Treatment Plant facilities construction and operations;
- Initial and operational cost; and
- Development of a management plan to efficiently use the reuse supply; and
- Currently, several log removal required by TCEQ: 5.5 log crypto, 6 log giardia, 8 log virus (after secondary/tertiary WWTP) means that the city would need to provide additional treatment barriers beyond an AWWTP in order to achieve expected log removals. This analysis assumes construction of a new WTP to provide the additional log removals.

This water supply option has been compared to the plan development criteria, as shown in Table 3.9-2., and the option meets each criterion.

Table 3.9-2 Cost Estimate Summary: College Station DPR Project Option

Cost Estimate Summary Water Supply Project Option September 2023 Prices College Station - College Station DPR Carters Ck and Lick Ck WWTP Effluent Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (7.4 mgd)	$5,665,000
Transmission Pipeline (10-24 in. dia., 7.1 miles)	$9,619,000
Two Water Treatment Plants (0 mgd and 7.4 mgd)	$34,197,000
Advanced Water Treatment Facility (7.4 mgd)	$41,149,000
Integration, Relocations, Backup Generator & Other	$437,000
TOTAL COST OF FACILITIES	**$91,067,000**
- Planning (3%)	$2,732,000
- Design (7%)	$6,375,000
- Construction Engineering (1%)	$911,000
Legal Assistance (2%)	$1,821,000
Fiscal Services (2%)	$1,821,000
Pipeline Contingency (15%)	$1,443,000
All Other Facilities Contingency (20%)	$16,290,000
Environmental & Archaeology Studies and Mitigation	$499,000
Land Acquisition and Surveying (43 acres)	$780,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$4,016,000
TOTAL COST OF PROJECT	**$127,755,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$8,976,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$101,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$142,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$2,442,000
Advanced Water Treatment Facility	$3,923,000
Pumping Energy Costs (3064284 kW-hr @ 0.09 $/kW-hr)	$276,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$15,860,000**
Available Project Yield (acft/yr)	**7,842**
Annual Cost of Water ($ per acft), based on PF=1	**$2,022**

Cost Estimate Summary Water Supply Project Option September 2023 Prices College Station - College Station DPR Carters Ck and Lick Ck WWTP Effluent Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$878**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$6.21**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$2.69**
JMP	*2/2/2025*

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3.10 City of Georgetown Reuse

3.10.1 Description of Option

The average annual effluent discharge from the City of Georgetown's Dove Springs Wastewater Treatment Plant (WWTP) was 1.6 mgd in 2022. Dove Springs WWTP has a permitted average effluent discharge at 2.5 mgd. Georgetown applies treated effluent as a source of reuse water with average reuse volume equal to 0.75 mgd in a year. Another 0.55 mgd of treated water could potentially be used for reuse purposes. Two potential options for reuse were considered. The preferred reuse option would be to connect a reclaimed water supply line from Dove Springs WWTP to the existing reclaimed irrigation lines. The proposed reuse pipeline from Dove Springs WWTP would be 2.41 miles. Dove Springs WWTP is assumed to treat effluent to a Type 1 quality.

Locations of the Dove Springs WWTP plant, ground storage tank, pump stations and transmission pipeline are shown in Figure 3.10-1.

3.10.2 Available Supply

The planned capacity of the Georgetown Reuse project is 1.3 mgd (1,456 acft/yr).

3.10.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible low impact on recharge rates in Edwards Aquifer due to reduced effluent return flow rates;
- Possible negative impact to fish and wildlife habitat with substantially reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.10-1.

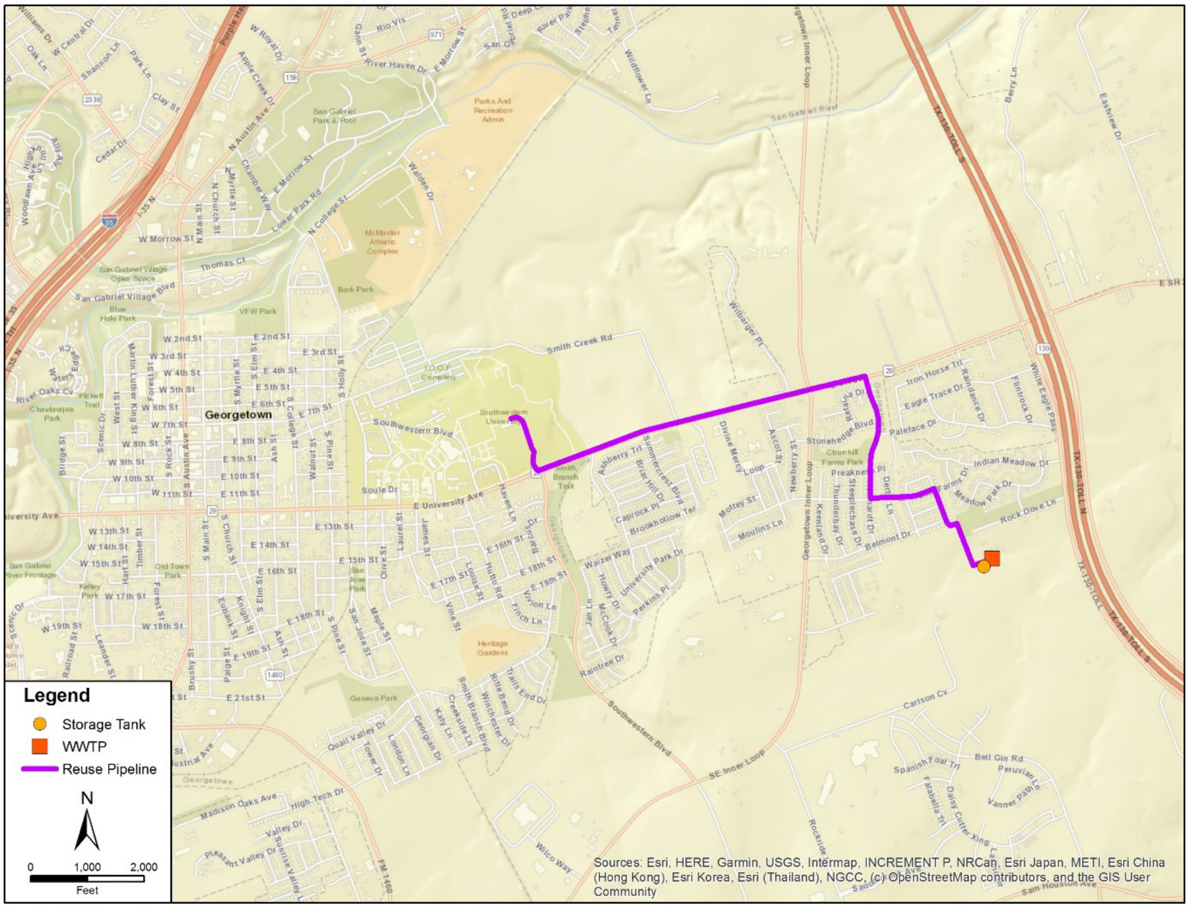

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Figure 3.10-1 Georgetown Reuse

Table 3.10-1 Environmental Issues: Georgetown Reuse

Issue	Description
Implementation Measures	Development of additional ground storage tank, transmission pipeline, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Edwards Aquifer	Possible increased water quality to stream flows and Edwards Aquifer recharge zone. Possible low impact on recharge rates due to decreased effluent flow
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible negative impact to fish and wildlife habitat due to reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

3.10.4 Engineering and Costing

The required improvements to implement a wastewater reuse supply Georgetown are summarized in Table 3.10-2. The project requires a 5.2 mgd pump station along with a storage tank located at the Dove Springs WWTP. A 2.35 mile, 16-inch diameter pipe would deliver the reuse supply to the existing reuse system. This section does not include costs for potential distribution lines from the proposed reuse pipeline system.

Table 3.10-2 Required Facilities –Georgetown Reuse

Facility	Description
Pump Stations	160 HP at Dove Springs WWTP; 5.2 mgd capacity to deliver at peak capacity at uniform rate.
Storage Tanks	1.3 MG; balancing storage at Dove Springs WWTP.
Pipelines	12,800 ft of 16-inch pipe; from Dove Springs to East View High School
Available Project Yield	1.3 mgd (1,456 acft/yr)

The total costs for developing a wastewater reuse supply from Dove Springs WWTP are shown in Table 3.10-3. The project will have an estimated total capital cost $12,953,000 and an annual cost of $1,041,000. This cost translates to a $715 per acft or $2.19 per 1,000 gallons unit cost of the reuse water.

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- TCEQ authorization to reuse domestic wastewater under 30 TAC Chapter 210 (“210 authorization”);
- U.S. Army Corps of Engineers 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;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Table 3.10-3 Cost Estimate Summary: Georgetown Reuse

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Georgetown - Georgetown Reuse	
Cost based on ENR CCI 13485.67 for September 2023 and	
a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Pump Stations (5.2 mgd)	$2,102,000
Transmission Pipeline (16 in. dia., 2.4 miles)	$5,284,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,784,000
Integration, Relocations, Backup Generator & Other	$4,000
TOTAL COST OF FACILITIES	**$9,174,000**
- Planning (3%)	$275,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Georgetown - Georgetown Reuse	
Cost based on ENR CCI 13485.67 for September 2023 and	
a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
- Design (7%)	$642,000
- Construction Engineering (1%)	$92,000
Legal Assistance (2%)	$183,000
Fiscal Services (2%)	$183,000
Pipeline Contingency (15%)	$793,000
All Other Facilities Contingency (20%)	$778,000
Environmental & Archaeology Studies and Mitigation	$162,000
Land Acquisition and Surveying (19 acres)	$263,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$408,000
TOTAL COST OF PROJECT	**$12,953,000**
	x
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$911,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$71,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$53,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (62628 kW-hr @ 0.09 $/kW-hr)	$6,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,041,000**
Available Project Yield (acft/yr)	**1,456**
Annual Cost of Water ($ per acft), based on PF=4	**$715**
Annual Cost of Water After Debt Service ($ per acft), based on PF=4	**$89**
Annual Cost of Water ($ per 1,000 gallons), based on PF=4	**$2.19**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=4	**$0.27**
JMP	*2/4/2025*

Table 3.10-4 Comparison of Georgetown Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient for intended uses
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Reduces instream flows—possible low impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. 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 Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

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3.11 Waco WMARSS Reuse Projects

Since the 2011 Brazos G Regional Plan, Waco Metropolitan Area Regional Sewerage System (WMARSS) has constructed the Sandy Creek Energy Associates (SCEA) Project which provides 15,000 acft/yr of treated effluent from the WMARSS Central Wastewater Treatment Plant to the SCEA power plant. WMARSS continues to consider the development of four wastewater reuse systems to supply reuse water to customers. These reuse systems are referred to as the Waco North China Spring reuse, Flat Creek Interceptor Project and Bull Hide (3.5mgd) through the Bull Hide Creek, I-84 reuse and Bellmead/Lacy Lakeview reuse projects. Future projects would consider supplying an additional 3,920 acft/yr.

Assuming simultaneous implementation of the other reuse projects, potential available supply from the Flat Creek Reuse Project would be 7,847 acft/yr (7 mgd) capacity prior to 2030. For 2018 through 2022, the minimum annual average WMARSS effluent discharge was 19,840 acft/yr (17.7 mgd). By 2080, the effluent volume available for reuse is is estimated to be 47,910 acft/yr (42.8 mgd). These options consist of integrated reuse projects to deliver Type 1 reuse water from the existing WMARSS Central Wastewater Treatment Plant located southeast of Waco along the Brazos River and from the Bull Hide WWTP.

Locations of each of the Waco reuse projects including treatment plants, proposed transmission pipelines, ground storage tanks, and pump stations are shown in Figure 3.11-1. Descriptions of each of the options are included in Sections 3.11.1 through 3.11.5.

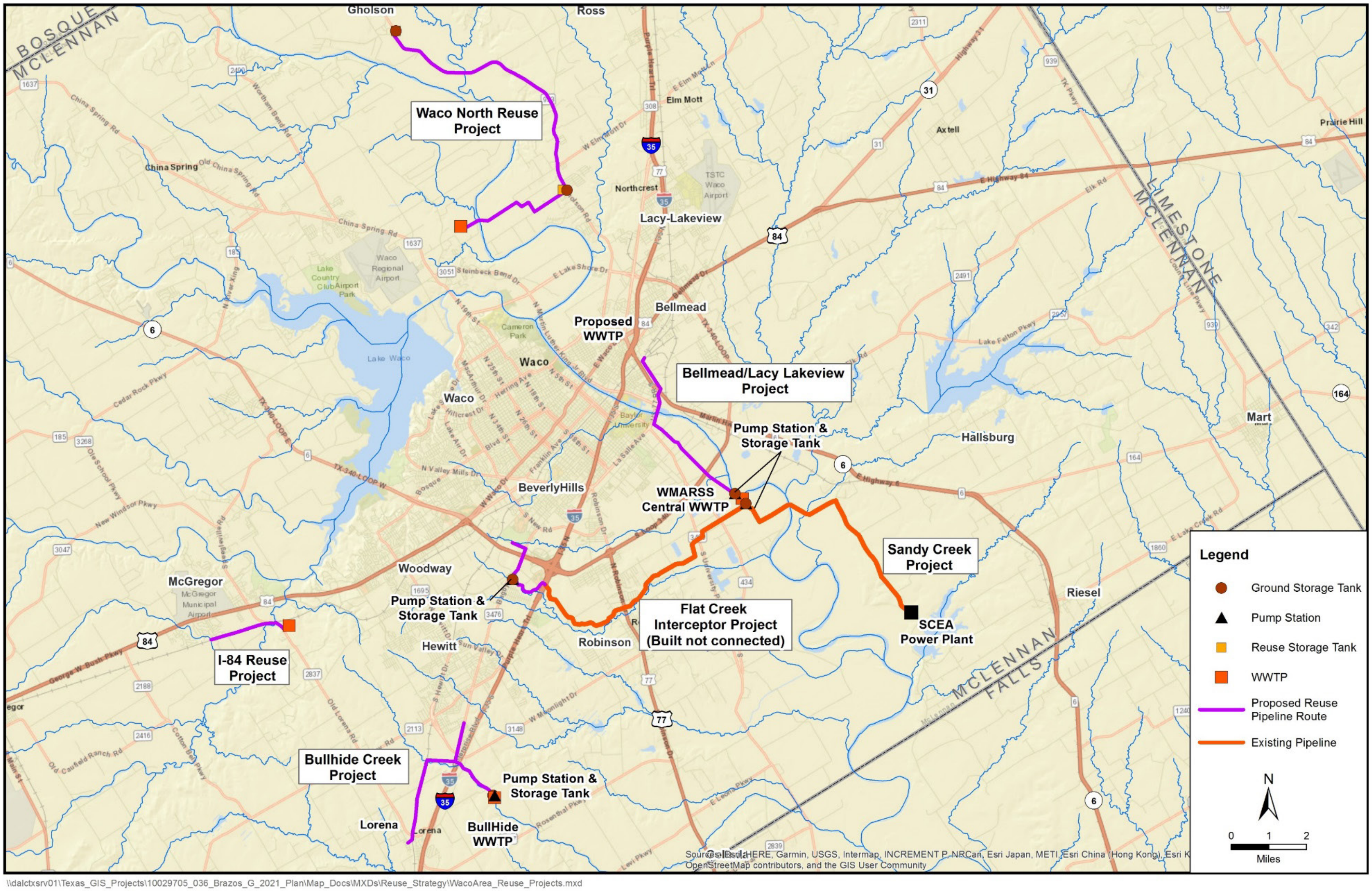

Figure 3.11-1 Locations of Waco Area Reuse Projects

3.11.1 WMARSS Bellmead/Lacy-Lakeview Reuse

3.11.1.1 Description of Option

WMARSS is considering the development of a wastewater reuse system to supply reuse water to customers within the Cities of Bellmead and Lacy-Lakeview. This option consists of an integrated reuse project to deliver Type 1 reuse water from the existing WMARSS Central WWTP located southeast of Waco along the Brazos River. Treated reuse water would be transported to the industrial and municipal sectors of Bellmead and Lacy Lakeview. Locations of the WMARSS Central WWTP plant, and proposed transmission pipelines, ground storage tanks, and pump stations are shown in Figure 3.11-2.

The transmission system will be capable of delivering 2 mgd (2,242 acft/yr) of treated reuse water from the WMARSS Central WWTP. Supplies to the two cities are divided equally at 50% of the planned system capacity. This Type 1 reuse water may be utilized for landscape irrigation at existing or future parks, schools, ball fields, and other green spaces. Reuse water may also potentially supply existing or future industrial customers.

3.11.1.2 Available Supply

The planned capacity of the WMARSS Bellmead/Lacy Lakeview Reuse project is 2 mgd (2,242 acft/yr).

3.11.1.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible negative impact to fish and wildlife habitat with substantially reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.11-1.

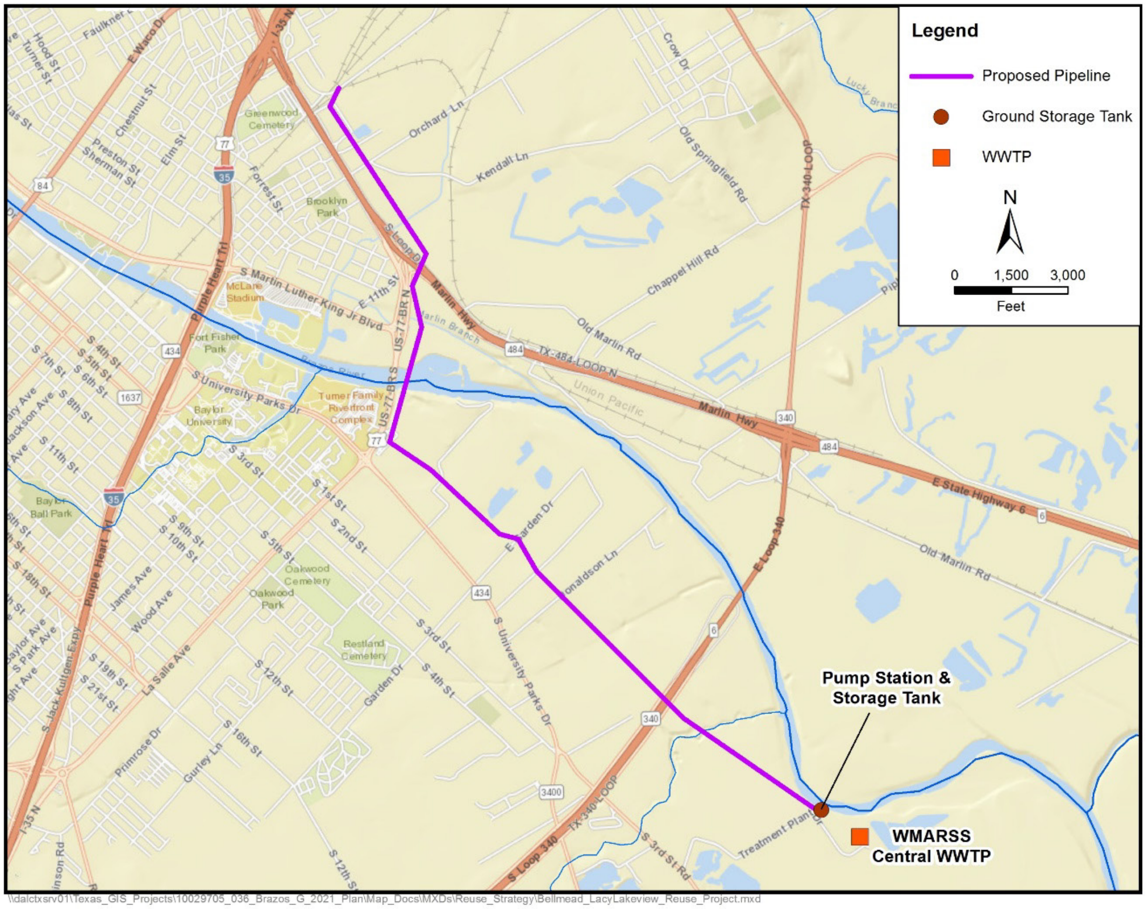

Figure 3.11-2 WMARSS Bellmead/Lacy-Lakeview Reuse

Table 3.11-1 Environmental Issues: WMARSS Bellmead/Lacy-Lakeview Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible negative impact to fish and wildlife habitat due to reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

3.11.1.4 Engineering and Costing

The required improvements to implement a wastewater reuse supply for Bellmead and Lacy-Lakeview are summarized in Table 3.11-2. The project requires a 2 mgd pump station along with a 1.5 MG storage tank located at the WMARSS Central WWTP. A 5 mile, 12-inch diameter pipe would deliver the reuse supply to the Bellmead city limits. Distribution lines not included in this cost estimate would deliver supply to Lacy-Lakeview and customers of the two cities.

Table 3.11-2 Required Facilities – WMARSS Bellmead/Lacy-Lakeview Reuse

Facility	Description
Pump Stations	124 HP at WMARSS Central WWTP; 2 mgd capacity to deliver at uniform rate to Bellmead
Storage Tanks	1.5 MG; balancing storage at WMARSS Central WWTP
Pipelines	51,000 ft of 12-inch pipe; from WMARSS Central WWTP to I-35 Pump Station
Available Project Yield	2.0 mgd (2,240 acft/yr); total yield for all Bellmead/Lacy-Lakeview projects supplied

The total costs for developing a wastewater reuse supply for Bellmead and Lacy-Lakeview are shown in Table 3.11-3. The project will have an estimated total project cost of $17,868,000 and an annual cost of $1,637,000. This cost translates to a unit cost of $731 per acft or $2.24 per 1,000 gallons.

Table 3.11-3 Cost Estimate Summary: WMARSS Bellmead/Lacy Lakeview Reuse

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
City of Waco - WMARSS Bellmead & Lacy Lakeview Reuse	
Cost based on ENR CCI 13485.67 for September 2023 and	
a PPI of 278.502 for September 2023	
Item	**Estimated Costs for Facilities**
Intake Pump Stations (2.1 mgd)	$1,634,000
Transmission Pipeline (12 in. dia., 4.9 miles)	$7,608,000
Storage Tanks (Other Than at Booster Pump Stations)	$3,306,000
Integration, Relocations, Backup Generator & Other	$41,000
TOTAL COST OF FACILITIES	**$12,589,000**
	x
- Planning (3%)	$378,000
- Design (7%)	$881,000
- Construction Engineering (1%)	$126,000
Legal Assistance (2%)	$252,000
Fiscal Services (2%)	$252,000
Pipeline Contingency (15%)	$1,141,000
All Other Facilities Contingency (20%)	$996,000
Environmental & Archaeology Studies and Mitigation	$240,000
Land Acquisition and Surveying (31 acres)	$453,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
City of Waco - WMARSS Bellmead & Lacy Lakeview Reuse	
Cost based on ENR CCI 13485.67 for September 2023 and	
a PPI of 278.502 for September 2023	
Item	**Estimated Costs for Facilities**
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$562,000
TOTAL COST OF PROJECT	**$17,870,000**
	x
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,254,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$110,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$41,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (664977 kW-hr @ 0.09 $/kW-hr)	$60,000
Purchase of Water (2240 acft/yr @ 76.8592833752094 $/acft)	$172,000
TOTAL ANNUAL COST	**$1,637,000**
Available Project Yield (acft/yr)	**2,240**
Annual Cost of Water ($ per acft), based on PF=1	**$731**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$171**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$2.24**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$0.52**
JS	*2/3/2025*

Table 3.11-4 Comparison of WMARSS Bellmead/Lacy-Lakeview Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient for intended uses
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Reduces instream flows—possible low impact

Impact Category	Comment(s)
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. 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 Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- TCEQ authorization to reuse domestic wastewater under 30 TAC Chapter 210 ("210 authorization");
- U.S. Army Corps of Engineers 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;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

3.11.2 WMARSS Bull Hide Creek Reuse

3.11.2.1 Description of Option

WMARSS is considering the development of a wastewater reuse system to supply reuse water to customers within the Cities of Hewitt and Lorena. This option consists of an integrated reuse project to deliver Type 1 reuse water from the WMARSS Bull Hide Creek WWTP located approximately 1.2 miles southeast of I-35 on Bull Hide Creek. Treated reuse water from this satellite plant would be transported to the industrial and municipal sectors of Hewitt and Lorena. Locations of the proposed reuse treatment plant, transmission pipelines, ground storage tanks, and pump stations are shown in Figure 3.11-3.

The potential reuse water demand for the City of Hewitt and Lorena is based upon hydraulic constraints of the transmission system. The transmission system will be capable of delivering 1.5 mgd (1,681 acft/yr) of treated reuse water from the WMARSS Bull Hide Creek WWTP. The planned system provides Hewitt with 1,233 acft/yr (1.1 mgd) of reuse water and 448 acft/yr (0.4 mgd) of reuse water to Lorena. This Type 1 reuse water may be utilized for landscape irrigation at existing or future parks, schools, ball fields, and other green spaces. Reuse water may also potentially supply existing or future industrial customers.

3.11.2.2 Available Supply

The capacity for the WMARSS Bull Hide Creek WWTP is 1.5 mgd (1,681 acft/yr).

3.11.2.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible negative impact to fish and wildlife habitat due to reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.11-5.

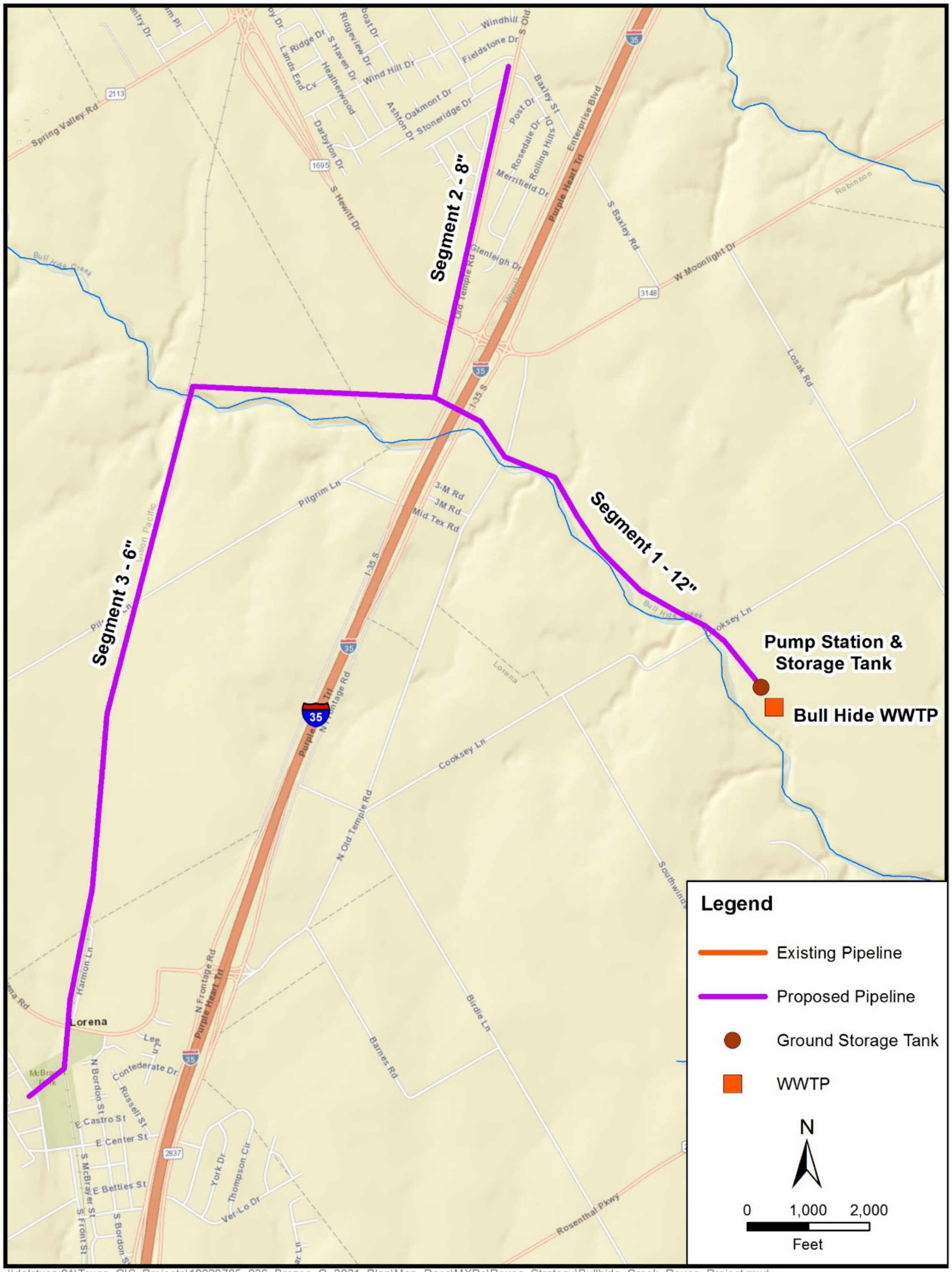

Figure 3.11-3. WMARSS Bull Hide Creek Reuse

Table 3.11-5 Environmental Issues: WMARSS Bull Hide Creek Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible negative impact to fish and wildlife habitat due to reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

3.11.2.4 Engineering and Costing

The required improvements to implement a wastewater reuse supply for Hewitt and Lorena are summarized in Table 3.11-6. The project requires a 1.5 mgd pump station along with a 1.5 MG storage tank located at the WMARSS Bull Hide Creek WWTP site. The transmission pipeline system is separated into three separate components. The first segment is a 12-inch pipe capable of transporting 1.5 mgd of reuse water from the proposed WWTP site. Segment 2 is an 8-inch pipe that splits of from the main line to provide reuse water to the City of Hewitt. Segment 2 is capable of delivering 1.1 mgd based on hydraulic constraints of the system. Segment 3 transports the remaining 0.4 mgd of reuse water through a 6-inch pipe to the City of Lorena.

Table 3.11-6 Required Facilities – WMARSS Bull Hide Creek Reuse

Facility	Description
Pump Stations	111 HP at WMARSS Bull Hide Creek WWTP; 1.5 mgd capacity to deliver at uniform rate to Hewitt and Lorena
Storage Tanks	1.5 MG; balancing storage at WMARSS Bull Hide Creek WWTP
Pipelines	Segment 1; 1.3 miles of 12-inch pipe; from proposed WMARSS Bull Hide Creek WWTP to Segment 2/Segment 3 intersection Segment 2; 1.0 mile of 8-inch pipe; from Segment 1 intersection to Hewitt Segment 3; 3.0 miles of 6-inch pipe from Segment 1 intersection to Lorena
Available Project Yield	1.5 mgd (1,681 acft/yr); total yield for all Hewitt and Lorena projects supplied

Costs presented in Table 3.11-7 provide the total option costs for developing a wastewater reuse supply for Hewitt and Lorena. The project will have an estimated total project cost of $13,959,000 and an annual cost of $1,388,000. This cost translates to a unit cost of $826 per acft or $2.53 per 1,000 gallons.

3.11.2.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.11-8, and the option meets each criterion. Before pursuing wastewater reuse, the WMARSS entities will need to investigate concerns that would include at a minimum:

- Amount and timing of treated effluent available.
- 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).
- Capital costs of constructing needed distribution systems connecting the treatment and transmission facilities to the ultimate points of end use.

Table 3.11-7 Cost Estimate Summary: WMARSS Bull Hide Creek Reuse

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
City of Waco - WMRSS Bullhide Creek Reuse	
Cost based on ENR CCI 13485.67 for September 2023 and	
a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (1.6 mgd)	$1,537,000
Transmission Pipeline (6-12 in. dia., 5.4 miles)	$5,406,000
Storage Tanks (Other Than at Booster Pump Stations)	$2,545,000
Integration, Relocations, Backup Generator & Other	$56,000
TOTAL COST OF FACILITIES	**$9,544,000**
	x
- Planning (3%)	$286,000
- Design (7%)	$668,000
- Construction Engineering (1%)	$95,000
Legal Assistance (2%)	$191,000
Fiscal Services (2%)	$191,000
Pipeline Contingency (15%)	$811,000
All Other Facilities Contingency (20%)	$827,000
Environmental & Archaeology Studies and Mitigation	$333,000
Land Acquisition and Surveying (39 acres)	$575,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$438,000
TOTAL COST OF PROJECT	**$13,959,000**
	x
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$978,000
Reservoir Debt Service (3.5 percent, 40 years)	$0

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
City of Waco - WMRSS Bullhide Creek Reuse	
Cost based on ENR CCI 13485.67 for September 2023 and	
a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$80,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$38,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$81,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (913607 kW-hr @ 0.09 $/kW-hr)	$82,000
Purchase of Water (1681 acft/yr @ 76.8592833752094 $/acft)	$129,000
TOTAL ANNUAL COST	**$1,388,000**
Available Project Yield (acft/yr)	**1,681**
Annual Cost of Water ($ per acft), based on PF=1	**$826**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$244**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$2.53**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$0.75**
JS	*2/3/2025*

Table 3.11-8 Comparison of WMARSS Bull Hide Creek Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient for intended uses
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Reduces instream flows—possible low impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. 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

Impact Category	Comment(s)
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 Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- TCEQ authorization to reuse domestic wastewater under 30 TAC Chapter 210 ("210 authorization");
- U.S. Army Corps of Engineers 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;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

3.11.3 WMARSS Flat Creek Reuse

3.11.3.1 Description of Option

WMARSS is considering the development of a wastewater reuse system to supply reuse water to customers within the City of Waco. This option consists of an integrated reuse project to deliver Type 1 reuse water from the existing WMARSS Central WWTP located southeast of Waco along the Brazos River. Treated reuse water from the WMARSS Central WWTP would be transported to the industrial and municipal sectors of Waco and the Cottonwood Creek Golf Course. Locations of the existing reuse treatment plant, and proposed transmission pipelines, ground storage tanks, and pump stations are shown in Figure 3.11-4. Approximately 42,000 feet of 20-inch diameter pipeline has been constructed extending from the WMARSS Central WWTP to Interstate I-35.

The potential reuse water demand for the City of Waco is assumed to be the entire amount of available yield (7,847 acft/yr) from the WMARSS Central WWTP. This Type 1 reuse water may be utilized for landscape irrigation at existing or future parks, schools, ball fields, and other green spaces. Reuse water may also potentially supply existing or future industrial customers. Discussions with industrial customers indicate that public-private partnerships may be viable project funding option. The transmission system will be capable of delivering 7 mgd (7,847 acft/yr) of treated reuse water from the WMARSS Central WWTP.

3.11.3.2 Available Supply

The WMARSS system is contracted to supply 15,000 acft/yr (13.4 mgd) of the treated effluent from the WMARSS system to the SCEA Power Plant (Section 3.6.1). An additional 3,920 acft/yr (3.5 mgd) would be supplied through the Bull Hide Creek and Bellmead/Lacy Lakeview reuse projects. The Year 2011 effluent from WMARSS was 25,355 acft/yr (22.62 mgd). The Year 2070 estimated effluent from WMARSS is 36,370 acft/yr (32.5 mgd). Assuming simultaneous implementation of the other reuse projects, potential available supply from the Flat Creek Reuse Project would be 7,847 acft/yr (7 mgd) capacity sometime by 2030.

3.11.3.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible negative impact to fish and wildlife habitat due to reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.11-9.

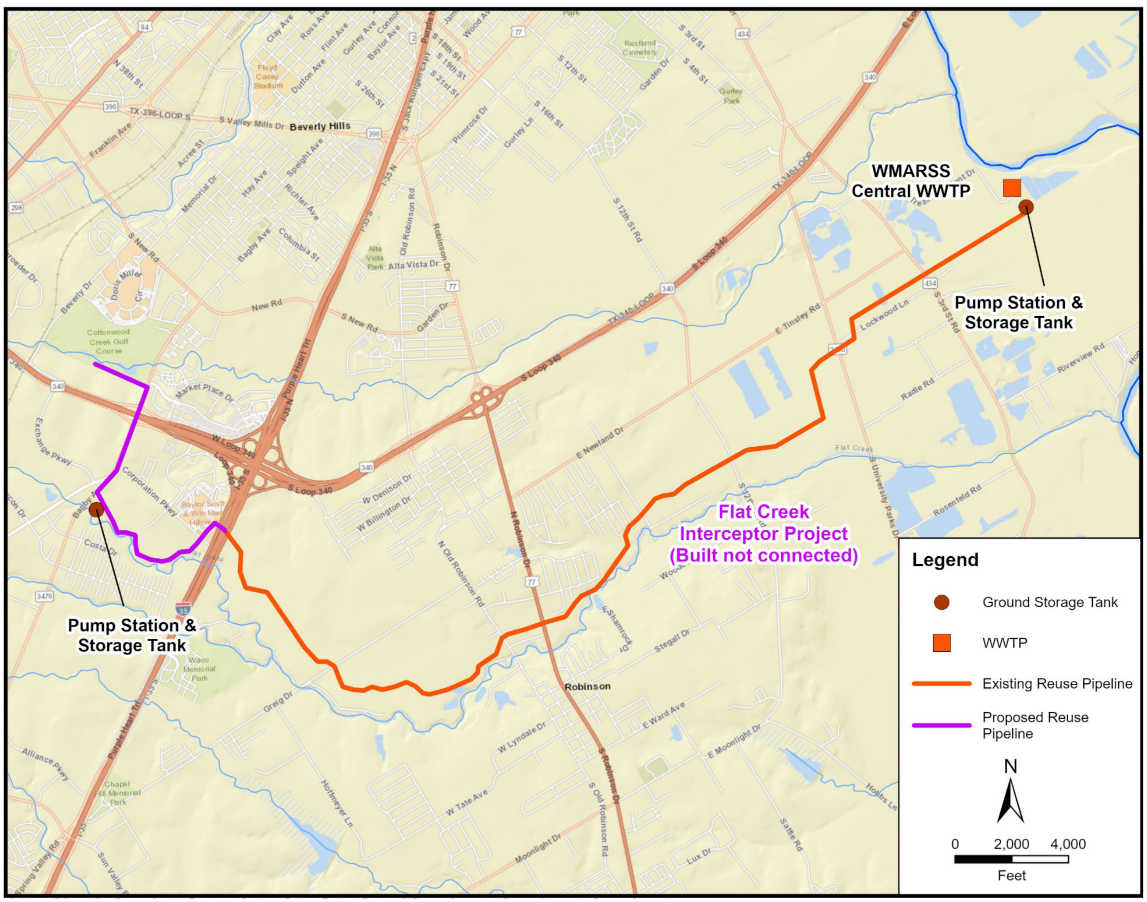

Figure 3.11-4 WMARSS Flat Creek Reuse

Table 3.11-9 Environmental Issues: WMARSS Flat Creek Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible negative impact to fish and wildlife habitat due to reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

3.11.3.4 Engineering and Costing

The required improvements to implement a wastewater reuse supply for Waco are summarized in Table 3.11-10. The project requires a 7 mgd pump station along with two 1.5 MG storage tanks located at the WMARSS Central WWTP. A 6,000 ft, 20-inch diameter pipe connects the existing pipeline to a 1 MG storage tank located west of I-35. Distribution lines to connect the 20-inch pipeline to industrial customers within the City of Waco are not included in this cost estimate. At the I-35 site, a 1500 gpm pump station would deliver up to 2 mgd of reuse water through a 6,720 ft, 12-inch diameter pipe to Cottonwood Creek Golf Course for irrigation purposes.

Table 3.11-10 Required Facilities – WMARSS Flat Creek Reuse

Facility	Description
Pump Stations	5000 gpm at WMARSS Central WWTP; 7 mgd capacity to deliver at uniform rate to Waco and Storage Tanks at I-35 Pump Station 1500 gpm at I-35 Site; 2 mgd capacity to deliver at uniform rate to Cottonwood Creek Golf Course
Storage Tanks	2, 1.5 MG tanks to provide balancing storage at WMARSS Central WWTP 1 MG tank to provide balancing storage at I-35 Pump Station
Pipelines	6,000 ft of 20-inch pipe; from WMARSS Central WWTP to I-35 Pump Station 6,720 ft of 12-in pipe; from I-35 Pump Station to Cottonwood Creek Golf Course
Available Project Yield	7.0 mgd (7,847 acft/yr); total yield for all Flat Creek projects supplied

Costs presented in Table 3.11-11 provide the total option costs for developing a wastewater reuse supply for Waco and Cottonwood Creek Golf Course. The project will have an estimated total project cost of $21,742,000 and an annual cost of $2,630,000. This cost translates to a unit cost of $335 per acft or $1.03 per 1,000 gallons, upon utilization of the full 7 mgd (7,847 acft/yr).

3.11.3.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.11-12, and the option meets each criterion. Before pursuing wastewater reuse, the WMARSS entities will need to investigate concerns that would include at a minimum:

- Amount and timing of treated effluent available.
- 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).
- Capital costs of constructing needed distribution systems connecting the treatment facilities to the areas of reuse.

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- TCEQ authorization to reuse domestic wastewater under 30 TAC Chapter 210 (“210 authorization”);
- U.S. Army Corps of Engineers 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;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Table 3.11-11 Cost Estimate Summary: WMARSS Flat Creek Reuse

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
City of Waco - WMARSS Flat Creek Reuse Project	
Cost based on ENR CCI 13485.67 for September 2023 and	
a PPI of 278.502 for September 2023	
Item	**Estimated Costs for Facilities**
Intake Pump Stations (7.4 mgd)	$5,651,000
Transmission Pipeline (12-20 in. dia., 2.4 miles)	$3,299,000
Storage Tanks (Other Than at Booster Pump Stations)	$6,114,000
Integration, Relocations, Backup Generator & Other	$183,000
TOTAL COST OF FACILITIES	**$15,247,000**
	x
- Planning (3%)	$457,000
- Design (7%)	$1,067,000
- Construction Engineering (1%)	$152,000
Legal Assistance (2%)	$305,000
Fiscal Services (2%)	$305,000
Pipeline Contingency (15%)	$495,000

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

City of Waco - WMARSS Flat Creek Reuse Project

Cost based on ENR CCI 13485.67 for September 2023 and

a PPI of 278.502 for September 2023

Item	Estimated Costs for Facilities
All Other Facilities Contingency (20%)	$2,390,000
Environmental & Archaeology Studies and Mitigation	$261,000
Land Acquisition and Surveying (26 acres)	$381,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$679,000
TOTAL COST OF PROJECT	**$21,739,000**
	x
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,517,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$96,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$141,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (3009747 kW-hr @ 0.09 $/kW-hr)	$271,000
Purchase of Water (7847 acft/yr @ 76.8592833752094 $/acft)	$603,000
TOTAL ANNUAL COST	**$2,628,000**
Available Project Yield (acft/yr)	7,847
Annual Cost of Water ($ per acft), based on PF=1	$335
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$142
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.03
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.43
JS	*2/3/2025*

Table 3.11-12 Comparison of Flat Creek Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient for intended uses
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Reduces instream flows—possible low impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. 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 Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

3.11.4 Waco North – China Spring WWTP

3.11.4.1 Description of Option

The City of Waco is considering the development of a satellite wastewater treatment plant for the area known as China Spring in the north portion of the city. The area is isolated hydraulically from the rest of the regional sewerage and it is more cost effective to develop a regional wastewater treatment plant than deliver the wastewater to the central WMARSS facility. This option consists of an integrated reuse project to deliver Type 1 reuse water from a new satellite wastewater treatment plant located north of Waco, which would divert wastewater from a collection main of the WMARSS. Treated reuse water from this satellite plant would be transported to Chalk Bluff WSC and the City of Gholson. The new satellite reuse treatment plant and transmission pipeline locations are shown in Figure 3.11-5.

The potential reuse water demand for Chalk Bluff WSC and the City of Gholson is estimated at 30 percent of their 2080 water demand for purposes of this option. This Type 1 reuse water may be utilized for landscape irrigation at existing or future parks, schools, ball fields, and other green spaces. Reuse water may also potentially supply existing or future industrial customers. For this option the transmission system to supply reuse water for these entities also includes capacity to supply 1,264 acft/yr of reuse water for use by Mining entities within the vicinity of the reuse transmission pipelines. The amount of reuse water supplied to each entity for this option is summarized in Table 3.11-13.

3.11.4.2 Available Supply

The wastewater treatment plant is currently under design with an average flow of 1,120 acft/yr (1.0 mgd) at 2050. The amount of reuse water available for Waco China Spring WWTP reuse will be limited by the wastewater flow in the collector main feeding the new satellite reuse treatment plant. The entire wastewater stream could be used for reuse.

3.11.4.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points of WMARSS due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible low impact to fish and wildlife habitat with reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.11-14.

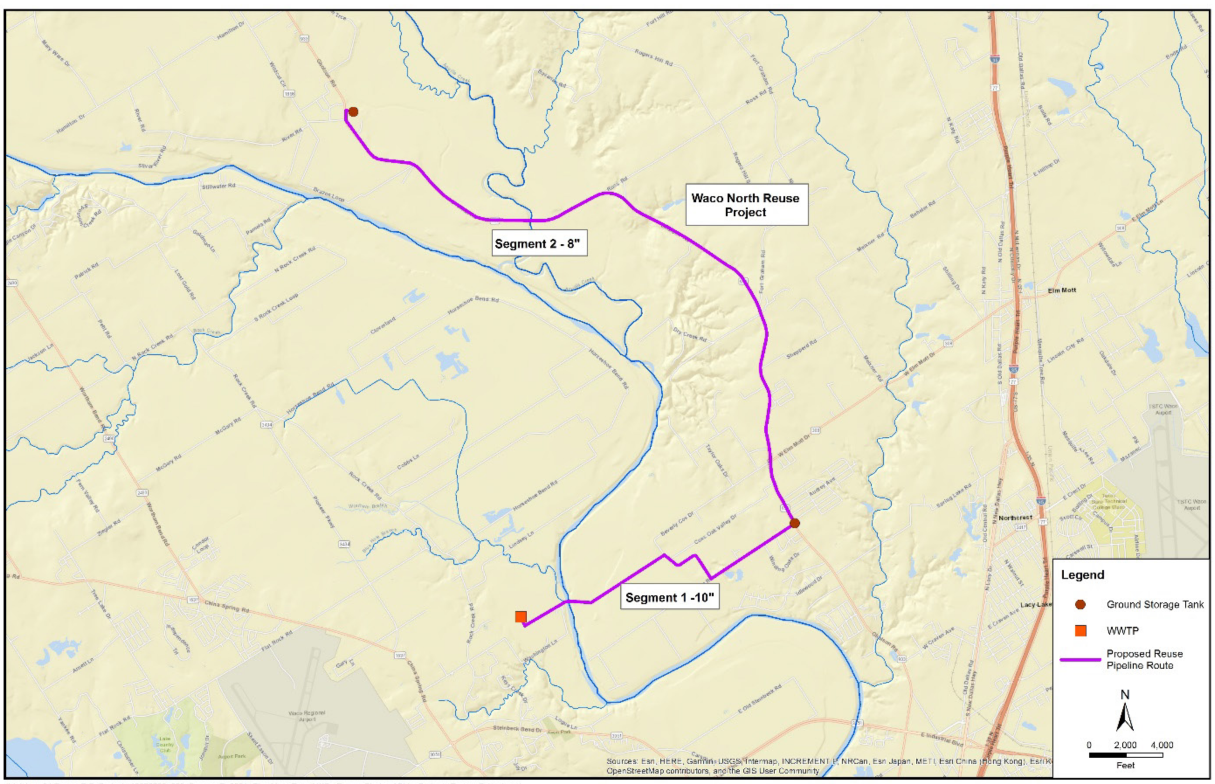

Figure 3.11-5 China Spring WWTP and Waco North Reuse

Table 3.11-13 Waco North Potential Reuse Water Demand

Entity	2080 Demand (acft/yr)	Reuse Water Demand (acft/yr)
Chalk Bluff WSC	971	291
Gholson WSC	1,012	304
McLennan County Mining	472	142
Total		**737**

Table 3.11-14. Environmental Issues: Waco North – China Spring WWTP Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible low negative impact to fish and wildlife habitat with reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas and sited to avoid wetlands, waters of the U.S. and cultural resources, where possible.

Engineering and Costing

This option has a total project cost of $44,298,000 and an annual cost of $4,150,000. Many of the required improvements to implement a reuse supply for this option are shared between the multiple entities. These shared facilities include the China Spring satellite wastewater treatment plant, pump stations, and transmission pipelines. The shared facilities are sized to supply the combined demand for the entities served by each improvement.

The costs to develop the entire project are shown in Table 3.11-15. Due to the economy of scale, significant cost savings are realized by utilizing shared larger improvements for the treatment and delivery of reuse water to all entities supplied by the China Spring - Waco North water supply option.

The required improvements to implement wastewater reuse supplies for Chalk Bluff WSC and Gholson are summarized in Table 3.11-16 through Table 3.11-18. Storage and irrigation pumping are included for Chalk Bluff WSC and Gholson.

Costs presented in Table 3.11-15 provide the total option costs for developing a wastewater reuse supply for Chalk Bluff WSC, Gholson and Mining. The demand from McLennan County Mining is divided between pipeline Segments 1 and 2. Inclusion of the Mining shared use of these transmission facilities greatly decreases the unit cost for transmission of reuse water to Chalk Bluff WSC and Gholson. Without participation from Mining or other non-municipal demand (irrigation, manufacturing) in this reuse water supply option, supplying the relatively small quantity of reuse water demanded by Chalk Bluff WSC and Gholson would likely not be economical.

Table 3.11-15. Cost Estimate Summary: WMARSS Waco North Reuse

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
China Springs - China Springs WWTP	
Cost based on ENR CCI 13485.67 for September 2023 and	
a PPI of 278.502 for September 2023	
Item	**Estimated Costs for Facilities**
Intake Pump Stations (1.1 mgd)	$1,273,000
Transmission Pipeline (8-10 in. dia., 11.2 miles)	$14,602,000
Storage Tanks (Other Than at Booster Pump Stations)	$3,984,000
Advanced Water Treatment Facility (1 mgd)	$11,403,000
Integration, Relocations, Backup Generator & Other	$27,000
TOTAL COST OF FACILITIES	**$31,289,000**
- Planning (3%)	$939,000
- Design (7%)	$2,190,000
- Construction Engineering (1%)	$313,000
Legal Assistance (2%)	$626,000
Fiscal Services (2%)	$626,000
Pipeline Contingency (15%)	$2,190,000
All Other Facilities Contingency (20%)	$3,337,000
Environmental & Archaeology Studies and Mitigation	$456,000
Land Acquisition and Surveying (64 acres)	$938,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,394,000
TOTAL COST OF PROJECT	**$44,298,000**
ANNUAL COST	x
Debt Service (3.5 percent, 20 years)	$3,115,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$186,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$32,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$778,000
Pumping Energy Costs (437254 kW-hr @ 0.09 $/kW-hr)	$39,000
Purchase of Water (acft/yr @ $/acft)	$0

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
China Springs - China Springs WWTP	
Cost based on ENR CCI 13485.67 for September 2023 and	
a PPI of 278.502 for September 2023	
Item	**Estimated Costs for Facilities**
TOTAL ANNUAL COST	**$4,150,000**
	x
Available Project Yield (acft/yr)	**1,120**
Annual Cost of Water ($ per acft), based on PF=1	**$3,705**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$924**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$11.37**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$2.84**
JS	*2/3/2025*

Table 3.11-16 Required Facilities –China Spring- Waco North

Facility	Description
WWTP	New 1.0 mgd satellite reuse WWTP
Pump Station	80 hp; 1.0 mgd capacity to deliver at uniform rate to storage tanks at Chalk Bluff WSC and Gholson with 27 psi residual pressure
Storage Tank	1 MG; balancing storage at new satellite reuse plant; 0.1 MG tanks for Gholson and Chalk Bluff WSC
Pipeline	18,250 ft of 10-inch pipe; 40,702 ft of 8-inch pipe
Available Project Yield	Total yield is 1.0 mgd: 1.0 mgd (1,120 acft/yr) delivered, and 1.0 mgd available at plant.

Table 3.11-17 Required Facilities – Chalk Bluff WSC

Facility	Description
Treatment Upgrade	Purchase 0.07 mgd treated reuse water from Waco
Pump Station	52 hp; 0.26 mgd capacity to deliver peak daily capacity in 6 hours at 60 psi; shared use of segment 1 pump station
Storage Tank	0.07 MG; Store one days treated reuse water at tank near Chalk Bluff WSC demand
Pipeline	Shared use of pipeline segment 1
Available Project Yield	0.07 mgd (73 acft/yr), yield is based on 30 percent of total year 2070 demand to be used for irrigation and/or industrial customers

Table 3.11-18 Required Facilities – Gholson

Facility	Description
Treatment Upgrade	Purchase 0.12 mgd treated reuse water from Waco
Pump Station	79 hp; 0.48 mgd capacity to deliver peak daily capacity in 6 hours at 60 psi; shared use of segment 1 pump station

Facility	Description
Storage Tank	0.12 MG; Store one days treated reuse water at tank in Gholson
Pipeline	Shared use of pipeline segments 1 and 2
Available Project Yield	0.12 mgd (135 acft/yr), yield is based on 30 percent of total year 2070 demand to be used for irrigation and/or industrial customers

Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.11-19, and the option meets each criterion. Before pursuing wastewater reuse, the Waco North entities will need to investigate concerns that would include at a minimum:

- Amount of treated effluent available, taking into consideration downstream water commitments and discharge permit requirements.
- 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).
- Capital costs of constructing needed distribution systems connecting the treatment facilities to the areas of reuse.

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- U.S. Army Corps of Engineers 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;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Table 3.11-19 Comparison of Waco North China Spring Reuse 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. Potential impact
6. Wetlands	6. None or low impact

Impact Category	Comment(s)
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 Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

3.11.5 WMARSS I-84 Indirect Potable Reuse

3.11.5.1 Description of Option

The City of Waco is pursuing the development of a satellite wastewater treatment plant known as I-84 Corridor WWTP to service rapid growth in the I-84 area west of Waco. Conveying water from the I-84 area to existing WMARSS wastewater plants would be costly and inefficient; and therefore, a satelite 1.5 mgd (1,680 acft/yr) WWTP is being planned for construction. The treated effluent from the proposed WWTP will outfall into the Harris Creek, a tributary to Lake Waco. Discharge from the plant will be treated to Level I standards for indirect potable reuse.

The treated effluent from the plant would mix with the natural streamflow of Harris Creek and travel 5.8 miles to Lake Waco. Travel time to Lake Waco and residence time in the lake will need to be determined. From the reservoir, the indirect reuse supply would be blended with water in the lake and supplement the WTP intake for the Mt. Carmel Drinking Water Treatment Plant. The new satellite reuse treatment plant, transmission pipeline, and outfall are shown in Figure 3.11-6.

3.11.5.2 Available Supply

The wastewater treatment plant is currently under design with an average flow of 1,680 acft/yr (1.5 mgd) at 2050. All flow will be considered indirect reuse supply. The amount of reuse water available for Waco I-84 WWTP indirect reuse will be limited by the wastewater flow in the collector main feeding the new satellite wastewater treatment plant. The entire wastewater stream could be considered for reuse.

3.11.5.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points on Harris Creek due to increased effluent return flow rates;
- Possible decreased water quality to stream flows;
- Possible low impact to fish and wildlife habitat with increased stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.11-20.

Table 3.11-20. Environmental Issues: WMARSS I-84 Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, discharge pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to increased effluent return flows; possible decreased water quality to stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows.
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas and sited to avoid wetlands, waters of the U.S. and cultural resources, where possible.

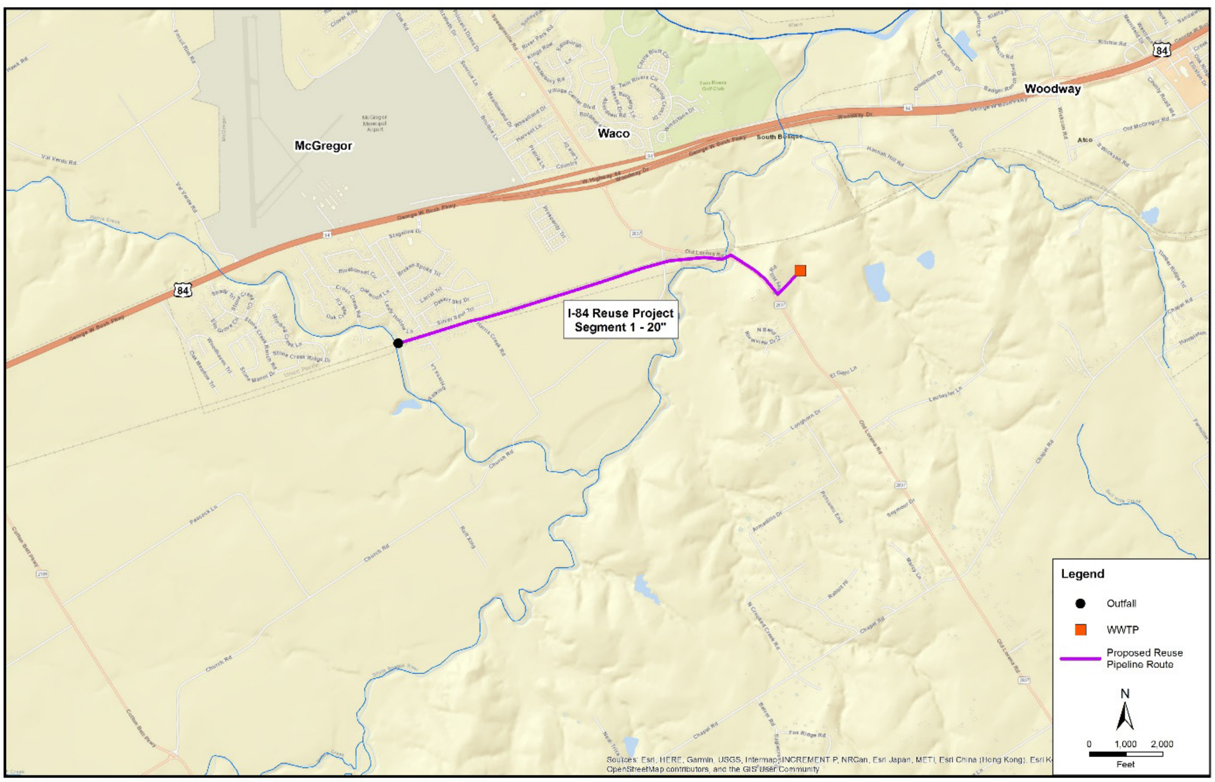

Figure 3.11-6 WMARSS I-84 Indirect Reuse

3.11.5.4 Engineering and Costing

This option has a total project cost of $33,311,000 and an annual cost of $4,375,000. A summary of costs is included in Table 3.11-21.

Table 3.11-21 Cost Estimate Summary: WMARSS Waco I-84 Indirect Potable Reuse

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
I-84 Cooridor - Waco I-84 WWTP	
Cost based on ENR CCI 13485.67 for September 2023 and	
a PPI of 278.502 for September 2023	
Item	**Estimated Costs for Facilities**
Intake Pump Stations (0 mgd)	$921,000
Transmission Pipeline (12 in. dia., 2.3 miles)	$3,551,000
Advanced Water Treatment Facility (1.5 mgd)	$15,819,000
Integration, Relocations, Backup Generator & Other	$610,000
TOTAL COST OF FACILITIES	**$20,901,000**
- Planning (3%)	$627,000
- Design (7%)	$1,463,000
- Construction Engineering (1%)	$209,000
Legal Assistance (2%)	$418,000
Fiscal Services (2%)	$418,000
Pipeline Contingency (15%)	$533,000
All Other Facilities Contingency (20%)	$3,470,000
Environmental & Archaeology Studies and Mitigation	$1,500,000
Land Acquisition and Surveying (17 acres)	$1,739,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$2,033,000
TOTAL COST OF PROJECT	**$33,311,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,343,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$42,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$23,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$1,950,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
I-84 Cooridor - Waco I-84 WWTP	
Cost based on ENR CCI 13485.67 for September 2023 and	
a PPI of 278.502 for September 2023	
Item	**Estimated Costs for Facilities**
Pumping Energy Costs (183788 kW-hr @ 0.09 $/kW-hr)	$17,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$4,375,000**
Available Project Yield (acft/yr)	**1,680**
Annual Cost of Water ($ per acft), based on PF=1	**$2,604**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$1,210**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$7.99**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$3.71**
Note: One or more cost element has been calculated externally	
JS	*2/3/2025*

Table 3.11-22. Required Facilities –Waco I-84

Facility	Description
WWTP	New 1.5 mgd satellite WWTP
Pump Station	31 hp; 1.5 mgd capacity to deliver at uniform rate to outfall on Harrison Creek
Pipeline	12,038 ft of 12-inch pipe
Available Project Yield	Total yield is 1.5 mgd: 1.5 mgd (1,680 acft/yr) delivered to outfall

3.11.5.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.11-23, and the option meets each criterion. Before pursuing wastewater reuse, the Waco I-84 entities will need to investigate concerns that would include at a minimum:

- Environmental impact of the effluent and increased flow in the rivers and streams.
- Water quality impacts on the surrounding area.

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- U.S. Army Corps of Engineers 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;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Table 3.11-23 Comparison of Waco I-84 Reuse 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. Potential 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 Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

CHAPTER 4 NEW RESERVOIRS

4.1 Brushy Creek Reservoir

4.1.1 Description of Option

The proposed Brushy Creek Reservoir will serve water supply, recreation and flood control purposes in the Big Creek watershed. The reservoir site is located in Falls County on Brushy Creek, which is a tributary to Big Creek. The proposed reservoir is located approximately 26 miles southeast of the City of Waco and 8 miles east of the City of Marlin (Figure 4.1-1). This project was included as a water management strategy in the 2001, 2006, 2011, 2016 and 2021 Brazos G Regional Water Plans. Other Brushy Creek Reservoir studies include the 1984 Final Watershed Plan and Environmental Impact Statement for the Big Creek Watershed for Falls, Limestone, and McLennan Counties[1] and the 2008 Reservoir Site Protection Study[2].

Certificate of Adjudication 12-4355, as amended, authorizes 6,560 acre-feet of storage at a conservation level of 380.5 feet above mean sea level (ft-msl) in Brushy Creek Reservoir. The conservation pool of the reservoir will inundate an area of approximately 697 acres and the land required to create the reservoir has already been acquired by the City of Marlin.

The certificate also authorizes New Marlin City Lake and Marlin City Lake which impound 3,135 and 791 acre-feet of water, respectively. Marlin City Lake is used as a sedimentation basin. The City of Marlin is permitted to divert 4,000 acre-feet per year from New Marlin City Lake and/or Brushy Creek Reservoir for municipal purposes. The certificate also authorizes diversions between October and April from the Brazos River at the rate of 2,000 acft/yr for municipal purposes and 2,000 acft/yr for industrial purposes. A continuous release of 0.1 cfs must be made from Brushy Creek Reservoir to maintain instream flows. Table 4.1-1 is a summary of the authorizations made by Certificate No. 12-4355.

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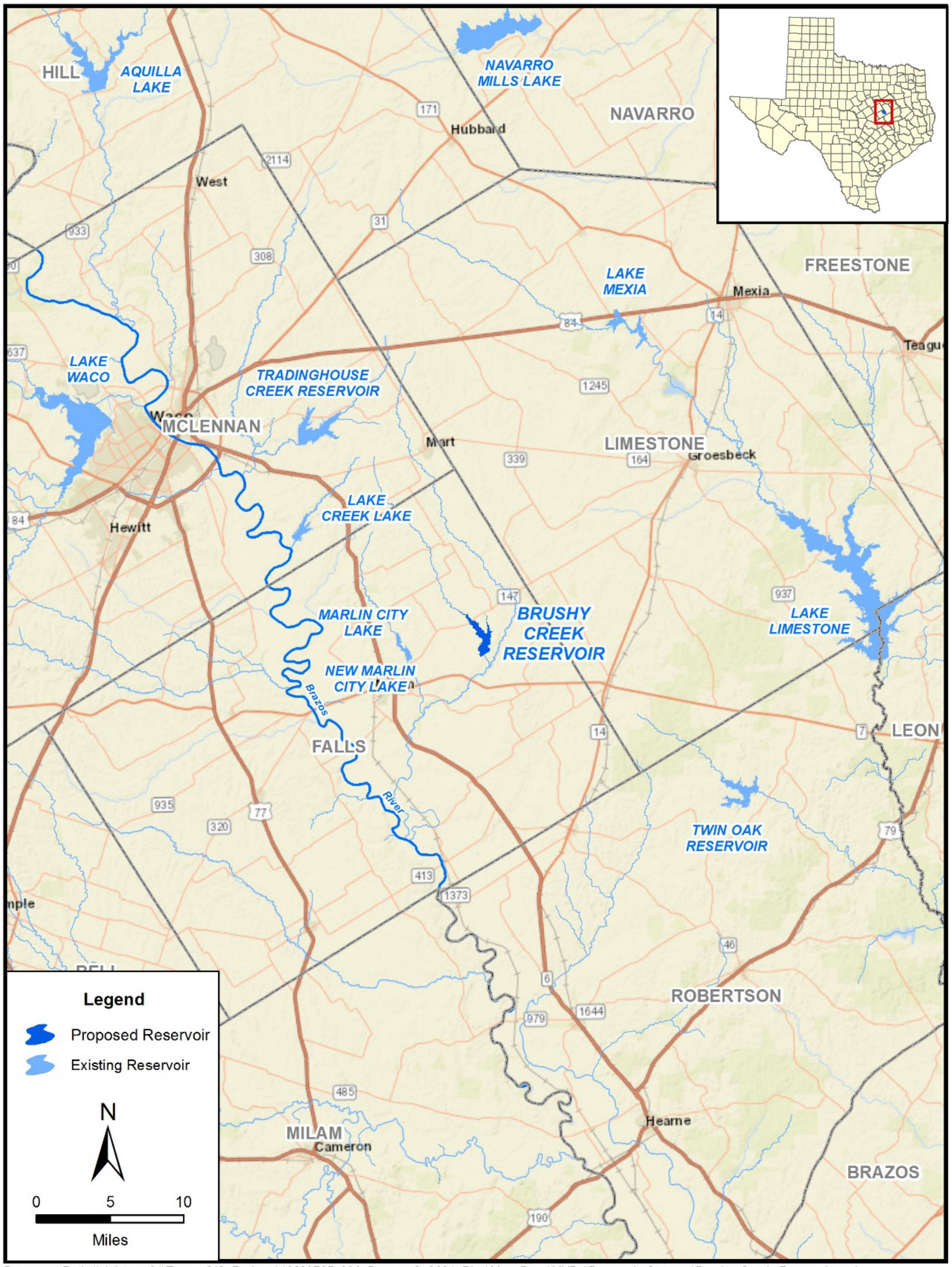
[1] USDA, 1984. *Final Watershed Plan and Environmental Impact Statement for the Big Creek Watershed for Falls, Limestone, and McLennan Counties*. U.S. Department of Agriculture, Soil Conservation Service. July 1984.

[2] TWDB, 2008. *Reservoir Site Protection Study* – Chapter 5.3 Brushy Creek Reservoir. Technical Report 370. Prepared for the Texas Water Development Board by R. J. Brandes and R. D. Purkeypile of the R.J. Brandes Company. July 2008. Pg 46-53.

Figure 4.1-1 Brushy Creek Reservoir Location



Document Path: \\dalctxsrv01\Texas_GIS_Projects\10029705_036_Brazos_G_2021_Plan\Map_Docs\MXDs\Reservoir_Strategy\Brushy_Creek_Reservoir.mxd

Table 4.1-1 Summary of Authorizations for Certificate of Adjudication 12-4355

Source	Storage (acft)	Impoundment Priority Date	Diversion (acft/year)	Use	Diversion Priority Date
New Marlin Reservoir	3,135	4/9/1948	1,500	Municipal	4/9/1948
Brushy Creek Reservoir	2,921	11/22/1982	1,500	Municipal	11/27/1956
	3,639	12/3/1990	1,000	Municipal	11/22/1982
Marlin City Lake	650	11/1/1976			
	141	11/22/1982			
Brazos River			2,000	Municipal	11/27/1956
			2,000	Industrial	11/27/1956

4.1.2 Available Yield

Water potentially available for impoundment in the proposed Brushy Creek Reservoir is estimated using the TCEQ Brazos WAM Run 3. The model utilizes a January 1940 through December 2018 hydrologic period of record and assumes no return flows and permitted storages and diversions for all water rights in the basin. The model computes streamflow available for impoundment in Brushy Creek Reservoir without causing increased shortages to existing downstream rights and subject to the reservoir and diversion having to pass inflows to meet environmental flow standards. Additionally, impoundment of streamflows in Brushy Creek Reservoir is subject to a minimum required instream flow release of 0.1 cfs as specified in Special Condition G of Certificate of Adjudication 12-4355.

The firm yield of the reservoir is calculated to be 2,050 acre-feet per year assuming the authorized storage capacity of Brushy Creek Reservoir. This yield is in addition to the yield of the City's existing reservoir storage, i.e., New Marlin Reservoir. The elevation-area-capacity relationship assumed in the water availability analysis is shown in Table 4.1-2.

Figure 4.1-2 shows the simulated storage in Brushy Creek Reservoir assuming an annual diversion amount equal to the firm yield of 2,050 acft/yr. The storage frequency curve is presented in Figure 4.1-3.

Table 4.1-2 Elevation-Area-Capacity Relationship for Brushy Creek Reservoir

Elevation (feet)	Area (acres)	Capacity (acre-feet)
352	0	0
356	1	1
360	33	68
364	115	363
368	234	1,059
372	341	2,208
376	497	3,884
380	668	6,214
380.5*	697	6,560*

* Authorized conservation pool elevation and storage.

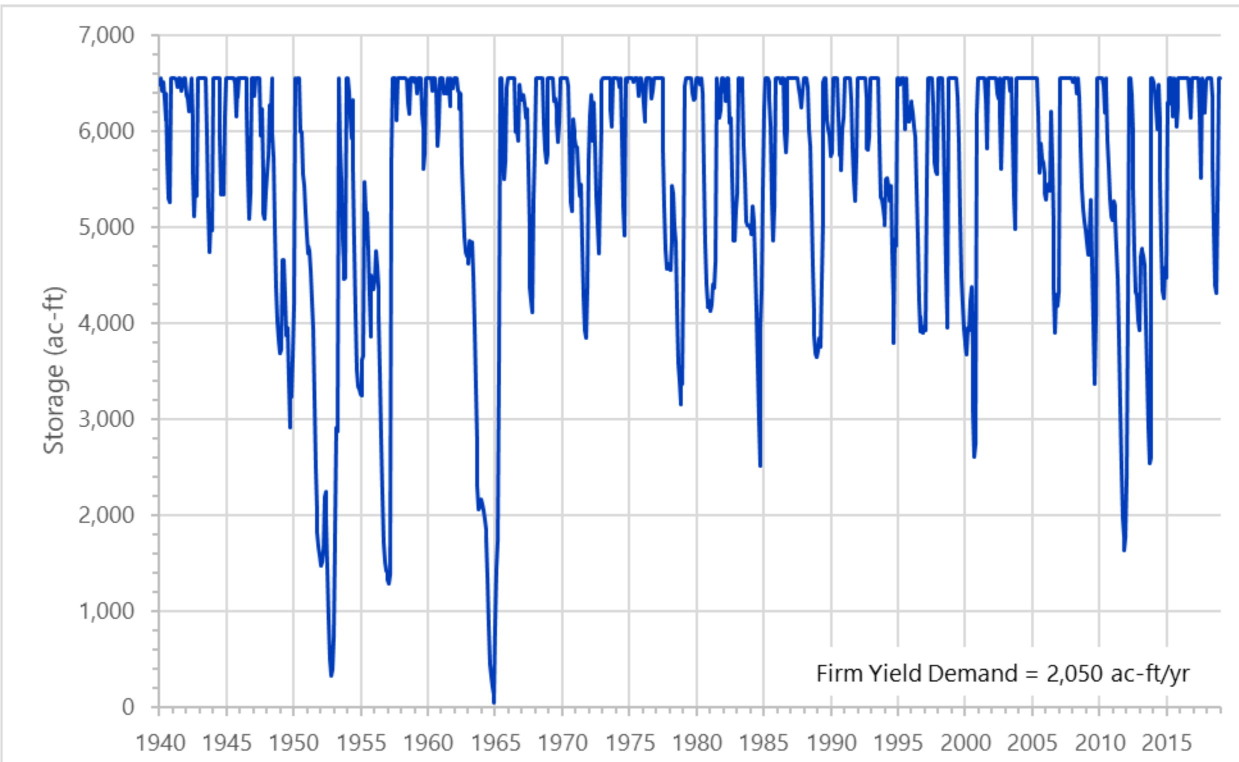
4.1.3 Environmental Issues

4.1.3.1 Existing Environment

The proposed Brushy Creek Reservoir site in Falls County lies within the Texas Blackland Prairies Ecological Region.[3] This region is characterized by gentle topography and black alkaline clay soils. Historically, the region was covered with native tall-grass prairies but today most of it has been converted to agriculture. The project area includes a vegetation type defined by Texas Parks and Wildlife (TPWD) as crops.[4] The climate of this area is characterized as subtropical humid and is noted for its warm summers. On average, area precipitation ranges from 36 to 38 inches per year.

There are no major aquifers beneath the project site, however, the Trinity Aquifer is located five miles to the northwest and the Carrizo Aquifer is seven miles to the southeast of the proposed reservoir site.

Figure 4.1-2 Simulated Storage in Brushy Creek Reservoir



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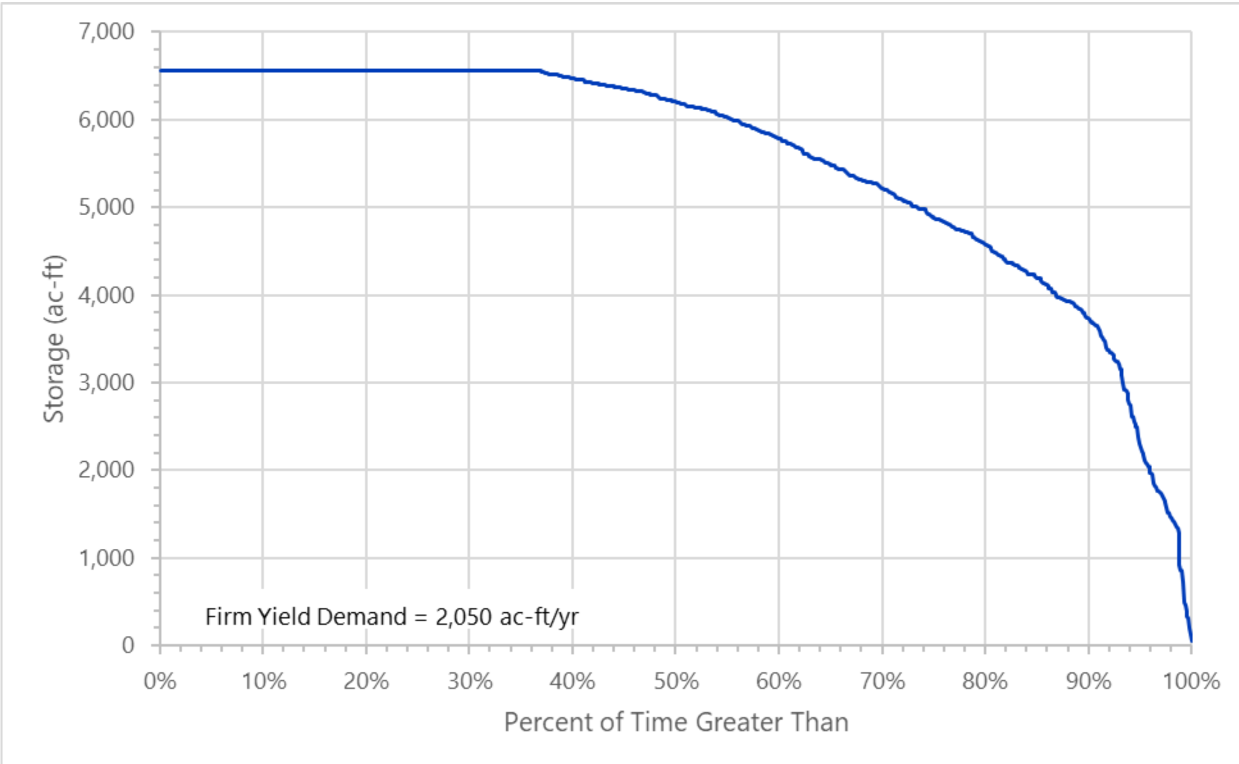
[3] Griffith, Glenn, Sandy Bryce, James Omernik and Anne Rogers. 2007. Ecoregions of Texas. Texas Commission on Environmental Quality and Environmental Protection Agency, Austin, Texas.
[4] McMahan, Craig A., Roy G. Frye and Kirby L. Brown. 1984. The Vegetation Types of Texas Including Cropland. Texas Parks and Wildlife Department, Austin, Texas.

Figure 4.1-3 Storage Frequency Curve for Brushy Creek Reservoir



4.1.3.2 Potential Impacts

Aquatic Environments including Bays and Estuaries

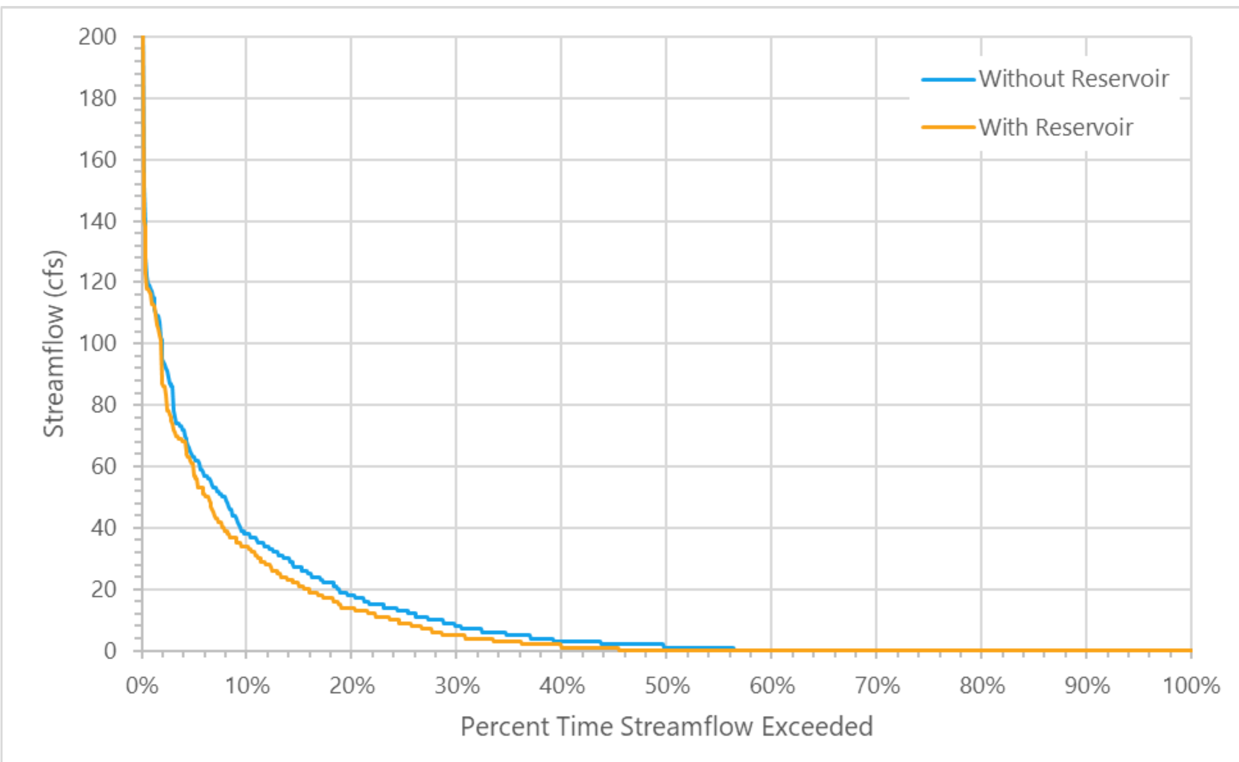
Construction of the Brushy Creek Reservoir project could reduce the quantity and variability of median monthly streamflows in Brushy Creek downstream of the reservoir (Table 4.1-3). Assuming annual diversions equal to the permitted amounts, these reductions could range from 1.9 cfs (95 percent) in October to 8.8 cfs (64 percent) in May. Figure 4.1-4 shows that without the reservoir, streamflow would likely cease 14 percent of the time. With the reservoir, streamflow will likely persist because a minimum release of 0.1 cfs is required to maintain instream flows. Without the required instream flow releases, streamflow would likely cease over 50 percent of the time.

Changes in streamflow could impact instream and riparian biological communities by potentially affecting their reproductive cycles and changing the composition of species. Substantial reductions in streamflow during the summer months could result in higher temperatures and higher concentrations of contaminants.

Table 4.1-3 Median Monthly Streamflow for Brushy Creek Reservoir

Month	Without Project (cfs)	With Project (cfs)	Difference (cfs)	Percent Reduction
January	3.6	1.9	1.7	47.2
February	4.1	0.9	3.2	78.0
March	6.5	3.3	3.2	49.2
April	5.7	2.8	2.9	5.9
May	5.6	3.8	1.8	32.1
June	3.0	1.7	1.3	43.3
July	1.0	0.1	0.9	90.0
August	0.1	0.1	0	0
September	0.1	0.1	0	0
October	0.1	0.1	0	0
November	1.0	0.1	0.9	90.0
December	2.3	0.5	1.8	78.3

Figure 4.1-4 Brushy Creek Reservoir Streamflow Frequency Comparison



Threatened & Endangered Species

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD frequently updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Falls County can be found at https://tpwd.texas.gov/gis/rtest/.

Two bird species that could potentially occur in the vicinity of the Brushy Creek Reservoir site are federally listed as endangered. They are the whooping crane (Grus americana) and the interior least tern (Sterna antillarum athalassos). However, because these two birds are seasonal migrants, they are not likely to be impacted by the proposed project. There are no areas of critical habitat designated within or near the project area.[5]

The project area may provide potential habitat to endangered or threatened species listed for Falls County. A survey of the project area may be required prior to project construction to determine whether populations of or potential habitats used by listed species occur in the area to be affected. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

Wildlife Habitat

The quality of wildlife habitat in the Brushy Creek area has been previously impacted due to aggressive brush eradication efforts and the conversion of native habitats into agricultural lands. The reservoir would inundate approximately 697 acres of land at conservation capacity.[6] Landcover of the reservoir area includes 44 percent Upland Deciduous Forest, 39 percent Agricultural Land, 10 percent Grassland and 7 percent Shrubland. Current aerial photography shows riparian and wooded areas along Brushy Creek within the proposed reservoir area.

Cultural Resources

A cultural resource surface survey of the Brushy Creek Reservoir area was conducted in 1978[7]. The study identified nine prehistoric cultural resource sites located in the area to be inundated by the reservoir. In April 2005, another cultural resource survey of the site was conducted by TRC Environmental Corporation[8]. The 2005 survey revisited these nine sites and identified 15 additional sites. The 24 sites contained primarily diagnostic projectile points, debris from the manufacture of chipped stone tools, and a few burned rocks. The survey area did not completely cover the footprint of the dam or the emergency spillway. The study found six sites that have the potential to contribute important information about the region. Their eligibility for inclusion in the National Register of Historic Places (NRHP) and/or as State Archeological Landmarks (SAL) still needs to be assessed. The other 18 cultural sites investigated in the study do not have sufficient potential to be considered for inclusion in the NRHP or for designation as SALs. Cultural resources that occur on public lands or within the Area of Potential Effect of publicly funded

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[5] USFWS. Critical Habitat Portal. Accessed online at http://ecos.fws.gov/crithab/ May 13, 2019.
[6] TWDB. 2008. Reservoir Site Protection Study. Report 370.
[7] Nunley, 1978. *Archeological Survey of Portions of Big Creek Watershed, Falls, Limestone and McLennan Counties, Texas*. Nunley Multimedia Productions, Miscellaneous Papers, No. 2, Dallas.
[8] TRC, 2006. *Cultural Resource Survey of the Proposed Brushy Creek Reservoir – Structure 19 Project Area, Falls County, Texas*. Technical Report 43211. Prepared for City of Marlin by J. M. Quigg, M. J. Archambeault, E. Schroeder, and P. M. Matchen of the TRC Environmental Corporation. July 2006.

or permitted projects are governed by the Archeological and Historic Preservation Act (PL93-291), the National Historic Preservation Act (PL96-515), and the Texas Antiquities Code (Title 9, Chapter 191, Texas Natural Resource Code of 1977).

The development of this strategy would include potential changes to in-stream flows in and below Brushy Creek which could affect aquatic and other species, and loss of riparian and other existing habitat in the reservoir and dam area. Development of the reservoir would inundate existing habitat areas resulting in habitat loss for some species and producing new habitat for others. It is anticipated that any additional facilities needed such as pipelines and pump stations would be positioned to avoid impacts to known cultural resources, sensitive habitats, wetlands or stream crossings as much as reasonably possible.

Agricultural Impacts

The Brushy Creek Reservoir site contains approximately 185 acres of Pasture/Hay fields and 84 acres of cropland. These two agricultural land uses account for roughly 25 percent of the reservoir footprint.

4.1.4 Engineering and Costing

The Brushy Creek Reservoir strategy includes the construction of a rolled earth dam and a 12-inch diameter, 12-mile pipeline to deliver raw water supplies to the City of Marlin. shows the estimated costs for the strategy, including the construction of the dam, land acquisition, resolution of conflicts, environmental permitting and mitigation, and engineering services. The City of Marlin has previously acquired the land for the reservoir; therefore, only land acquisition for the pipeline right-of-way is included in the costs.

The estimated cost of the project is $54.4 million. The annual costs of the project, including debt service and operation and maintenance, are estimated to be $4.2 million. The resulting unit cost of 2,000 acft/yr of raw water from the strategy is $2,082 per acft ($6.39 per 1,000 gallons).

Table 4.1-4 Cost Estimate Summary for Brushy Creek Reservoir

Item	Estimated Costs for Facilities
Dam and Reservoir (Conservation Pool 6560 acft, 697 acres)	$9,541,000
Intake Pump Stations (1.9 mgd)	$8,288,000
Transmission Pipeline (12 in. dia., 11.9 miles)	$16,212,000
Integration, Relocations, Backup Generator & Other	$4,858,000
TOTAL COST OF FACILITIES	**$38,899,000**
Engineering:	
- Planning (3%)	$1,167,000
- Design (7%)	$2,723,000
- Construction Engineering (1%)	$389,000
Legal Assistance (2%)	$778,000
Fiscal Services (2%)	$778,000
Pipeline Contingency (15%)	$2,432,000
All Other Facilities Contingency (20%)	$4,538,000

Item	Estimated Costs for Facilities
Environmental & Archaeology Studies and Mitigation	$358,000
Land Acquisition and Surveying (72 acres)	$629,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,711,000
TOTAL COST OF PROJECT	**$54,402,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,884,000
Reservoir Debt Service (3.5 percent, 40 years)	$625,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$211,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$207,000
Dam and Reservoir (1.5% of Cost of Facilities)	$143,000
Pumping Energy Costs (1042306 kW-hr @ 0.09 $/kW-hr)	$94,000
TOTAL ANNUAL COST	**$4,164,000**
Available Project Yield (acft/yr)	**2,000**
Annual Cost of Water ($ per acft), based on PF=1	**$2,082**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$328**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$6.39**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$1.00**
Note: One or more cost element has been calculated externally	
CB	*1/14/2025*

4.1.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 4.1-5 and the option meets each criterion.

4.1.5.1 Potential Regulatory Requirements

- Texas Commission on Environmental Quality Water Right and Storage permits have already been obtained;
- U.S. Army Corps of Engineers Permits will be required for discharges of dredge or fill into wetlands and waters of the U.S. for dam construction, and other activities (Section 404 of the Clean Water Act);
- Texas Commission on Environmental Quality administered Texas Pollutant Discharge Elimination System Storm Water Pollution Prevention Plan;
- General Land Office Easement if State-owned land or water is involved; and
- Texas Parks and Wildlife Department Sand, Shell, Gravel and Marl permit if state-owned streambed is involved.

4.1.5.2 State and Federal Permits may require the following studies and plans

- Environmental impact or assessment studies;
- Wildlife habitat mitigation plan that may require acquisition and management of additional land;
- Flow releases downstream to maintain aquatic ecosystems;
- Assessment of impacts on Federal- and State-listed endangered and threatened species;
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction; and
- Cultural resources studies to determine resources impacts and appropriate mitigation plan that may include cultural resource recovery and cataloging; requires coordination with the Texas Historical Commission.

4.1.5.3 Land Acquisition Issues

- Land acquired for reservoir and/or mitigation plans could include market transactions and/or eminent domain;
- Additional acquisition of rights-of-way and/or easements may be required; and
- Possible relocations or removal of residences, utilities, roads, or other structures.

Table 4.1-5 Evaluations of Brushy Creek Off-Channel Reservoir Option to Enhance Water Supplies

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. Reasonable (moderate to high)
B. Environmental factors	
1. Environmental Water Needs	Negligible impact
2. Habitat	Negligible impact
3. Cultural Resources	Low impact
4. Bays and Estuaries	Negligible impact
5. Threatened and Endangered Species	Low impact
6. Wetlands	Negligible impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

4.2 Cedar Ridge Reservoir

4.2.1 Description of Option

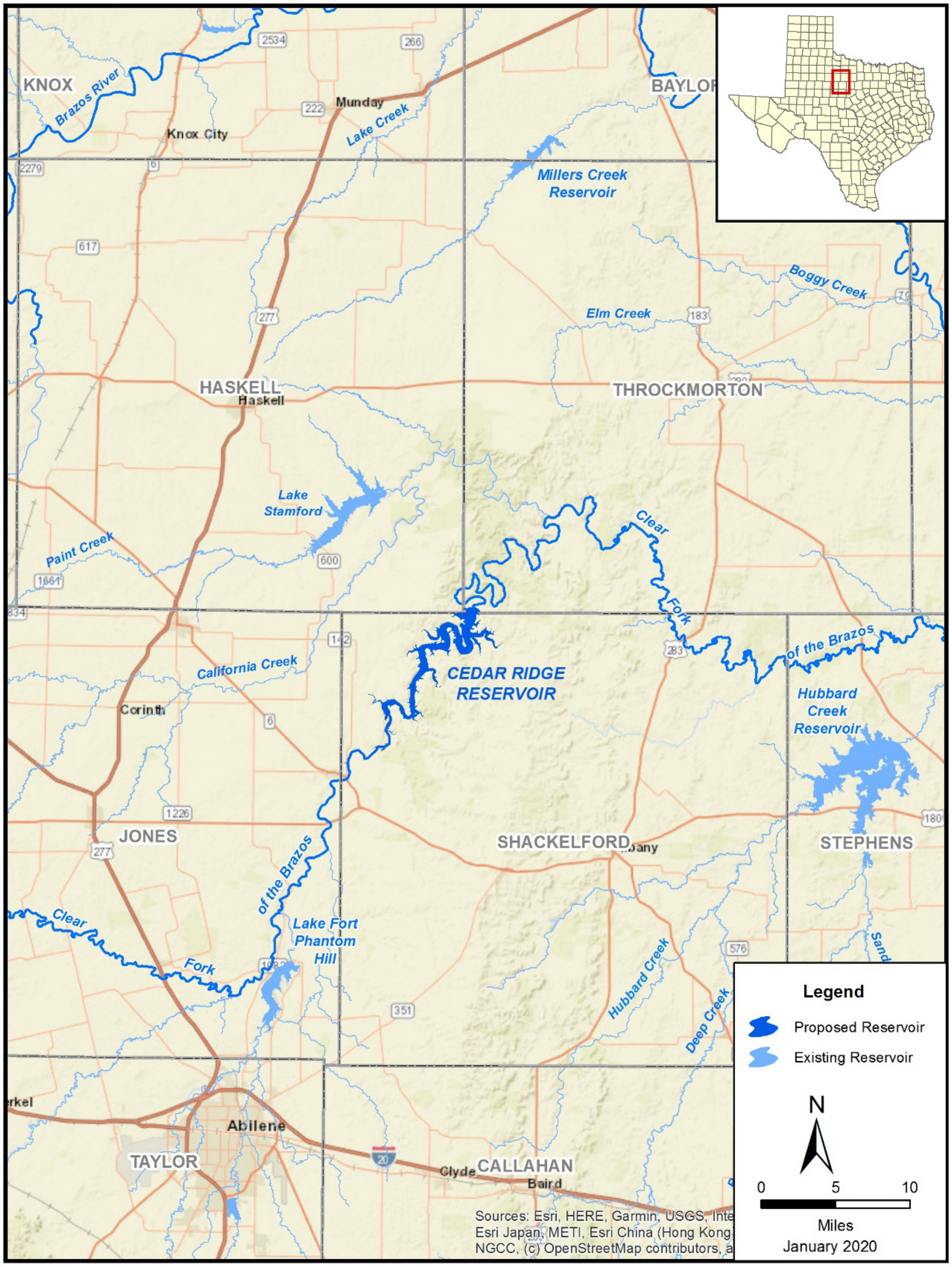
Cedar Ridge Reservoir (CRR) is recommended in the 2001, 2006, 2011, 2016, 2021, and 2026 Brazos G Regional Plans. The proposed reservoir is located in Shackelford County on the Clear Fork of the Brazos River about 40 miles north of the City of Abilene (City), as shown in Figure 4.2-1. Initially located further downstream and known as the Breckenridge Reservoir, this project was originally studied in 1971 by the Texas Water Development Board. The proposed reservoir will contain approximately 227,127 acft of conservation storage and inundate 6,635 acres at the conservation storage level of 1,489 ft-msl. The contributing drainage area of the proposed reservoir is approximately 2,748 sq. miles. Additionally, Abilene and BRA have signed an interlocal agreement for the subordination of Possum Kingdom Reservoir water rights to the proposed CRR.

The water supply from CRR will be used to meet municipal shortages in the area, and Abilene plans to operate CRR as a supply in conjunction with its existing water supply system. Abilene is actively pursuing the necessary permits to implement this project and the information contained in this section is based on the water right permit application filed at the Texas Commission on Environmental Quality (TCEQ) and the Clean Water Act, Section 404 permit application filed with the U.S. Army Corps of Engineers, Ft. Worth District (USACE).

4.2.2 Available Yield

Abilene has applied for a water right permit with the TCEQ to impound 227,127 acft and divert up to 34,400 acft/yr of water from the reservoir for multi-purpose uses including: municipal, domestic, industrial, agriculture, livestock, steam-electric, mining, and recreation. The calculated firm yield of the reservoir using the TCEQ Brazos WAM is 25,760 acft/yr, assuming permitted storages and authorized diversions for all other water right holders in the Brazos basin for the 1940 to 2018 hydrologic period and subordination of Possum Kingdom Reservoir (C5155 owned by the BRA) water rights.

Figure 4.2-1 Cedar Ridge Reservoir



Document Path: C:\Users\ngonsalv\Documents\ArcGIS\Packages\Cedar_Ridge_Reservoir_37E6F8BE-90AC-4C74-9774-63D0F047689D\v106\Cedar_Ridge_Reservoir.mxd

Figure 4.2-2 illustrates the simulated Cedar Ridge Reservoir storage levels operated at a firm yield demand of 25,760 acft/yr for the 1940 to 2018 historical period. The storage trace shows that the recent drought beginning in the late 1990s is significantly more severe than the drought of the 1950s.

Figure 4.2-3 illustrates the storage frequency of the simulated Cedar Ridge Reservoir subject to the firm yield demand of 25,760 acft/yr. Simulated reservoir contents remain above half full almost 80 percent of the time under the firm yield demand.

Figure 4.2-4 presents the changes in Clear Fork monthly median streamflows caused by impoundments in the reservoir considering pass-through flows for downstream senior water rights and environmental needs per TCEQ environmental flow requirements. Figure 4.2-5 compares the existing Clear Fork streamflow frequency characteristics for the full period (1940 – 2018) of the analysis without the project to simulated streamflow characteristics with the project.

Figure 4.2-2 Cedar Ridge Reservoir Firm Yield Storage Trace

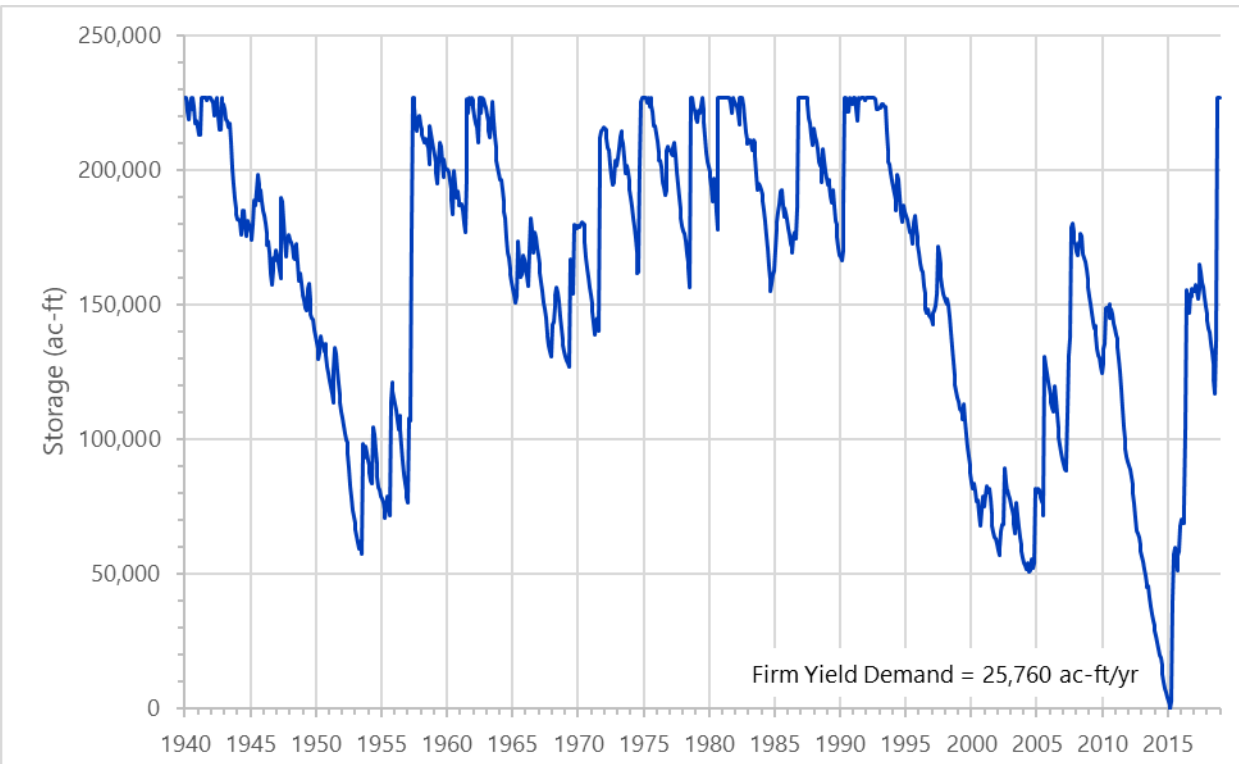


Figure 4.2-3 Cedar Ridge Reservoir Firm Yield Storage Frequency

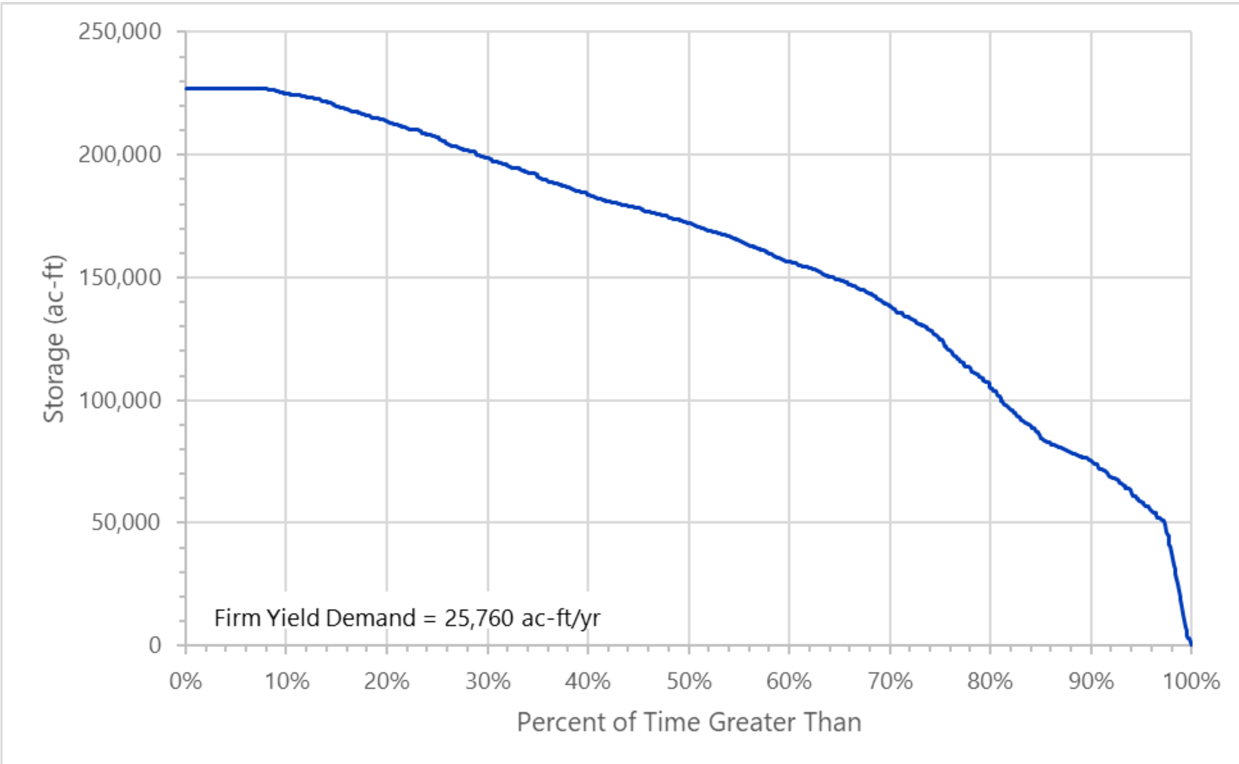


Figure 4.2-4 Cedar Ridge Reservoir Median Streamflow Comparison

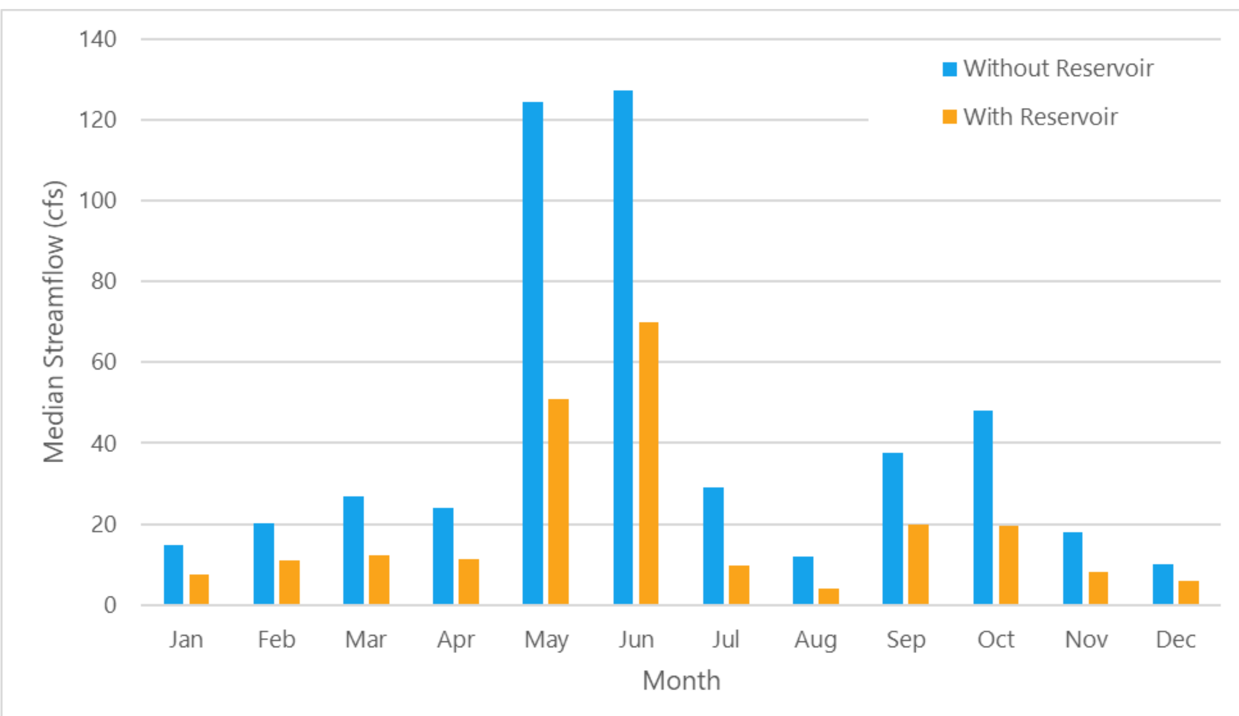
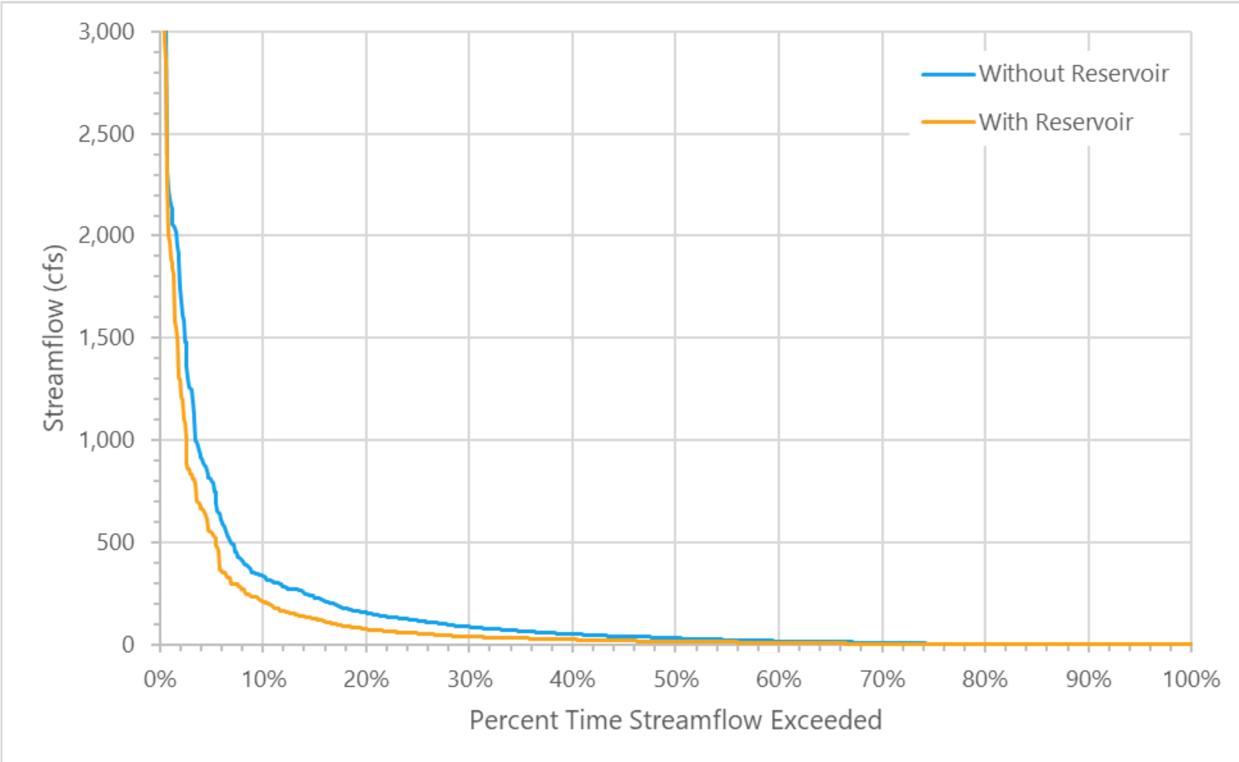


Figure 4.2-5 Cedar Ridge Reservoir Streamflow Frequency Comparison



4.2.3 Environmental Issues

The following section focuses on providing a general summary of environmental issues consistent with other water management strategies evaluated as part of the 2026 Brazos G Plan.

4.2.3.1 Existing Environment

The Cedar Ridge reservoir will inundate 6,635 acres at its conservation storage level of 1,489 ft-msl. The project will require an intake pump station, a water treatment plant expansion at one of the City's existing water treatment plants, and a transmission pipeline of approximately 29 miles. Water diverted from this reservoir will be used to meet water supply needs for the City and include existing and future customers.

Steep canyon walls are present throughout this area, ranging from 5 to 30 percent slopes with near-vertical cliffs in some areas. Soils in the study area are predominantly loamy and clayey with clayey soils occurring primarily in the upstream portions of the study area. General soil map units in the project area include the Palopinto-Throck and Clairemont-Grandfield-Clearfork soil units.

No major or minor aquifers underlie the project area. The Trinity Aquifer lies south of the project area and consists of interbedded sandstone, sand, limestone, and shale of Cretaceous Age. The Seymour Aquifer is located west and north of the project area and is composed of isolated areas of alluvium.[1]

The climate in the study area is subtropical subhumid, with hot, dry summers and mild, dry winters. Temperatures range from an average low of 31°F in January to an average maximum of 97°F in July with a mean average temperature of 64°F.[2] The growing season is approximately 224 days, and annual precipitation averages between 25 and 28 inches. Most precipitation occurs from April to October during thunderstorms of short duration and high intensity. Recurring droughts are common in this area and can last many years.

The project area lies within the Limestone Plains subregion of the portion of the Central Great Plains ecoregion in Texas[3] and the vegetational area known as the Rolling Plains.[4] Although this subregion is principally covered by a mixed grass prairie dominated by grasses such as little bluestem (Schizachyrium scoparium), indiangrass (Sorghastrum nutans), and buffalograss (Bouteloua dactyloides), it also includes scattered trees such as honey mesquite (Prosopis glandulosa).

The dominant vegetation type found within the project area, as mapped by the TPWD, is mesquite brush, which covers approximately 61 percent of the conservation pool area of Cedar Ridge Reservoir.[5] Plants commonly associated with this vegetation type include narrow-leaf yucca (Yucca glauca), purple pricklypear (Opuntia macrocentra), juniper (Juniperus spp.), red grama (Bouteloua trifida), Texas grama (Bouteloua rigidiseta), purple three-awn (Aristida purpurea var. purpurea), James' rushpea (Caesalpinia jamesii), and wild buckwheat (Eriogonum spp.).[6]

The mesquite-lotebush shrub vegetation type is also found within the project area. This vegetation type is dispersed relatively evenly along the reservoir site, covering approximately 39 percent of the conservation pool area. Commonly associated plants in this vegetation type include honey mesquite, yucca (Yucca spp.), fragrant sumac (Rhus aromatica), elbowbush (Forestiera pubescens), cane bluestem (Bothriochloa barbinodis), silver bluestem (Bothriochloa laguroides ssp. torreyana), Texas wintergrass (Nassella leucotricha), Engelmann's daisy (Engelmannia peristenia), and bitter rubberweed (Hymenoxys odorata).[7]

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1 Texas Water Development Board (TWDB). 2010a. Major and Minor Aquifers of Texas; Maps online at http://www.twdb.state.tx.us/mapping/index.asp.

2 Handbook of Texas Online (HTO), s.v. "Shackelford County, Texas,". http://www.tshaonline.org/handbook/online/articles/SS/hcs8.htm.

3 Griffith, G. E., S. A. Bryce, J. M. Omernik, J. A.Comstock, A. C.Rogers, B.Harrison, and S. L. Hatch, and D. Bezanson. 2004. Ecoregions of Texas (color poster with map, descriptive text, and photographs): Reston, VA, U.S. Geological Survey.

4 Hatch, S. L., N. G. Kancheepuram, and L. E. Brown. 1990. Checklist of the Vascular Plants of Texas. Texas Agricultural Experiment Station. Texas A&M University, College Station.

5 McMahan, C. A., R. G. Frye, K. Brown. 1984. The Vegetation Types of Texas, Including Cropland. Wildlife Division, Texas Parks and Wildlife Department, Austin.

6 Ibid.

7 McMahan, C. A., R. G. Frye, K. Brown. 1984. The Vegetation Types of Texas, Including Cropland. Wildlife Division, Texas Parks and Wildlife Department, Austin.

Permanent impacts will occur to all the current vegetation located within the conservation pool of the reservoir and some portions of the construction area. This vegetation will be impacted either by clearing at the dam site or inundation by the reservoir. Temporary impacts may also occur to the vegetation located outside of the conservation pool area but within the flood pool area. These areas will be inundated only occasionally for a few days as floods will be passed through an ungated spillway. Pipeline areas will primarily impact vegetation during construction and maintenance activities with some areas returning to their original states after the initial disturbance.

4.2.3.2 Potential Impacts

Aquatic Environments including Bays & Estuaries

With the construction of the new reservoir, the current floodplains along the Clear Fork and its major tributaries within the new reservoir's conservation pool area will be inundated. Although some stream and wetland functions would be impacted due to inundation by the conservation storage area, the creation, enhancement, and/or protection of aquatic habitat resulting from the new reservoir will replace some of the biological, chemical, and physical functions of the impacted resources and habitats.

The anticipated impact of this project would be lower variability and reductions in the quantity of median monthly flows. Variability in flow is important to the instream biological community as well as riparian species and pass throughs for environmental needs are proposed to be in accordance with recently adopted TCEQ flow requirements. The TCEQ flow requirements for this segment of the Clear Fork were based, in part, on in-stream flow studies performed for the project to assure that adequate flows remained in the stream to maintain the existing biological community.

Although there may be some impacts on the biological community in the immediate vicinity of the project site and downstream, this project would not have a substantial influence on total discharge in the Brazos River or to freshwater inflows to the Brazos River estuary. As a new reservoir, Cedar Ridge Reservoir would be required to pass through environmental flows based on TCEQ's recently adopted environmental flow requirements.

Wildlife Habitat

The project area is located within the Kansan biotic province.[8] The Kansan Province is divided into three districts that include (from west to east) the short-grass plains, mixed-grass plains, and the mesquite plains. The project area is situated within the mesquite plains district. Within this district, the typical vegetation community generally consists of clusters of mesquite and other shrubs interspersed with open areas of grasses. Common wildlife species found in the Kansan Biotic Province include the Great Plains toad (Anaxyrus cognatus), turkey vulture (Cathartes aura), scaled quail (Callipepla squamata), big brown bat (Eptesicus fuscus) and eastern collared lizard (Crotaphytus collaris) among others. Wildlife species inhabiting the project area utilize it to varying extents depending on specific biologic need.

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8 Blair, W. F. 1950. The biotic provinces of Texas. Texas Journal of Science 2:93–117.

Inundation of existing habitat by the reservoir will force non-aquatic species inhabiting these areas to relocate to surrounding suitable habitats unaffected by reservoir filling. Greater adverse impacts will occur to those wildlife species that currently utilize riparian habitats within the reservoir's footprint; however, similar habitats exist along upstream and downstream reaches of the Clear Fork, and additional riparian habitat will develop along portions of the reservoir shoreline after reservoir filling.

Threatened & Endangered Species

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Haskell, Jones, Shackelford, and Throckmorton counties can be found at https://tpwd.texas.gov/gis/rtest/.

A search of the Texas Natural Diversity Database (TNDD)[9] identified the state threatened Brazos water snake as the only threatened or endangered species with documented occurrences within or near the new reservoir site. The plains spotted skunk, a species of concern, was also documented in the vicinity of the new reservoir; however, this species is not state or federally protected. While based on the best information available to TPWD, TNDD data do not provide a definitive statement as to the presence, absence, or condition of special species, natural communities, or other significant features in the project area.

Listed species with the potential to occur within the project area are discussed in the following paragraphs. These species include two birds, the Whooping Crane (Grus americana) and the Interior Least Tern (Sterna antillarum athalassos). These birds are federally listed as endangered and could occur within the project and surrounding areas as seasonal migrants. During migration, Whooping Cranes primarily utilize wetland areas as rest stops. Wetland habitat within the project area is limited, and occurrences of this species would be limited to occasional migratory stops. The Interior Least Tern typically nests on bare or sparsely vegetated areas associated with streams or lakes, such as sand and gravel bars, beaches, islands, and salt flats. Occasional migrants of these species are possible within the new reservoir site.

Two fishes, the sharpnose shiner (Notropis oxyrhynchus) and the smalleye shiner (N. buccula) are small, slender minnows endemic to the Brazos River Basin.[10] Historically, these fishes existed throughout the Brazos River and several of its major tributaries; however, both species have experienced significant population declines. General habitat associations for both species include relatively shallow water with moderate currents flowing through broad, open sandy channels. Surveys of the Clear Fork performed within and downstream of the reservoir footprint indicate that suitable habitat for both the sharpnose and smalleye shiner is not present.

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9 Texas Parks and Wildlife Department (TPWD). 2019. Element occurrence records for Haskell, Jones, Shackelford, and Throckmorton Counties. Texas Natural Diversity Database, Texas Parks and Wildlife Department.
10 Cross, F. B. 1953. A new minnow, Notropis bairdi buccula, from the Brazos River, Texas. Texas Journal of Science 5:252-259.

Two mussel species, the smooth pimpleback (Quadrula houstonensis) and the Texas fawnsfoot (Truncilla macrodon), are endemic to the Brazos River Basin and could potentially occur within or in the surrounding vicinity of the new reservoir footprint. The smooth pimpleback prefers small to moderate-sized streams and rivers, as well as moderate-sized reservoirs, and is typically found in substrates of mixed mud, sand and fine gravel in water flowing at a very slow to moderate rate.[11] While it is unlikely that the smooth pimpleback inhabits the reach of the Clear Fork to be impacted by the new reservoir, this species is known to tolerate impoundment.

The Texas fawnsfoot historically occurred in the Brazos and Colorado River drainages. Little is known about the preferred habitat of this species; however, it is known to be intolerant of impoundment.[12] Texas fawnsfoot specimens potentially occurring downstream of the new reservoir are not anticipated to be significantly impacted by the project, as this species has been reported to occur downstream of other impoundments along the Brazos River. Surveys of the project reach for mussels were conducted in 2009, 2010, and 2011. No live or recently dead specimens of either the smooth pimpleback or the Texas fawnsfoot were identified upstream, within, and downstream of the project reach.

The new reservoir could potentially cause adverse impacts to two state threatened reptile species. These species include the Texas horned lizard (Phrynosoma cornutum) and the Brazos water snake (Nerodia harteri harteri). The Texas horned lizard is a relatively small lizard that is known to occur in a variety of habitats, including short-grass prairie, mesquite grasslands, shrublands, desert scrub, and desert grasslands.[13] Potentially suitable habitat for the Texas horned lizard is present both within and surrounding the reservoir footprint. As the Cedar Ridge Reservoir fills, Texas horned lizards inhabiting areas within the reservoir footprint would be displaced. Potential impacts to this state-threatened lizard would likely be minimal given the estimated slow filling rate of the new reservoir and abundant suitable habitat immediately surrounding the project area.

The Brazos water snake is a highly aquatic, endemic Texas snake with a limited and patchy distribution along the upper Brazos River drainage in north-central Texas. Preferred habitat consists of shallow rocky riffles along the river that have a gently sloping rocky shoreline free of vegetation.[14] Investigation of the project area indicates that Brazos water snake populations and suitable habitat exist along the Clear Fork, both within and downstream of the proposed Cedar Ridge reservoir footprint. Potential impacts to the Brazos water snake from the construction of the Cedar Ridge Reservoir include the inundation and loss of existing habitat along the Clear Fork. However, geologic investigations of the Cedar Ridge Reservoir shoreline indicate that there will be significant areas of rocky shoreline that will provide significant habitat after the reservoir fills. Based on the occurrence and populations of Brazos Water Snakes that have continued to reproduce in Possum Kingdom Lake since its initial filling in 1941, it is anticipated that the Brazos Water Snake will have suitable habitat to maintain viable populations in Cedar Ridge Reservoir.

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11 Howells, R. G., R. W. Neck, and H. D. Murray. 1996. Freshwater Mussels of Texas. Inland Fisheries Division, Texas Parks and Wildlife Department, Austin..
12 Ibid.
13 Price, A. H. 1990. Phrynosoma cornutum. Catalogue of American Amphibians and Reptiles. 469:1–7.
14 Scott, N. J., Jr., T. C. Maxwell, O. W. Thornton, Jr., L. A. Fitzgerald, and J. W. Flury. 1989. Distribution, habitat, and future of Harter’s Water Snake, Nerodia harteri, in Texas. Journal of Herpetology 23:373-389.

Cultural Resources

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets provided by the Texas Historical Commission (THC), there are no National Register Properties, National Register Districts, State Historic Sites, cemeteries, or historical markers located within or near the reservoir or pipeline project areas. The owner of the project is required to coordinate with the Texas Historical Commission regarding potential impacts to cultural resources.

The Texas Archeological Sites Atlas online database of the Texas Historical Commission (THC) was also consulted, and background research was conducted to determine any previous cultural resources survey efforts as well as the locations of previously recorded historic and archaeological resources in the project area. Records indicate that eight previously recorded prehistoric archaeological sites were located within a 1-mile radius of the reservoir area.

The City conducted preliminary Phase 1A archeological surveys and historical evaluations, and the results and recommendations from these Phase 1A surveys were provided to the TCEQ in the Water Rights application submitted on August 17, 2011, and to the THC and USACE under separate cover. Phase 1B surveys, including trenching at selected alluvial terrace locations, were initiated in 2011 and completed in 2012. The findings of the Phase 1B surveys were provided to the USACE and THC in support of Section 404 Permit coordination per the requirements of Section 106 of the National Historic Preservation Act (NHPA). The City will also coordinate the findings of the archeological surveys with the THC and TCEQ in conjunction with the review of the project under the Antiquities Code of Texas.

The Phase 1A and 1B investigations identified 66 prehistoric sites, five historic sites, and four multi-component sites. Four archeological sites located within the project area are recommended for further testing to determine their eligibility for listing in the National Register of Historic Places (NRHP) and designation as a State Archeological Landmark (SAL) by the City pending concurrence from the USACE and THC. Additionally, historical sites were evaluated, and 62 architectural resources at five sites were recorded. Fifty-seven of the sites are associated with the proposed Hendrick River Ranch Historic District. Evaluation of the pre-historic and historic resources in the area of potential effect of the reservoir will be conducted and documented per standard practices for determination of NRHP and SAL eligibility, and mitigation measures will be implemented, if necessary.

Specific project features, such as pipelines, generally have sufficient design flexibility to avoid most impacts or significantly mitigate potential impacts to geographically limited environmental and cultural resource sites. Field surveys conducted at the appropriate phase of development should be employed to minimize the impacts of project construction and operations on sensitive resources.

Threats to Natural Resources

Threats to natural resources include lower streamflows below the reservoir. However, due to the nutrient removal that will occur as a result of the new reservoir and a planned multi-level outlet, water quality downstream of the reservoir is anticipated to improve with respect to increasing dissolved oxygen concentrations, and lowering concentrations of any existing stream pollutants.

Agricultural Impacts

The Cedar Ridge Reservoir site contains approximately 35 acres of pasture and hay fields and 58 acres of cropland. These two agricultural land uses account for less than two percent of the reservoir footprint.

4.2.4 Engineering and Costing

The proposed CRR includes the construction of an earthen dam, principal spillway, emergency spillway, and appurtenant structures. eHT and HDR completed a study[15] in 2009 of the proposed Cedar Ridge Reservoir. Estimated costs for the reservoir included in the study are indexed to September 2023 dollars. Transmission facilities are sized to deliver the firm yield supply of 25,760 acft/yr with an estimated five percent downtime. Estimated capital costs for transmission facilities, relocations, and integration were provided by Abilene.

The capital cost of the project is estimated to be $379.2 million and includes the construction of the dam, land acquisition, and resolution of conflicts. Also included in the capital costs are facilities to deliver supplies to the City through a 42-inch, 29-mile pipeline. The total cost of the project is estimated to be $611.5 million and includes environmental permitting and mitigation, and technical services. A summary of the estimated costs for the project is provided in Table 4.2-1. The annual project costs are estimated to be $47.6 million, which includes annual debt service, operation and maintenance, and an annual payment to BRA for lost yield in Possum Kingdom Reservoir. The resulting unit cost to deliver the firm yield supply 25,760 acft/yr is $5.67 per 1,000 gallons or $1,849 per acft. Treatment costs are included in another water management strategy recommended for Abilene.

Table 4.2-1 Cost Estimate for Cedar Ridge Reservoir

Cost Estimate Summary Water Supply Project Option September 2023 Prices City of Abilene - Cedar Ridge Reservoir Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Dam and Reservoir (Conservation Pool acft, 9786 acres)	$98,795,000
Intake Pump Stations (24.2 mgd)	$56,697,000
Transmission Pipeline (42 in. dia., 29.4 miles)	$154,987,000
Water Treatment Plant (21.1 mgd)	$49,688,000
Integration, Relocations, Backup Generator & Other	$19,100,000
TOTAL COST OF FACILITIES	**$379,267,000**
- Planning (3%)	$11,378,000
- Design (7%)	$26,549,000
- Construction Engineering (1%)	$3,793,000
Legal Assistance (2%)	$7,585,000
Fiscal Services (2%)	$7,585,000

15 eHT and HDR, Op. Cit., November 2009.

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
City of Abilene - Cedar Ridge Reservoir	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Pipeline Contingency (15%)	$23,248,000
All Other Facilities Contingency (20%)	$44,856,000
Environmental & Archaeology Studies and Mitigation	$37,435,000
Land Acquisition and Surveying (9980 acres)	$32,519,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$37,325,000
TOTAL COST OF PROJECT	**$611,540,000**
ANNUAL COST	x
Debt Service (3.5 percent, 20 years)	$27,912,000
Reservoir Debt Service (3.5 percent, 40 years)	$10,060,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,741,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$1,417,000
Dam and Reservoir (1.5% of Cost of Facilities)	$1,482,000
Water Treatment Plant	$3,478,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (16022497 kW-hr @ 0.09 $/kW-hr)	$1,442,000
Purchase of Water (1081 acft/yr @ 99.5 $/acft)	$108,000
TOTAL ANNUAL COST	**$47,640,000**
Available Project Yield (acft/yr)	**25,760**
Annual Cost of Water ($ per acft), based on PF=1	**$1,849**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$375**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$5.67**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$1.15**
Note: One or more cost element has been calculated externally	
CJM	*1/16/2025*

4.2.5 Implementation Issues

The CRR water supply option has been compared to the plan development criteria, as shown in Table 4.2-2, and the option meets each criterion.

4.2.5.1 Potential Regulatory Requirements:

- Texas Commission on Environmental Quality Water Right and Storage permit (pending at TCEQ);
- U.S. Army Corps of Engineers Permit will be required for discharges of dredged or fill into wetlands and waters of the U.S. for dam construction, and other activities (Section 404 of the Clean Water Act) (pending at the USACE-SWF);
- Texas Commission on Environmental Quality administered Texas Pollutant Discharge Elimination System Storm Water Pollution Prevention Plan;
- Texas General Land Office Easement if State-owned land or water is involved; and
- Texas Parks and Wildlife Department Sand, Shell, Gravel, and Marl permit if state-owned streambed is involved.

4.2.5.2 State and Federal Permits may require the following studies and plans:

- Environmental impact or assessment studies;
- Wildlife habitat mitigation plan that may require acquisition and management of additional land;
- Flow releases downstream to maintain aquatic ecosystems;
- Assessment of impacts on Federal- and State-listed endangered and threatened species;
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction; and
- Cultural resources studies to determine resources impacts and appropriate mitigation plan that may include cultural resource recovery and cataloging; requires coordination with the Texas Historical Commission.

4.2.5.3 Land Acquisition Issues:

- Land acquired for reservoir and mitigation plans could include market transactions or other local landowner agreements;
- Additional acquisition of rights-of-way and easements may be required; and
- Relocations or removal of residences, utilities, roads, or other structures.

Table 4.2-2 Comparison of Cedar Ridge Reservoir Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. Reasonable to High
B. Environmental factors	
1. Environmental Water Needs	1. Moderate impact
2. Habitat	2. High impact
3. Cultural Resources	3. Moderate impact based on surveys of the site
4. Bays and Estuaries	4. Low impact due to distance from the coast
5. Threatened and Endangered Species	5. Possible moderate impact
6. Wetlands	6. Low impact

Impact Category	Comment(s)
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	Potential impact on bottomland farms and habitat in the reservoir area
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	None
G. Third-Party Social and Economic Impacts from Voluntary Redistribution	None

4.3 Coryell County Off-Channel Reservoir

4.3.1 Description of Option

The Coryell County Off-Channel Reservoir (OCR) is located on a tributary adjacent to Cowhouse Creek about four miles southeast of the Coryell-Hamilton County Line, as shown in Figure 4.3-1. Supplies from the OCR would be used to meet needs in Coryell County and potentially Bell, Lampasas, Williamson, or Hamilton Counties.

The OCR would impound streamflow pumped from Cowhouse Creek from a diversion site directly downstream of the proposed OCR dam location. The OCR would consist of a 4,767 ft earthfill embankment dam on the Cowhouse Creek tributary stream with a crest elevation at 1,080 ft-msl. The OCR includes a 5 ft vertical freeboard and a conservation pool elevation of 1,075 ft-msl. At conservation pool elevation, the reservoir will have a storage capacity of 15,380 acft and inundate 445 surface acres. All flows from the small contributing drainage area to the OCR would be passed through the dam and not impounded.

For the project to be economically feasible, an agreement with the Brazos River Authority (BRA) would be required to subordinate Lake Belton water rights to diversions from Cowhouse Creek for impoundment in the OCR. Without subordination, the unappropriated flows in Cowhouse Creek are not sufficient to maintain adequate water levels in the OCR. Currently, BRA indicates that no subordination agreement is likely to be possible.

4.3.2 Available Yield

Water potentially available for impoundment in the proposed Coryell Off-Channel Reservoir was estimated using the TCEQ Brazos WAM Run 3. The model utilizes a January 1940 through December 2018 hydrologic period of record and assumes no return flows and permitted storages and diversions for all water rights in the basin. The model computes streamflow available for diversion from Cowhouse Creek into the Coryell OCR without causing increased shortages to existing downstream rights and subject to the subordination agreement with Lake Belton. Estimates of water availability were derived subject to all diversions and impoundments having to pass streamflows to meet TCEQ environmental flow standards.

Figure 4.3-1 Coryell County Off-Channel Reservoir

Document Path: \\dalctxsrv01\Texas_GIS_Projects\10029705_036_Brazos_G_2021_Plan\Map_Docs\MXDs\Reservoir_Strategy\Coryell_County_OCR.mxd

A 675 ft, 36-inch diameter pipeline would be used to deliver streamflow from Cowhouse Creek to the off-channel reservoir. Due to the short pipeline length, it was assumed the diversion system would be capable of transmitting water at a velocity of 7 feet per second (49.5 cfs). A possible 2,985 acft of water could be diverted per month if the transmission system operated every day at full capacity. However, for the transmission system to be able to operate, streamflow in Cowhouse Creek must exceed the pumping capacity (49.5 cfs) by 0.5 cfs to maintain enough suction head at the intake to transmit water. Streamflow was estimated at the diversion site using a drainage area ratio with available USGS daily streamgage data from 1950 to 2018 at Cowhouse Creek near Pidcoke, TX. The estimated streamflow indicates that on average, only 5.2 days per month exceed the required streamflow of 50.0 cfs. Therefore, it is assumed that the transmission system will only operate 5.2 days per month and transfer a maximum of 510 acre-feet per month of flow from Cowhouse Creek. Figure 4.3-2 illustrates the annual diversion amount under firm yield conditions from Cowhouse Creek used to refill storage. On average, 3,717 acft/yr of water would be diverted.

The calculated firm yield of the Coryell County OCR is 3,190 acft/yr. Figure 4.3-3 and Figure 4.3-4 illustrates the simulated Coryell County OCR storage levels for the 1940 to 2018 historical period, subject to the firm yield demand of 3,190 acft/yr and assuming subordination of Lake Belton and delivery of Cowhouse Creek diversions via a 36-inch pipeline. Simulated reservoir contents remain above 80 percent capacity about 35 percent of the time and above 50 percent capacity about 68 percent of the time. Results of the WAM simulation indicate no yield impact to Lake Belton when subordinated to the Cowhouse Creek diversions for the OCR.

Figure 4.3-5 illustrates the change in streamflows in Cowhouse Creek caused by the project. The largest change in the Cowhouse Creek would be a decline in median streamflow of 9.1 cfs during February.

Figure 4.3-6 illustrates the Cowhouse Creek streamflow frequency characteristics with and without the Coryell County OCR in place.

Figure 4.3-2 Coryell County Off-Channel Reservoir Firm Yield Diversions from Cowhouse Creek

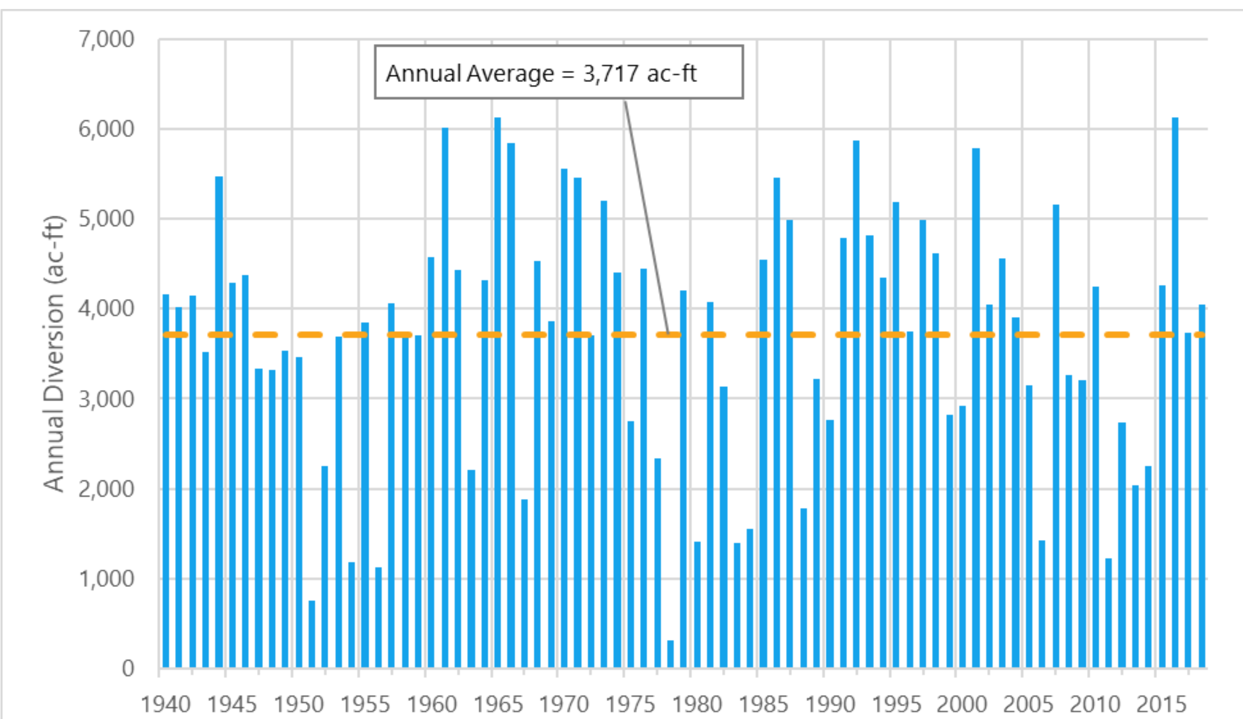


Figure 4.3-3 Coryell County Off-Channel Reservoir Storage Trace

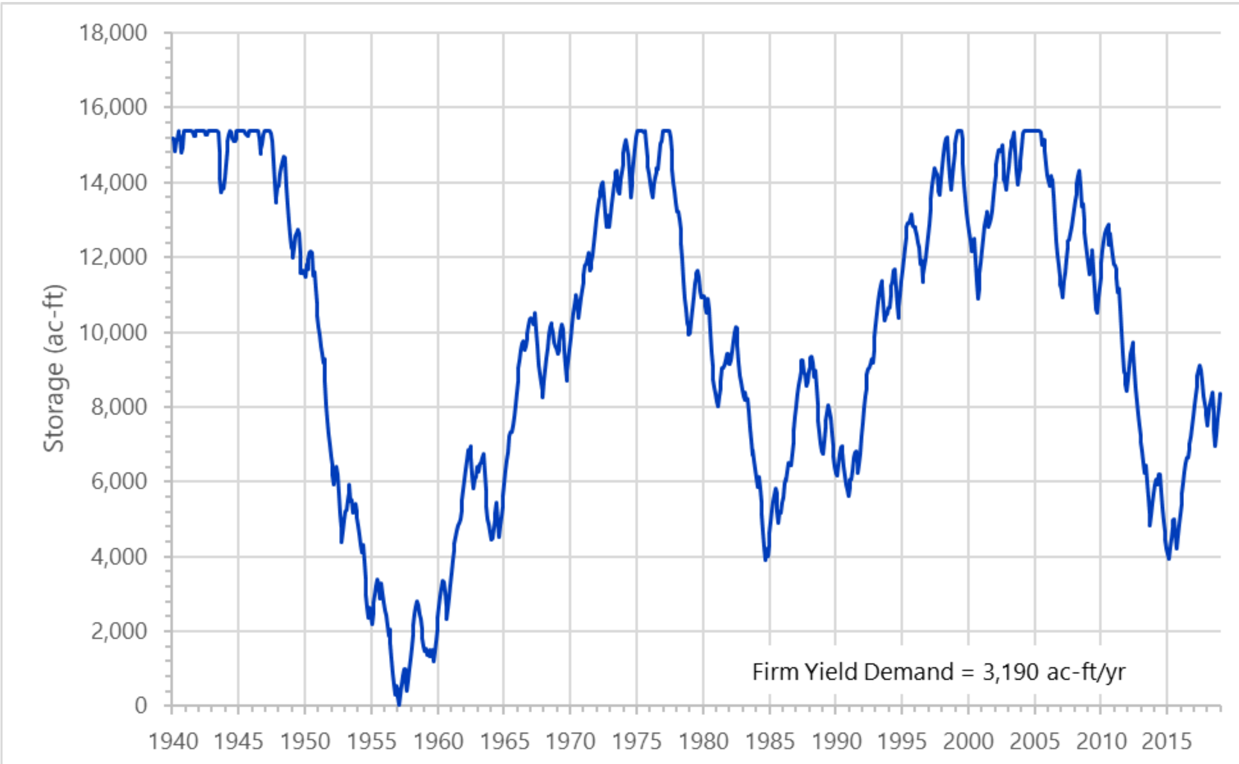


Figure 4.3-4 Coryell County Off-Channel Reservoir Storage Frequency at Firm Yield

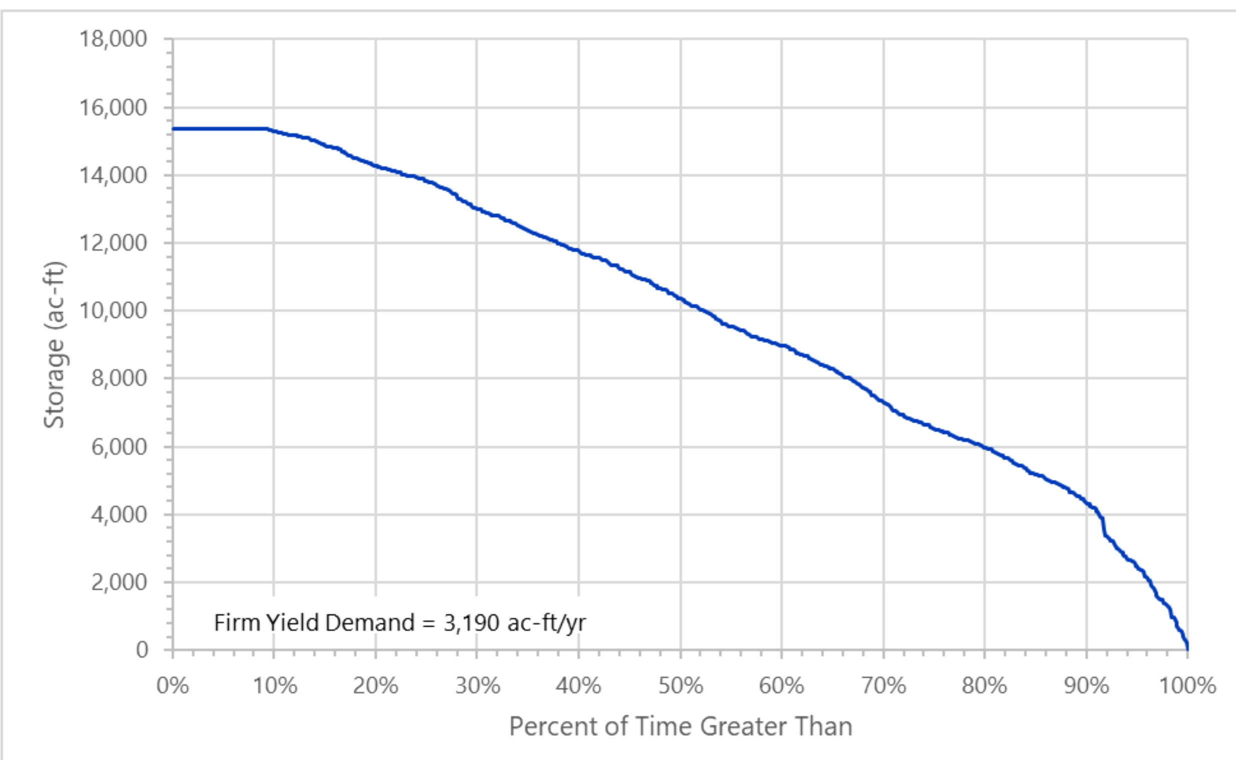


Figure 4.3-5 Cowhouse Creek Diversion Median Streamflow Comparison

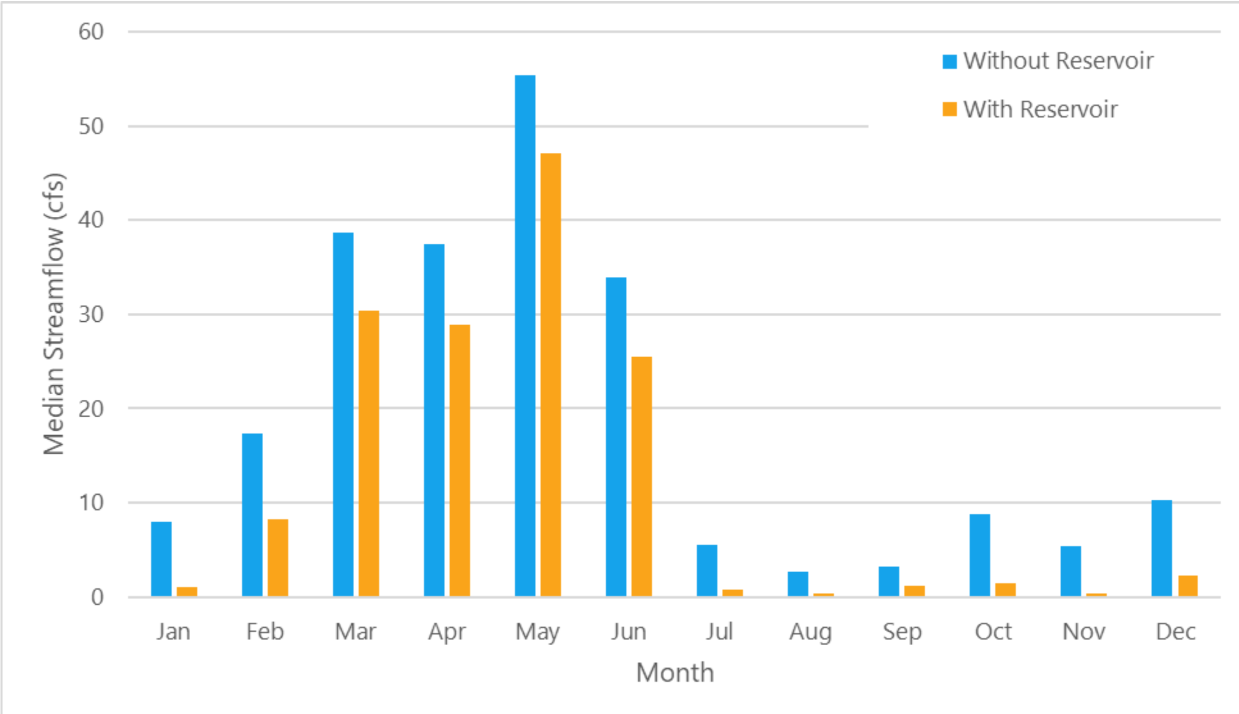
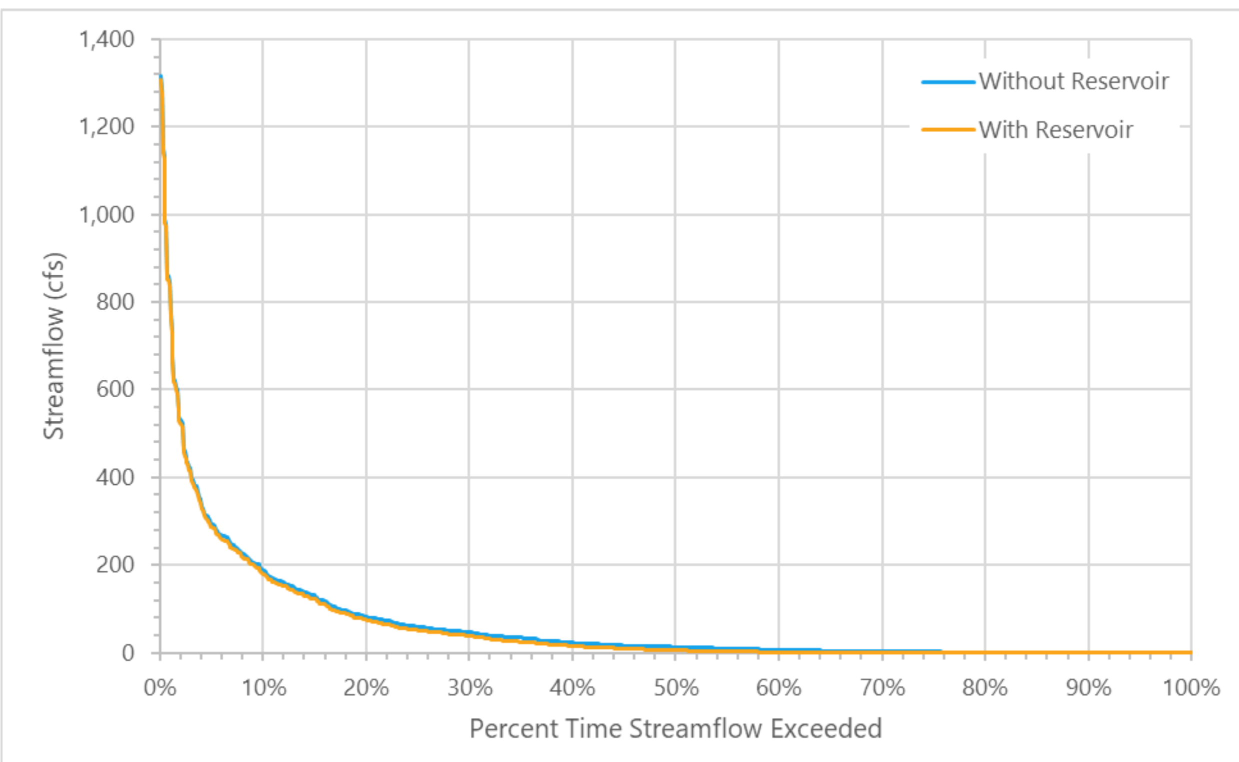


Figure 4.3-6 Cowhouse Creek Diversion Streamflow Frequency Comparison



4.3.3 Environmental Issues

4.3.3.1 Existing Environment

The Coryell County OCR involves the construction of a pipeline to capture flood water from Cowhouse Creek, and dam construction and inundation of approximately 445 acres in a tributary east of Cowhouse Creek. The proposed OCR site is located in northwestern Coryell County. The site is situated on the ecotone between the Central Oklahoma/Texas Plains and the Edwards Plateau Ecoregions[1] and is within the Balconian biotic province.[2] This region is characterized by rolling to hilly topography, with interspersed grassland and woodland, and soils ranging from the deep, fertile, black soils of the Central Oklahoma/Texas Plains to the shallow, dry limestone of the Edwards Plateau. The climate in this area is characterized as subtropical humid with warm summers. Average annual precipitation is approximately 33 inches.[3] The Trinity Aquifer is the only major aquifer underlying the project area.[4]

A Custom Soil Resource Report was completed for the Coryell County OCR site[5]. According to this report, five soil types underlie the project site. Doss-Real complex, 1-8 percent slopes, is the most abundant soil at 50 percent of the project area. These soils typically occupy backslopes of ridges. This soil is well drained, has a very low available water capacity and consists of clay loam to very gravelly clay loam. Wise clay loam soils occur within 30 percent of the project area. These soils are found on ridges, are well drained and have a low available water capacity. They are comprised of clay loam at the surface, underlain by silty clay loam and stratified very fine sandy loam to silty clay loam.

Nuff very stony silty clay loam, 2 to 6 percent slopes, which comprises approximately 11% of the reservoir area is typically found on the backslopes of ridges, is well drained and consists of a surface layer covered with cobbles, stones or boulders underlain by silty clay loam. Seawillow clay loam, 3 to 5 percent slopes, and Cisco fine sandy loam, 1 to 5 percent slopes, moderately eroded each occur in less than 7 percent of the project area. The Seawillow soils within the site occur on stream terraces, are well drained and consist of clay loam. Cisco soils in the project area are found on ridges, are well drained and have a moderate available water capacity. Fine sandy loam is found at the surface and below about 40 inches, and clay loam is present in the middle layers of these Cisco soils. Water areas comprise a little over one percent of the project area and include existing stock tanks. None of the soils found within the project area are considered to be prime farmland soils.

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[1] Griffith, G.E., Bryce, S.A., Omernik, J.M., Comstock, J.A., Rogers, A.C., Harrison, B., Hatch, S.L., and Bezanson, D., 2004. Ecoregions of Texas. Reston, Virginia, U.S. Geological Survey.
[2] Blair, W.F., "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117, 1950.
[3] The Dallas Morning News, 2008, "Texas Almanac 2008-2009." Texas A&M University Press Consortium, College Station, Texas.

[4] Texas Water Development Board (TWDB), *Major and Minor Aquifers of Texas*, Maps online at http://www.twdb.state.tx.us/mapping/index.asp, 2004.
[5] NRCS. "Custom Soil Resource Report for Coryell County, Texas – Coryell County Off-Channel Site. November 24, 2014.

Vegetation within the project area is primarily Silver Bluestem-Texas Wintergrass Grassland with a smaller area of Oak-Mesquite-Juniper Parks/Woods6. Silver bluestem-Texas wintergrass grasslands could include the following commonly associated plants: little bluestem (*Schizachyrium scoparium*), sideoats grama (*Bouteloua curtipendula*), Texas grama (*Bouteloua rigidiseta*), three-awn (*Aristida sp.*), hairy grama *(Bouteloua hirsute*), tall dropseed (*Sporobolus asper*), buffalograss (*Bouteloua dactyloides*), windmillgrass (*Chloris verticillata*), hairy tridens (*Erioneuron pilosum*), tumblegrass (*Schedonnardus paniculatus*), western ragweed (*Ambrosia psilostachya*), broom snakeweed (*Gutierrezia sarothrae*), Texas bluebonnet (*Lupinus texensis*), live oak (*Quercus virginiana*), post oak (*Q. stellata*) and mesquite (*Prosopis glandulosa*). Commonly associated plants in the Oak-Mesquite-Juniper Parks/Woods include: post oak, Ashe juniper (*Juniperus ashei*), shin oak (*Q. sinuata*), Texas oak (*Q. buckleyi*), blackjack oak (*Q. marilandica*), live oak, cedar elm (*Ulmus crassifolia*), agarito (*Berberis trifoliolata*) , soapberry (*Sapindus saponaria*), sumac (*Rhus sp.*), hackberry (*Celtis reticulata*), Texas pricklypear (*Opuntia sp.*), Mexican persimmon (*Diospyros texana*), purple three-awn (*Aristida purpurea*), hairy grama, Texas grama, sideoats grama, curly mesquite (*Hilaria mutica*), and Texas wintergrass (*Stipa leucotricha*).

4.3.3.2 Potential Impacts

Aquatic Environments including Bays and Estuaries

The potential impacts of this project were evaluated at Cowhouse Creek where water will be pumped and diverted to the project site. At the diversion site on Cowhouse Creek, it is anticipated that there would be a reduction in the quantity of median monthly flows as shown in Table 4.3-1. Median monthly flows are expected to be reduced in all months of the year. Changes in flow variability at the diversion point is expected. Variability in flow is important to the instream biological community as well as riparian species and a reduction could influence the timing and success of reproduction as well as modify the current composition of species by favoring some and reducing suitability for others. Siting of the intake and pump station for this project should be situated as to result in minimal disturbance to existing area species.

Although there would be impacts in the immediate vicinity of the project site and downstream, it appears that this project, alone, would have minimal influence on total discharge in the Brazos River, resulting in a minimal influence on freshwater inflows to the Brazos River estuary. However, the cumulative impact of multiple projects of this type may reduce freshwater inflows into the estuary.

Threatened & Endangered Species

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Coryell County can be found at https://tpwd.texas.gov/gis/rtest/.

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[6] McMahan, C. A., R. G. Frye and K. L. Brown, " The Vegetation Types of Texas -- Including Cropland," Texas Parks and Wildlife Department - PWD Bulletin 7000-120. 1984.

Data from the TPWD Texas Natural Diversity Database[7] did not reveal any documented occurrences of listed species within the vicinity of the proposed Coryell OCR. However, these data are not a representative inventory of rare resources or sensitive sites. Although based on the best information available to TPWD, these data do not provide a definitive statement as to the presence, absence, or condition of special species, natural communities, or other significant features in the project area. On-site evaluations will be required by qualified biologists to confirm the occurrence of sensitive species or habitats. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

Table 4.3-1 Median Monthly Streamflow: Cowhouse Creek Diversion Site

Month	Without Project (cfs)	With Project (cfs)	Difference (cfs)	Percent Reduction
January	8.0	1.0	7	87.5%
February	17.3	8.2	9.1	52.6%
March	38.7	30.4	8.3	21.4%
April	37.5	28.9	8.6	22.9%
May	55.4	47.1	8.3	15.0%
June	34.0	25.5	8.5	25.0%
July	5.5	0.8	4.7	85.5%
August	2.6	0.3	2.3	88.5%
September	3.2	1.2	2	62.5%
October	8.8	1.5	7.3	83.0%
November	5.4	0.4	5.0	92.6%
December	10.3	2.3	8.0	77.7%

Wildlife Habitat

The primary impacts that would result from construction and operation of the proposed Coryell County OCR include conversion of approximately 445 acres of existing habitat within the conservation pool to open water. Projected wildlife habitat that will be impacted includes approximately 337 acres of Savanna Grassland, 76 acres of Ashe Juniper/Live Oak Shrubland, three acres of Ashe Juniper/Love Oak Slope Shrubland, one acre of Ashe Juniper Motte and Woodland, one acre of Ashe Juniper Slope Forest, seven acres of Oak/Hardwood Motte and Woodland, less than one acre of Oak/hardwood Slope Forest, 11 acres of Mesquite Shrubland, and seven acres of open water, primarily from existing stock tanks.[8] Siting of the raw water intake, pump station and raw water pipeline needed to complete the project should be located

[7] Texas Parks and Wildlife Department (TPWD), Texas Natural Diversity Database, November 10, 2014.
[8] Texas Parks and Wildlife. Ecological Mapping Sytem GIS layer. Accessed at http://www.tpwd.state.tx.us/gis/data/ November 18, 2014.

in an area that would result in minimal impacts to existing aquatic and terrestrial species. Impacts from the pipeline and associated appurtenances are anticipated to be low and primarily limited to the construction of these facilities and subsequent maintenance activities.

A number of vertebrate species could occur within the Coryell County OCR site including smaller mammals such as the eastern red bat (*Lasiurus borealis*), hispid cotton rat (*Sigmodon hispidus*), white-footed mouse (*Peromyscus leucopus*), eastern fox squirrel (*Sciurus niger*), and woodland vole (*Microtus pinetorum*).[9] Reptiles and amphibians known from the county include the western rough green snake (*Opheodrys aestivus majalis*), Strecker's chorus frog (*Pseudacris streckeri*), Texas toad (*Bufo speciosus*), and Great Plains rat snake (E*laphe guttata emoryi*) among others.[10] An undetermined number of bird species and a variety of fish species would also be expected to inhabit the various habitat types within the site, with distributions and population densities limited by the types and quality of habitats available.

Cultural Resources

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets provided by the Texas Historical Commission (THC) for the 2011 Regional Water Plan, there are no National Register Properties, National Register Districts, cemeteries, or historical markers are located within or near the project area. Because the owner or controller of the project will likely be a political subdivision of the State of Texas (i.e. river authority, municipality, county, etc.), they will be required to coordinate with the Texas Historical Commission regarding potential impacts to cultural resources.

Threats to Natural Resources

This project would likely increase adverse effects on streamflow below the diversion point along Cowhouse Creek. Decreased stream flow would contribute to declines in dissolved oxygen and higher temperatures during summer periods. Additional impacts would be expected to terrestrial species found within the proposed OCR area that would be displaced by the reservoir filling. The project is expected to have negligible impacts to the streamflow and water quality in the Brazos River.

Agricultural Impacts

The Coryell County OCR site contains approximately zero acres of Pasture/Hay fields and 25 acres of cropland. These two agricultural land uses account for less than three percent of the reservoir footprint.

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[9] Davis, William B. and David J. Schmidly. 1994. The Mammals of Texas. Texas Parks and Wildlife, Austin, Texas

[10] Dixon, James R., Amphibians and Reptiles of Texas. 1987, Texas A&M Press.

4.3.4 Engineering and Costing

The Coryell County OCR project would require additional facilities to divert water from Cowhouse Creek to the OCR. The facilities required for implementation of the project include:

- Raw water intake and pump station at the Cowhouse Creek diversion site with a capacity of 33.7 mgd;
- 674 feet of raw water pipeline (36-inch diameter) from the pump station to the off-channel reservoir;
- Off-channel dam including spillway, intake tower, and 451 acres of land for the reservoir and pipeline right-of-way.

A summary of the total project cost in September 2023 dollars is presented in Table 4.3-2. The total project cost of the Coryell County OCR project is estimated to be $120.7 million for surface water supply facilities. This includes the construction of the dam, land acquisition, resolution of conflicts, environmental permitting and mitigation, and technical services. The project costs also include the cost for the raw water facilities to convey surface water from the Cowhouse Creek diversion site to the off-channel reservoir. Costs associated with the transmission and treatment of raw water stored in the OCR to future customers is not included. The annual project costs are estimated to be $9,990,000. This includes annual debt service, operation and maintenance, pumping energy costs, and purchase of water from BRA for compensation of yield impacts to Lake Belton.

The off-channel project will be able to provide raw water prior to treatment and transmission of treated water to entities in Coryell County at a unit cost of $3,187 per ac-ft or $9.78 per 1,000 gallons.

Table 4.3-2 Cost Estimate Summary for Coryell County Off-Channel Reservoir

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Multi County WSC - Coryell County OCR	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Dam and Reservoir (Conservation Pool acft, acres)	$3,300,000
Off-Channel Storage/Ring Dike (Conservation Pool 15380 acft, 445 acres)	$30,353,000
Intake Pump Stations (33.7 mgd)	$44,328,000
Transmission Pipeline (36 in. dia., 0.1 miles)	$478,000
Integration, Relocations, Backup Generator & Other	$552,000
TOTAL COST OF FACILITIES	**$79,011,000**
- Planning (3%)	$2,370,000
- Design (7%)	$5,531,000
- Construction Engineering (1%)	$790,000
Legal Assistance (2%)	$1,580,000
Fiscal Services (2%)	$1,580,000
Pipeline Contingency (15%)	$72,000
All Other Facilities Contingency (20%)	$15,707,000
Environmental & Archaeology Studies and Mitigation	$3,329,000
Land Acquisition and Surveying (451 acres)	$3,362,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Multi County WSC - Coryell County OCR	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$7,367,000
TOTAL COST OF PROJECT	**$120,699,000**
ANNUAL COST	x
Debt Service (3.5 percent, 20 years)	$4,927,000
Reservoir Debt Service (3.5 percent, 40 years)	$2,373,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$10,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$1,108,000
Dam and Reservoir (1.5% of Cost of Facilities)	$505,000
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (9055772 kW-hr @ 0.09 $/kW-hr)	$815,000
Purchase of Water (2536 acft/yr @ 99.5 $/acft)	$252,000
TOTAL ANNUAL COST	**$9,990,000**
Available Project Yield (acft/yr)	**3,135**
Annual Cost of Water ($ per acft), based on PF=1	**$3,187**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$858**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$9.78**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$2.63**
Note: One or more cost element has been calculated externally	
CJM	*1/17/2025*

4.3.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 4.3-3, and the option meets each criterion.

Table 4.3-3 Evaluations of Coryell County Off-Channel Reservoir Option to Enhance Water Supplies

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. Reasonable (moderate to high)
B. Environmental factors	
1. Environmental Water Needs	1. Negligible impact
2. Habitat	2. Negligible impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Negligible impact
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Negligible impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

Implementation of the off-channel reservoir project will require permits from various state and federal agencies, land acquisition, and design and construction of the facilities. The project may also have an impact on the firm yield of Lake Belton, which may require mitigation with the Brazos River Authority in terms of a water supply contract in the amount of the firm yield impact. A summary of the implementation steps for the project is presented below.

4.3.5.1 Potential Regulatory Requirements

- Texas Commission on Environmental Quality Water Right and Storage permits;
- U.S. Army Corps of Engineers Permits will be required for discharges of dredge or fill into wetlands and waters of the U.S. for dam construction, and other activities (Section 404 of the Clean Water Act);
- Texas Commission on Environmental Quality administered Texas Pollutant Discharge Elimination System Storm Water Pollution Prevention Plan;
- General Land Office Easement if State-owned land or water is involved; and,
- Texas Parks and Wildlife Department Sand, Shell, Gravel and Marl permit if state-owned streambed is involved.

4.3.5.2 State and Federal Permits May Require the Following Studies and Plans

- Environmental impact or assessment studies;
- Wildlife habitat mitigation plan that may require acquisition and management of additional land;
- Flow releases downstream to maintain aquatic ecosystems;
- Assessment of impacts on Federal- and State-listed endangered and threatened species;
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction; and
- Cultural resources studies to determine resources impacts and appropriate mitigation plan that may include cultural resource recovery and cataloging; requires coordination with the Texas Historical Commission.

4.3.5.3 Land Acquisition Issues

- Land acquired for reservoir and/or mitigation plans could include market transactions and/or eminent domain;
- Additional acquisition of rights-of-way and/or easements may be required; and
- Possible relocations or removal of residences, utilities, roads, or other structures.

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4.4 City of Groesbeck Off-Channel Reservoir

4.4.1 Description of Option

The Groesbeck Off-Channel Reservoir is a proposed new reservoir adjacent to the Navasota River, northeast of the City of Groesbeck in Limestone County, as shown in Figure 4.4-1 and Figure 4.4-2. The City of Groesbeck uses surface water directly from the Navasota River and has water rights on the Navasota River that authorize diversion of 2,500 acft/yr and storage of 500 acft with a priority of June 1921. This water right is one of the more senior water rights in the Brazos River Basin.

The diversion point for the City of Groesbeck is just north (upstream) of the City and downstream (south) of Springfield Lake at Fort Parker. A natural spring occurs just below Springfield Lake that provides a base flow to the river just upstream of the City's diversion point during most years. However, during past drought periods the spring flow has not been sufficient to meet the City's full water demand and the City was forced to use stored water from Springfield Lake. Springfield Lake is owned by the TPWD for recreation purposes; however, Groesbeck's 500 acft storage right extends to the lake. During drought periods, when the flow in the Navasota River is not adequate to meet the City's water needs, the City siphons water from storage in Springfield Lake over the dam and into the downstream river channel for subsequent diversion downstream at the water treatment plant intake.

Springfield Lake was built in 1939 for the primary purpose of recreation. The lake is very shallow, originally storing about 3,100 acft over a surface area of 750 acres, making the average depth of the lake about 4 feet. Over the years, the lake has lost significant storage due to sedimentation. In 1991, the City of Groesbeck and the TPWD jointly participated in a project[1] to dredge the lake making the average lake depth approximately 4 feet over 500 acres. Groesbeck has relied on this storage during recent drought periods to meet their needs and has implemented water rationing in the City as recently as 1998.

A yield analysis of Springfield Lake was completed to determine the reliable supply to Groesbeck from its Navasota River diversion rights and storage in Springfield Lake. The shallow depth of about four feet and effective surface area of 500 acres of Springfield Lake results in the reservoir being very inefficient. In comparison, net evaporation rates during the extended drought periods of the 1950s were as high as 4.2 feet annually, which would severely deplete the reservoir storage without any diversions by the City. Results of the yield analysis indicate that the firm yield of the City's water right, supplemented with storage from Springfield Lake, is less than 200 acft/yr.

The City of Groesbeck's water use in 2011 was 736 acft. The Brazos G WAM modeling results indicate that there is no reliable yield associated with the City's right.

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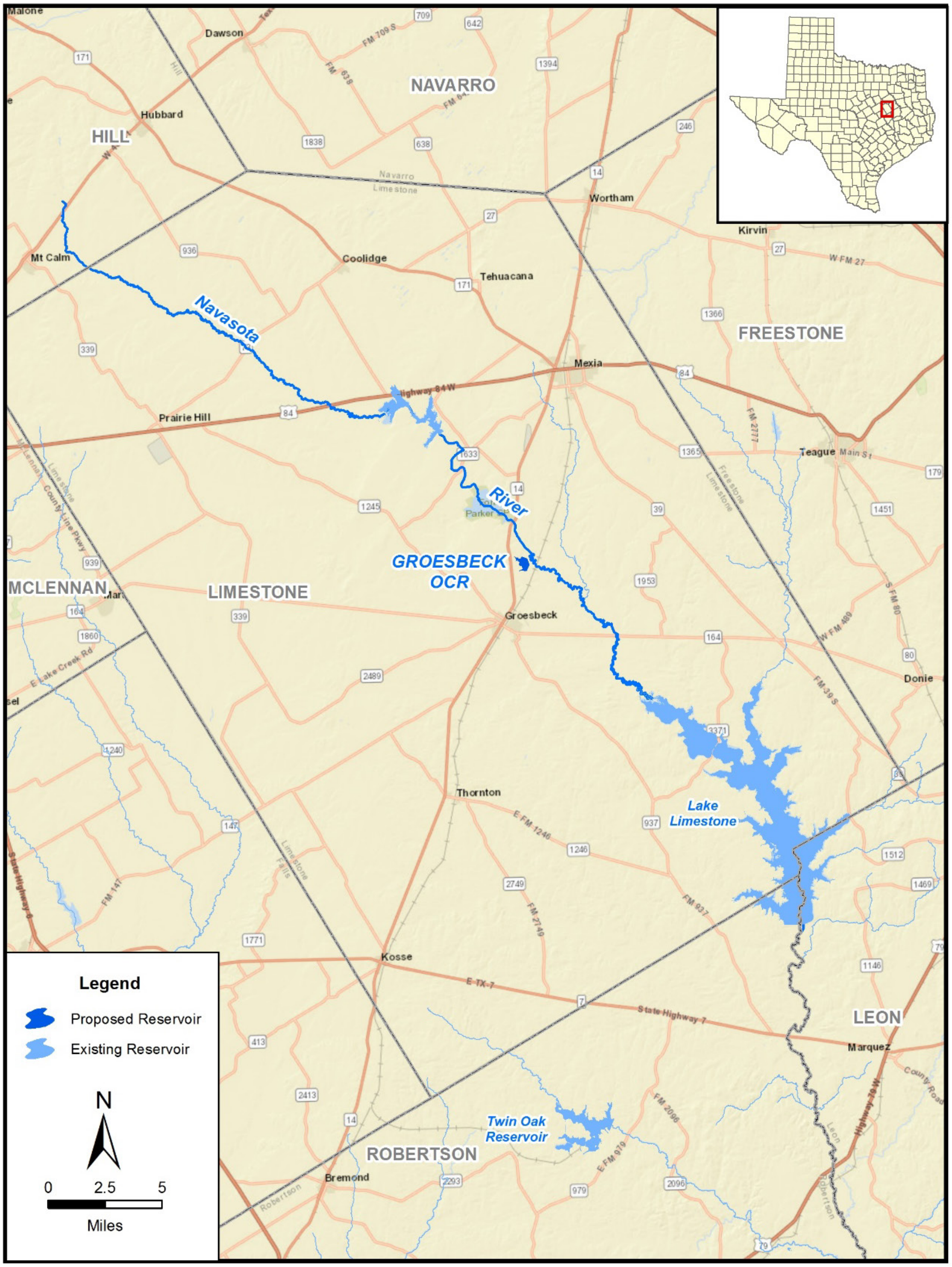
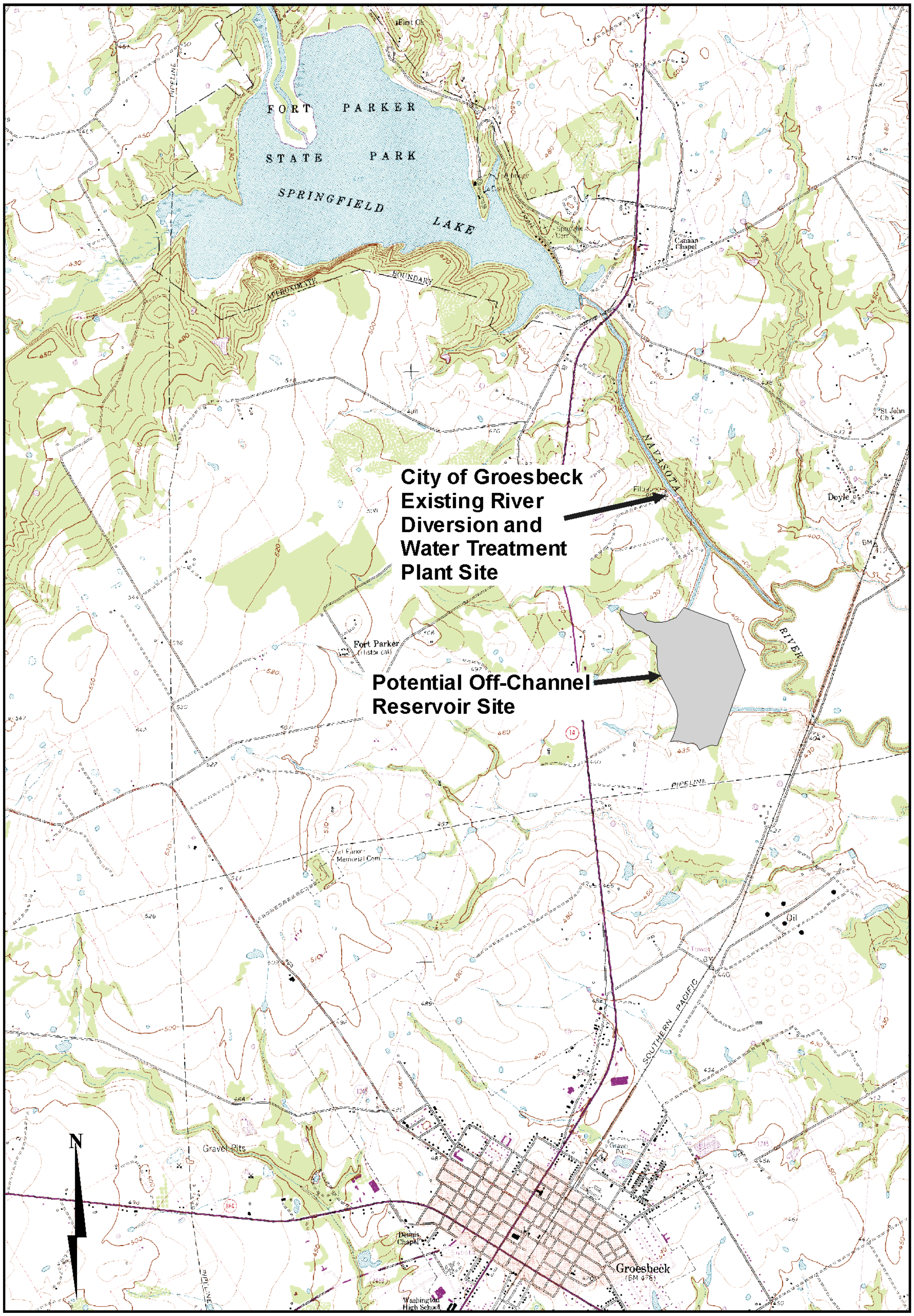
[1] Hunter & Associates, Inc., "A Plan for Dredging and Rehabilitation of Springfield Lake at Fort Parker, Limestone County, Texas," prepared for the City of Groesbeck and the Texas Parks and Wildlife Department, January 1991.

Figure 4.4-1 Location of Groesbeck Off-Channel Reservoir



Document Path: \\dalctxsrv01\Texas_GIS_Projects\10029705_036_Brazos_G_2021_Plan\Map_Docs\MXDs\Reservoir_Strategy\Groesbeck_OCR.mxd

Figure 4.4-2 Groesbeck Off-Channel Reservoir


FORT PARKER
STATE PARK
SPRINGFIELD LAKE
City of Groesbeck
Existing River
Diversion and
Water Treatment
Plant Site
Potential Off-Channel
Reservoir Site
NAVASOTA
RIVER
Fort Parker
Doyle
PIPELINE
SOUTHERN PACIFIC
Gravel Pits
Groesbeck
N

City can expect substantially less than the authorized diversion of 2,500 acft/yr. As the City's demands grow, additional storage or a supplemental supply of water will be needed.

The off-channel reservoir alternative appears to be an economical solution to provide the City with a firm water supply, as the storage can be developed near the City's existing river diversion and water treatment facilities. A potential off-channel storage site along the Navasota River is shown in Figure 4.4-2. The dam would be an earthfill embankment that would extend approximately 1,500 feet and provide a conservation storage capacity of 2,317 acft at an elevation 420 ft-msl. The reservoir would inundate 146 surface acres and impound flows diverted from the Navasota River. All flows from the small watershed above the reservoir would be passed through the reservoir.

The City's senior water right with a diversion of 2,500 acft/yr and a priority of June 1921 would be utilized to divert water from the Navasota River to the off-channel reservoir. The City would then divert water from the reservoir for municipal use, allowing an increase in the City's current minimum annual diversion by providing an increase in storage of available flows for use during drought periods. Additionally, since the City's water right is senior to Lake Limestone, a subordination agreement with BRA is not required. The diversion amounts from the Navasota River into the off-channel reservoir will not exceed the original water right for the City. Any additional water diverted above the existing authorization would require the purchase of Lake Limestone supplies from BRA, or a subordination agreement with the BRA. Currently, BRA indicates that no subordination agreement is likely to be possible.

4.4.2 Available Yield

Water potentially available for impoundment in the proposed Groesbeck Off-Channel Reservoir was estimated using the TCEQ Brazos WAM Run 3 which assumes no return flows and permitted storages and diversions for all water rights in the basin. The model utilizes a January 1940 through December 2018 hydrologic period of record. The model computed the streamflow available for diversion from the Navasota River into the Groesbeck Off-Channel Reservoir without causing increased shortages to existing downstream rights. The off-channel reservoir was modeled such that it does not impound streamflow originating from its own contributing drainage area. Firm yield was computed subject to the reservoir and Navasota River diversion having to pass inflows to meet environmental flow standards associated with Senate Bill 3 (SB3).

A 24-inch diameter pipeline would be used to divert streamflow from the Navasota River to the off-channel reservoir. Assuming the pipeline would transmit water at a velocity of 5 feet per second (15.7 cfs), a possible 948 acft of water could be diverted per month if the transmission system operated every day at full capacity. However, for the transmission system to be able to operate, streamflow in the Navasota River must exceed the pumping capacity (15.7 cfs) by 0.5 cfs to maintain enough suction head at the intake to transmit water.

Available USGS daily streamgage data from 1978 to 2018 for the Navasota River above Groesbeck (USGS Gage 08110325) indicates that 25 percent of the time or on average 7.6 days per month, the required streamflow of 16.2 cfs is exceeded. Therefore, it is assumed that the transmission system will only operate 7.6 days per month and transfer a maximum of 237 acft/mo of flow from the Navasota River. Figure 4.4-3 illustrates the annual diversions under firm yield conditions from the Navasota River used to refill storage. On average, 2,054 acft/yr of water would be diverted.

The calculated firm yield of the Groesbeck Off-Channel Reservoir is 1,750 acft/yr. Figure 4.4-4 illustrates the simulated Groesbeck Off-Channel Reservoir storage levels for the 1940 to 2018 historical period, subject to the firm yield of 1,750 acft/yr and based on delivery of Navasota River diversions via a 24-inch pipeline. Figure 4.4-5 shows the storage frequency associated with firm yield. Simulated reservoir contents remain above 80 percent capacity 54 percent of the time and above 50 percent capacity about 89 percent of the time.

Figure 4.4-6 illustrates the change in streamflows in the Navasota River caused by the project. From July through November, there is little or no water available in the stream. During January through June and December, there are decreases in median streamflow from the implementation of the off-channel reservoir. Figure 4.4-7 also illustrates the Navasota River streamflow frequency characteristics with the Groesbeck Off-Channel Reservoir in place.

Figure 4.4-3 Groesbeck OCR Firm Yield Diversions from Navasota River

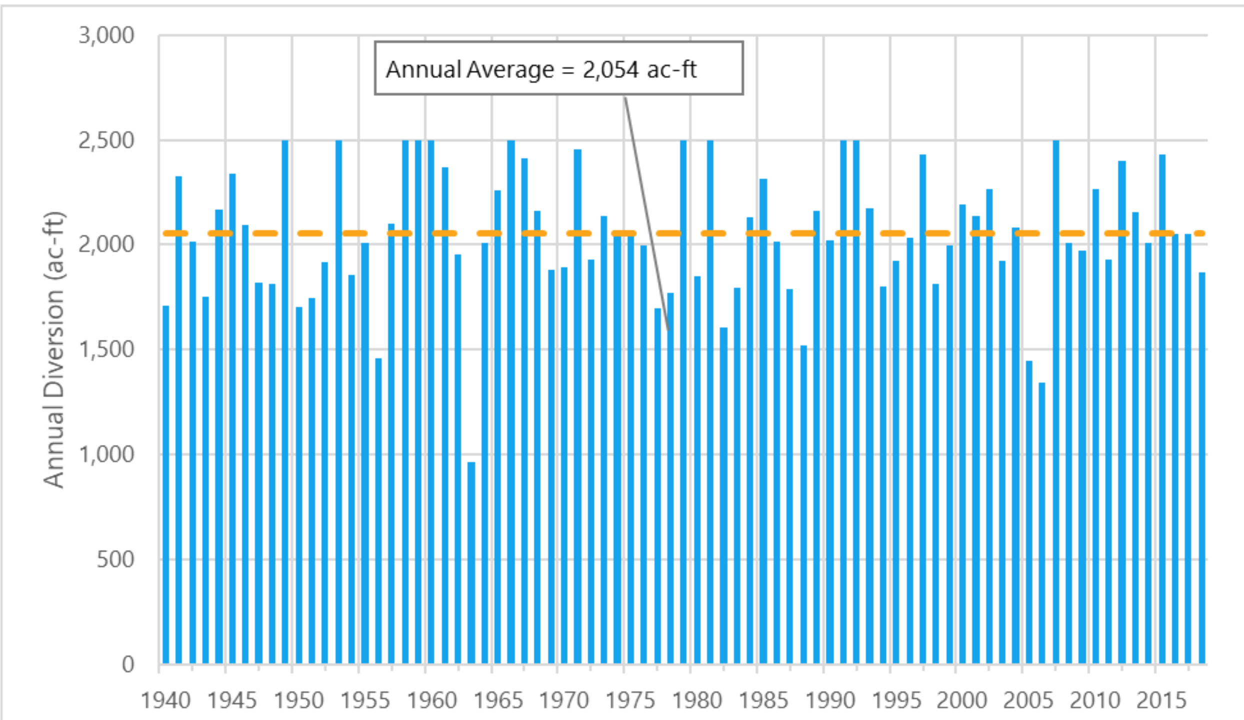


Figure 4.4-4 Groesbeck OCR Firm Yield Storage Trace

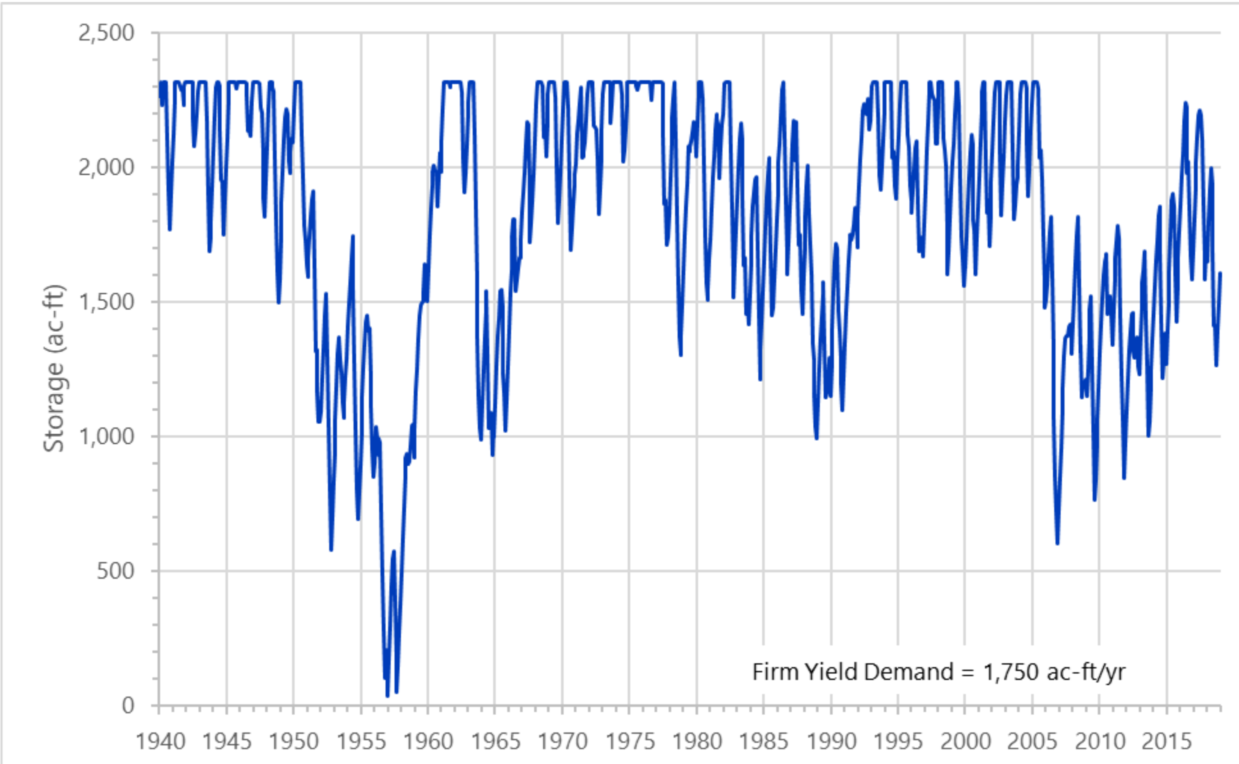


Figure 4.4-5 Storage Frequency at Firm Yield

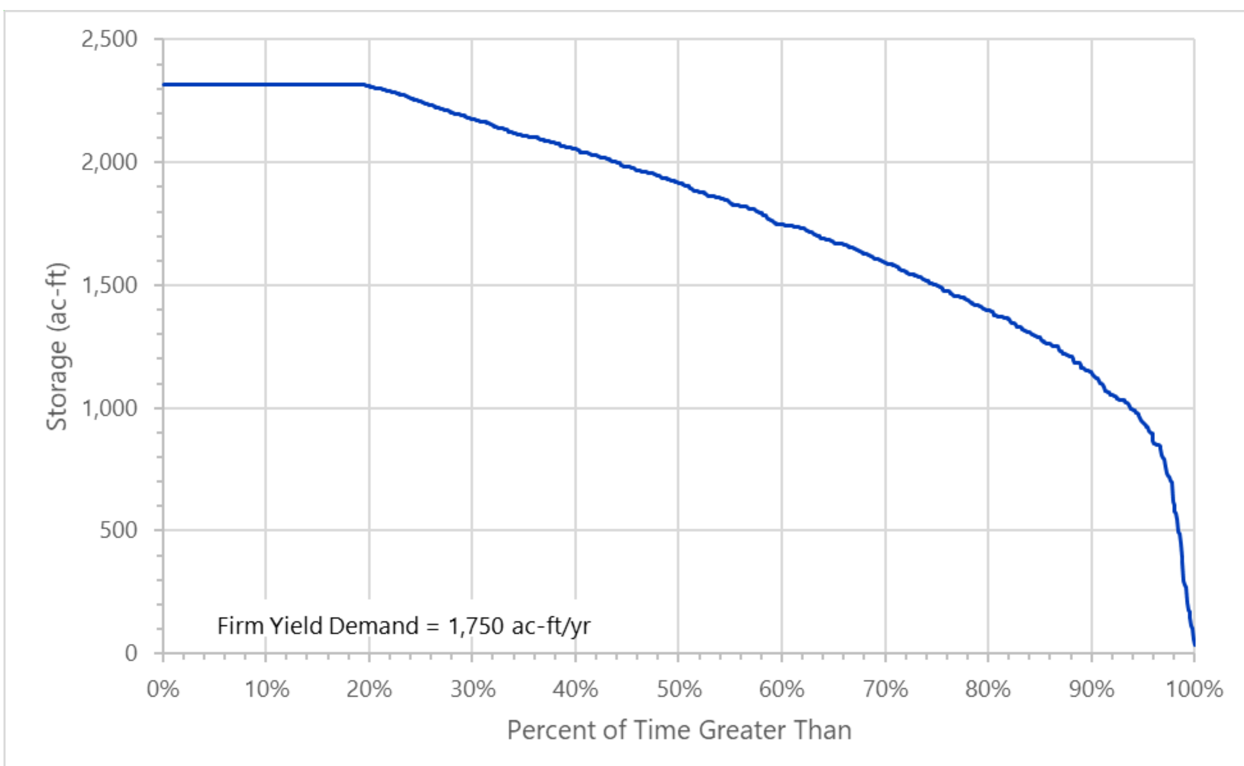


Figure 4.4-6 Navasota River Diversion - Median Streamflow Comparison

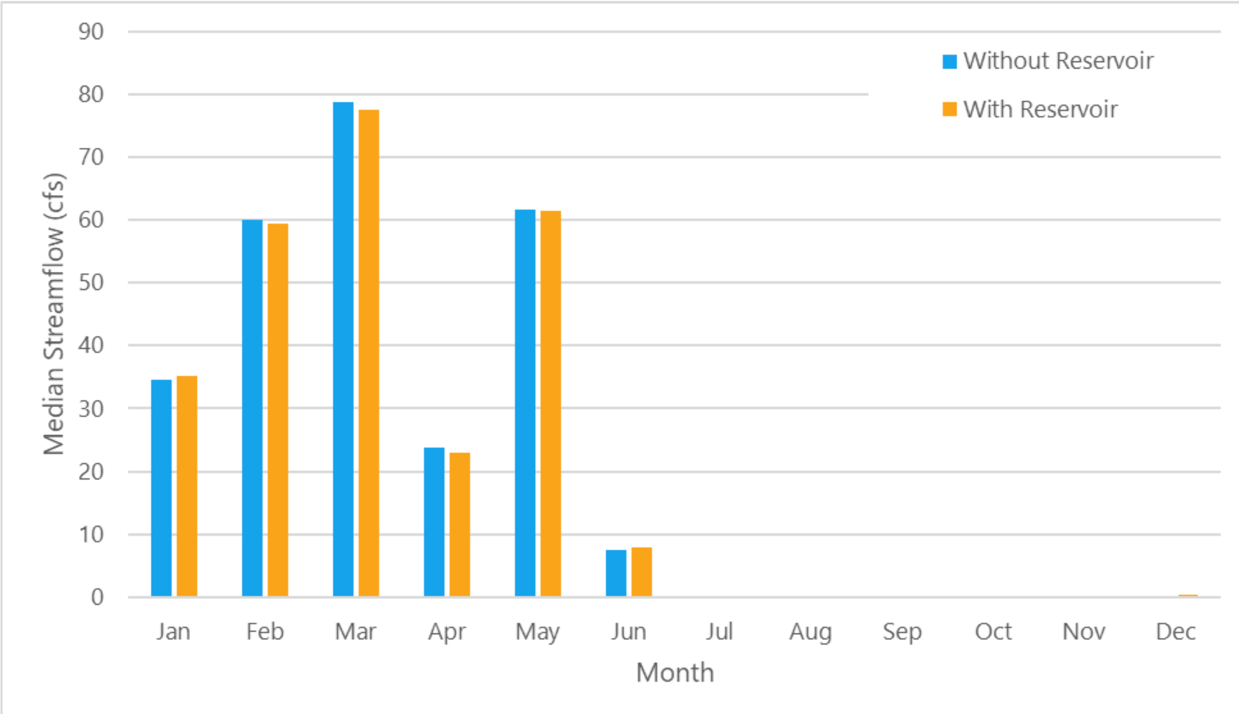
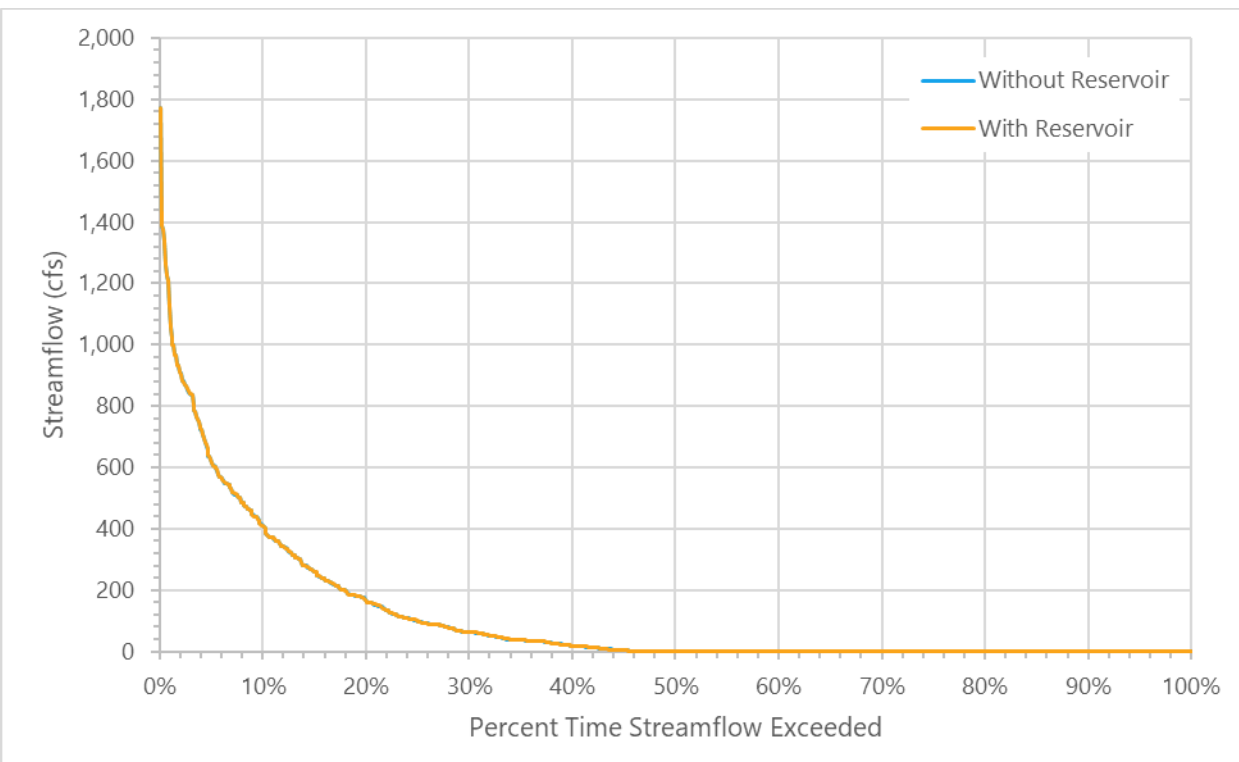


Figure 4.4-7 Navasota River Diversion- Streamflow Frequency Comparison



4.4.3 Environmental Issues

4.4.3.1 Existing Environment

The City of Groesbeck Off-Channel Reservoir site in Limestone County lies in the Blackland Prairies Vegetational Area.[2] This area is a rolling and well-dissected region that was historically a luxuriant tallgrass prairie dominated by little bluestem (*Schizachyrium scoparium var. frequens*), big bluestem (*Andropogon gerardii*), indiangrass (*Sorghastrum nutans*), and dropseeds (*Sporobolus sp.*). During the turn of the 20th century, the majority of the Blackland Prairie was cultivated for crops. Livestock production within this area has increased dramatically since the 1950s and now only about half of the area is used for cropland. Grazing pressure has caused an increase in grass species such as sideoats grama (*Bouteloua curtipendula*), hairy grama (*B. hirsuta*), Mead's sedge (*Carex meadii*), Texas Wintergrass (*Nassella leucotricha*) and buffalograss (*Buchloe dactyloides*). Common woody species of this area include mesquite (*Prosopis glandulosa*), huisache (*Acacia smallii*), oak (*Quercus sp.*) and elm (*Ulmus sp.*). Oak, elm, cottonwood (*Populus sp.*) and pecan are common larger tree species found along drainages in this area.

Based on vegetation types as defined by the Texas Parks and Wildlife Department (TPWD) the vegetation type that occurs within the project area is Elm-Hackberry Parks/ Woods.[3] Elm-Hackberry Parks/Woods could include the following commonly associated plants: mesquite (*Prosopis glandulosa*), post oak (*Quercus stellata*), woollybucket bumelia (*Sideroxylon lanuginosum*), honey locust (*Gleditsia triacanthos*), coralberry (*Symphoricarpos orbiculatus*), pasture haw (*Crataegus spathulata*), elbowbush (*Forestiera pubescens*), Texas pricklypear (*Opuntia engelmannii var. lindheimeri*), tasajillo (*Opuntia leptocaulis*), dewberry (*Rubus spp.*), silver bluestem (*Bothriochloa saccharoides*), buffalograss (*Buchloe dactyloides*), western ragweed (*Ambrosia cumanensis*), giant ragweed (*A. trifida*), goldenrod (*Solidago spp.*), frostweed (*Verbesina virginica*), ironweed (*Vernonia spp.*), prairie parsley (*Polytaenia nuttallii*), and broom snakeweed (*Gutierrezia sarothrae*). Variations of this primary type may occur based on changes in the composition of woody and herbaceous species and the physiognomy of localized conditions and specific range sites.

The average annual precipitation for Limestone County is almost thirty-eight inches, and the temperatures range from an average low of 37° F in January to an average high of 96° in July. The average growing season lasts 255 days.[4] No major or minor aquifer underlies the project area.[5]

Soil units found within the proposed off-channel reservoir area include Axtell fine sandy loam, 1 to 3 percent slopes, Edge fine sandy loam, 2 to 5 percent slopes, Kaufman clay, occasionally flooded, Lavender-Rock outcrop complex, Silawa fine sandy loam, 5 to 12 percent slopes and Whitesboro loam, frequently flooded. Of these six soil types only one, Kaufman clay, occasionally flooded is considered to be a prime farmland soil. This soil type is found within 49 acres or approximately 33.5 percent of the

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[2] Gould, F.W., G.O. Hoffman, and C.A. Rechenthin, Vegetational Areas of Texas, Texas A&M University, Texas Agriculture Experiment Station Leaflet No. 492, 1960.
[3] McMahan, C.A., R.F. Frye, and K.L. Brown, "The Vegetation Types of Texas Including Cropland," Texas Parks and Wildlife Department, Wildlife Division, Austin, Texas, 1984.
[4] Ellen Maschino, "LIMESTONE COUNTY," Handbook of Texas Online (http://www.tshaonline.org/handbook/online/articles/hcl09), accessed November 17, 2014.
[5] Texas Water Development Board (TWDB), *Major and Minor Aquifers of Texas*, Maps online at http://www.twdb.state.tx.us/mapping/index.asp, 2004.

project area. Current aerial photography of the OCR site shows agricultural activity in the eastern portion of the area.

4.4.3.2 Potential Impacts

Aquatic Environments including Bays & Estuaries

The potential impacts of this project were evaluated in two locations, at the proposed reservoir site and in the Navasota River where water will be pumped and diverted to the project site. The potential impacts of this project are very different in the two locations. In the diversion site on the Navasota River, minimal impacts are anticipated in terms of a reduction in variability or quantity of median monthly flows. But in the proposed project site, there would be a moderate reduction in variability and dramatic reductions in the quantity of median monthly flows. Variability in flow is important to the instream biological community as well as riparian species and a reduction could influence the timing and success of reproduction as well as modify the current composition of species by favoring some and reducing suitability for others.

In the Navasota River, non-negligible reductions in streamflow would occur in January through June and December, as shown in Table 4.4-1. All other months would have little or no reduction in median monthly flow at the diversion. Because low-flows occur frequently without the project in place, the addition of this project would have minimal impact on these low-flow conditions. At the Navasota River diversion site, the 85 percent exceedance values would be 0.015 cfs without the project and zero cfs with the project.

Table 4.4-1 Median Monthly Streamflow: Navasota River Diversion Site

Month	Without Project (cfs)	With Project (cfs)	Difference (cfs)	Percent Reduction
January	34.5	35.1	-0.6	-1.7%
February	60.1	59.4	0.7	1.2%
March	78.8	77.6	1.2	1.5%
April	23.8	22.9	0.9	3.8%
May	61.7	61.6	0.1	0.2%
June	7.4	7.9	-0.5	-6.8%
July	0.0	0.0	0.0	100%
August	0.0	0.0	0.0	100%
September	0.0	0.0	0.0	100%
October	0.0	0.0	0.0	100%
November	0. 0	0.0	0. 0	100%
December	0.2	0.4	-0.2	-100%

Although there would be impacts in the immediate vicinity of the project site and downstream, it appears that this project, alone, would have minimal influence on total discharge in the Navasota or Brazos Rivers, in which case there would be minimal influence on freshwater inflows to the Brazos River estuary. However, the cumulative impact of multiple projects may reduce freshwater inflows into the estuary. As a new reservoir without a current operating permit, the Groesbeck Reservoir would likely be required to meet environmental flow requirements determined by site-specific studies.

Threatened & Endangered Species

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD frequently updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Limestone County can be found at https://tpwd.texas.gov/gis/rtest/.

Data from the TPWD Texas Natural Diversity Database[6] did not reveal any documented occurrences of listed species within the vicinity of the proposed City of Groesbeck Off-Channel Reservoir. However these data are not a representative inventory of rare resources or sensitive sites. Although based on the best information available to TPWD, these data do not provide a definitive statement as to the presence, absence, or condition of special species, natural communities, or other significant features in the project area. On-site evaluations will be required by qualified biologists to confirm the occurrence of sensitive species or habitats. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

Wildlife Habitat

Approximately 146 acres are estimated to be inundated by the reservoir. Projected wildlife habitat that will be impacted includes approximately 21 acres of floodplain hardwood forest, 33 acres of floodplain herbaceous vegetation, 7 acres of riparian hardwood forest, 30 acres of post oak motte and woodland areas, 13 acres of savanna grassland, 43 acres of crops and less than one acre of urban low intensity area.[7] Siting of the raw water intake, pump station and raw water pipeline needed to complete the project should be situated in a way that would result in minimal impacts to existing aquatic and terrestrial species. Impacts from this portion of the project are anticipated to be low and primarily limited to construction of these facilities and subsequent maintenance activities.

A number of vertebrate species could occur within the City of Groesbeck Reservoir site including smaller mammals such as the hispid cotton rat (*Sigmodon hispidus*), white-footed mouse (*Peromyscus leucopus*), eastern gray squirrel (*Sciurus carolinensis*), and common muskrat (*Ondatra zibethicus*).[8] Reptiles and amphibians known from the county include the central newt (*Notophthalmus viridescens louisianensis*), Strecker's chorus frog (*Pseudacris streckeri*), red-eared slider (*Trachemys scripta elegans*), and western rough green snake (*Opheodrys aestivus aestivus*) among others.[9] An undetermined number of bird species and a variety of fish species would also be expected to inhabit the various habitat types within the site, with distributions and population densities limited by the types and quality of habitats available.

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[6] Texas Parks and Wildlife Department (TPWD), Texas Natural Diversity Database, 04/18/2019.
[7] Texas Parks and Wildlife. Ecological Mapping Sytem GIS layer. Accessed at http://www.tpwd.state.tx.us/gis/data/ November 18, 2014.
[8] Davis, William B. and David J. Schmidly. 1994. The Mammals of Texas. Texas Parks and Wildlife, Austin, Texas.
[9] Dixon, James R., Amphibians and Reptiles of Texas. 1987, Texas A&M Press.

Cultural Resources

Cultural resources that occur on public lands or within the Area of Potential Effect of publicly funded or permitted projects are governed by the Texas Antiquities Code (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (PL96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets provided by the Texas Historical Commission (THC) for the 2011 Regional Water Plan, there are no National Register Properties, National Register Districts, cemeteries, or historical markers located within the project area. Because the owner or controller of the project will likely be a political subdivision of the State of Texas (i.e., river authority, municipality, county, etc.), they will be required to coordinate with the Texas Historical Commission regarding potential impacts to cultural resources.

A search of the Texas Archeological Sites Atlas database indicates that 27 archeological sites have been documented within the general vicinity of the proposed reservoir. Fifteen of these sites were recorded by the Texas Parks and Wildlife Department as part of a survey of Fort Parker in 1994. While all of these sites lie outside the limits of the proposed reservoir, it is possible that similar unrecorded sites could occur within the project's Area of Potential Effect. These sites represent a variety of historic and prehistoric site types. Prior to reservoir inundation, the project must be coordinated with the Texas Historical Commission and a cultural resources survey must be conducted to determine if any cultural resources are present within the conservation pool. Any cultural resources identified during survey will need to be assessed for eligibility for inclusion in the National Register of Historic Places (NRHP) or as State Archeological Landmarks (SAL).

Threats to Natural Resources

Threats to natural resources include lower stream flows, declining water quality, and reduced inflows to reservoirs. This project would likely increase adverse effects on stream flow below the reservoir site, but the reservoir would trap sediment and/or dilute pollutants, providing some positive benefits to water quality downstream. These benefits could be offset by declines in dissolved oxygen through decreased flows and higher temperatures during summer periods. The project is expected to have negligible impacts to the stream flow and water quality in the Navasota and Brazos Rivers. No significant impacts to any listed threatened or endangered species is anticipated from this project.

Agricultural Impacts

The Groesbeck OCR site contains approximately 54 acres of Pasture/Hay fields and zero acres of cropland. These two agricultural land uses account for roughly 37 percent of the reservoir footprint.

4.4.4 Engineering and Costing

The potential off-channel reservoir project for the City of Groesbeck would require additional facilities to divert water from the Navasota River to the off-channel reservoir site. The facilities required for implementation of the project included:

- Raw water intake and pump station at the Navasota River diversion site with a capacity of 10.2 MGD;
- 3,500 feet of raw water pipeline (24-inch diameter) from the pump station to the off-channel reservoir;
- Pump station at the off-channel reservoir site with a capacity of 3 MGD;

- 3,500 feet of raw water pipeline (12-inch diameter) from the off-channel pump station to the water treatment plant; and
- Off-channel dam including spillway, intake tower, and 146 acres of land for the reservoir.

A summary of the total project cost is presented in . The proposed Groesbeck Off-Channel Reservoir project would cost approximately $35.3 million for surface water supply facilities. This includes the construction of the dam, land acquisition, resolution of conflicts, environmental permitting and mitigation, and technical services. The project cost also includes the cost for the raw water facilities to convey surface water from the Navasota River to the off-channel reservoir and back to the City's existing water treatment plant. The annual project costs are estimated to be $2.8 million. This includes annual debt service, operation and maintenance, and pumping energy costs. With an available project yield of 1,750 acft/yr, the cost of water per acft would be $1,624 ($4.98 per 1,000 gallons).

Table 4.4-2 Cost Estimate Summary for Groesbeck Off-Channel Reservoir

Item	Estimated Costs for Facilities
Dam and Reservoir (Conservation Pool 2317 acft, 146 acres)	$6,745,000
Intake Pump Stations (10.2 MGD)	$14,756,000
Transmission Pipeline (12-24 in. dia., 1.3 miles)	$1,985,000
Integration, Relocations, Backup Generator & Other	$101,000
TOTAL COST OF FACILITIES	**$23,587,000**
Engineering:	
- Planning (3%)	$708,000
- Design (7%)	$1,651,000
- Construction Engineering (1%)	$236,000
Legal Assistance (2%)	$472,000
Fiscal Services (2%)	$472,000
Pipeline Contingency (15%)	$298,000
All Other Facilities Contingency (20%)	$4,320,000
Environmental & Archaeology Studies and Mitigation	$1,192,000
Land Acquisition and Surveying (164 acres)	$1,234,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,108,000
TOTAL COST OF PROJECT	**$35,278,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,656,000
Reservoir Debt Service (3.5 percent, 40 years)	$545,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$21,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$369,000
Dam and Reservoir (1.5% of Cost of Facilities)	$101,000

Item	Estimated Costs for Facilities
Pumping Energy Costs (1662681 kW-hr @ 0.09 $/kW-hr)	$150,000
TOTAL ANNUAL COST	**$2,842,000**
Available Project Yield (acft/yr)	**1,750**
Annual Cost of Water ($ per acft), based on PF=1	**$1,624**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$366**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$4.98**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$1.12**
CB	*1/16/2025*

4.4.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 4.4-3, and the option meets each criterion.

Table 4.4-3 Evaluations of Coryell County Off-Channel Reservoir Option to Enhance Water Supplies

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. Reasonable (moderate to high)
B. Environmental factors	
1. Environmental Water Needs	1. Negligible impact
2. Habitat	2. Negligible impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Negligible impact
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Negligible impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

Implementation of the off-channel reservoir project for the City of Groesbeck will require permits from various state and federal agencies, land acquisition, and design and construction of the facilities. The project may also have an impact on the firm yield of Lake Limestone, which may require mitigation with the Brazos River Authority in terms of a water supply contract in the amount of the firm yield impact. A summary of the implementation steps for the project is presented below.

Potential Regulatory Requirements:

- Texas Commission on Environmental Quality Water Right and Storage permits;
- U.S. Army Corps of Engineers Permits will be required for discharges of dredge or fill into wetlands and waters of the U.S. for dam construction, and other activities (Section 404 of the Clean Water Act);
- Texas Commission on Environmental Quality administered Texas Pollutant Discharge Elimination System Storm Water Pollution Prevention Plan;
- General Land Office Easement if State-owned land or water is involved; and
- Texas Parks and Wildlife Department Sand, Shell, Gravel and Marl permit if state-owned streambed is involved.

State and Federal Permits may require the following studies and plans:

- Environmental impact or assessment studies;
- Wildlife habitat mitigation plan that may require acquisition and management of additional land;
- Flow releases downstream to maintain aquatic ecosystems;
- Assessment of impacts on Federal- and State-listed endangered and threatened species;
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction. Cultural resources studies to determine resources impacts and appropriate mitigation plan that may include cultural resource recovery and cataloging; requires coordination with the Texas Historical Commission; and

Land Acquisition Issues:

- Land acquired for reservoir and/or mitigation plans could include market transactions and/or eminent domain;
- Additional acquisition of rights-of-way and/or easements may be required; and
- Possible relocations or removal of residences, utilities, roads, or other structures.

4.5 NCTMWA Lake Creek Reservoir (formerly Millers Creek Off-Channel Reservoir)

4.5.1 Description of Option

A potentially feasible water management strategy for North Central Texas Municipal Water Authority (NCTMWA) is a new reservoir located on Lake Creek in the southeast corner of Knox County as shown in Figure 4.7-1. The proposed Lake Creek diversion site for the Millers Creek Augmentation WMS is shown in Figure 4.7-1 for comparison purposes.

The proposed NCTMWA Lake Creek Reservoir, also known as the Millers Creek Off-Channel Reservoir, will contain approximately 58,560 acft of conservation storage and inundate 2,866 acres at the conservation pool elevation of 1,400 ft-msl. The reservoir would impound Lake Creek streamflow and diversions from the Brazos River. Almost all of the streamflow originating in Lake Creek must be passed downstream for senior water rights at Possum Kingdom Reservoir. A subordination agreement with the BRA regarding Possum Kingdom Reservoir would allow for these inflows to be impounded by the NCTMWA Lake Creek Reservoir, thus significantly increasing the yield of the project. Currently, BRA indicates that no subordination agreement is likely to be possible.

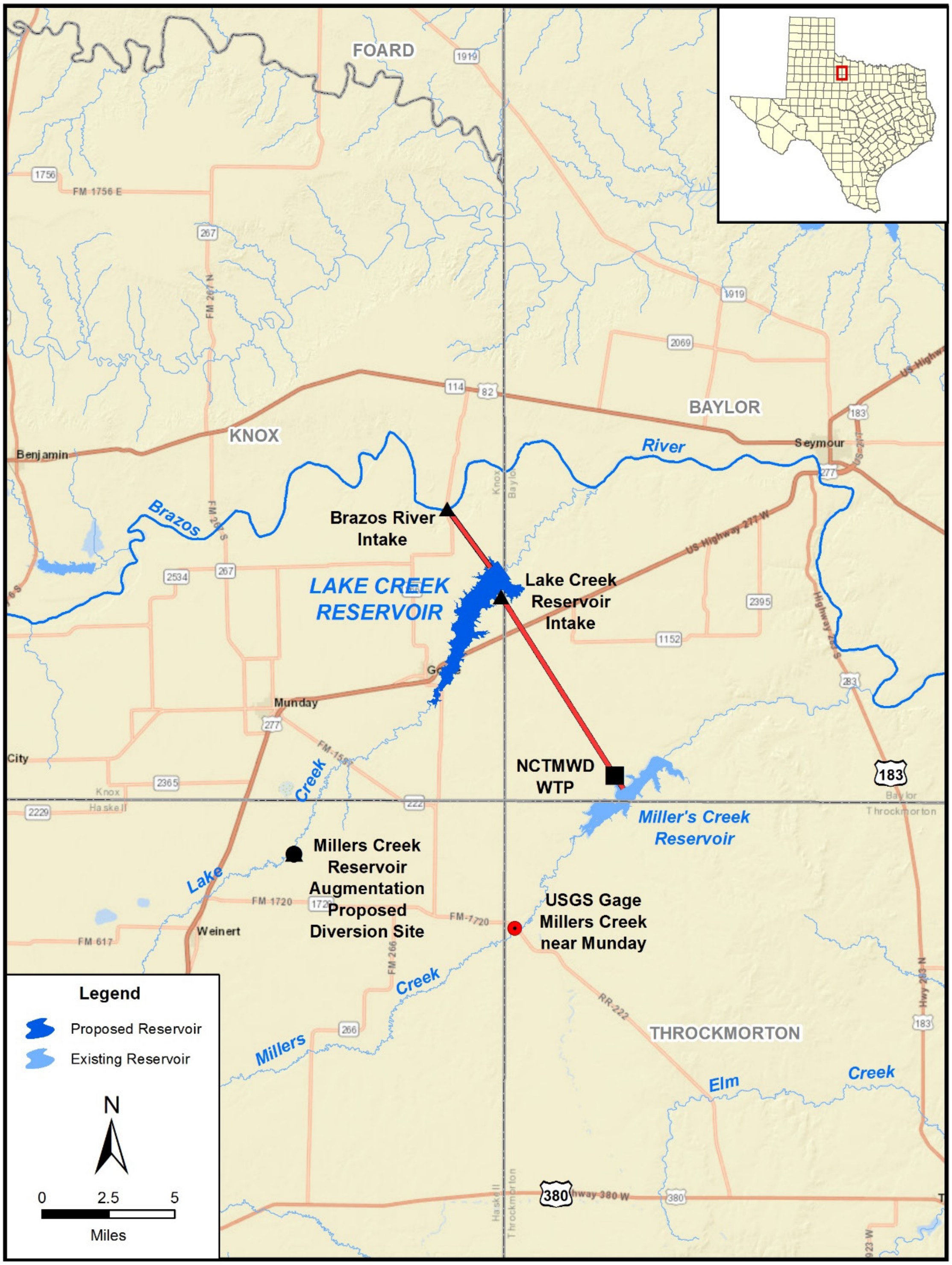
Diversions from the Brazos River would be transported through a 3-mile, 120-in pipeline to the reservoir for impoundment. Due to water quality concerns in the main stem of the Brazos River, diversions would only occur during flood flow periods. However, a significant portion of the available streamflow during high flow periods is now appropriated by BRA under the System Operations permit. As a result, a contract with BRA for non-firm system water during these high flow periods is necessary for adequate supplies to be diverted from the Brazos River for impoundment in NCTMWA Lake Creek Reservoir.

Stored water in the reservoir would be transported to the NCTMWA WTP or Millers Creek Reservoir via an 8-mile, 30-in pipeline. NCTMWA would have the operational flexibility to treat the supplies or discharge the raw water into Millers Creek Reservoir if storage is available. A 12.1 MGD expansion of the WTP would also be required to treat the additional raw water supplied by the project.

4.5.2 Available Yield

Water potentially available for impoundment in the proposed NCTMWA Lake Creek Reservoir was estimated using the TCEQ Brazos WAM Run 3 which assumes no return flows and permitted storages and diversions for all water rights in the basin. The model utilizes a January 1940 through December 2018 hydrologic period of record and includes

Figure 4.5-1 NCTMWA Lake Creek Reservoir



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TCEQ environmental flow standards. The model computed the streamflow available for impoundment with Possum Kingdom Reservoir subordination and diversions from the Brazos River without causing increased shortages to existing downstream rights.

The calculated firm yield of the NCTMWA Lake Creek Reservoir project is 6,090 acft/yr. Figure 4.7-2 provides the individual contributions to the total firm yield from junior reservoir impoundments, the Possum Kingdom subordination and the Brazos River diversions. The project would not provide 280 acft/yr of firm supplies without the subordination agreement or Brazos River diversions. The Possum Kingdom Subordination provides the greatest contribution to the firm yield (3,860 acft/yr). The subordination agreement would result in a 540 acft/yr yield impact to Possum Kingdom Reservoir.

Figure 4.7-3 provides the annual volumes of reservoir impoundments and Brazos River diversion for the model simulation period.

Figure 4.5-2 NCTMWA Lake Creek Reservoir Firm Yield Components

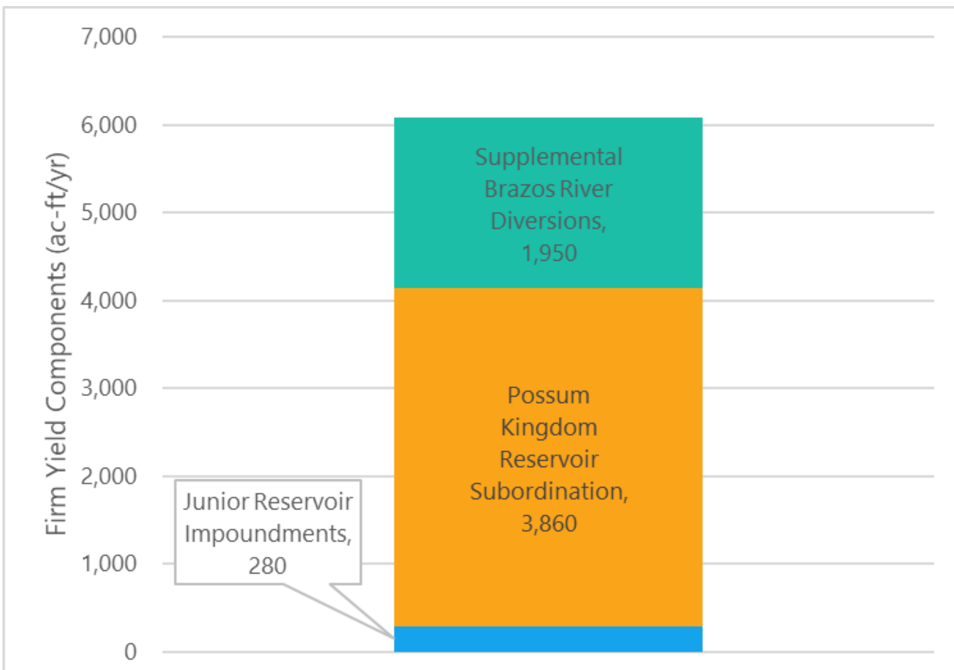


Figure 4.5-3 Annual NCTMWA Lake Creek Impoundments and Brazos River Diversions

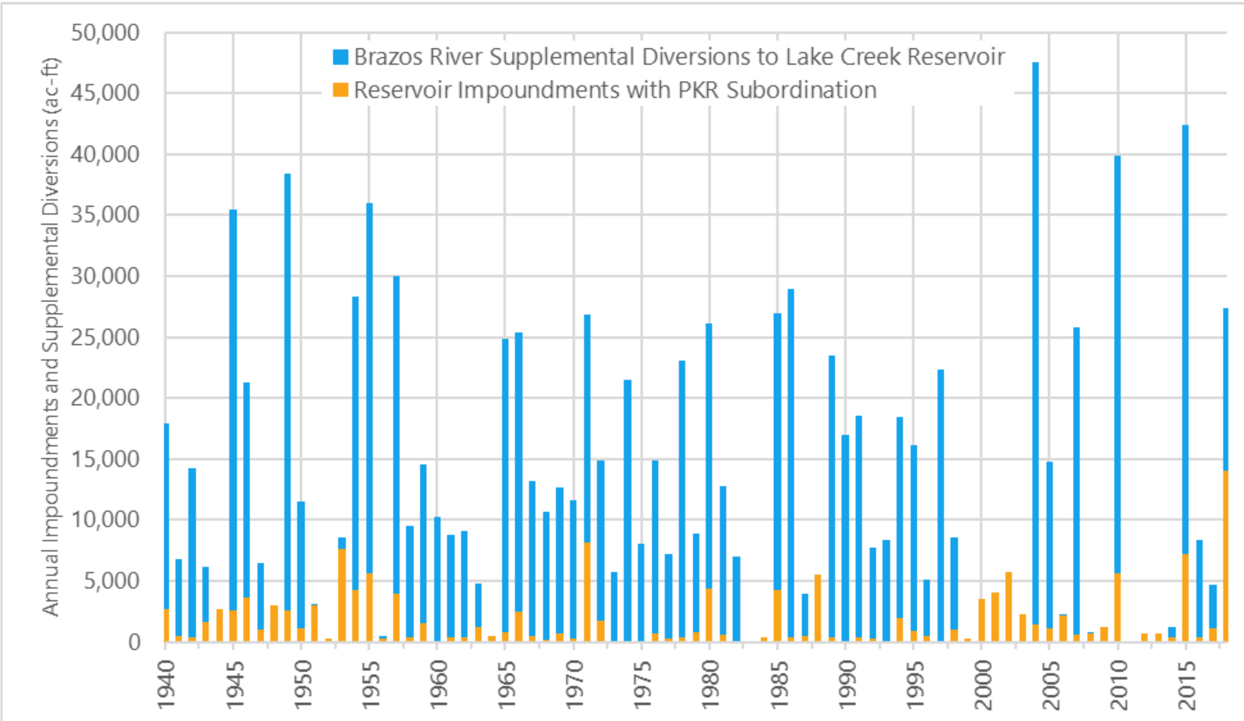


Figure 4.7-4 illustrates the storage trace of NCTMWA Lake Creek Reservoir for the 79-year model simulation period under the firm yield demand of 6,060 acft/yr. Figure 4.7-5 provides a frequency of the storage in NCTMWA Lake Creek Reservoir under the firm yield demand. The storage frequency reveals that the reservoir remains full about 10 percent of the time and over half full approximately 85 percent of the time.

Figure 4.7-6 presents the monthly changes in the Lake Creek median streamflow values from reservoir impoundments. Even though the reservoir would only be able to impound flows in excess of that required for downstream senior water rights and environmental needs, median streamflow values are reduced to zero for all months.

Figure 4.7-7 compares the existing Lake Creek streamflow frequency characteristics without the project to simulated streamflow characteristics with NCTMWA Lake Creek Reservoir in place. For times when flows are less than the upper quartile, there are minimal reductions from the project because streamflows without the project are less than 6 cfs. There is a more pronounced reduction in streamflows during periods when flows are in the upper quartile because the reservoir has more frequent opportunities to impound significant streamflows.

Figure 4.7-8 and Figure 4.7-9 provide similar median streamflow statistics and streamflow frequency for the Brazos River at the diversion site. The figures reveal that the greatest reduction in streamflows occurs during the months of May and June when flood flows typically occur the most.

Figure 4.5-4 NCTMWA Lake Creek Reservoir Firm Yield Storage Trace

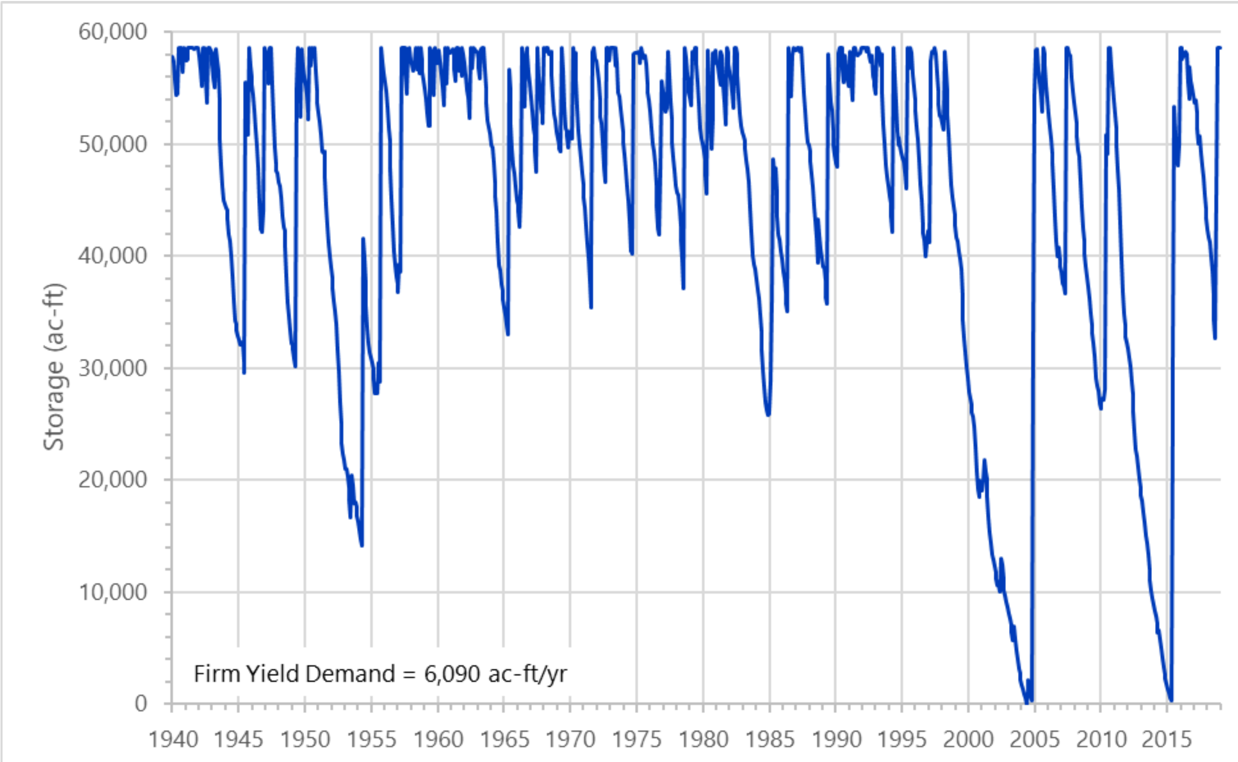


Figure 4.5-5 NCTMWA Lake Creek Reservoir Firm Yield Storage Frequency

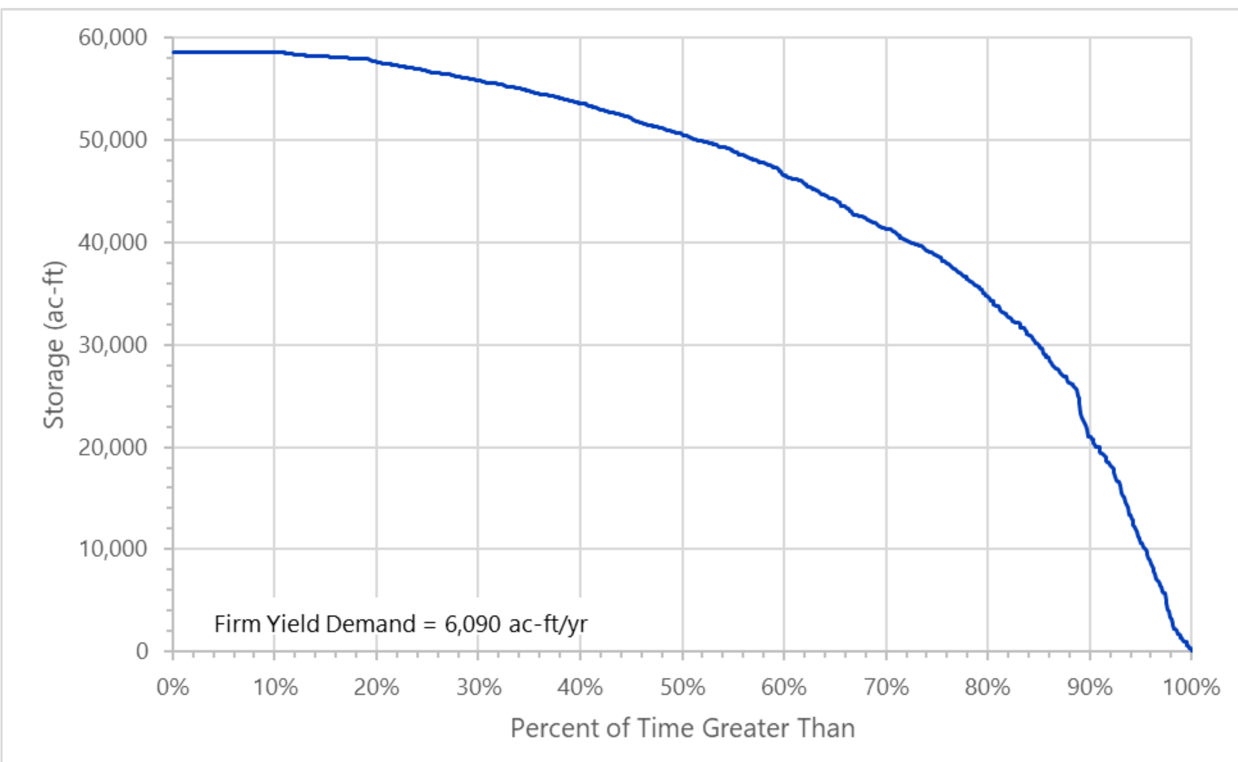


Figure 4.5-6 Lake Creek Median Streamflow Comparison

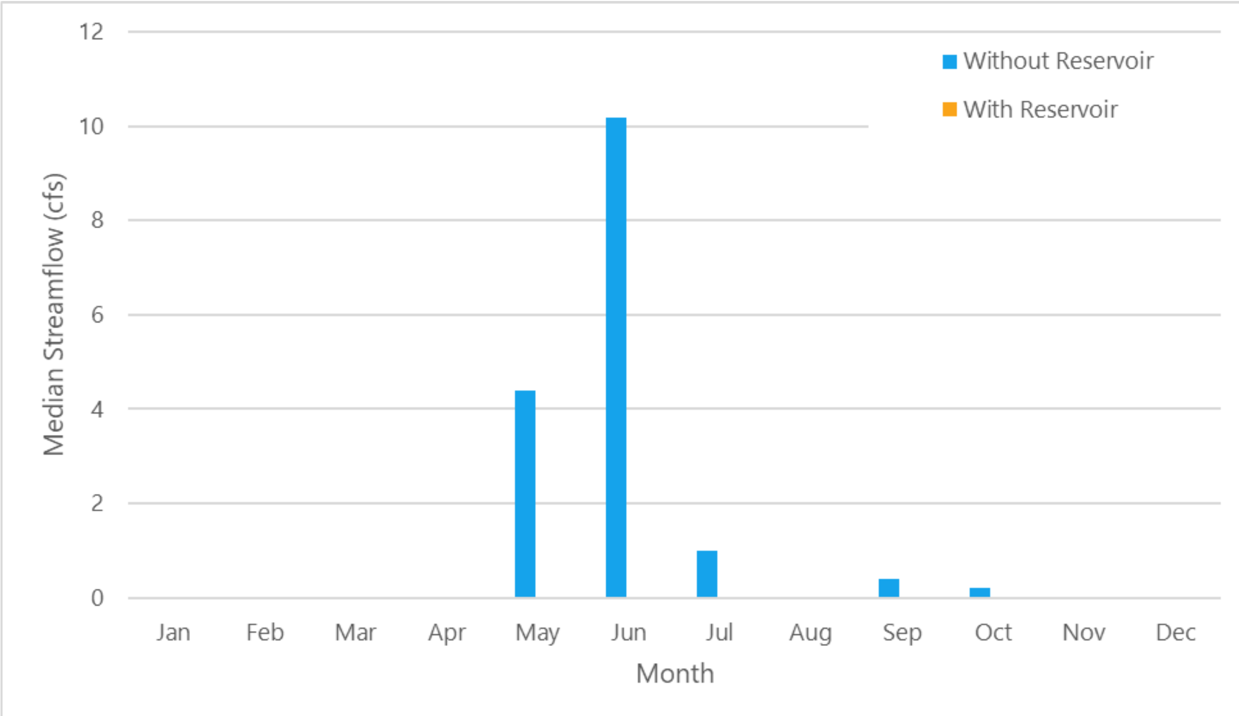


Figure 4.5-7 Lake Creek Streamflow Frequency Comparison

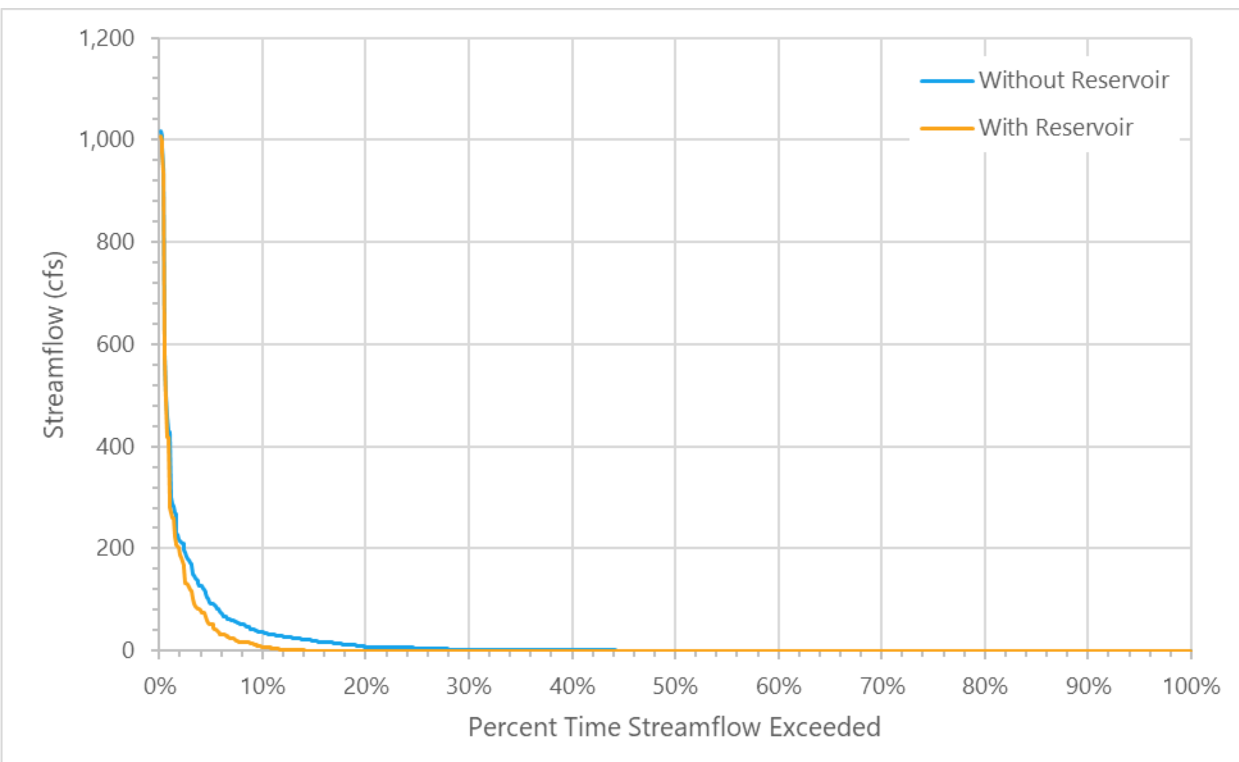


Figure 4.5-8 Brazos River Diversion Median Streamflow Comparison

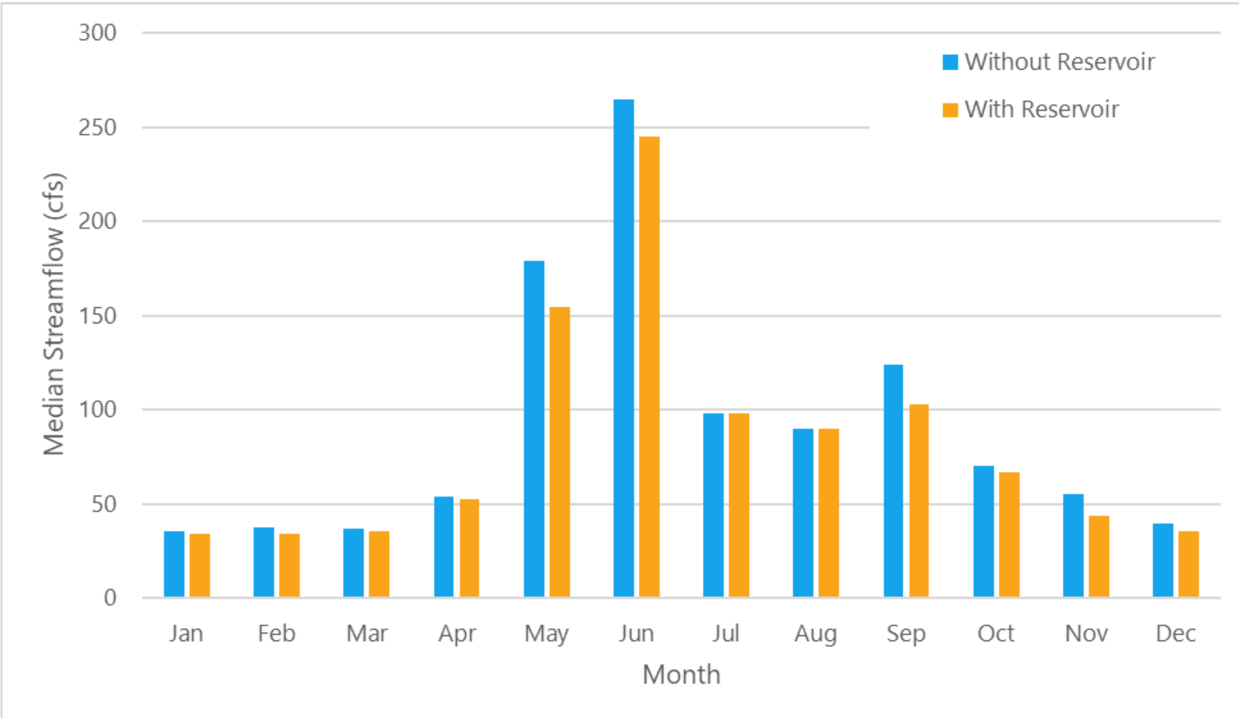
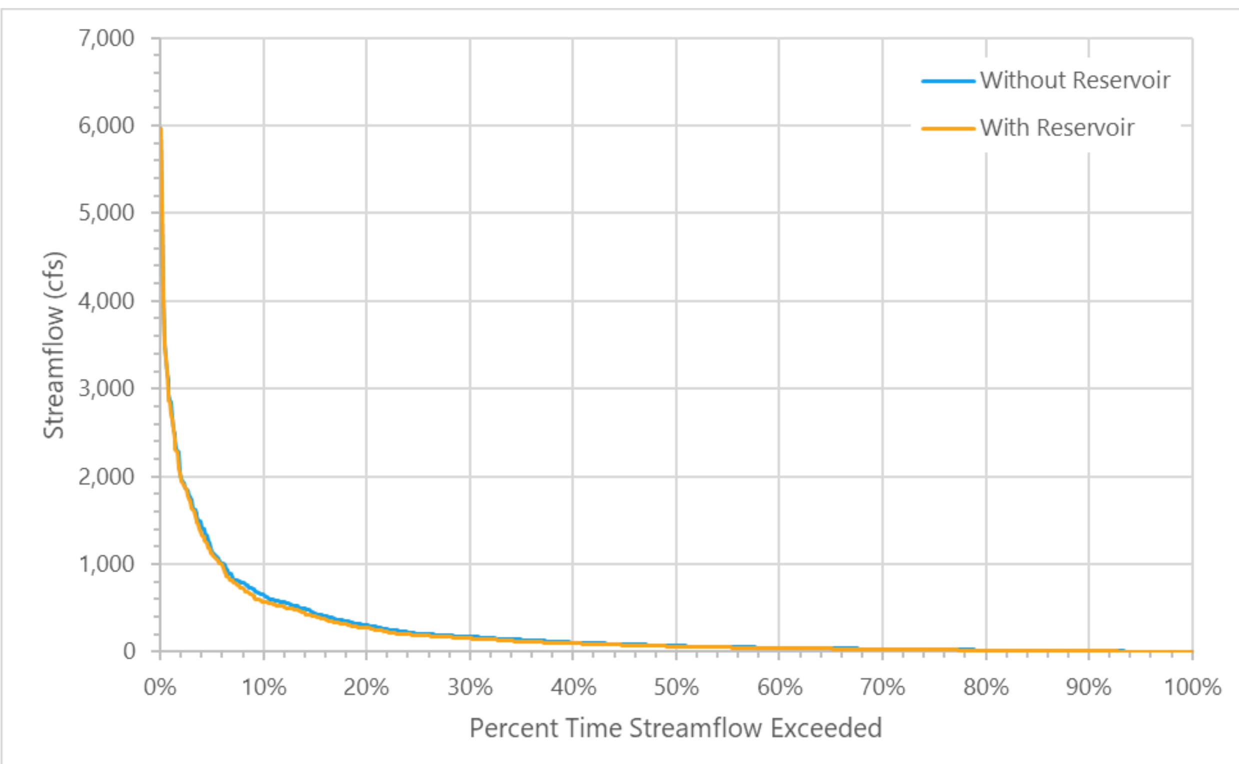


Figure 4.5-9 Brazos River Diversion Streamflow Frequency Comparison



4.5.3 Environmental Issues

The proposed NCTMWA Lake Creek Reservoir (LCR) project will consist of three components. These include: 1) an on-channel reservoir on Lake Creek, 2) an intake and pump station at the Brazos River and associated pipeline to NCTMWA Lake Creek Reservoir to provide supplemental diversions to the reservoir, and 3) an intake and pipeline from NCTMWA Lake Creek Reservoir to the existing water treatment plant (WTP) located near Millers Creek Reservoir which will be expanded.

The proposed project would occur in the Central Great Plains Ecoregion of Texas. The majority of this ecoregion is now cropland, but once included either grassland or a mixed transitional prairie. The project area includes two major vegetation types as defined by Texas Parks and Wildlife (TPWD), the majority type includes crops, however smaller portions of Mesquite/Saltcedar Brush/Woods occur along the margins of rivers and other drainages. Plants commonly found within the Mesquite/Saltcedar Brush/Woods vegetation type include Creosotebush (*Larrea tridentata*), cottonwood (*Populus* ssp.), desert willow (*Chilopsis linearis*), common buttonbush (*Cephalanthus occidentalis*), whitethorn acacia (Acacia constricta), lotebush (Ziziphus obtusifolia), Johnsongrass (*Sorghum halepense*), bushy bluestem (*Andropogon glomeratus*), and Mexican devil-weed (*Leucosyris spinosa*).

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Baylor and Knox counties can be found at https://tpwd.texas.gov/gis/rtest/.

Two fish species, the sharpnose shiner (*Notropis oxyrhynchus*) and smalleye shiner (*Notropis buccula*) are listed as endangered by the USFWS. These two minnows are native to the arid prairie streams of Texas and are considered to be in danger of extinction. The USFWS has designated approximately 623 miles of the Upper Brazos River Basin and the upland areas extending beyond the river channel by 98 feet on each side as critical habitat for these two fish. These areas occur within the counties of Baylor, Crosby, Fisher, Garza, Haskell, Kent, King, Knox, Stonewall, Throckmorton and Young. In addition, TPWD has identified a number of stream segments throughout the state as ecologically significant on the basis of biological function, hydrologic function, riparian conservation, exceptional aquatic life uses, and/or threatened or endangered species. The segment of the Brazos River, located within the project area, is listed by TPWD as an Ecologically Significant River and Stream Segment.

Potential impacts to these species could occur from the construction and operation of the intake and pump station proposed along the Brazos River intended to provide supplemental diversion to NCTMWA Lake Creek Reservoir. Appropriate site selection and screening technology must be considered during the project system design as part of the overall effort to avoid or minimize potential impacts to aquatic species. Coordination with USFWS would be required for listed species within the project area.

Construction of the water transmission pipelines located between the Brazos River and LCR and from LCR to the WTP near Millers Creek Reservoir would include the clearing and removal of woody vegetation. Surveys for protected species should be conducted within the proposed construction corridors where preliminary evidence indicates their existence. State threatened species, including the Texas horned lizard (*Phrynosoma cornutum*), and Brazos water snake (*Nerodia harteri*) are dependent on shrubland or riparian habitat. Because the majority of pipeline construction will occur in previously disturbed areas such as croplands the destruction of potential habitat utilized by terrestrial species will be minimized.

Although suitable habitat for several state threatened species may exist within the project area, no significant impact to these species is anticipated due to limited area that will be impacted by the project, the abundance of similar habit nearby and these species ability to relocate to those areas if necessary. The presence or absence of potential habitat does not confirm the presence or absence of a listed species. No species-specific surveys were conducted in the project area for this report.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets provided by the Texas Historical Commission (THC), there are no National Register Properties, National Register Districts, cemeteries, or historical markers located within the project area. However, there is a high probability for undocumented significant cultural resources to occur within the alluvial deposits and terrace formations associated with waterways, specifically the intermittent and perennial aquatic resources. A review of archaeological resources in the proposed project area should be conducted during the project planning phase.

Specific project features, such as pump stations, and pipelines generally have sufficient design flexibility to avoid most impacts or significantly mitigate potential impacts to geographically limited environmental and cultural resource sites. Field surveys conducted at the appropriate phase of development should be employed to minimize the impacts of project construction and operations on sensitive resources.

Taking into consideration that the owner or controller of the project will likely be a political subdivision of the State of Texas (i.e., river authority, municipality, county, etc.), they will be required to coordinate with the THC regarding impacts to cultural resources. The project sponsor will also be required to coordinate with the U.S. Army Corps of Engineers regarding any impacts to waters of the United States or wetlands.

4.5.3.1 Agricultural Impacts

The NCTMWA Lake Creek Reservoir site contains approximately zero acres of Pasture/Hay fields and 203 acres of cropland. These two agricultural land uses account for roughly seven percent of the reservoir footprint.

4.5.4 Engineering and Costing

In addition to the new reservoir, the potential NCTMWA Lake Creek Reservoir project for NCTMWA would require additional facilities to divert water from the Brazos River to the reservoir Site on Lake Creek and from the reservoir to the water treatment plant at Millers Creek Reservoir. The facilities required for implementation of the project include:

- A raw water intake and pump station at the Brazos River diversion site with a capacity of 400 cfs (258 MGD);

- 3-mile, 120-inch pipeline from the pump station to the NCTMWA Lake Creek Reservoir;
- On-channel dam including spillway, intake tower, and 2,866 acres of land for the reservoir;
- 12.1 MGD intake and pump station at NCTMWA Lake Creek Reservoir;
- 8-mile, 30-in pipeline to NTMWD WTP and Millers Creek Reservoir; and
- 12.1 MGD expansion of the NTMWD WTP.

A summary of the total project cost in September 2023 dollars is presented in Table 4.7-1. The estimated total project cost for the proposed NCTMWA Lake Creek Reservoir project is $236.0 million. This cost includes land acquisition, resolution of conflicts, environmental permitting and mitigation, and technical services. The annual project costs are estimated to be $19.7 million. This includes annual debt service, operation and maintenance, pumping energy costs, and purchase of firm and non-firm water from BRA. The off-channel reservoir project will be able to provide treated water at a unit cost of $3,227 per acft or $9.90 per 1,000 gallons.

Table 4.5-1 Cost Estimate for NCTMWA Lake Creek Reservoir

Cost Estimate Summary Water Supply Project Option September 2023 Prices NCTMWD - Lake Creek Reservoir Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Dam and Reservoir (Conservation Pool acft, acres)	$241,000
Off-Channel Storage/Ring Dike (Conservation Pool 29280 acft, 1433 acres)	$42,063,000
Intake Pump Stations (54.4 MGD)	$66,391,000
Transmission Pipeline (20-60 in. dia., 10.7 miles)	$29,738,000
Water Treatment Plant (6.1 MGD)	$19,470,000
Integration, Relocations, Backup Generator & Other	$173,000
TOTAL COST OF FACILITIES	**$158,076,000**
Planning (3%)	$4,742,000
Design (7%)	$11,065,000
Construction Engineering (1%)	$1,581,000
Legal Assistance (2%)	$3,162,000
Fiscal Services (2%)	$3,162,000
Pipeline Contingency (15%)	$4,461,000
All Other Facilities Contingency (20%)	$25,668,000
Environmental & Archaeology Studies and Mitigation	$4,876,000
Land Acquisition and Surveying (1511 acres)	$4,870,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$14,409,000
TOTAL COST OF PROJECT	**$236,072,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$11,672,000
Reservoir Debt Service (3.5 percent, 40 years)	$3,286,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$299,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$1,660,000
Dam and Reservoir (1.5% of Cost of Facilities)	$635,000
Water Treatment Plant	$1,396,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (2842210 kW-hr @ 0.09 $/kW-hr)	$256,000
Purchase of Water (4505 acft/yr @ 99.5 $/acft)	$448,000
TOTAL ANNUAL COST	**$19,652,000**
Available Project Yield (acft/yr)	6,090
Annual Cost of Water ($ per acft), based on PF=10	$3,227
Annual Cost of Water After Debt Service ($ per acft), based on PF=10	$771

Cost Estimate Summary Water Supply Project Option September 2023 Prices NCTMWD - Lake Creek Reservoir Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Annual Cost of Water ($ per 1,000 gallons), based on PF=10	$9.90
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=10	$2.37
Note: One or more cost element has been calculated externally.	
CJM	*1/19/2025*

4.5.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 4.5-2, and the option meets each criterion.

Table 4.5-2 Comparison of NCTMWA Lake Creek Reservoir Project to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. Reasonable to High
B. Environmental factors	
1. Environmental Water Needs	1. Moderate impact
2. Habitat	2. High impact
3. Cultural Resources	3. High impact
4. Bays and Estuaries	4. Low impact due to distance from coast
5. Threatened and Endangered Species	5. Possible moderate impact
6. Wetlands	6. Low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	Potential impact on bottomland farms and habitat in reservoir area
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	None
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

Implementation of the reservoir project will require permits from various state and federal agencies, land acquisition, and design and construction of the facilities. The project may also have an impact on the firm yield of Possum Kingdom, which may require mitigation with the Brazos River Authority in terms of a water supply contract in the amount of the firm yield impact. A summary of the implementation steps for the project is presented below.

Potential Regulatory Requirements

- Texas Commission on Environmental Quality Water Right and Storage permits;
- U.S. Army Corps of Engineers Permits will be required for discharges of dredge or fill into wetlands and waters of the U.S. for dam construction, and other activities (Section 404 of the Clean Water Act);
- Texas Commission on Environmental Quality administered Texas Pollutant Discharge Elimination System Storm Water Pollution Prevention Plan;
- Texas General Land Office Easement if State-owned land or water is involved; and
- Texas Parks and Wildlife Department Sand, Shell, Gravel and Marl permit if state-owned streambed is involved.

State and Federal Permits may require the following studies and plans

- Environmental impact or assessment studies;
- Wildlife habitat mitigation plan that may require acquisition and management of additional land;
- Flow releases downstream to maintain aquatic ecosystems;
- Assessment of impacts on Federal- and State-listed endangered and threatened species;
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.
- Cultural resources studies to determine resources impacts and appropriate mitigation plan that may include cultural resource recovery and cataloging; requires coordination with the Texas Historical Commission; and

Land Acquisition Issues

- Land acquired for reservoir and/or mitigation plans could include market transactions or other local landowner agreements;
- Additional acquisition of rights-of-way and/or easements may be required; and
- Possible relocations or removal of residences, utilities, roads, or other structures.

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4.6 New Throckmorton Reservoir

4.6.1 Description of Option

A potential water management strategy for the City of Throckmorton is a new reservoir located approximately 3 miles northwest of the city as shown in Figure 4.6-1. The proposed reservoir will be located on the North Elm Creek and will contain approximately 15,900 acft of conservation storage and inundate 1,161 acres at the full conservation storage level of 1,345 ft-msl. The contributing drainage area is approximately 82 square miles.

4.6.2 Available Yield

Water potentially available for impoundment in the proposed New Throckmorton Reservoir was estimated using the TCEQ Brazos WAM Run 3. The model includes a January 1940 through December 2018 hydrologic period of record and computes streamflow available from North Elm Creek without causing increased shortages to existing downstream rights. The safe yield of the project was computed subject to the reservoir and North Elm Creek diversion having to pass inflows to meet TCEQ environmental flow standards.

This strategy would require a subordination agreement with BRA for Possum Kingdom Reservoir. The calculated safe yield of New Throckmorton Reservoir is 1,280 acft/yr, assuming subordination of Possum Kingdom Reservoir. The estimated impact to the Possum Kingdom firm yield from the subordination is 80 acft/yr. Currently, BRA indicates that no subordination agreement is likely to be possible.

Figure 4.6-2 illustrates the simulated New Throckmorton Reservoir storage levels for the 1940 to 2018 historical period, subject to the safe yield of 1,280 acft/yr. Figure 4.6-3 shows that simulated reservoir contents remain above 80 percent capacity about 76 percent of the time and above 50 percent capacity above 95 percent of the time. Figure 4.6-4 illustrates the changes in North Elm Fork streamflows caused by impounding unappropriated water. Median streamflow would be reduced to near zero in all months from implementation of the project. The largest changes would be declines in median streamflow of 9.1 cfs during May and 16 cfs during June. Figure 4.6-5 also illustrates the North Elm Creek streamflow frequency characteristics with New Throckmorton Reservoir in place.

Figure 4.6-1 New Throckmorton Reservoir

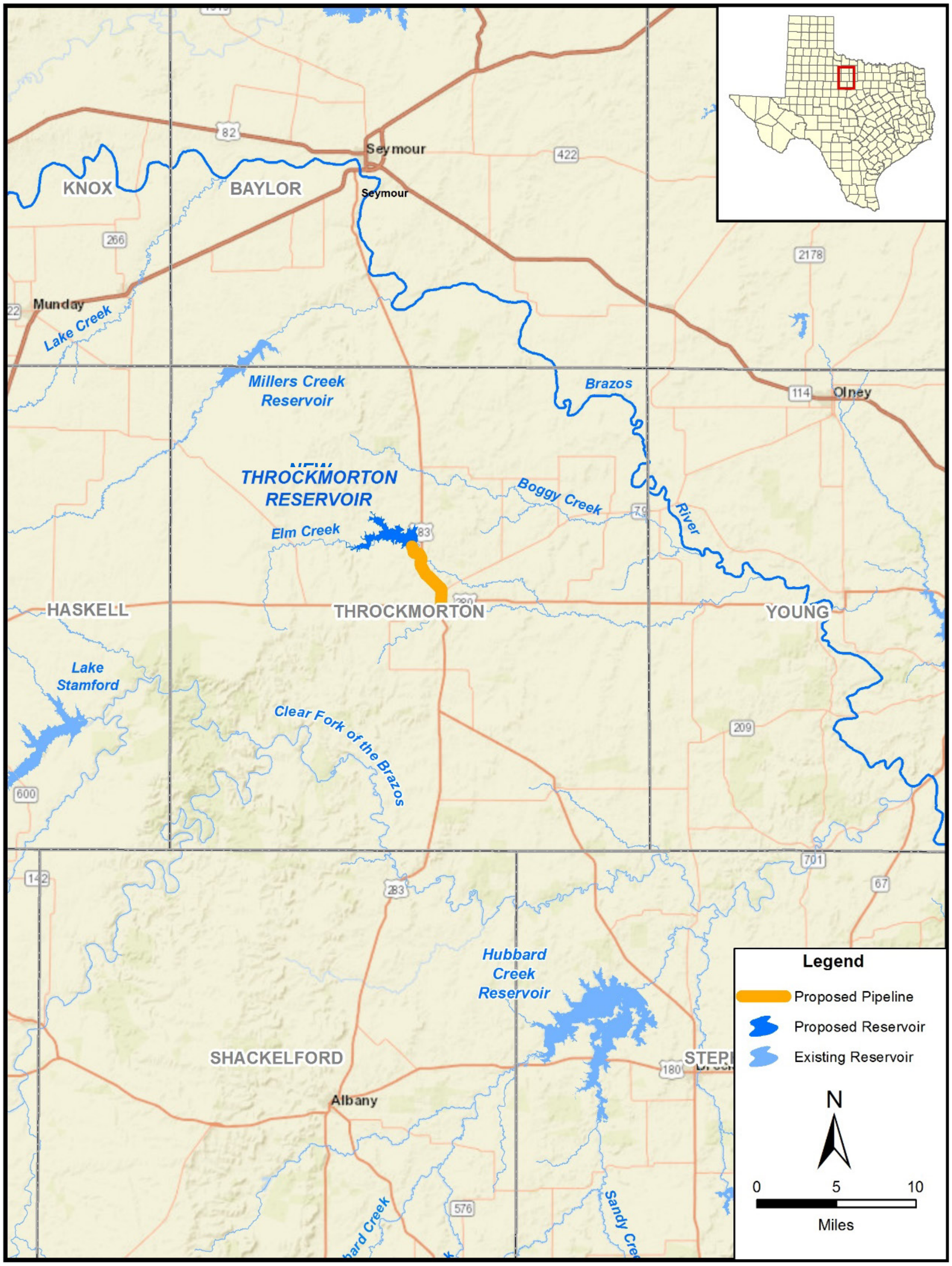

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Figure 4.6-2 New Throckmorton Reservoir Firm Yield Storage Trace

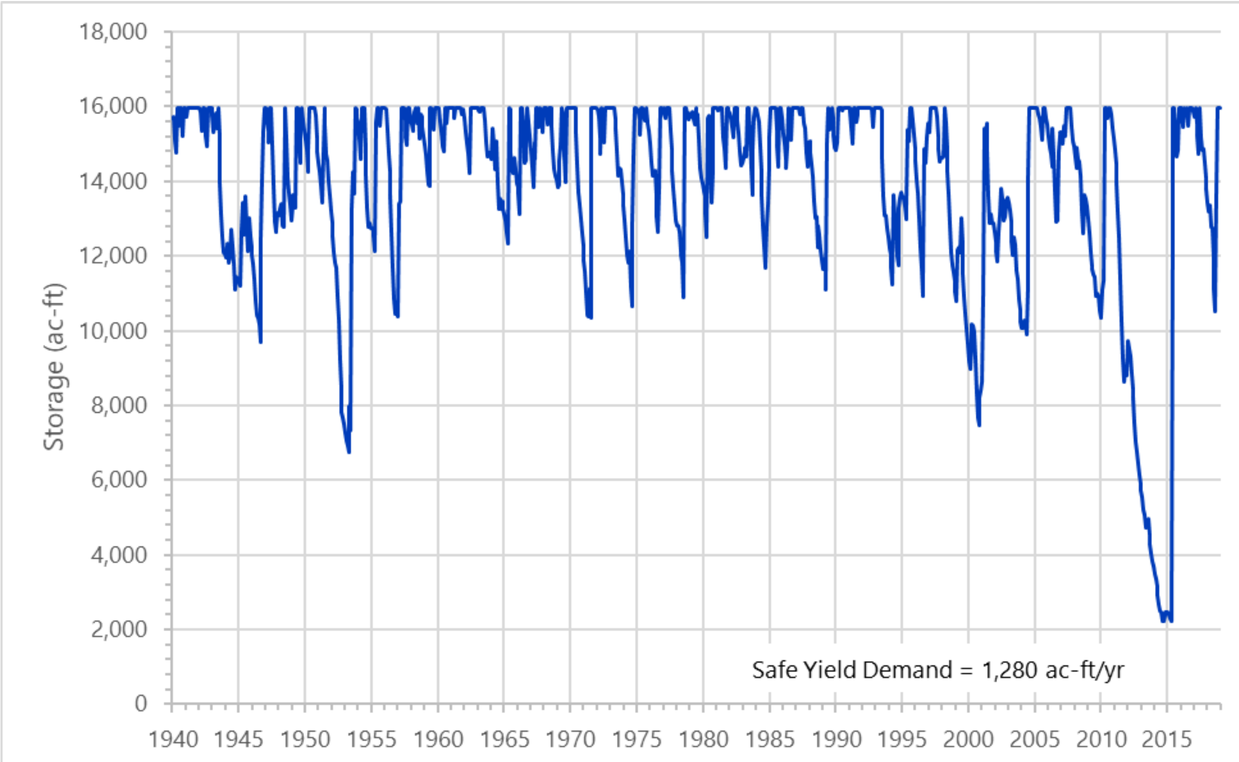


Figure 4.6-3 New Throckmorton Reservoir Storage Frequency at Safe Yield

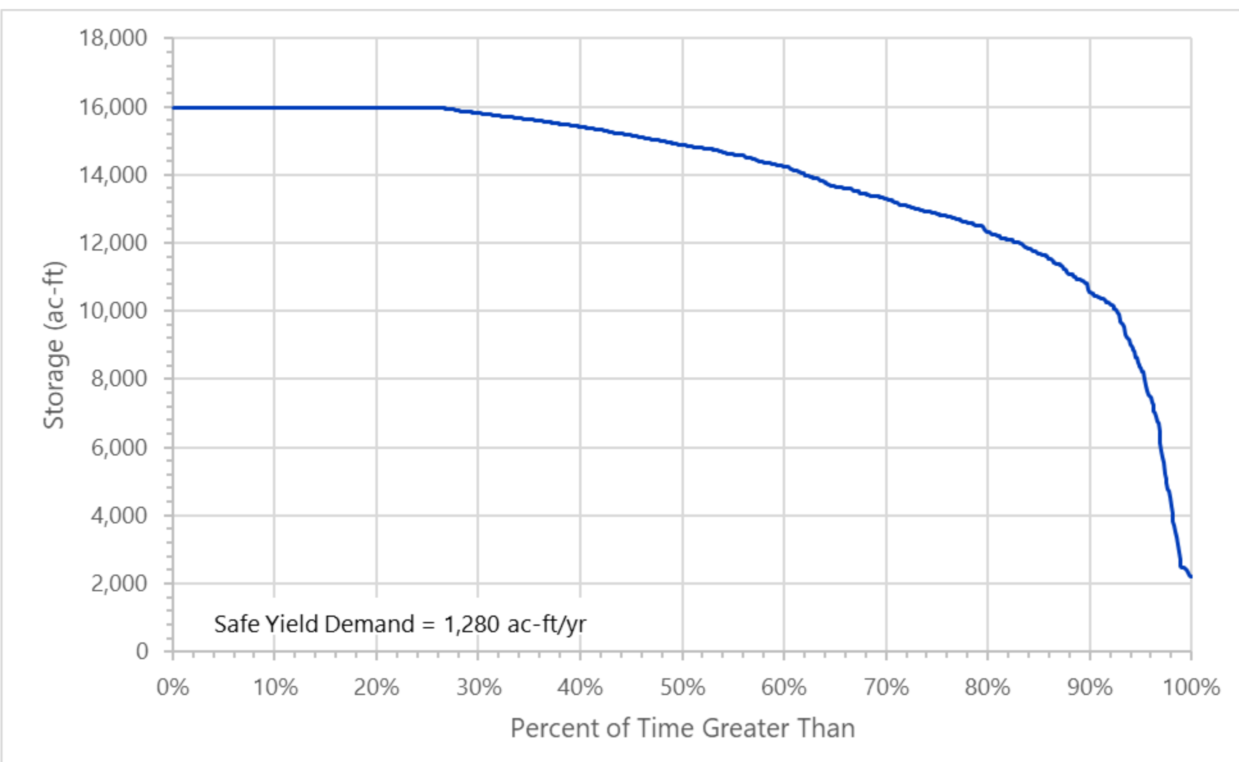


Figure 4.6-4 North Elm Fork Diversion - Median Streamflow Comparison

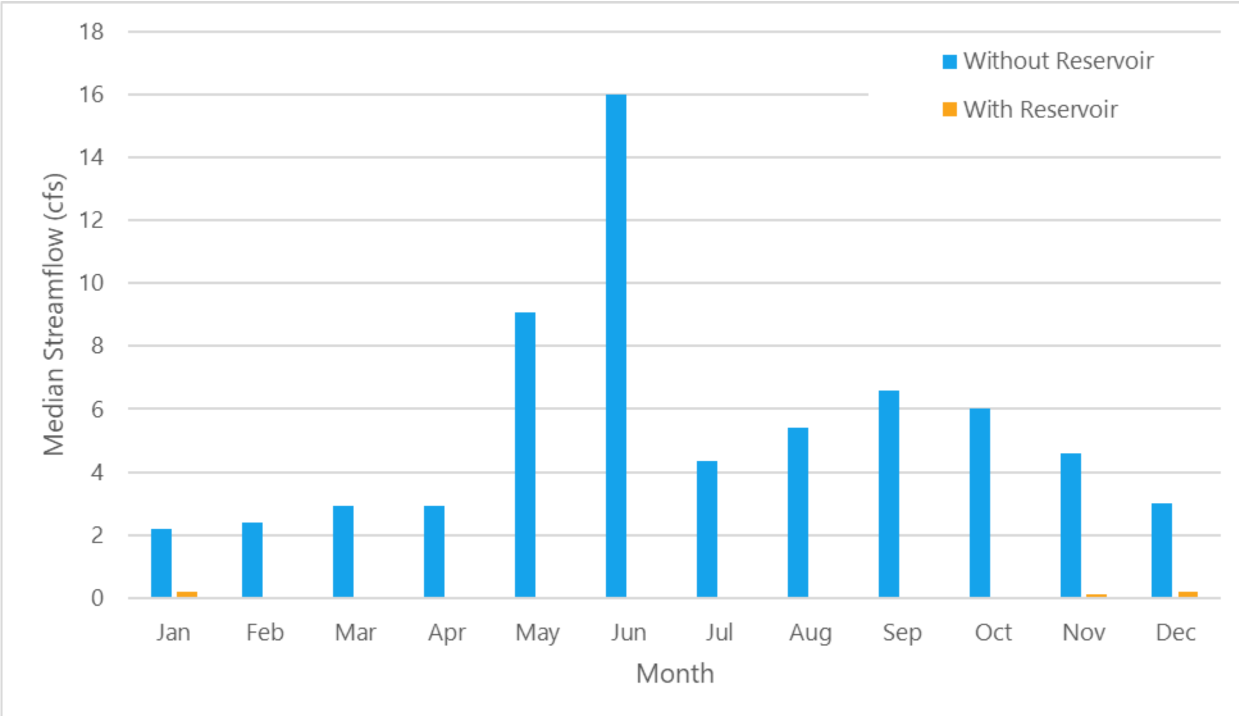
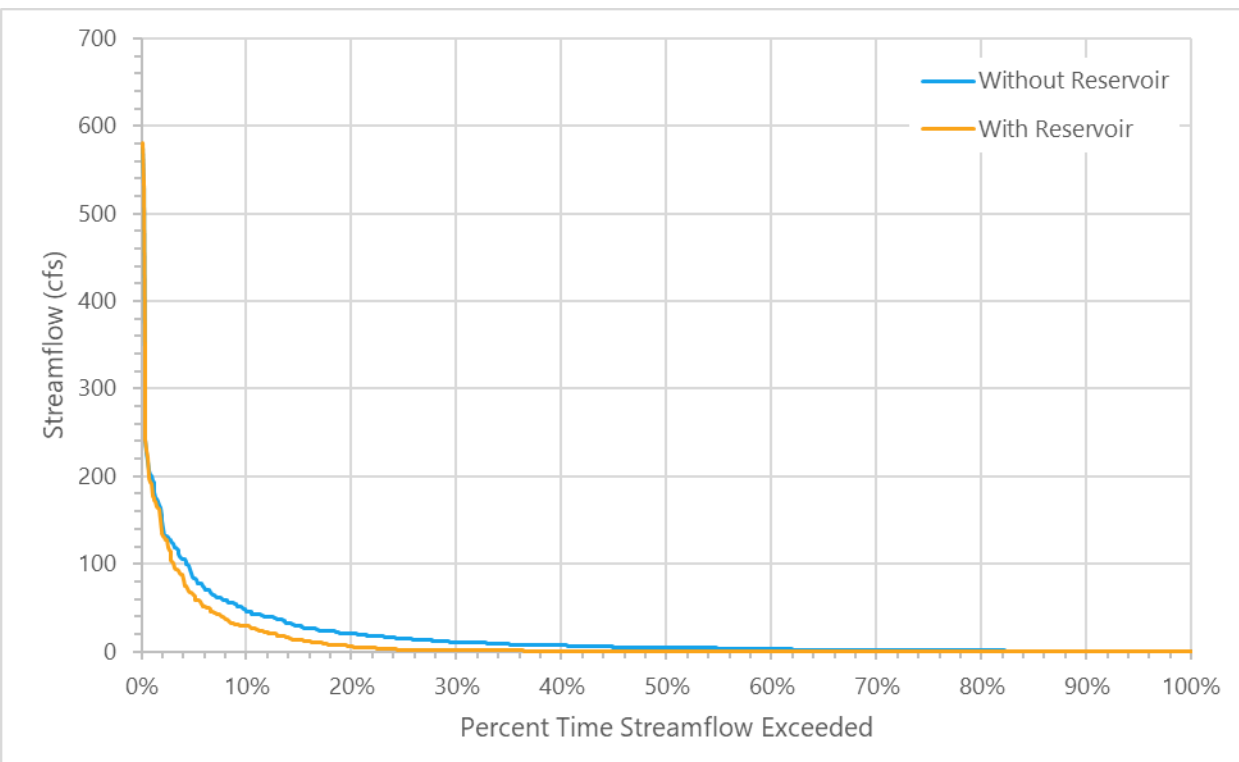


Figure 4.6-5 North Elm Fork Diversion- Streamflow Frequency Comparison



4.6.3 Environmental Issues

4.6.3.1 Existing Environment

The New Throckmorton Reservoir site in Throckmorton County is within the Rolling Plains Ecological Region[1]. This region is located east of the High Plains, west of the Cross Timbers and Prairies, and north of the Edwards Plateau. It is characterized by nearly level to rolling topography, soft prairie sands and clays, and alternating woodlands and prairies. The physiognomy of the region varies from open, short to tall, scattered to dense grasslands to savannahs with bunch grasses. Most of the plains are rangeland, but cultivated crops are important in certain localities. Poor range management practices of the past have increased the density of invasive woody plant species and have decreased the value of the land for cattle production. Farming and grazing practices have also reduced the abundance and diversity of wildlife in the region[2]. The climate is characterized as subtropical subhumid, with hot summers and dry winters. Average annual precipitation is approximately 27 inches. [3]

The Seymour aquifer, an unconsolidated sand and gravel aquifer, is the only major aquifer in the county, but does not underlie the proposed reservoir site. [4] The aquifer consists of Quaternary-age, alluvial sediments unconformably overlying Permian-age rocks. Water is contained in isolated patches of alluvium as much as 360 feet thick. Water ranges from fresh to slightly saline. Most of the groundwater pumped from the aquifer (about 90%) is used for irrigation, with the remainder used primarily for municipal supply. [5]

The region lies within the North-Central Plains physiographic region which includes elevations between 900 and 3,000 feet above sea level. Bedrock includes limestones, sandstones, and shales. Where shale bedrock prevails, meandering rivers traverse stretches of local prairie. In areas of harder bedrock, hills and rolling plains dominated. Local areas of hard sandstones and limestones cap steep slopes severly dissected near rivers.[6] The predominant soil types in the project area are the Clearfork silty clay loam, occasionally flooded and Lueders-Throck complex, 1-8 percent slopes, extremely stony.

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[1] Gould, F.W., G.O. Hoffman, and C.A. Rechenthin, Vegetational Areas of Texas, Texas A&M University, Texas Agriculture Experiment Station Leaflet No. 492, 1960.

[2] Telfair, R.C., *Texas Wildlife Resources and Land Uses*, University of Texas Press, Austin, Texas, 1999.

[3] Texas Almanac, 2008. Texas Almana 2008-2009. The Dallas Morning News Inc., Dallas, TX 2008.

[4] Texas Water Development Board (TWDB), *Major and Minor Aquifers of Texas*, Maps online at http://www.twdb.texas.gov/groundwater/aquifer/major.asp, accessed November 25, 2004.

[5] TWDB, *Seymour Aquifer*, http://www.twdb.texas.gov/groundwater/aquifer/majors/seymour.asp, accessed November 25, 2014.

[6] Wermund, E.G., *Physiographic Map of Texas*, Bureau of Economic Geology, University of Texas, Austin, Texas, 1996. Accessed online at http://www.beg.utexas.edu/UTopia/images/pagesizemaps/physiography.pdf on November 25, 2014.

The Clearfork silty clay loams are very deep, well drained soils present on floodplains on draws. These soils are considered prime farmland soils. The Lueders-Throck complex soils are soils are generally found on hillslopes on ridges and are derived from gravelly residuum weathered from limestone. These soils are well drained and are not considered prime farmland. Other soils comprise a smaller portion of the project area. These include Leeray clay, 0 to 1 percent slopes, Lueders cobbly loam, 1 to 5 percent slopes, Lueders-Springcreek complex, 1 to 8 percent slopes, very stony, Nukrum clay loam, 1 to 3 percent slopes, Nuvalde clay loam, 0 to 1 percent slopes, Nuvalde clay loam, 1 to 3 percent slopes, Owens-Harpersville complex, 8 to 45 percent slopes, extremely bouldery, Owens-Lueders complex, 5 to 30 percent slopes, extrememly bouldery, Rowden clay loam, 0 to 2 percent slopes, Rowena clay loam, 0 to 1 percent slopes, Sagerton clay loam, moist, 1 to 3 percent slopes, Speck silty clay loam, 0 to 2 percent slopes, Springcreek clay loam, 1 to 3 percent slopes, and Throck silty clay loam, 1 to 5 percent slopes. Of these soils, approximately 46 percent are considered to be prime farmland soils.[7]

Two major vegetation types occur within the general vicinity of the proposed project: Mesquite (*Prosopis glandulosa*)–Lotebush Shrub, and crops.[8] Variations of these primary types occur involving changes in the composition of woody and herbaceous species and physiognomy according to localized conditions and specific range sites. Mesquite-Lotebush Shrub could include the following commonly associated plants: yucca (*Yucca* spp.), skunkbush sumac (*Rhus trilobata*), agarito (*Berberis trifoliolata*), elbowbush (*Forestiera angustifolia*), juniper, tasajillo (*Opuntia leptocaulis*), cane bluestem (*Bothriochloa barbinodis*), silver bluestem (*Bothriochloa saccharoides*), little bluestem (*Schizachyrium scoparium*), sand dropseed (*Sporobolus cryptandrus*), Texas grama (*Bouteloua rigidiseta*), sideoats grama (*Bouteloua curtipendula*), hairy grama (*Bouteloua hirsuta*), red grama (*Bouteloua trifida*), tobosagrass (*Pleuraphis mutica*), buffalograss (*Buchloe dactyloides*), Texas wintergrass (*Nasella leucotricha*), purple three-awn (*Aristida purpurea*), Engelmann daisy (*Engellmania peristena*), broom snakeweed (*Gutierrezia sarothrae*), and bitterweed (*Hymenoxys odorata*). Crops include cultivated cover crops or row crops providing food and/or fiber for either man or domestic animals and may also include grassland associated with crop rotations and hay production.

4.6.3.2 Potential Impacts

4.6.3.2.1 Aquatic Environments including Bays and Estuaries

The anticipated impact of this project would be minimal reduction in variability and substantial reductions in quantity of median monthly flows. The reduction in variability of monthly flow values would probably not have much impact on the instream biological community or riparian species. However, there would be a reduction in the quantity of median monthly flows downstream of the project ranging from 2.2 cfs in January to 9.1 cfs in May, as shown in Table 4.6-1.

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[7] Natural Resources Conservation Service, *Custom Soil Resource Report for Throckmorton County, Texas*, United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with Texas Agricultural Experiment Station, November 25, 2014.

[8] McMahan, C.A., R.F. Frye, and K.L. Brown, *The Vegetation Types of Texas*, Texas Parks and Wildlife Department, Wildlife Division, Austin, Texas, 1984.

The highest reductions (>10 cfs) would occur in June, and all months would have significant reductions in flow. This project would also result in a higher frequency of low-flow conditions. Without the project, the monthly flow would be less than 0.72 cfs only 15 percent of the time (85 percent exceedance value) and would be less than 0.72 cfs 70 percent of the time with the project in place. These reductions in flow would have substantial impacts on the instream biological community, especially since the greatest reductions are predicted for the summer months when flows are already historically low and water chemistry conditions are the most stressful for aquatic species (e.g., high temperatures and high nutrient growth).

Although there would be biological impacts in the immediate vicinity of the project site and downstream, it is not likely that this project, alone, would have a substantial influence on total discharge in the Brazos River or to freshwater inflows to the Brazos River estuary. However, the cumulative impact of multiple projects may reduce freshwater inflow to the estuary. As a new reservoir without a current operating permit, the New Throckmorton Reservoir would likely be required to meet environmental flow requirements determined by site-specific studies.

Table 4.6-1 Median Monthly Streamflow: North Elm Creek Diversion Site

Month	Without Project (cfs)	With Project (cfs)	Difference (cfs)	Percent Reduction
January	2.2	0.2	2	90.9%
February	2.4	0.0	2.4	100%
March	2.9	0.0	2.9	100%
April	2.9	0.0	2.9	100%
May	9.1	0.0	9.1	100%
June	16	0.0	16	100%
July	4.3	0.0	4.3	100%
August	5.4	0.0	5.4	100%
September	6.6	0.0	6.6	100%
October	6.0	0.0	6.0	100%
November	4.6	0.1	4.5	97.8%
December	3.0	0.2	2.8	9.3%

4.6.3.2.2 Threatened & Endangered Species

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Throckmorton County can be found at https://tpwd.texas.gov/gis/rtest/.

No documented occurrences of any state or federally listed threatened, endangered, or candidate species or species of concern were revealed within at least 2.5 miles of the proposed New Throckmorton Reservoir during a search of the Texas Natural Diversity Database[9] maintained by TPWD (as noted on representative 7.5 minute quadrangle map(s) that include the project site). This data is not a representative inventory of rare resources or sensitive sites. Although based on the best information available to TPWD, these data do not provide a definitive statement as to the presence, absence, or condition of special species, natural communities, or other significant features in the project area. On-site evaluations will be required by qualified biologists to confirm the occurrence of sensitive species or habitats.

4.6.3.2.3 Wildlife Habitat

Approximately 1,160 acres are estimated to be inundated by the reservoir. Utilizing Ecological Mapping Systems of Texas data [10], the projected wildlife habitat that will be impacted includes dominantly mixed grass prairie (approximately 760 acres), mesquite shrubland (approximately 470 acres), native invasive mesquite shrubland (approximately 430 acres), floodplain herbaceous vegetation (approximately 255 acres), and row crops (approximately 250 acres). Other wildlife habitat types that would be impacted include riparian herbaceous vegetation, native invasive juniper shrubland, floodplain hardwood forest, native invasive juniper woodland, marsh and barren land.

A number of vertebrate species would be expected to occur within Throckmorton County near the proposed reservoir site including many game and non-game animals. These include 11 species of frogs and toads, 6 species of turtles, 10 species of lizards and skinks, and 24 species of snakes.

Additionally, 78 species of mammals could occur within the site or surrounding region [11] in addition to an undetermined number of bird species. A variety of fish species would be expected to inhabit streams and ponds within the site, but with distributions and population densities limited by the types and quality of habitats available.

4.6.3.2.4 Cultural Resources

A search of the Texas Historical Commission's online database for the 2011 Regional Water Plan identified no mapped cemeteries, historical markers, National Register of Historic Places sites or districts or State historic sites within the proposed reservoir site. A search of the Texas Archeological Sites Atlas database indicated that no archeological sites have been documented within the general vicinity of the proposed reservoir. However, the area has never been surveyed by a professional archeologist and the absence of documented sites may reflect the lack of investigation rather than the absence of archeological sites.

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[9] Texas Parks and Wildlife Department (TPWD), Texas Natural Diversity Database, *Element of Occurrence Records*, November 24, 2014.

[10] Texas Parks & Wildlife Department (TPWD), "Ecological Mapping Systems of Texas," https://drive.google.com/folderview?id=0B32g5sG2VKbgbl9oOGlneUdMZjA&usp=sharing accessed November 21, 2014.

[11] Davis, W.B., and D.J. Schmidly, *The Mammals of Texas – Online Edition*, Texas Tech University, http://www.nsrl.ttu.edu/tmot1/Default.htm, 1997.

Prior to reservoir inundation the project must be coordinated with the Texas Historical Commission and a cultural resources survey must be conducted to determine if any cultural resources are present within the conservation pool. Any cultural resources identified during survey will need to be assessed for eligibility for inclusion in the National Register of Historic Places (NRHP) or as State Archeological Landmarks (SAL). Cultural resources that occur on public lands or within the Area of Potential Effect of publicly funded or permitted projects are governed by the Texas Antiquities Code (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (PL96-515), and the Archeological and Historic Preservation Act (PL93-291).

4.6.3.2.5 Threats to Natural Resources

Threats to natural resources include lower stream flows, declining water quality, and reduced inflows to reservoirs. This project would likely have increased adverse effects on stream flow below the reservoir site as a reduction in the quantity of median monthly flow is projected downstream, but the reservoir would also trap sediment and/or dilute pollutants, providing some positive benefits to water quality immediately downstream. These benefits could be offset by declines in dissolved oxygen through decreased flows and higher temperatures during summer periods. The project is expected to have negligible impacts to total discharge downstream and overall water quality in the Brazos River.

4.6.3.2.6 Agricultural Impacts

The New Throckmorton Reservoir site contains approximately 180 acres of Pasture/Hay fields and zero acres of cropland. These two agricultural land uses account for roughly 8 percent of the reservoir footprint.

4.6.4 Engineering and Costing

Construction of the New Throckmorton Reservoir project will cost approximately $102.5 million. This includes the construction of the dam, land acquisition, resolution of conflicts, environmental permitting and mitigation, and technical services. The annual project costs are estimated to be $9.7 million; this includes annual debt service and operation and maintenance. The cost for the available project safe yield of 3,500 acft/yr translates to an annual unit cost of raw water of $8.53 per 1,000 gallons, or $2,781/acft. A summary of the cost estimate is provided in Table 4.6-2. Costs shown herein are for raw water supply at the reservoir and do not include transmission, local distribution, or treatment costs. These costs include compensation to BRA for impacts of subordination of Possum Kingdom Reservoir to New Throckmorton Reservoir. Note that any subordination agreement would need to be negotiated with BRA.

Table 4.6-2 Cost Estimate Summary for New Throckmorton Reservoir

Cost Estimate Summary Water Supply Project Option September 2023 Prices Throckmorton Reservoir Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
CAPITAL COST	
Dam and Reservoir (Conservation Pool 15900 acft, 1161 acres)	$21,136,000
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0

Cost Estimate Summary Water Supply Project Option September 2023 Prices Throckmorton Reservoir Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (3.3 MGD)	$7,939,000
Transmission Pipeline (14 in. dia., 4.7 miles)	$8,011,000
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$0
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (3.3 MGD)	$34,240,000
Advanced Water Treatment Facility (MGD)	$0
Conservation (Leaking Pipe/Meter Replacement)	$0
Integration, Relocations, Backup Generator & Other	$57,000
TOTAL COST OF FACILITIES	**$71,383,000**
Engineering:	
Planning (3%)	$2,142,000
Design (7%)	$4,997,000
Construction Engineering (1%)	$714,000
Legal Assistance (2%)	$1,428,000
Fiscal Services (2%)	$1,428,000
Pipeline Contingency (15%)	$1,202,000
All Other Facilities Contingency (20%)	$12,675,000
Environmental & Archaeology Studies and Mitigation	$142,000
Land Acquisition and Surveying (1196 acres)	$169,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$6,259,000
TOTAL COST OF PROJECT	**$102,539,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$5,071,000
Reservoir Debt Service (3.5 percent, 40 years)	$1,427,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$81,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$198,000
Dam and Reservoir (1.5% of Cost of Facilities)	$317,000
Water Treatment Plant	$2,556,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (937560 kW-hr @ 0.09 $/kW-hr)	$84,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$9,734,000**
Available Project Yield (acft/yr)	**3,500**

Cost Estimate Summary Water Supply Project Option September 2023 Prices Throckmorton Reservoir Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Annual Cost of Water ($ per acft), based on PF=1	**$2,781**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$925**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$8.53**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$2.84**
Note: One or more cost element has been calculated externally.	
QZ	*1/27/2025*

4.6.4.1 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 4.6-3, and the option meets each criterion.

Potential Regulatory Requirements

- Texas Commission on Environmental Quality Water Right and Storage permits;
- U.S. Army Corps of Engineers Permits will be required for discharges of dredge or fill into wetlands and waters of the U.S. for dam construction, and other activities (Section 404 of the Clean Water Act);
- Texas Commission on Environmental Quality administered Texas Pollutant Discharge Elimination System Storm Water Pollution Prevention Plan;
- General Land Office Easement if State-owned land or water is involved; and
- Texas Parks and Wildlife Department Sand, Shell, Gravel and Marl permit if state-owned streambed is involved.

State and Federal Permits may require the following studies and plans

- Environmental impact or assessment studies;
- Wildlife habitat mitigation plan that may require acquisition and management of additional land;
- Flow releases downstream to maintain aquatic ecosystems;
- Assessment of impacts on Federal- and State-listed endangered and threatened species;
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction; and
- Cultural resources studies to determine resources impacts and appropriate mitigation plan that may include cultural resource recovery and cataloging; requires coordination with the Texas Historical Commission.

Land Acquisition Issues

- Land acquired for reservoir and/or mitigation plans could include market transactions and/or eminent domain;
- Additional acquisition of rights-of-way and/or easements may be required; and
- Possible relocations or removal of residences, utilities, roads, or other structures.

Table 4.6-3 Evaluations of New Throckmorton Reservoir Option to Enhance Water Supplies

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Moderate impact
2. Habitat	2. High impact
3. Cultural Resources	3. High impact
4. Bays and Estuaries	4. Negligible impact
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	Potential impact on bottomland farms and habitat in the reservoir area
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

4.7 Turkey Peak Dam – Lake Palo Pinto Enlargement

4.7.1 Description of Option

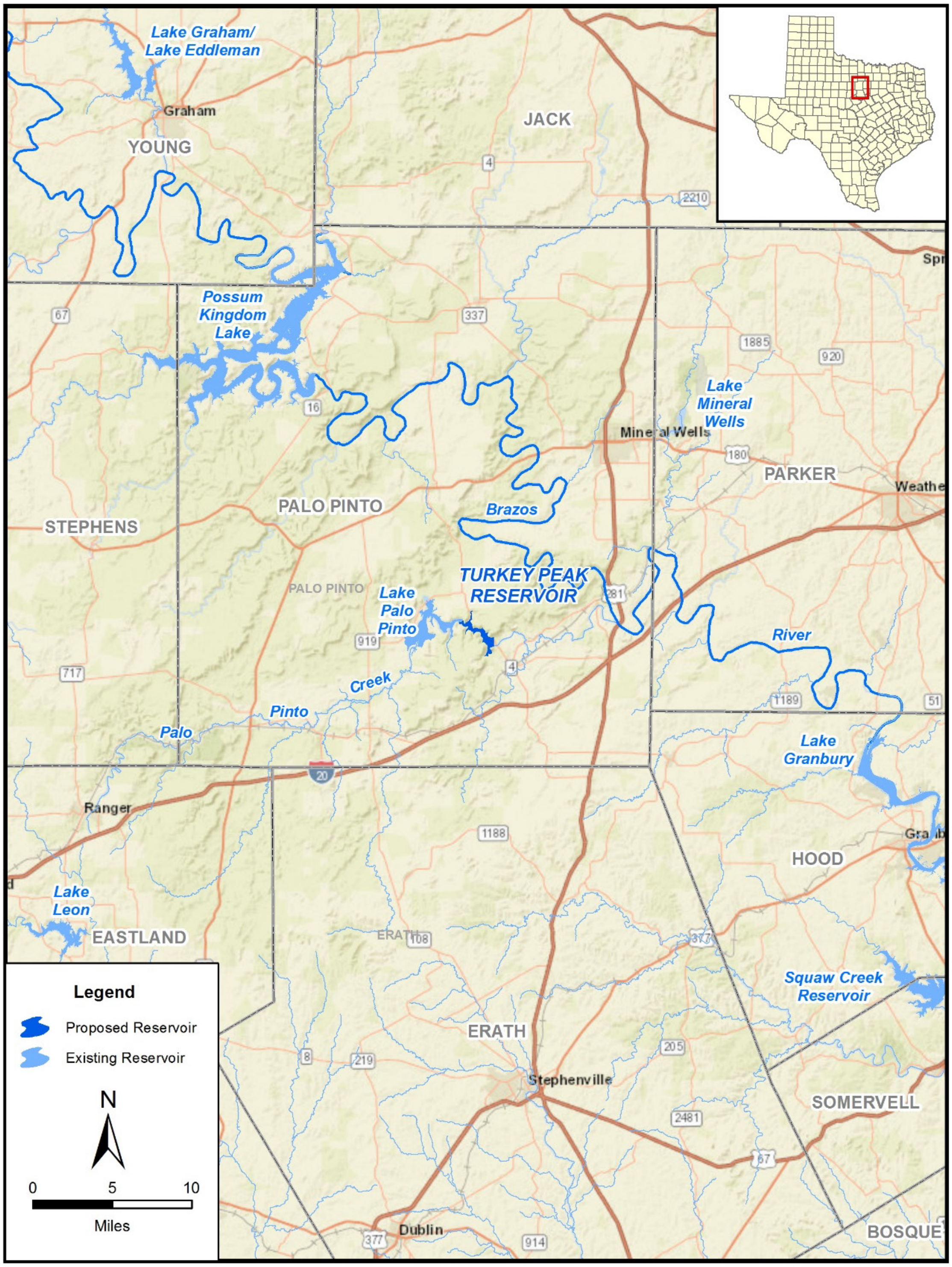
The Lake Palo Pinto (LPP) dam was initially constructed in 1963 and 1964 with a conservation pool level of 863.0 feet above mean sea level (ft-msl) and deliberate impoundment began in April 1964. In 1966 the conservation storage level was raised four feet to 867.0 ft-msl. The Palo Pinto County Municipal Water District No. 1 (District) operates LPP by making releases through the reservoir outlet works for subsequent diversion downstream. Additionally, the District's water right allows for the diversion of intervening streamflow entering Palo Pinto Creek downstream of LPP. As a result, the District is able to conserve storage in LPP by ceasing releases from LPP during wet periods and meeting demands by diverting the intervening streamflow.

In the early 1980s, the District became concerned about the capacity of LPP and in 1985, a volumetric survey of the reservoir was performed. This survey determined the reservoir's conservation capacity to be 27,650 acft, about 63 percent of its authorized storage. In 2007, an additional volumetric survey was performed by the Texas Water Development Board and this survey determined the reservoir's capacity to be 27,215 acft (about 62 percent of its authorized storage of 44,100 acft). Based on the June 2007 TWDB survey, the LPP conservation pool currently inundates 2,176 acres at its conservation level and has an average depth of only 12.5 feet. The construction of the Turkey Peak Dam is currently being pursued by the District to expand LPP and recover the storage authorized under Certificate of Adjudication 12-4031.

The proposed Turkey Peak Dam is located on Palo Pinto Creek immediately downstream of LPP, as shown in Figure 4.7-1. The proposed dam is located approximately 2 miles northwest of the City of Santo, just upstream from the bridge over Palo Pinto Creek on FM4. The conservation capacity of the expanded portion of LPP is 22,577 acft and covers 648 acres, resulting in an average reservoir depth of 35 ft.

The normal pool elevation of the expanded LPP will be 867.0 ft-msl, the same as the existing LPP. A portion of the existing dam and spillway at LPP will be removed and the two reservoir pools will be connected above an elevation of 863.0 ft-msl. Below this elevation a pipe will connect both pools and the two pools can be operated either as a single reservoir or as separate reservoirs. The expanded LPP will contain approximately 49,792 acft of conservation storage and inundate 2,824 acres at its conservation storage level of 867 ft-msl.

Figure 4.7-1 Location of Turkey Peak Dam – Lake Palo Pinto Enlargement



Document Path: \\dalctxsrv01\Texas_GIS_Projects\10029705_036_Brazos_G_2021_Plan\Map_Docs\MXDs\Reservoir_Strategy\Turkey_Peak_Reservoir.mxd

The Turkey Peak Dam will increase storage by 83 percent (as compared to the existing LPP), while only inundating an additional 20 percent of the surface area of the existing LPP. Because the expanded portion of the reservoir is significantly deeper than the existing LPP, the surface area of the combined reservoirs is 695 acres less (20 percent) when compared to raising the conservation level of LPP by 5.5 feet (and storing 44,100 acft, its current permit authorization). This results in a significant reduction in reservoir evaporation between the two alternative configurations.

The District has been granted an amendment to their surface water permit for LPP (Certificate of Adjudication 12-4031A) for the expansion of the reservoir and has obtained the required Section 404 permit of the Clean Water Act for construction of the Turkey Peak Dam. The District is currently in the final design phase of the project and is beginning to acquire property. The District anticipates construction to begin in 2025.

1.1.1 Available Yield

Water potentially available for impoundment in the expanded LPP was estimated using the TCEQ Brazos WAM Run 3 which assumes no return flows and permitted storages and diversions for all water rights in the basin. The model utilizes a January 1940 through December 2018 hydrologic period of record. Estimates of water availability were derived subject to the reservoir having to pass inflows to meet TCEQ environmental flow standards.

Because this project is being pursued to recover lost storage in LPP and to increase the reliability of the supply as currently authorized by the District's water right, the additional storage provided by Turkey Peak Dam was modeled at the LPP priority date of July 3, 1962, which is consistent with Certificate of Adjudication 12-4031A. When the expanded LPP is simulated with the TCEQ Brazos WAM Run 3 and diversions of released water from the reservoir taken at the downstream diversion point, the full authorized diversion amount of 18,500 acft/yr is firm.

However, during the recent 2015 drought, storage levels in LPP were reduced to critical levels, signifying a new drought of record for the Palo Pinto Creek watershed. As a result, the District adopted an approximate 6-month safe yield for planning purposes. The recent drought is included in the TCEQ Brazos WAM Run 3 hydrologic period of record. Analyses performed by Brazos G indicates the safe yield of the existing LPP is 6,980 acft/yr. With the expanded LPP, the safe yield is increased by 5,730 acft/yr to 12,710 acft/yr.

Figure 4.7-2 shows the simulated expanded LPP storage levels for the 1940 to 2018 period included in the TCEQ Brazos WAM, subject to the safe yield demand of 12,710 acft/yr. Figure 4.7-3 illustrates the storage frequency of the combined reservoir under the same safe yield demand. Simulated contents remain full over 20 percent of the time and above 90 percent full approximately 45% of the time.

Figure 4.7-2 Expanded Lake Palo Pinto Storage Trace

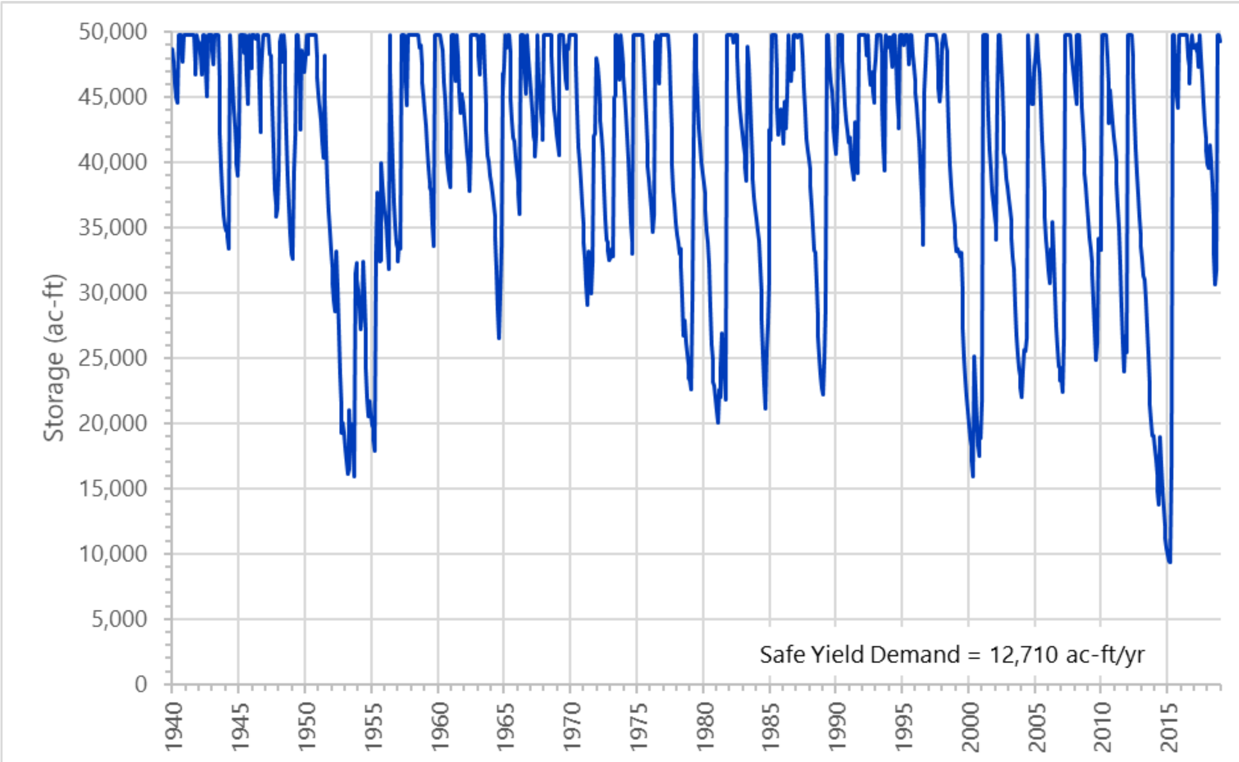


Figure 4.7-3 Expanded Lake Palo Pinto Reservoir Storage Frequency

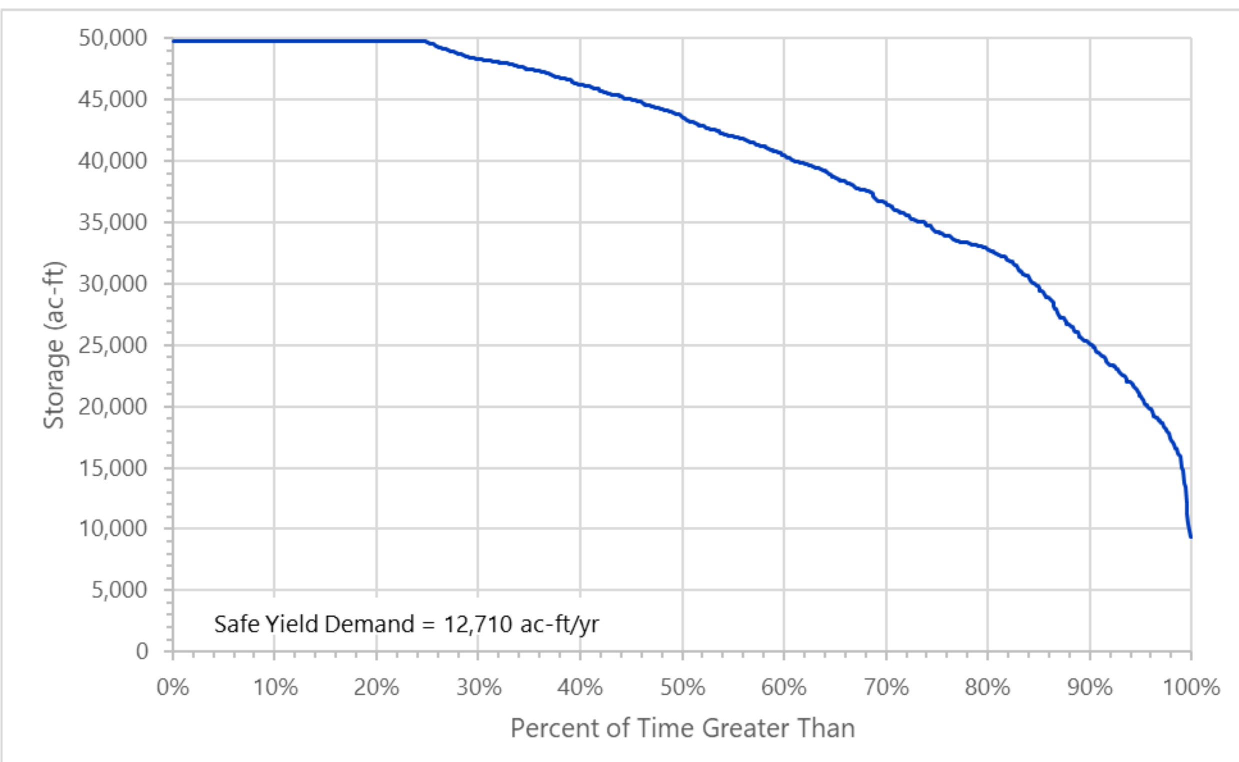


Figure 4.7-4 illustrates the changes in Palo Pinto Creek streamflows as a result of the Turkey Peak dam construction. The median streamflows are reduced in May and June as a result of the expanded reservoir impounding a greater amount of available streamflow. Median streamflows are increased in all other months of the project due to the expanded reservoir being able to release additional water for subsequent diversion downstream. Figure 4.7-5 compares the streamflow frequency at the Proposed Turkey Peak Dam with and without the project. The figure shows that streamflow will not be significantly impacted from implementation of the project.

Figure 4.7-4 Monthly Median Streamflow near Proposed Turkey Peak Reservoir Dam

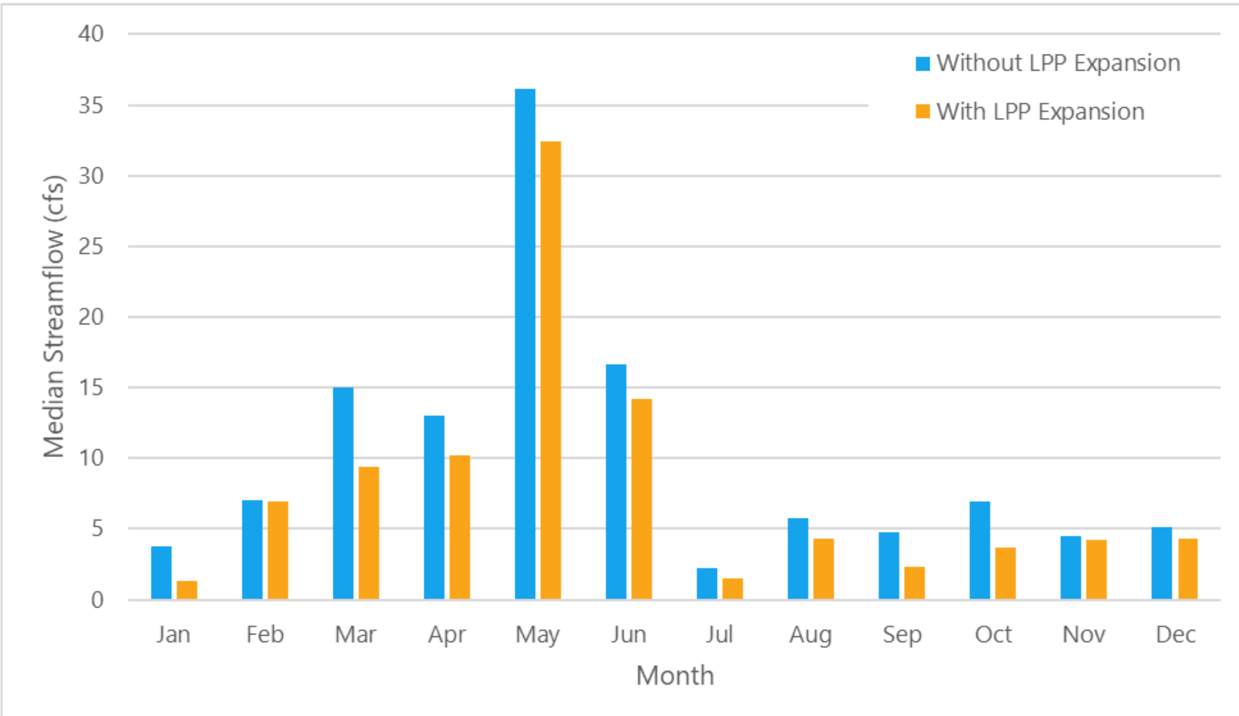
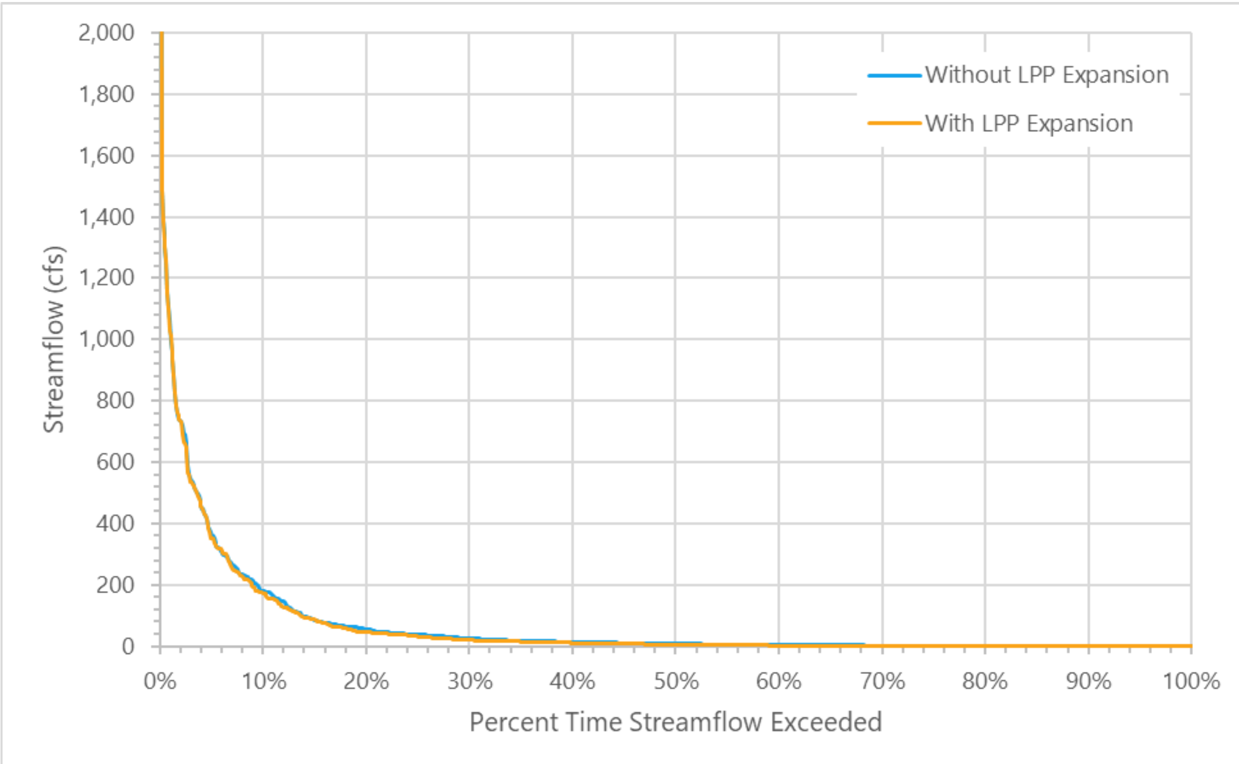


Figure 4.7-5 Streamflow Frequency Comparison at Turkey Peak Dam



1.1.2 Environmental Issues

1.1.2.1 Existing Environment

The Turkey Peak Project site in Palo Pinto County is within the Cross Timbers Ecoregion.[1] This complex transitional area of prairie dissected by parallel timbered strips is located in north-central Texas west of the Texas Blackland Prairies Ecoregion, east of the Central Plains Ecoregion and north of the Edwards Plateau Ecoregion. The physiognomy of the Cross Timbers Ecoregion is oak and juniper woods, and mixed grass prairie. Much of the native vegetation has been displaced by agriculture and development. Range management techniques, including fire suppression, have contributed to the spread of invasive woody species and grasses within this area. Farming and grazing practices have also reduced the abundance and diversity of wildlife in the region.[2] The climate within this area is characterized as subtropical subhumid, with hot summers and dry winters. Average annual precipitation ranges between 28 and 32 inches.[3]

[1] Griffith, G.E., Bryce, S.A., Omernik, J.M., Comstock, J.A., Rogers, A.C., Harrison, B., Hatch, S.L., and Bezanson, D., 2004, Ecoregions of Texas (color poster with map, descriptive text, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:2,3000,000).
[2] Telfair, R.C., "Texas Wildlife Resources and Land Uses," University of Texas Press, Austin, Texas, 1999.
[3] Larkin, T.J., and G.W. Bomar, "Climatic Atlas of Texas," Texas Department of Water Resources, Austin, Texas, 1983.

No major or minor aquifers underlie the project area, however the Trinity Aquifer, a major aquifer consisting of interbedded sandstone, sand, limestone, and shale of Cretaceous Age, lies east and south of the project area.[4]

The physiography of the region includes hard sandstone, mud, and mudstone (undifferentiated), ceramic clay and lignite/coal, terraces, and flood-prone areas. The topography ranges from flat to rolling, and from steeply to moderately sloped, with local shallow depressions in flood-prone areas along waterways.[5] The predominant soil associations in the project area are the Bosque-Santo and Bonti-Truce-Shatruce associations. Bosque-Santo soils are deep, nearly level to gently sloping, loamy soils, typically found on flood plains. Bonti-Truce-Shatruce soils are moderately deep and deep, gently sloping to steep, loamy, stony, and bouldery upland soils.[6]

The dominant vegetation types found within the project area as mapped by the TPWD are Ashe Juniper Parks/Woods and Oak-Mesquite-Juniper Parks/Woods.[7] Variations of these primary types occur within the region, which reflect changes in the composition of woody and herbaceous species and physiognomy. Ashe Juniper Parks/Woods, which occur principally on the slopes of hills in Palo Pinto County, usually include the following commonly associated plants: live oak (*Quercus virginiana*), Texas oak (*Q. texana*), cedar elm (*Ulmus crassifolia*), mesquite (*Prosopis glandulosa*), agarito (*Mahonia trifoliolata*), tasajillo (*Opuntia leptocaulis*), western ragweed (*Ambrosia cumanensis*), scurfpea (*Psoralea spp.*), little bluestem (*Schizachyrium scoparium*), sideoats grama (*Bouteloua curtipendula*), Texas wintergrass (*Nasella leucotricha*), silver bluestem (*Bothriochloa saccharoides*), hairy tridens (*Erioneuron pilosum*), tumblegrass (*Schedonnardus paniculatus*), and red three-awn (*Aristida purpurea var. longiseta*).

Oak-Mesquite-Juniper Parks/Woods, which occur as associations or as a mixture of individual (woody) species stands on uplands, generally include the following commonly associated plants: post oak (*Q. stellata*), Ashe juniper (*Juniperus ashei*), shin oak (*Q. sinuata var. breviloba*), Texas oak, blackjack oak (*Q. marilandica*), live oak, cedar elm, agarito, soapberry (*Sapindus saponaria*), sumac (*Rhus spp.*), hackberry (*Celtis spp.*), Texas pricklypear (Opuntia engelmannii var. lindheimeri), Mexican persimmon (*Diospyros texana*), purple three-awn (*Aristida purpurea*), hairy grama (*Bouteloua hirsuta*), Texas grama (*B. texana*), curly mesquite (*Hilaria belangeri*), and Texas wintergrass (*Nassella leucotricha*).

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[4] Texas Water Development Board (TWDB), Major and Minor Aquifers of Texas; Maps online at http://www.twdb.state.tx.us/mapping/index.asp, 2004.
[5] Kier, R.S., L.E. Garner, and L.F. Brown, Jr., "Land Resources of Texas." Bureau of Economic Geology, University of Texas, Austin, Texas, 1977.

[6] Moore, J.D., *Soil Survey of Palo Pinto County, Texas*, United States Department of Agriculture, Soil Conservation Service, in cooperation with Texas Agricultural Experiment Station, 1981.
[7] McMahan, C.A., R.F. Frye, and K.L. Brown, "The Vegetation Types of Texas," Texas Parks and Wildlife Department, Wildlife Division, Austin, Texas, 1984.

1.1.2.2 Potential Impacts

Aquatic Environments including Bays & Estuaries

Currently there is no requirement for pass throughs of environmental flows from Lake Palo Pinto. However, the permit issued by TCEQ for the Turkey Peak project requires pass through of inflows originating in the intervening drainage area between the dams of 1 cfs for subsistence flow and between 1 and 4 cfs for base flows in Palo Pinto Creek. Additionally, the USACE 404 permit requires the District to maintain a minimum 1 cfs flow downstream of the Turkey Peak dam by passing inflows or releasing stored water when the reservoir is greater than 50 percent full. Therefore, only minimal differences in streamflow frequencies in Palo Pinto Creek are anticipated. This project will not have a substantial influence on total discharge in downstream locations on the Brazos River including freshwater inflows to the Brazos River estuary.

Threatened & Endangered Species

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD frequently updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Palo Pinto County can be found at https://tpwd.texas.gov/gis/rtest/. On-site evaluations by qualified biologists are required to confirm the occurrence of sensitive species or habitats.

The Migratory Bird Treaty Act protects most bird species, including, but not limited to, cranes, ducks, geese, shorebirds, hawks, and songbirds. Migratory bird pathways, stopover habitats, wintering areas, and breeding areas may occur within and adjacent to the project area, and may be associated with wetlands, ponds, shorelines, riparian corridors, fallow fields and grasslands, and woodland and forested areas. Although reservoir construction would remove some habitats utilized by certain migratory bird species, it would create more habitats for others. It is anticipated that the reservoir would reach its full capacity in one to three years. This transition from terrestrial to aquatic habitat would allow time for migratory species to acclimate to the altered condition within the project area and movement of non-aquatic species to similar areas nearby.

Three bird species federally listed as threatened or endangered may occur in the project vicinity. These include the golden-cheeked warbler (*Dendroica chrysoparia*), interior least tern (*Sterna antillarum athalassos*), and whooping crane (Grus americana). Two of these bird species are seasonal migrants that could pass through the project area. The interior least tern typically nests on bare or sparsely vegetated areas associated with streams or lakes, such as sand and gravel bars, beaches, islands, and salt flats. Unvegetated bars within wide river channels or open flats along lake or reservoir shorelines are preferred and provide nesting habitat and access to adjacent open water for foraging for this tern.

The main whooping crane flock nests in Canada and migrates annually to their wintering grounds in and around the Aransas National Wildlife Refuge near Rockport on the Texas coast. Whooping cranes occasionally utilize wetlands as an incidental rest stop during this migration. Habitat elements particularly attractive to the interior least tern and whooping crane do not appear to be present on or adjacent to the proposed reservoir site, although migrants are possible.

The golden-cheeked warbler is the only federally-listed avian species with potential to utilize the proposed reservoir site for nesting. Juniper-oak woodlands found on canyon slopes may provide the isolated woodland habitat of deciduous oaks and mature junipers required by this migratory songbird. A detailed field survey for this species was conducted by qualified personnel in March–May 2006, and no sightings or detections of the warbler were documented.[8] This survey and habitat assessment concluded that the Turkey Peak study area lacked the appropriate habitat for the golden-cheeked warbler, and that the Turkey Peak Project area was not likely to support this species.[9]

Avian species listed by the State of Texas as endangered or threatened include the bald eagle (*Haliaeetus leucocephalus*). Bald eagles are listed as threatened in Texas and occur as winter migrants. The majority of nesting bald eagle pairs currently reported are found along major rivers and near reservoirs in eastern Texas. Bald eagles are opportunistic predators, feeding primarily on fish captured in the shallow water of both lakes and streams or scavenged food sources. These birds may utilize tall trees near perennial water as roosting or nesting sites. Although the bald eagle could use either Lake Palo Pinto or Possum Kingdom Reservoir for foraging or nesting, the species has not been reported in the region. It is not expected that the bald eagle would be directly affected by the proposed reservoir construction at the Turkey Peak site.

The Texas horned lizard (*Phrynosoma cornutum*), Texas fawnsfoot mussel (*Truncilla macrodon*), and Brazos water snake (*Nerodia harteri*), three state threatened species, and the plains spotted skunk (*Spilogale putorius interrupta*), Texas garter snake (*Thamnophis sirtalis annectens*), and granite spiderwort (*Tradescantia pedicellata*), three species of concern, are possible inhabitants of the reservoir site or its adjacent upland pastures. Texas horned lizards inhabit deserts and grasslands in semi-arid to arid landscapes with sparse vegetation and gravelly soils. Their habitat must contain a stable population of harvester ants, the primary prey of the horned lizard, which make up the majority of its diet. Patchy environments that contain bare areas mixed with patches of vegetation are ideal to attract harvester ants and Texas horned lizards. This species could be displaced within the areas that will be gradually inundated. Relocation would then be possible into similar and acceptable habitat available adjacent to the project area.

Several species of freshwater mussels including the Texas fawnsfoot (*Truncilla macrodon*) have been listed as threatened by the state of Texas. This species is currently considered a candidate by the USFWS. The Texas fawnsfoot has been documented within the Brazos River Basin although it is generally thought to prefer large to medium streams or rivers which are not representative of Palo Pinto Creek. No Texas fawnsfoot specimens (live or dead) were identified during mussel surveys conducted in 2009 of the project reach downstream of the existing Lake Palo Pinto dam.

The Brazos water snake (*Nerodia harteri*) is limited in range to the Brazos River drainage and is usually found in riffle areas along the riverbank. Possible suitable habitat for this species occurs along Palo Pinto Creek within the reservoir area; however, comparable habitat occurs downstream of the proposed dam site. Occurrences of the endemic Brazos water snake have been documented by TPWD near Palo Pinto Creek. Surveys for the Brazos water snake along Palo Pinto Creek within the Turkey Peak Project site and downstream were undertaken in 2009 and there were no sightings of this species. Adverse impacts to this

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[8] Ladd, Clifton and Amanda Aurora. Endangered Species Survey Summary for the Golden-Cheeked Warbler. Loomis Austin, 2006.
[9] Ibid.

snake are not anticipated as it has been documented to persist along rocky shorelines in reservoirs, such as in Possum Kingdom.

The plains spotted skunk (*Spilogale putorius interrupta*) is generally found in open fields, prairies, and croplands. Vegetation within the project area generally consists of moderately dense mixed deciduous woodlands in the canyons, with pastures or pecan orchards in the floodplains. It is expected that if the plains spotted skunk is present in the project area, the gradual transition to an aquatic system could displace these species. However, the project area is rural, and similar suitable habitats exist adjacent to the project area; therefore, it is anticipated that the spotted skunk could relocate to those areas if necessary.

The sharpnose shiner (*Notropis oxyrhynchus*) and the smalleye shiner (*Notropis buccula*) are two small, slender minnows endemic to the Brazos River Basin that are federally listed as endangered. Historically, these sympatric fish existed throughout the Brazos River and several of its major tributaries. The population of each species within the Upper Brazos River drainage which occurs upstream of Possum Kingdom Reservoir is apparently stable, while the population within the middle and lower segments of the Brazos River Basin may exist only in remnant areas of suitable habitat. General habitat associations for both species include relatively shallow water of moderate currents flowing through broad and open sandy channels. Typical habitat is similar for both species and includes the often saline and turbid water of the Upper Brazos River. The last documented occurrence of the smalleye shiner within the lower segment of the Brazos River was recorded near the confluence of Palo Pinto Creek and the Brazos River in 1953. The stored water released from the existing Lake Palo Pinto is fresh and does not provide the saline water quality conditions needed by both species. Additionally, the existing channel dam constructed in the mid 1960's would likely restrict upstream movement of these minnows. The study area lies downstream of any recently recorded occurrences for these species; therefore, the occurrence of either cyprinid species is unlikely. The Guadalupe bass (*Micropterus treculii*) is endemic to the perennial streams of the Edwards Plateau region and is considered introduced in the Nueces River system. It is possible, but unlikely, that this species will be found within project area.

Information received from the TPWD Texas Natural Diversity Database[10] revealed no documented occurrences of endangered or threatened species within or near the proposed Turkey Peak Project. Although based on the best information available to TPWD, these data do not provide a definitive statement as to the presence, absence, or condition of special species, natural communities, or other significant features in the project area.

Based on the lack of suitable habitat for listed endangered or threatened species, the degree of previous land modification, and the anticipated gradual transition of the area into an aquatic system, this project is unlikely to have an adverse effect on any listed threatened or endangered species.

[10] Texas Parks and Wildlife Department (TPWD), Texas Natural Diversity Database, Received 10/04/2014.

Wildlife Habitat

Palo Pinto County is included in the Texan Biotic Province as delineated by Blair and modified by TPWD. [11] This province includes bands of prairie and woodland that begin in South Central Texas and run north to Kansas. The Texan Biotic Province constitutes a broad ecotone between the forests in the eastern portion of this region and the western grasslands. Although varied, the vertebrate community within the area of the proposed reservoir includes no true endemic species. The wildlife habitat types of the study area coincide closely with the major plant community types present. The mountains and associated vegetation areas within Palo Pinto County are similar to that of the Edwards Plateau; therefore, the wildlife habitats and species of the study area represent a mixture of those typical of the surrounding areas.

Within this province, western species tend to encroach into open habitats, and eastern species intrude along the many wooded drainageways extending through the landscape. Mammals typical of this province include the Virginia opossum (*Didelphis virginiana*), eastern mole (*Scalopus aquaticus*), fox squirrel (Sciurus niger), Louisiana pocket gopher (*Geomys breviceps*), fulvous harvest mouse (*Reithrodontomys fulvescens*), white-footed mouse (*Peromyscus leucopus*) and swamp rabbit (*S. aquaticus*). Animals typical of grasslands of this province include the thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), hispid pocket mouse (*Chaetodipus hispidus*), and black-tailed jackrabbit (*Lepus californicus*).

Typical anuran species to the Texan Biotic Province include the Hurter's spadefoot (*Scaphiopus holbrookii hurteri*), Gulf Coast toad (*Bufo valliceps*), green treefrog (*Hyla cinerea*), bullfrog (*Rana catesbeiana*), southern leopard frog (*Rana sphenocephala*) and eastern narrowmouth toad (*Microhylla carolinensis*).

According to TPWD geographic information system (GIS) data, 84 percent of the habitat which will be inundated by the project includes forest or woodland areas, 6 percent is grassland, approximately 4 percent is shrubland, and the remaining 6 percent includes herbaceous vegetation, open water and urban areas.[12]

Cultural Resources

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets provided by the Texas Historical Commission (THC), there are no National Register Properties, National Register Districts, State Historic Sites, cemeteries or historical markers located within or near the reservoir project area. The owner or controller of the project would be required to coordinate with the Texas Historical Commission regarding potential impacts to cultural resources.

The Texas Archeological Sites Atlas online database of the Texas Historical Commission (THC) was also consulted and background research was conducted to determine any previous cultural resources survey efforts as well as the locations of previously recorded historic and archaeological resources in the project area. Records indicate that eight previously recorded prehistoric archaeological sites were located within a 1-mile radius of the reservoir area.

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[11] Blair, W. Frank. 1950. "The Biotic Provinces of Texas," Texas Journal of Science 2 (1):93-117, modified by TPWD GIS lab.
[12] TPWD. 2014. Texas Ecological Systems GIS mapping layers.

In addition, a Phase IA cultural resource assessment was conducted for the proposed development of the Turkey Peak Project site in January 2009. This research revealed that there were no previously documented archeological sites found within the proposed reservoir area. Phase 1B surveys, including trenching at selected alluvial terrace locations, were initiated in 2010. The findings of the Phase 1B surveys were provided to the USACE and THC in support of Section 404 Permit coordination in accordance with the requirements of Section 106 of the National Historic Preservation Act (NHPA). The District will also coordinate the findings of the archeological surveys with the THC and TCEQ in conjunction with the review of the project under the Antiquities Code of Texas.

The Phase 1B investigations recorded two prehistoric localities, 13 prehistoric sites, and one historic site. Nine sites are recommended for further testing to determine eligibility for listing in the National Register of Historic Places (NRHP) and designation as a State Archeological Landmark (SAL). Five sites are recommended as not eligible for NRHP listing or SAL designation. The evaluation of the pre-historic and historic resources in the area of potential effect of the reservoir will be conducted and documented in accordance with standard practices for determination of NRHP and SAL eligibility and mitigation measures will be implemented, if necessary.

Threats to Natural Resources

The Turkey Peak Project will have little adverse effect on stream flow below the reservoir site and will meet TCEQ environmental flow requirements included in the water rights permit. In addition, the reservoir would trap and/or dilute pollutants, providing some positive benefits to water quality immediately downstream. Dissolved oxygen levels on Palo Pinto Creek are expected to be slightly improved as the project includes plans to construct a multi-level outlet tower which will always release water to Palo Pinto Creek from the top 10 to 15 feet of the reservoir pool.

Current conditions include an existing outlet pipe at Lake Palo Pinto at a fixed elevation of 835 ft-msl which is 32 feet below conservation level. The project is expected to have negligible impacts to total discharge downstream and overall water quality in the Brazos River or Brazos River estuary.

Agricultural Impacts

The Turkey Peak Reservoir site includes hay fields and a pecan orchard. As a result, some impacts are expected for agricultural land use.

1.1.3 Engineering and Costing

The cost estimates for the Turkey Peak/Palo Pinto Reservoir were indexed to current September 2023 dollars from those used within the 2021 Brazos G RWP and align with the Palo Pinto County Municipal Water District No. 1’s projected project cost. The estimated capital cost of $110 million includes costs associated with the relocation of FM 4, the construction of a new bridge and road at the existing dam and spillway at Lake Palo Pinto, and the construction of the new dam and spillways including modifications to the existing dam and spillway. The total project cost is approximately $201 million (Table 4.7-1). This includes the costs for construction, land acquisition, resolution of conflicts, environmental permitting and mitigation, engineering, mapping and surveying, utility relocations, design, TxDOT plan review, and construction phase services. Since the project is currently being implemented, the District has already financed a portion of the permitting, planning and design activities as well as legal assistance associated with permit acquisitions. The 12-month safe yield increase of 9,660 acft/yr from the project would provide raw water to the District at a unit cost of $1,202 per acft or $3.69 per 1,000 gallons.

Table 4.7-1 Cost Estimate for Turkey Peak Project

Item	Estimated Costs for Facilities
Capital Cost	
Dam and Reservoir	$90,089,000
Integration, Relocation, & Other	$19,599,000
Total Cost of Facilities	**$109,688,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$38,392,000
Environmental & Archaeological Studies and Mitigation	$19,928,000
Land Acquisition and Surveying (9,978 acres)	$20,526,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$12,255,000
Total Cost Of Project	**$200,789,000**
Debt Service (3.5 percent, 20 years)	$1,983,000
Reservoir Debt Service (3.5 percent, 40 years)	$8,083,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks	$196,000
Dam and Reservoir	$1,351,000
Pumping Energy Costs ($0.09 kwh)	$0
Total Annual Cost	**$11,613,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	**9,660**
Annual Cost of Water ($ per acft)	**$1,202**
Annual Cost of Water ($ per 1,000 gallons)	**$3.69**

1.1.4 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 4.7-2, and the option meets each criterion.

The District is actively implementing this project with plans to begin construction in 2020. A summary of the planned implementation steps for the project follows.

- Complete final design of the project.
- Complete land acquisition for the project.
- Secure additional state funding to implement the project.
- Begin construction of the project.
- Remaining Regulatory Requirements:
  - None.

Table 4.7-2 Comparison of Turkey Peak Project to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Low impact
2. Habitat	2. Low impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Low impact due to distance from coast
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Low impact
C. Impact on Other State Water Resources	Low to none
D. Threats to Agriculture and Natural Resources	Low to none
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	None
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

CHAPTER 5 GROUNDWATER SUPPLIES AND PROJECTS

5.1 City of Bryan Groundwater Strategies

5.1.1 Description of Option

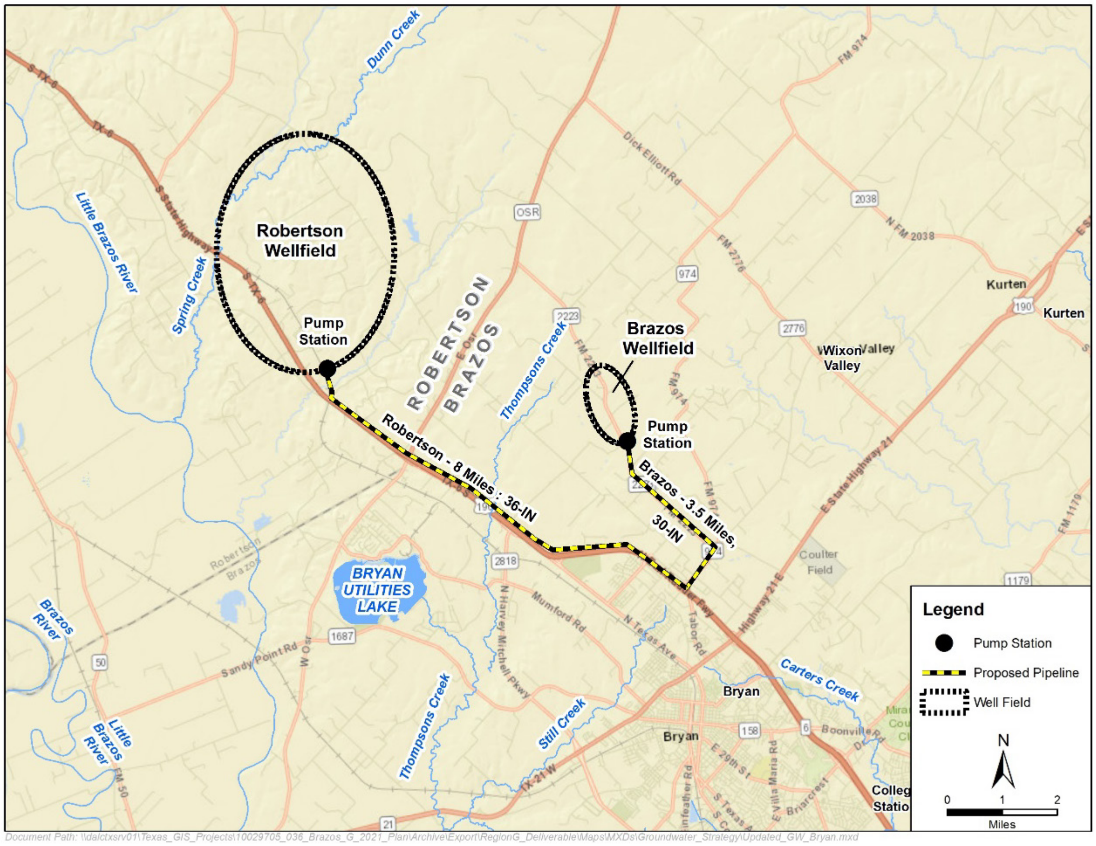
The City of Bryan (Bryan) currently supplies all of its customers with water from the Sparta and Carrizo-Wilcox (Simsboro) Aquifers in Brazos County. By 2080, Bryan has been allocated 19,107 acft/yr of existing supply from the Carrizo-Wilcox Aquifer through this regional planning process. Bryan is projected to grow significantly over the planning period and the demands can no longer be met solely by groundwater within Brazos County. Estimated water needs for Bryan ranges from 6,554 acft/yr in 2030 to 35,740 acft/yr in 2080. Due to these needs, the City is planning on expanding their groundwater supplies from the Carrizo-Wilcox Aquifer in Brazos County as well as adding a Carrizo-Wilcox well field in Robertson County.

To help meet the future needs in the Bryan, two groundwater strategies are proposed, a new well field in Robertson County and the expansion of the Bryan's existing well field in Brazos County. The Robertson County well field project contains an ultimate build out with Simsboro Formation wells northwest of the existing Bryan well field in Brazos County. Additional groundwater production from the Carrizo-Wilcox in Brazos County will be accomplished by the expansion of the existing Brazos County well field. The Robertson well field and Brazos well field expansion are expected to provide up to 17,474 ac-ft/yr of groundwater to help meet Bryan's needs through 2080. Figure 5.1-1 illustrates the proposed regional groundwater system for the City of Bryan.

5.1.2 Available Yield

The new production wells in Brazos and Robertson Counties produce water from the Simsboro Formation of the Carrizo-Wilcox Aquifer. Based on data from existing wells in the area, the Simsboro wells are capable of producing 2,000 to 3,500 gpm, and will be 2,500 ft deep in Robertson County and 2,800 ft in Brazos County. The TWDB has determined that the Modeled Available Groundwater (MAG) for the Carrizo-Wilcox Aquifer in Brazos and Robertson counties is 77,496 in 2030 and 156,608 acft/yr in 2080. Each of the two groundwater strategies will include two Simsboro Aquifer wells.

Figure 5.1-1 Locations of Planned Bryan Well Fields and Facilities



5.1.3 Environmental Issues

The Bryan Project involves the development of a new well field in Robertson County and the expansion of an existing well field in Brazos County, associated well collection pipelines and pumps, upgrades to an existing water treatment plant and a transmission pipeline. The Robertson County well field will include two Simsboro Aquifer wells, and the Brazos County existing well field will add two Simsboro wells to the existing well field.

This report section discusses the potential impacts to environmental and cultural resources known to exist within the proposed project area.

The project area occurs in the Post Oak Savannah Vegetational Area. [1] Common woody species of the Post Oak Savannah Vegetational Area include post oak (*Quercus stellata*), blackjack oak (*Q. marilandica*), and species of hickory (*Carya* sp.). Grasses of this area commonly include little bluestem (*Schizachyrium scoparium*), indiangrass (*Sorghastrum nutans*) and switchgrass (*Panicum virgatum*).

[1] Gould, F.W., "The Grasses of Texas," Texas A&M University Press, College Station, Texas, 1975.

Vegetation types as described by TPWD [2] within the project area includes Post Oak Woods/Forest, Post Oak Woods-Forest and Grassland Mosaic, and Other Native and Introduced Grasses areas. Descriptions of these vegetation types closely follow those included in the Post Oak Vegetational Area above. No agricultural impacts are expected as pipelines and well locations will avoid affecting cropland.

Construction of the pipelines, pump stations and wells would involve the disturbance of existing habitat. The proposed transmission pipeline would require a construction corridor and maintenance corridor after completion. Significant portions of this pipeline are located along existing rights-of-way, fencerows, and other disturbed areas including cropland, which would reduce their overall vegetative impact. Herbaceous habitats would recover quickly from impacts and would experience low negative impacts. Outside the maintained right-of-way, land use would not be anticipated to change due to pipeline construction. However, any impacts to woody vegetation would be permanent due to required pipeline, pump and well maintenance activities.

The transmission pipeline would cross several waterbodies within the project area including Peach, Thompsons and Campbells Creeks, and Thompsons Branch which is a tributary of Thompsons Creek. Appropriate Best Management Practices (BMPs) used during pipeline construction would help minimize impacts from these pipeline construction activities. National Wetland Inventory (NWI) maps show wetlands occurring along the transmission pipeline and within the well field areas. The Brazos well field mapped areas include primarily freshwater ponds, however the Robertson County well field contains numerous occurrences of several types of wetland areas including freshwater ponds, freshwater emergent wetlands, forested/shrub wetlands and a freshwater lake. A ground survey wetland delineation would be required to determine which of these and other features would be affected by the project and to what extent. This delineation would document the locations of streambeds, stream widths, quality and type of water bodies, types of aquatic vegetation, presence of special aquatic resources and areas of jurisdictional Waters of the U.S. likely to be disturbed during construction. Coordination with the U.S. Army Corps of Engineers would be required for construction within waters of the U.S. Impacts from the proposed project resulting in a loss of less than 0.5 acres of waters of the U.S. could be covered under Nationwide Permit #12 for Utility Line Activities.

Concerns associated with the development of the two well field areas include changes in water levels in the two aquifers drawn upon and potential impacts to the surrounding streams, wetlands and existing water wells found near the well fields from lowered water levels. The possibility exists that water levels in the aquifers, affected by the new wells, could affect the habitat within the area. Waters of the U.S. found within the two-project area well field areas include Wickson Creek in Brazos County, and Walker, Spring, Peach, Dunn and Campbells Creeks in Robertson County.

The 2012 Texas Integrated Report - Texas 303(d) List identifies the water bodies in or bordering Texas for which effluent limitations are not stringent enough to implement water quality standards, and for which the associated pollutants are suitable for measurement by maximum daily load. The most recent 303(d) List includes segments of Carters Creek which is categorized as 5a for bacteria. Category 5a indicates that a Total Maximum Daily Load study is underway, scheduled, or will be scheduled for one or more parameters.

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[2] McMahan, Craig A, Roy G. Frye and Kirby L. Brown. 1984. *The Vegetation Types of Texas including Cropland*. Texas Parks and Wildlife, Austin, Texas.

Spring, Campbells, Thompsons, Still and Wickson Creeks are listed as 5b for bacteria. Category 5b indicates that a review of the standards for one or more parameters will occur before a management strategy is selected. Thompsons Creek is also listed for depressed dissolved oxygen with a category of 5c which means that additional data will be collected and/or evaluated for one or more parameters before a management strategy is selected. Potential impacts to existing water quality are not anticipated from this project.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Brazos and Robertson counties can be found at https://tpwd.texas.gov/gis/rtest/.

No USFWS designated critical habitat areas occur near the project area.

5.1.4 Engineering and Costing

The envisioned Robertson County groundwater project will be developed in phases as necessary to meet growing needs. At ultimate build out there will be 4 Simsboro wells in Robertson and Brazos counties, collector pipelines, and well pumps and motors, and a transmission line that delivers the groundwater to the Bryan's existing raw water pipelines. The major facilities required for this strategy are:

- Simsboro wells.
- Well field collection pipeline(s).
- Transmission pipeline/pump stations.
- Upgrade to existing Water Treatment Plant.

The approximate locations of these facilities are displayed in Figure 5.1-1.

The Robertson County Simsboro wells were assumed to be 2,500 feet deep and have a peaking capacity of 4,000 gpm. Power costs were estimated by calculating the horsepower needed to operate the wells and pump stations to deliver raw water from the well fields to an interconnect with the existing infrastructure. Costs were included for leasing property necessary to obtain groundwater permits, and for anticipated third party well mitigation activities to compensate for lowered pumping levels in existing wells.

Based on these assumptions, it is estimated that the water obtained through the Robertson county well field to Bryan will have a unit cost of $605 per acft (Table 5.1-1) during debt service.

The Brazos County Simsboro wells were assumed to be 2,800 feet deep and have a peaking capacity of 4,000 gpm. Power costs were estimated by calculating the horsepower needed to operate the wells and pump station to deliver the raw water to the tie in with the existing infrastructure. Costs were included for leasing property necessary to obtain groundwater permits, and for anticipated third party well mitigation activities to compensate for lowered pumping levels in existing wells.

Based on these assumptions, it is estimated that the water obtained through the Brazos County well field to Bryan will have a unit cost $550 per acft (Table 5.1-2) during debt service.

5.1.5 Implementation Issues

Implementation of the City of Bryan Groundwater Strategies with well fields in Brazos and Robertson Counties could involve limited conflicts with other planned water supply projects. The development of groundwater in the Carrizo-Wilcox Aquifer in the Brazos G Area must address several issues. Potential issues include:

- Acquisition of water rights from land owners,
- Exposure to groundwater conservation district rules that may reduce groundwater production if regional drawdown exceeds allowable limits,
- Changes in regulations by groundwater conservation districts,
- Changes in the MAG,
- Impact on:
  - Endangered and threatened wildlife species,
  - Water levels in the aquifer,
  - Baseflow in streams, and
  - Wetlands.
- Substantial drawdown in existing wells, and
- Competition with others in the area for groundwater.

This water supply option has been compared to the plan development criteria, as shown in Table 5.1-3, and the option meets each criterion.

Table 5.1-1 Cost Estimate Summary for Robertson County Well Field for Bryan

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Bryan - Robertson, Bryan, New Well(s) in the Carrizo-Wilcox Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (17.8 mgd)	$20,480,000
Transmission Pipeline (20-36 in. dia., 28.2 miles)	$69,084,000
Transmission Pump Station(s) & Storage Tank(s)	$104,765,000
Well Fields (Wells, Pumps, and Piping)	$12,916,000
Water Treatment Plant (17.8 mgd)	$1,219,000
Integration, Relocations, Backup Generator & Other	$757,000
TOTAL COST OF FACILITIES	**$209,221,000**
Planning (3%)	$6,277,000
Design (7%)	$14,646,000
Construction Engineering (1%)	$2,092,000
Legal Assistance (2%)	$4,184,000
Fiscal Services (2%)	$4,184,000
Pipeline Contingency (15%)	$10,363,000
All Other Facilities Contingency (20%)	$28,028,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Bryan - Robertson, Bryan, New Well(s) in the Carrizo-Wilcox Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Environmental & Archaeology Studies and Mitigation	$1,791,000
Land Acquisition and Surveying (414 acres)	$7,181,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$9,335,000
TOTAL COST OF PROJECT	**$297,302,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$20,865,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$991,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$2,722,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$731,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (17605641 kW-hr @ 0.09 $/kW-hr)	$1,585,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$26,894,000**
Available Project Yield (acft/yr)	9,973
Annual Cost of Water ($ per acft), based on PF=2	$2,697
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$605
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$8.27
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$1.85
MP	*1/1/2025*

Table 5.1-2 Cost Estimate Summary for Brazos County Wells for Bryan

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Bryan - Brazos, Bryan, New Well(s) in the Carrizo-Wilcox Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (13.4)	$3,578,000
Transmission Pipeline (30 in. dia., 3.5 miles)	$9,999,000
Well Fields (Wells, Pumps, and Piping)	$13,769,000
Water Treatment Plant (13.4 mgd)	$918,000
Integration, Relocations, Backup Generator & Other	$42,000
TOTAL COST OF FACILITIES	**$28,306,000**
Planning (3%)	$849,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Bryan - Brazos, Bryan, New Well(s) in the Carrizo-Wilcox Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Design (7%)	$1,981,000
Construction Engineering (1%)	$283,000
Legal Assistance (2%)	$566,000
Fiscal Services (2%)	$566,000
Pipeline Contingency (15%)	$1,500,000
All Other Facilities Contingency (20%)	$3,661,000
Environmental & Archaeology Studies and Mitigation	$359,000
Land Acquisition and Surveying (73 acres)	$1,028,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,270,000
TOTAL COST OF PROJECT	**$40,369,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,837,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$238,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$89,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$551,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (4532762 kW-hr @ 0.09 $/kW-hr)	$408,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$4,123,000**
Available Project Yield (acft/yr)	7,501
Annual Cost of Water ($ per acft), based on PF=2	$550
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$171
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$1.69
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$0.53
MP	*1/1/2025*

Table 5.1-3 Comparison of Robertson County Well Field for Bryan Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Partially meets demands
2. Reliability	2. High
3. Cost	3. Reasonable

Impact Category	Comment(s)
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

Table 5.1-4 Comparison of Brazos County Wells Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Partially meets demands
2. Reliability	2. High
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

5.2 City of College Station Groundwater Strategies

5.2.1 Description of Option

The City of College Station (College Station) currently supplies all its customers with groundwater from the Sparta, Carrizo and Simsboro Aquifers in Brazos County. The City has been allocated 16,261 acft/yr of existing supply in the Carrizo-Wilcox Aquifer and 603 to 742 acft/yr of existing supply from the Sparta Aquifer through this regional planning process. College Station's population is projected to increase by more than 50 percent over the planning period, with water demands increasing a similar amount. Because of this increase, the City's needs can no longer be met with existing wells. Estimated water needs for College Station range from about 7,763 acft/yr in 2030 to 19,152 acft/yr in 2080. Several water management strategies are being considered by the City, and three are included in this plan. These include a new well field in the Carrizo-Wilcox Aquifer in Robertson County strategy, expansion of Carrizo-Wilcox groundwater production in Brazos County, and a brackish groundwater desalination from the Carrizo-Wilcox Aquifer strategy in Brazos County.

<u>Carrizo-Wilcox Groundwater in Robertson County Strategy</u>- The City has plans to produce 9,115 ac-ft/yr of groundwater from the Simsboro Formation of the Carrizo-Wilcox Aquifer in Robertson County. The City owns several properties in Robertson County near their Brazos County well field, which is where the planned production will be located. Wells are anticipated to average between 2,600 and 2,800 feet deep and capable of producing over 3,000 gpm. Figure 5.2-3 illustrates the proposed regional groundwater system for the Carrizo-Wilcox groundwater in Robertson County strategy.

<u>Carrizo-Wilcox Groundwater in Brazos County Strategy</u>- The City has plans to increase their production from the Simsboro Aquifer in Brazos County by 5,065 ac-ft/yr. The City has an existing well field in Brazos County, and in order to produce the additional planned water 2 new wells will be required. Each well is anticipated to be between 2,800 and 3,000 feet deep and capable of producing over 3,000 gpm. Figure 5.2-3 shows the location of the existing Simsboro wellfield operated by the City of College Station. The new wells are assumed to be located within the existing wellfield.

<u>Brackish Carrizo-Wilcox Groundwater in Brazos County Strategy</u>- A third strategy for the City is to produce brackish groundwater from the Simsboro Formation of the Carrizo-Wilcox Aquifer from two wells located within city limits. The nature of the Simsboro Formation in the College Station is unknown, so the potential productivity of the aquifer is unknown. A monitoring well was drilled into the Simsboro in the area in 1975, which allowed for the characterization of the expected water quality. The total dissolved solids (TDS) concentration of the Simsboro from this monitoring well was approximately 8,000 mg/L. Water from the brackish wells will either be treated with a reverse osmosis (RO) system and/or blended with other water before using as a supply. This strategy will produce 6,720 ac-ft/yr of supply for the City. College Station anticipates that wells at the two sites will be approximately 3,800 feet deep with an estimated pumping rate of 2,100 gpm in order to produce the anticipated 6 mgd for this strategy. Brackish groundwater should not be subject to MAG limitations, however this remains to be determined as the local groundwater conservation district has not passed rules regarding brackish groundwater production. Figure 5.2-2 illustrates the proposed regional groundwater system for the brackish Carrizo-Wilcox groundwater strategy.

Figure 5.2-1 Locations of College Station Robertson County Well Field and Facilities

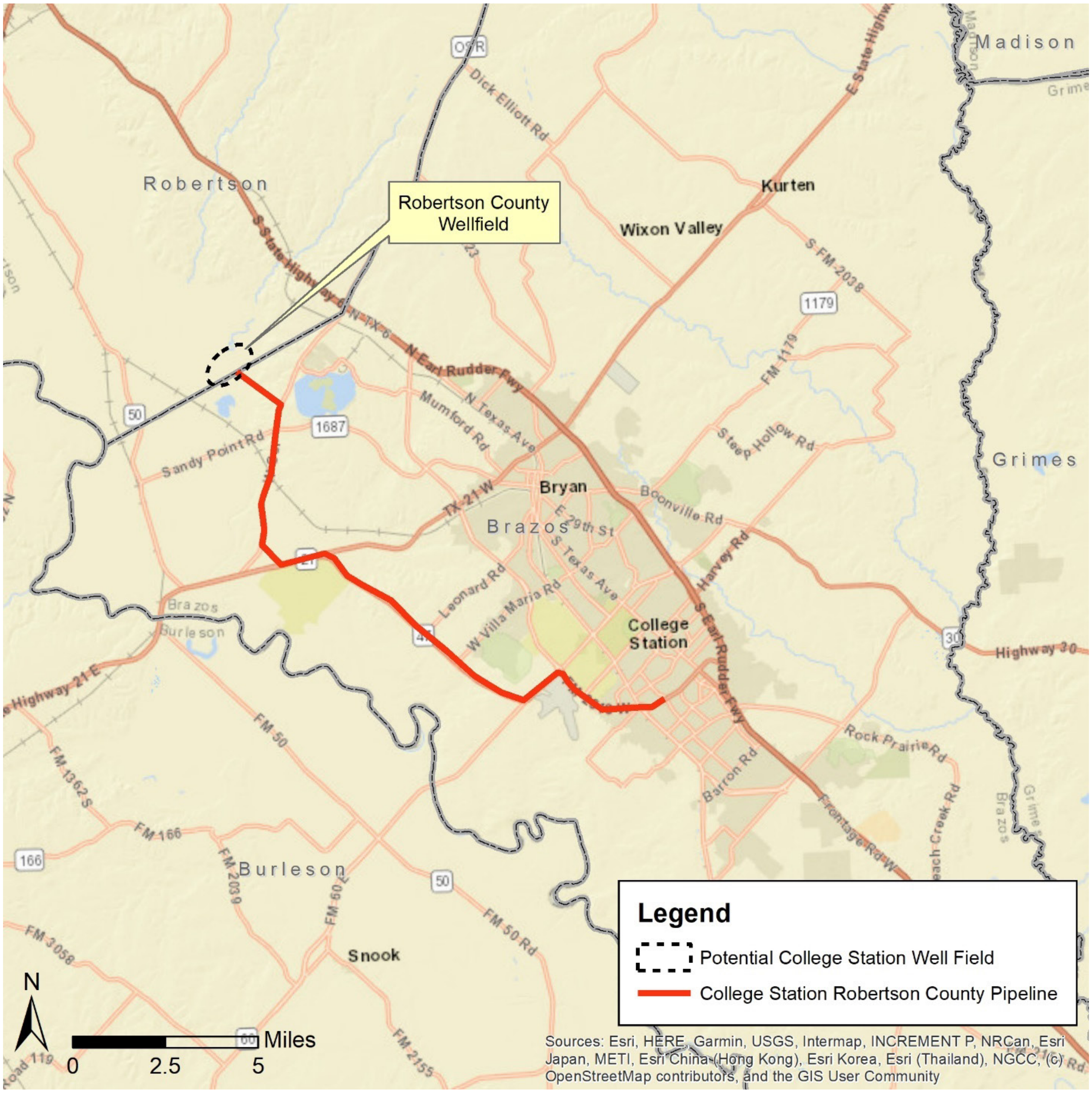


Figure 5.2-2 Location of Existing College Station Brazos County Well Field

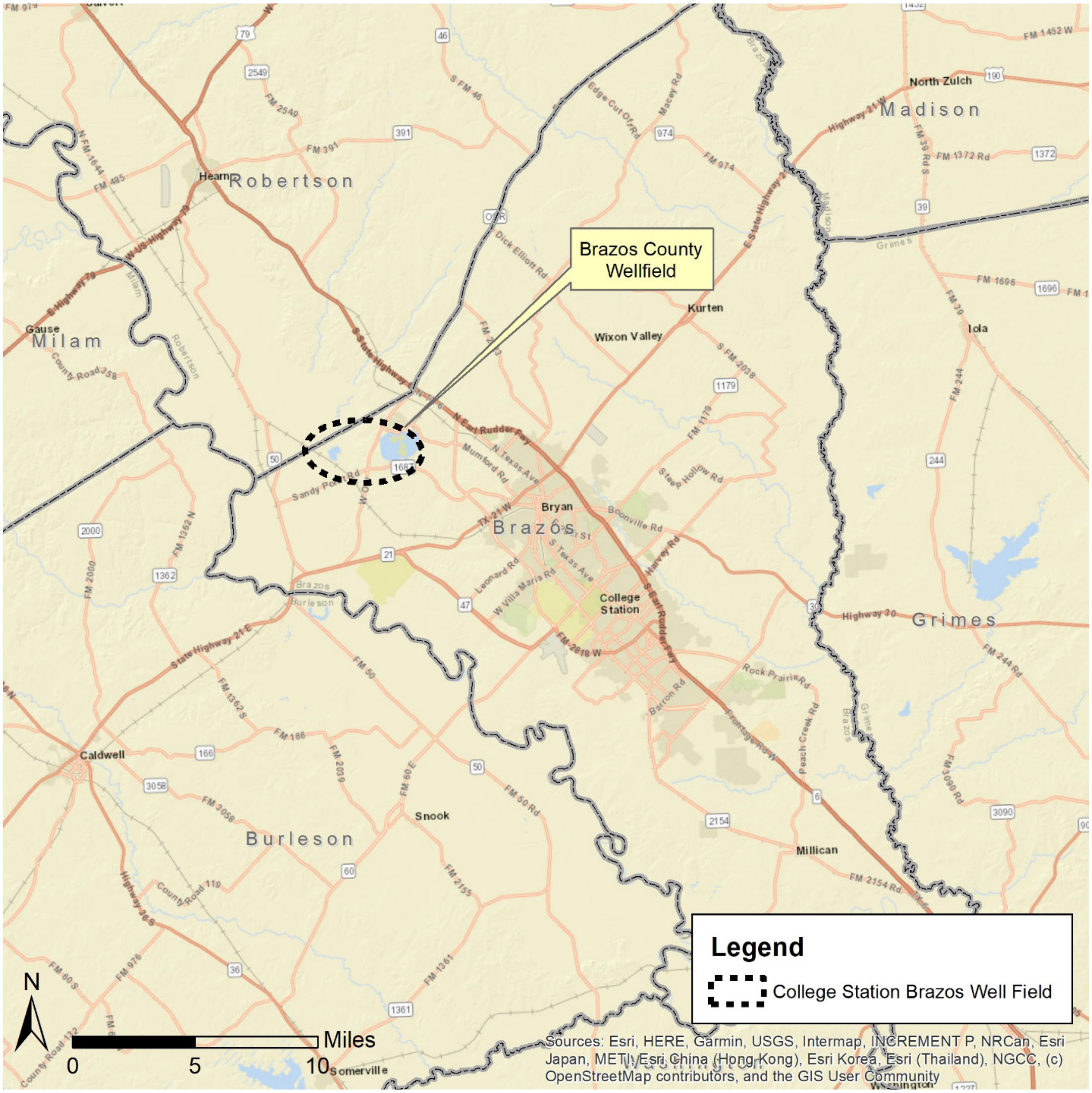
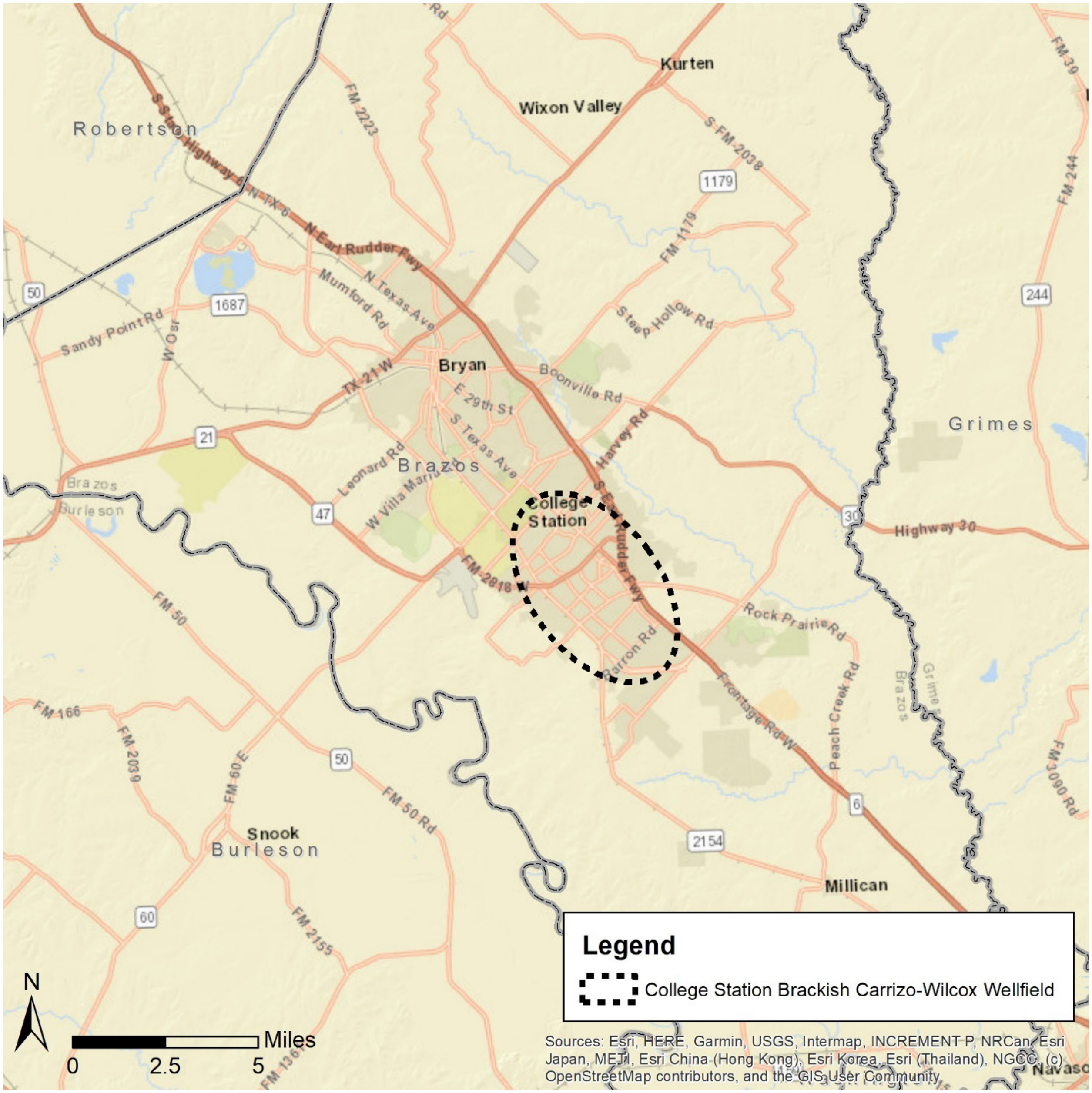


Figure 5.2-3 Location of College Station Brackish Carrizo-Wilcox Well Field



5.2.2 Available Yield

The well field in Robertson County will produce water from the Simsboro Formation of the Carrizo-Wilcox Aquifer. Based on data from nearby wells, wells should be capable of producing 3,000 to 3,500 gpm and are between 2,600 and 2,800 feet deep. The TWDB has determined that the Modeled Available Groundwater (MAG) for the Carrizo-Wilcox Aquifer in the Robertson County are 49,164 acft/yr in 2030 and increase to 88,424 acft/yr in 2080.

The additional wells in Brazos County will produce water from the Simsboro Formation of the Carrizo-Wilcox Aquifer. Based on data from existing wells in the wellfield, wells should be capable of producing 3,000 to 3,500 gpm and are between 2,800 and 3,000 feet deep. The TWDB has determined that the Modeled Available Groundwater (MAG) for the Carrizo-Wilcox Aquifer in the Robertson County are 49,164 acft/yr in 2030 and increase to 88,424 acft/yr in 2080.

The brackish well field in the College Station city limits will produce brackish groundwater from the Simsboro Formation of the Carrizo-Wilcox Aquifer. The depth of these wells is anticipated to be approximately 3,800 feet. Because there are no production wells in this part of the aquifer, the productivity of these wells is unknown, but is assumed to be approximately 2,100 gpm. However, it is important to note that the productivity of the aquifer in this area must be fully assessed prior to the development of the full project. Groundwater in this area contains approximately 8,000 mg/L of total dissolved solids. The TWDB has determined that the MAG for the Carrizo-Wilcox Aquifer in Brazos County is 44,153 acft/yr in 2030 and increase to 68,184 acft/yr in 2080. However, MAGs may not be applicable to brackish groundwater production from the aquifer.

5.2.3 Environmental Issues

The Carrizo-Wilcox strategies involve the expansion of an existing well field in Brazos County, a new Carrizo-Wilcox well field that will be located on properties owned by the City in Robertson County, and a brackish groundwater well field in the City of College Station, as well as the associated well collection pipelines and pumps, upgrades to an existing water treatment plant and a transmission pipeline. Each of the three groundwater strategies will include 2 wells. This report section discusses the potential impacts to environmental and cultural resources known to exist within the proposed project area.

The project area occurs in the Post Oak Savannah ecoregion, which lies between the Blackland Prairie to the west and the Pineywoods to the east.[1] Common woody species of this area include post oak (*Quercus stellata*), blackjack oak (*Q. marilandica*), and species of hickory (*Carya* sp.). Grasses of this area normally include little bluestem (*Schizachyrium scoparium*), indiangrass (*Sorghastrum nutans*) and switchgrass (*Panicum virgatum*).

Vegetation types as described by TPWD[2] within the project area include Post Oak Woods/Forest and a small area designated as crops. The Post Oak Woods/Forest vegetation type closely follows the species descriptions included for the Post Oak Vegetational Area above. No agricultural impacts are expected as pipelines and well locations will avoid affecting cropland. TPWD has recently produced more detailed vegetation maps called the Ecological Mapping Systems of Texas (EMST). The EMST shows the project area including Blackland Prairie disturbance or tame grassland and floodplain hardwood forest.

Construction of the collection and transmission pipelines, pump stations and wells would involve the disturbance of existing habitat. The proposed transmission pipeline would require a construction corridor and maintenance corridor after completion. Significant portions of this pipeline are located along existing rights-of-way, fencerows, and other disturbed areas, which would reduce their overall vegetative impact. Herbaceous habitats would recover quickly from impacts and would experience low negative impacts.

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[1] Gould, F.W., "The Grasses of Texas," Texas A&M University Press, College Station, Texas, 1975.
[2] McMahan, Craig A, Roy G. Frye and Kirby L. Brown. 1984. *The Vegetation Types of Texas including Cropland*. Texas Parks and Wildlife, Austin, Texas.

Outside the maintained right-of-way, land use would not be anticipated to change due to pipeline construction. However, any impacts to woody vegetation would be permanent due to required pipeline, pump and well maintenance activities.

The well field area includes sections of several creeks including Franks, Cedar, and Boggy Creeks which flow into the Brazos River, and Peach and Alum Creeks which flow into the Navasota River. Appropriate Best Management Practices (BMPs) used during pipeline construction would help minimize impacts from these pipeline construction activities. National Wetland Inventory (NWI) maps show a number of wetlands occurring along the transmission pipeline and within the well field area. These include numerous freshwater ponds, riverine wetlands, freshwater forested/shrub wetlands and a freshwater lake. Two surface waters (The Brazos River [TCEQ Segment 1242] and Carters Creek [TCEQ Segment 1209C]) were identified on the TCEQ Surface Water Quality Viewer3 within the proposed project area, or within 5 miles. Carters Creek is shown as impaired on the Surface Water Quality Viewer, however, Segment 1209C was not listed in either the 2018 or draft 2020 303(d) List. A ground survey wetland delineation would be required to determine which of these and other features would be affected by the project and to what extent. This delineation would document the locations of streambeds, stream widths, quality and type of water bodies, types of aquatic vegetation, presence of special aquatic resources and areas of jurisdictional Waters of the U.S. likely to be disturbed during construction. Coverage under a Nationwide Permit or coordination with the U.S. Army Corps of Engineers would be required for construction within waters of the U.S.

Concerns associated with the development of the well field include changes in water levels in the Carrizo-Wilcox Aquifer and potential impacts to the surrounding streams, wetlands and existing water wells found near the well field from lowered water levels. The possibility exists that water levels in the aquifers, affected by the new wells, could also affect the habitat within the area.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Brazos County can be found at https://tpwd.texas.gov/gis/rtest/.

According to the Information for Planning and Consultation (IPaC) website[4] maintained by the U.S. Fish & Wildlife Service (USFWS), the Whooping Crane, Texas fawnsfoot, and Navasota ladies-tresses need to be considered for the proposed project. The Least Tern, Piping Plover, and Red Knot were also mentioned, but only need to be considered for wind energy projects. The Whooping Crane could be a migrant through the project area, but no adverse impacts to the Whooping Crane would be expected. The Texas fawnsfoot is found in rivers and larger streams and Navasota Ladies-tresses is found on sandy loams in openings in post oak woodlands. No USFWS designated critical habitat areas occur near the project area.

[3] TCEQ, Surface Water Quality Viewer. Accessible online https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=b0ab6bac411a49189106064b70bbe778 accessed January 13, 2020.
[4] USFWS, 2020. Information for Planning and Consultation. Accessed online https://ecos.fws.gov/ipac/location/2CDHNRFRWZBEFN2BCFV527IIXM/resources January 13, 2020.

If this strategy is selected then surveys for potential habitat for these species should be initiated and coordination with USFWS for impacts to listed species.

According to the Texas Natural Diversity Data (TXNDD) obtained from the TPWD, there were 56 documented occurrences state listed threatened, endangered, and SGCN species within 5 miles of the project area these included occurrences of the following endangered species: Houston Toad, sharpnose shiner, and Navasota ladies-tresses; candidate species: smooth pimpleback and Texas fawnsfoot; state listed species: timber rattlesnake; SGCN: Strecker's chorus frog, southern crawfish frog, chub shiner, silverband shiner, eastern spotted skunk, plains spotted skunk, branched gay-feather, bristle nailwort, Florida pinkroot, Texas meadow-rue, small-headed pipewort, and Texas sunnybell.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). A review of Geographic Information System (GIS) shapefiles provided by the Texas Historical Commission identified two cemeteries, Wellborn Cemetery (approximately 300 feet east of the proposed pipeline) and Minter Springs Cemetery located approximately 0.6 mile west of the proposed well field area. No National Register Properties, National Register Districts, State Historic Sites, historical markers, or other cemeteries are located within a one-mile buffer of the proposed transmission pipeline route or well field area. Several archeological surveys have occurred adjacent to and within the project area which indicate that the probability exists for cultural resources to be present. An archeological review of the project area should be undertaken to more accurately determine impacts to cultural resources.

Because the owner or controller of the project will likely be a political subdivision of the State of Texas (i.e., municipality), they will be required to comply with the Texas Antiquities Code prior to construction. If the project will affect waters of the United States or wetlands, the project sponsor will also be required to coordinate with the U.S. Army Corps of Engineers regarding impacts to these resources.

Field surveys conducted at the appropriate phase of development should be employed to minimize the impacts of construction and operations on sensitive resources. Specific project features, such as well fields, pump stations, water treatment plants and pipelines generally have sufficient design flexibility to avoid most impacts or significantly mitigate potential impacts to geographically limited environmental and cultural resource sites.

5.2.4 Engineering and Costing

The two fresh-water Carrizo-Wilcox groundwater strategies for the College Station will be developed in phases as necessary to meet growing needs. At ultimate build out, in 2050, there will be 4 new wells along with collector pipelines, pump stations, a WTP and a transmission line that delivers the groundwater to the existing distribution system. The water treatment plant will provide disinfection and cooling before distribution. The brackish Carrizo-Wilcox groundwater strategy will include 2 wells along with collector pipelines, pump stations, a brackish desalination plant, and a transmission like that delivers the treated groundwater to the existing distribution system.

When completed, the new well field in Robertson County will have a maximum capacity of 9,115 acft/yr for College Station and the new wells in Brazos County will increase the capacity of groundwater produced in the county by 5,065 acft/yr. The brackish groundwater strategy in Brazos County will have a maximum capacity of 6,720 acft/yr. The major facilities required for these strategies are:

- Carrizo-Wilcox wells
- Well field collection pipeline(s)
- Transmission pipeline/pump stations
- Storage tanks for cooling
- Water Treatment Plant for disinfection and cooling.
- Reverse osmosis desalination plant

The approximate locations of these facilities are displayed in Figure 5.2-1.

The Carrizo-Wilcox wells are estimated to be 2,700 ft deep and have an estimated capacity of 2,746 gpm. Costs included leasing the property necessary to obtain groundwater permits, and for anticipated third party well mitigation activities to compensate for lowered pumping levels in existing wells. Power costs were estimated by calculating the horsepower needed to operate the wells and to lift the yield from the well field and to transmit the water to the existing distribution system. Based on these assumptions, it is estimated that the water obtained through the Carrizo-Wilcox well field to College Station will have a unit cost of $800 per acft/yr in the new well field in Robertson County to $303 per acft/yr for the well field expansion in Brazos County.

The brackish Carrizo-Wilcox wells are estimated to be 3,800 feet deep and have an estimated capacity of 2,083 gpm. The permitting requirements for brackish groundwater production with the Brazos Valley GCD is not known, to the need to lease property and obtain permits cannot be determined at this time. Power costs were estimated by calculating the horsepower needed to operate the wells and to lift the yield from the well field and to transmit the water to the existing distribution system. Based on these assumptions, it is estimated that the water obtained through the brackish Carrizo-Wilcox well field to College Station will have a unit cost that ranges from $2,703 to $1,551 per acft/yr after debt service.

5.2.5 Implementation Issues

Implementation of the College Station Carrizo-Wilcox County Groundwater Strategy with a well field in Robertson County may involve conflicts with other planned water supply projects, in particular relating to the MAG. This area in Robertson County is where several other potential large groundwater projects are located. Potential issues with this strategy include:

- Exposure to groundwater conservation district rules that may reduce groundwater production if regional drawdown exceeds allowable limits,
- Changes in regulations by groundwater conservation districts,
- Changes in the MAG,
- Impact on:
  - Endangered and threatened wildlife species,
  - Water levels in the aquifer,

- » Baseflow in streams, and
- » Wetlands.

- Substantial drawdown in existing wells, and
- Competition with others in the area for groundwater.

This water supply option has been compared to the plan development criteria, as shown in Table 5.2-4, and the option meets each criterion.

Implementation of the College Station Carrizo-Wilcox County Groundwater Strategy with additional wells in Brazos County may involve conflicts with other planned water supply projects, in particular relating to the MAG. This area in Brazos County is near where several other potential large groundwater projects are located. Potential issues with this strategy include:

- Exposure to groundwater conservation district rules that may reduce groundwater production if regional drawdown exceeds allowable limits,
- Changes in regulations by groundwater conservation districts,
- Changes in the MAG,
- Impact on:
  - » Endangered and threatened wildlife species,
  - » Water levels in the aquifer,
  - » Baseflow in streams, and
  - » Wetlands.
- Substantial drawdown in existing wells, and
- Competition with others in the area for groundwater.

This water supply option has been compared to the plan development criteria, as shown in Table 5.2-5, and the option meets each criterion.

Implementation of the College Station brackish Carrizo-Wilcox County Groundwater Strategy with a well field in the City of College Station in Brazos County may involve conflicts with other planned water supply projects. The impact of brackish groundwater production on water levels in the fresh portion of the aquifer is unknown, as is the impact of large amounts of production that may occur in the fresh portion of the aquifer to the north on water levels in the College Station area. Whether or not the production from a brackish groundwater well field will be subject to limitations based on the MAGs may depend on whether production from this well field impact water levels elsewhere in the aquifer, and therefore the DFCs for Brazos County. Potential issues with this strategy include:

- Exposure to groundwater conservation district rules that may reduce groundwater production based on the extent of drawdowns due to production from the well field,
- Changes in regulations by groundwater conservation districts,
- Changes in the MAG, if production is subject to MAG limitations,
- Uncertainty in the productivity of the Simsboro Aquifer in the planned project area,
- Uncertainty in the extent of impacts from groundwater production in the planned project area, including potential impacts to existing wells in the fresh portion of the aquifer, and

- Impact on:
  - Endangered and threatened wildlife species,
  - Water levels in the aquifer,
  - Baseflow in streams, and
  - Wetlands.

This water supply option has been compared to the plan development criteria, as shown in Table 5.2-6, and the option meets each criterion.

Table 5.2-1 Cost Estimate Summary for Robertson County Well Field for College Station

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
College Station - Robertson, College Station, New Well(s) in the Carrizo-Wilcox Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (0 mgd)	$5,225,000
Transmission Pipeline (20 in. dia., 20 miles)	$32,785,000
Transmission Pump Station(s) & Storage Tank(s)	$13,809,000
Well Fields (Wells, Pumps, and Piping)	$10,805,000
Integration, Relocations, Backup Generator & Other	$100,000
TOTAL COST OF FACILITIES	**$62,724,000**
- Planning (3%)	$1,882,000
- Design (7%)	$4,391,000
- Construction Engineering (1%)	$627,000
Legal Assistance (2%)	$1,254,000
Fiscal Services (2%)	$1,254,000
Pipeline Contingency (15%)	$4,918,000
All Other Facilities Contingency (20%)	$5,988,000
Environmental & Archaeology Studies and Mitigation	$929,000
Land Acquisition and Surveying (67 acres)	$1,206,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$2,765,000
TOTAL COST OF PROJECT	**$87,938,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$6,180,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$470,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$392,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
College Station - Robertson, College Station, New Well(s) in the Carrizo-Wilcox Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (2730251 kW-hr @ 0.09 $/kW-hr)	$246,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$7,288,000**
Available Project Yield (acft/yr)	9,115
Annual Cost of Water ($ per acft), based on PF=2	$800
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$122
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$2.45
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$0.37
MP	*1/1/2025*

Table 5.2-2 Cost Estimate Summary for Brazos County Wells for College Station

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
College Station - Brazos, College Station, New Well(s) in the Carrizo-Wilcox Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$11,844,000
TOTAL COST OF FACILITIES	**$11,844,000**
- Planning (3%)	$355,000
- Design (7%)	$829,000
- Construction Engineering (1%)	$118,000
Legal Assistance (2%)	$237,000
Fiscal Services (2%)	$237,000
All Other Facilities Contingency (20%)	$2,369,000
Environmental & Archaeology Studies and Mitigation	$109,000
Land Acquisition and Surveying (4 acres)	$76,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$526,000
TOTAL COST OF PROJECT	**$16,700,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,175,000
Reservoir Debt Service (3.5 percent, 40 years)	$0

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
College Station - Brazos, College Station, New Well(s) in the Carrizo-Wilcox Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$118,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (2663311 kW-hr @ 0.09 $/kW-hr)	$240,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,533,000**
Available Project Yield (acft/yr)	**5,065**
Annual Cost of Water ($ per acft), based on PF=0	**$303**
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	**$71**
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	**$0.93**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	**$0.22**
MP	*1/1/2025*

Table 5.2-3 Cost Estimate Summary for Brackish Groundwater in Brazos County for College Station

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
College Station-Brackish - Brazos, College Station-Brackish, New Well(s) in the Carrizo-Wilcox Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$25,067,000
Water Treatment Plant (6 mgd)	$53,560,000
TOTAL COST OF FACILITIES	**$78,627,000**
- Planning (3%)	$2,359,000
- Design (7%)	$5,504,000
- Construction Engineering (1%)	$786,000
Legal Assistance (2%)	$1,573,000
Fiscal Services (2%)	$1,573,000
All Other Facilities Contingency (20%)	$15,726,000
Environmental & Archaeology Studies and Mitigation	$262,000
Land Acquisition and Surveying (11 acres)	$207,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$3,466,000
TOTAL COST OF PROJECT	**$110,083,000**

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
College Station-Brackish - Brazos, College Station-Brackish, New Well(s) in the Carrizo-Wilcox Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
ANNUAL COST	x
Debt Service (3.5 percent, 20 years)	$7,746,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$251,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$9,738,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (4785469 kW-hr @ 0.09 $/kW-hr)	$431,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$18,166,000**
Available Project Yield (acft/yr)	**6,720**
Annual Cost of Water ($ per acft), based on PF=0	**$2,703**
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	**$1,551**
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	**$8.29**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	**$4.76**
MP	*1/1/2025*

Table 5.2-4 Comparison of Robertson County Well Field for College Station Groundwater Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Partially meets demands
2. Reliability	2. High
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	None

Impact Category	Comment(s)
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

Table 5.2-5 Comparison of Brazos County Wells for College Station Groundwater Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Partially meets demands
2. Reliability	2. High
3. Cost	???
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

Table 5.2-6 Comparison of Brackish Groundwater in Brazos County for College Station Groundwater Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Partially meets demands
2. Reliability	2. High
3. Cost	???
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None

Impact Category	Comment(s)
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

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5.3 City of Georgetown Groundwater Strategies

5.3.1 Description of Option

The City of Georgetown is one of the fastest growing areas in the country and is projected to have needs in excess of 100,000 ac-ft/yr by 2080. Because of the size of the needs projected for the City, no single water management strategy will be able to provide all of the water required by the City for the entire planning period. Several groundwater strategies have been developed to help meet the future needs of the City. These include groundwater in Lee County, groundwater from the Carrizo-Wilcox Aquifer in Robertson County, and groundwater from the Trinity Aquifer in Williamson County.

Lee County Groundwater Strategy- The City of Georgetown has contracted with GateHouse Water, LLC (GateHouse) for GateHouse to supply 18,500 ac-ft/yr of water to the City of Georgetown. GateHouse currently has three existing wells completed in the Simsboro portion of the Carrizo-Wilcox Aquifer in eastern Lee County and has permits for 18,500 ac-ft/yr from the Lost Pines Groundwater Conservation District. A review of the MAG for the Carrizo-Wilcox in Lee County after existing supplies are accounted for shows availability from 15,461 acft/yr in 2030 increasing to about 20,410 acft/yr in 2080. Due to MAG limitations this will have to be a partially alternative strategy. Figure 5.3-1 illustrates the proposed regional groundwater system for the Lee County Groundwater strategy. Lone Star Regional Water Authority has expressed interest in partnering with GateHouse to fund the development of GateHouse's infrastructure, but the final configuration of sponsorship for this strategy has not been determined. The RWPG supports the recommendation of this project in whichever sponsorship configuration is implemented. The sponsorship configuration presented herein is for the purposes of representation within the 2026 Brazos G RWP.

Additionally, the City is exploring a partnership with Recharge Water, LP (Recharge) for Recharge to deliver up to 34,800 ac-ft/yr of water to the City in three phases: an initial 10,000 ac-ft/year in 2030, an additional 10,000 ac-ft/year by 2034, and another additional 14,800 ac-ft/year in 2039. Recharge has already secured the necessary operating and transport permits from the Lost Pines Groundwater Conservation District.

Georgetown Hosston Groundwater Strategy- The City has plans to install three wells at two different sites to produce groundwater from the Hosston Formation, which is the deepest of the aquifer units within the Trinity Aquifer. Each well will have a capacity of producing 4 mgd of groundwater with total dissolved solids between 1,000 and 1,400 mg/L, which will be blended with other supplies prior to being used as a supply for the City. This strategy will produce 8,645 ac-ft/yr of supply for the City. Wells at the two sites are anticipated to be 2,000 to 2,500 feet deep with an estimated pumping rate of 2,000 gpm in order to produce the anticipated 4 mgd per well. Water from the two well sites will be moved to a proposed pipeline from Circleville to South Lake WTP. Due to MAG limitations this will have to be an alternative strategy. Figure 5.3-2 illustrates the proposed regional groundwater system for the Hosston groundwater strategy.

Carrizo-Wilcox Groundwater in Robertson County Strategy- The City has plans to obtain 39,399 ac-ft/yr of groundwater from the Simsboro Formation of the Carrizo-Wilcox Aquifer in Robertson County. Wells are anticipated to average between 1,200 and 1,500 feet deep and capable of producing between 1,000 and 3,000 gpm. Figure 5.3-3 illustrates the proposed regional groundwater system for the Carrizo-Wilcox groundwater in Robertson County strategy.

Figure 5.3-1 Locations of Planned Gatehouse Well Field and Facilities

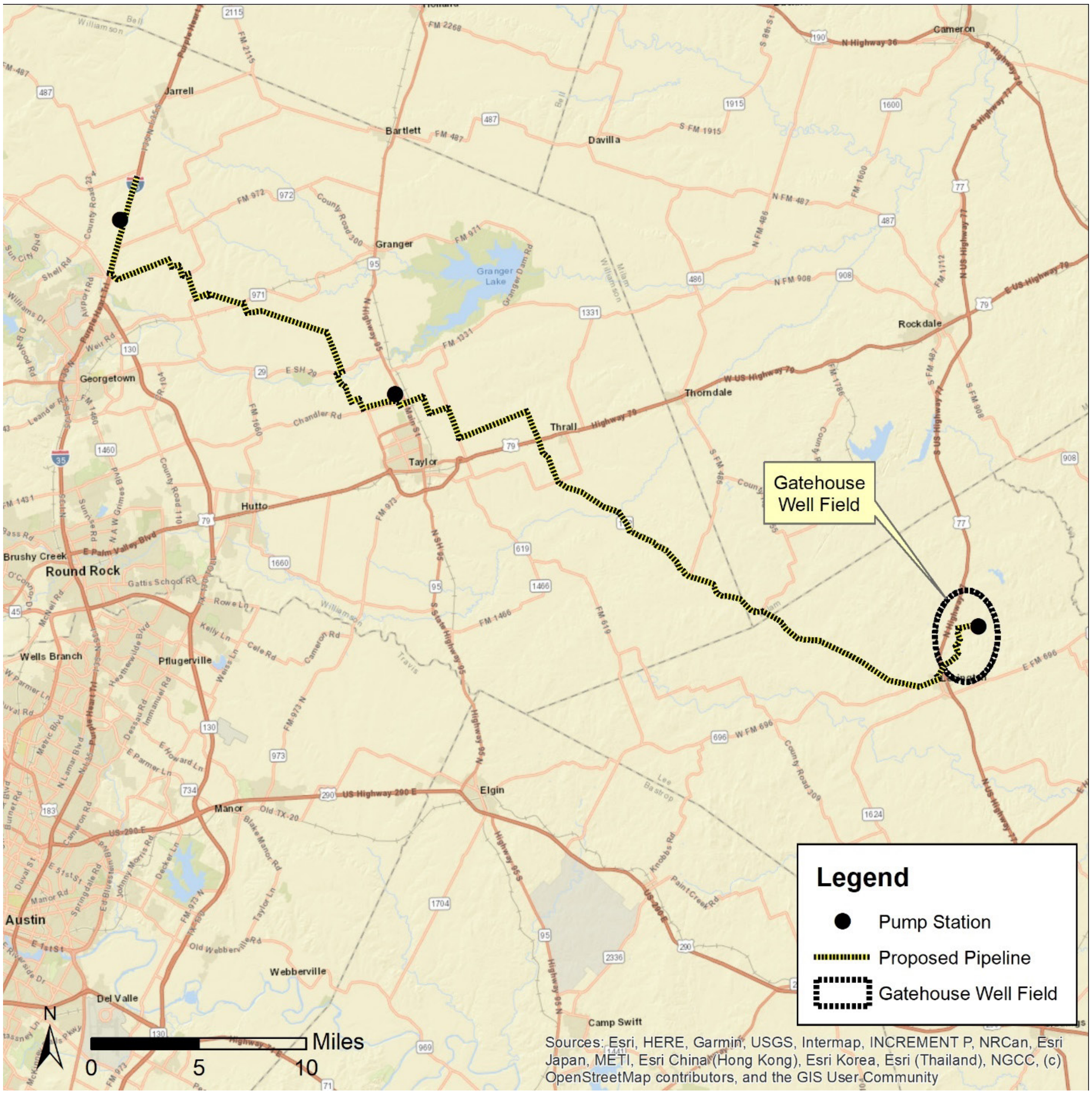


Figure 5.3-2 Locations of Planned Hosston Well Field and Facilities

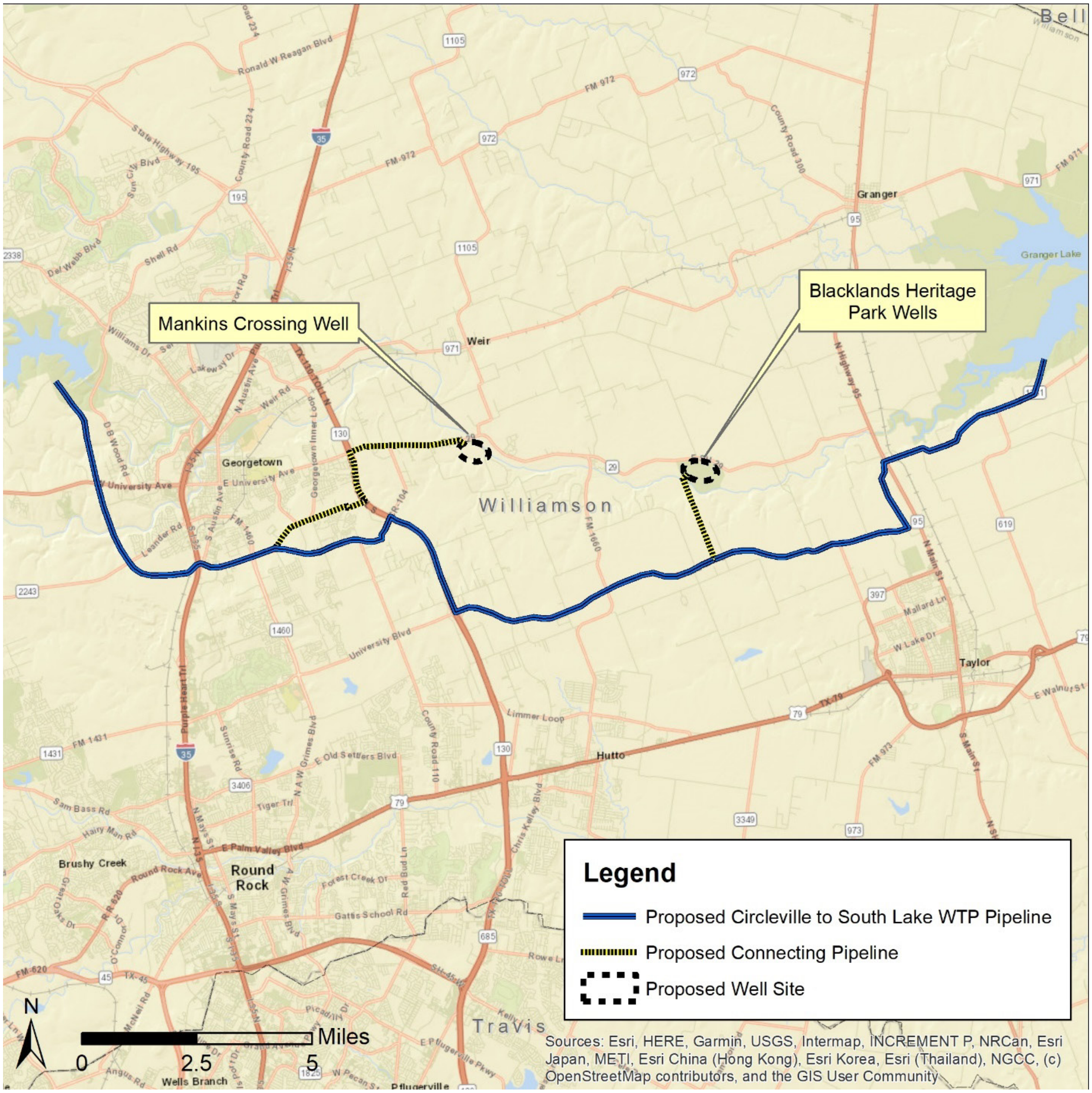
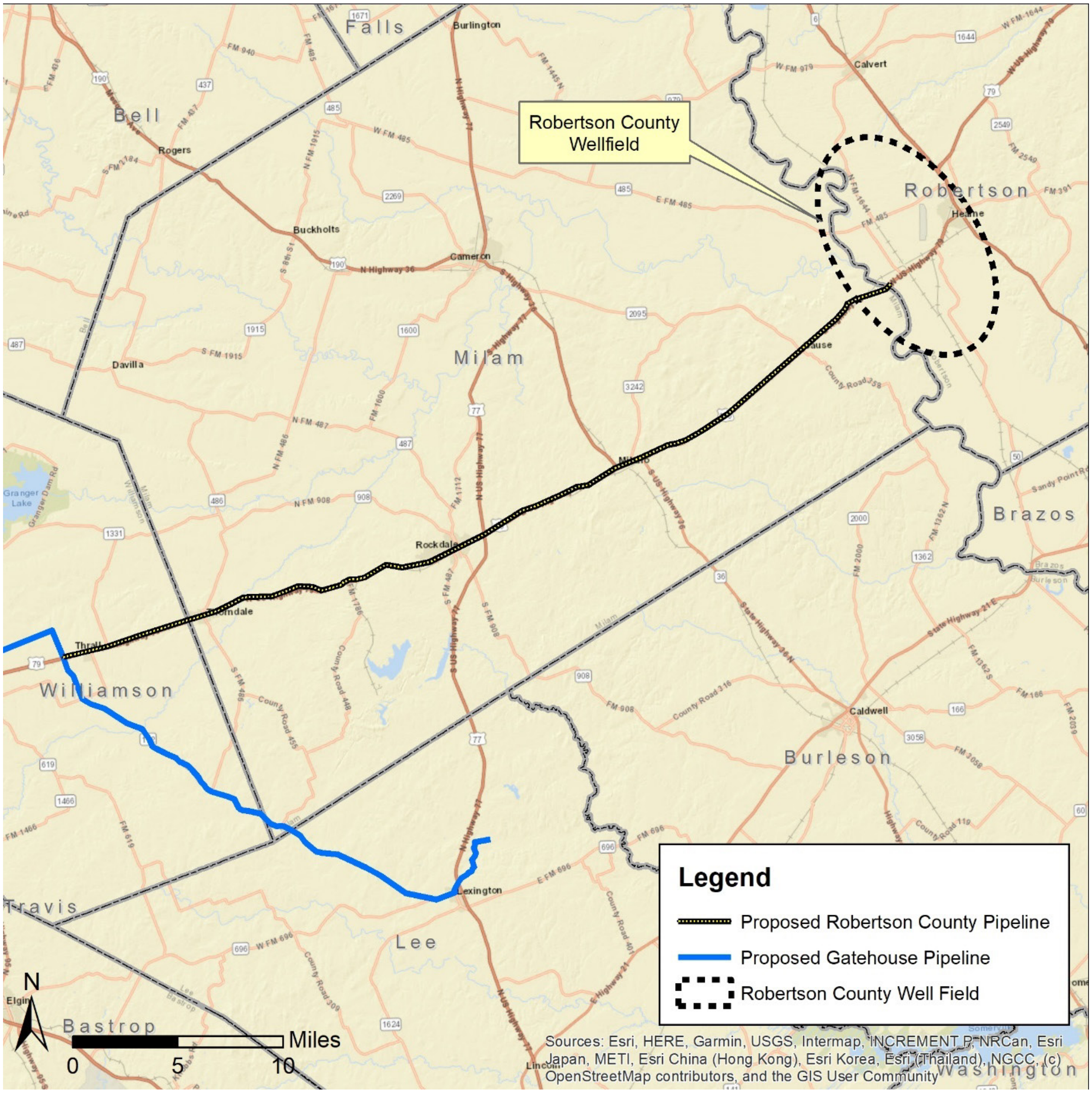


Figure 5.3-3 Locations of Planned Carrizo-Wilcox in Robertson County Well Field and Facilities



5.3.2 Available Yield

The Gatehouse well field in Lee County will produce water from the Simsboro Formation of the Carrizo-Wilcox Aquifer. According to data from the three existing Gatehouse wells, these wells are capable of producing 2,500 to 5,000 gpm and are between 2,100 and 2,200 feet deep. The TWDB has determined that the Modeled Available Groundwater (MAG) for the Carrizo-Wilcox Aquifer in the Lost Pines GCD are 75,946 acft/yr in 2030 and 101,766 acft/yr in 2080. The portion of the Lost Pines GCD MAG in Lee County is 29,283 acft/yr in 2030 and increases to 36,187 acf/yr in 2080. Because the MAGs are less than the existing supplies and planned strategies in the county, the Lone Star RWA/Gatehouse project will be a partially alternative strategy.

The Hosston wells in Williamson County will produce water from the Hosston Formation of the Trinity Aquifer. The depth of these wells is anticipated to be between 2,000 and 2,500 feet and the wells should be capable of producing approximately 2,000 gpm in order to produce the planned 4 mgd per well. The TWDB has determined that the MAG for the Trinity Aquifer Williamson County is 1,746 acft/yr, which is less than the anticipated production of this project, and therefore this will be an alternative strategy.

The Robertson County strategy will produce water from the Simsboro Formation of the Carrizo-Wilcox Aquifer. A combination of existing and new wells is anticipated for this strategy, with wells producing between 1,000 and 3,000 gpm. The TWDB has determined that the MAGs for the Carrizo-Wilcox Aquifer in the Brazos Valley GCD are 77,496 acft/yr in 2030 and 156,608 acft/yr in 2080. The portion of the Brazos Valley GCD MAG in Robertson County is 39,350 acft/yr in 2030 and increases to 88,424 acf/yr in 2080. These MAGs are less than the planned supply for this project and therefore this will be a partially alternative strategy.

5.3.3 Environmental Issues

The Georgetown strategies involve the development of two new well fields, one each in Robertson and Lee counties, and the installation of brackish wells in Williamson County, associated well collection pipelines and pumps, drop-off(s), and distribution pipeline system(s). The Lee County well field will include 3 Carrizo-Wilcox (Simsboro) Aquifer wells, which have already been installed. The number of wells in the Robertson County well field will depend on the total permits obtained, but may include up to 10 Simsboro wells if average production from each well is approximately 3,000 gpm. This report section discusses the potential impacts to environmental and cultural resources known to exist within the proposed project area.

The western portion of the project area includes land in the Cross Timbers and Prairies vegetational area, the central portion occurs within the Blackland Prairie vegetational area and the eastern end including the well fields occurs in the Post Oak Savannah vegetational area.[1] The Cross Timbers and Prairies vegetational area includes rolling to hilly areas which are deeply dissected causing rapid surface drainage. Differences in soils and topography within this area result in sudden changes in vegetation cover. Tall grasses in this area predominantly include little bluestem (*Schizachyrium scoparium* var. *frequens*), big bluestem (*Andropogon gerardii*), indiangrass (*Sorghastrum nutans*), and Texas wintergrass (*Nassella leucotricha*). Common woody species of the Post Oak Savannah vegetational area include post oak (*Quercus stellata*), blackjack oak (*Q. marilandica*), and species of hickory (*Carya* sp.). Grasses of the Post Oak Savannah commonly include little bluestem, indiangrass and switchgrass (*Panicum* virgatum).

The Blackland Prairies vegetational area includes a rolling and well-dissected vegetational area that was historically a luxuriant tallgrass prairie dominated by little bluestem, big bluestem, indiangrass, and dropseeds (*Sporobolus* sp.). During the turn of the 20th century, the majority of the Blackland Prairie was cultivated for crops. Livestock production within this area has increased dramatically since the 1950s and now only about half of the area is used for cropland. Grazing pressure has caused an increase in grass species such as sideoats grama (*Bouteloua curtipendula*), hairy grama (*B. hirsuta*), Mead's sedge (*Carex meadii*), Texas wintergrass and buffalograss (*Buchloe dactyloides*). Common woody species of this area include mesquite (*Prosopis glandulosa*), huisache (*Acacia smallii*), oak (*Quercus* sp.) and elm (*Ulmus* sp.).

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[1] Gould, F.W., "The Grasses of Texas," Texas A&M University Press, College Station, Texas, 1975.

Oak, elm, cottonwood (*Populus* sp.) and pecan are common along drainages. No agricultural impacts are expected as pipelines and well locations will avoid affecting cropland.

Construction of the pipelines, pumps and wells would involve the disturbance of existing habitat. The proposed shared distribution system pipeline would require a construction corridor and maintenance corridor after completion. Significant portions of the pipeline segments are located along existing rights-of-way, fencerows, and other disturbed areas including cropland, which would reduce their overall vegetative impact. Herbaceous habitats would recover quickly from impacts and would experience low negative impacts. Outside the maintained right-of-way, land use would not be anticipated to change due to pipeline construction. However, any impacts to woody vegetation would be permanent due to required pipeline, pump and well maintenance.

The proposed pipeline would cross numerous waterbodies including several tributaries of the San Gabriel River and Yegua Creeks. Appropriate Best Management Practices (BMPs) used during pipeline construction would help minimize impacts from project construction activities. National Wetland Inventory (NWI) maps show wetlands which occur along creeks crossed by the raw water pipelines and within the well field areas. A ground survey wetland delineation would be required to determine which of these and other features would be affected by the project and to what extent. This delineation would document the locations of streambeds, stream widths, quality and type of water bodies, types of aquatic vegetation, presence of special aquatic resources and areas of jurisdictional Waters of the U.S. likely to be disturbed during construction. Coordination with the U.S. Army Corps of Engineers would be required for construction within waters of the U.S. Impacts from the proposed project resulting in a loss of less than 0.5 acres of waters of the U.S. could be covered under Nationwide Permit #12 for Utility Line Activities.

Concerns associated with the development of the well field areas include changes in water levels in the two aquifers and potential impacts to the surrounding streams, wetlands or existing water wells near the well fields. The possibility exists that water levels in the aquifers, affected by the new wells, could affect the habitat within the area. Waters of the U.S. found approximate to the project well field areas include several tributaries of Yegua Creek in Lee County, Davidson Creek in Burleson County, and Little River, Pond Creek, and the Brazos River in Milam County.

The Draft 2018 Texas Integrated Report - Texas 303(d) List identifies the water bodies in or bordering Texas for which effluent limitations are not stringent enough to implement water quality standards, and for which the associated pollutants are suitable for measurement by maximum daily load. This list includes several segments within 5 miles of project components, including portions of Brushy Creek, Willis Creek, Little Creek, Big Elm Creek, Mud Creek, Pin Oak Creek, Spring Creek, Davison Creek, and Middle Yegua Creek for elevated bacteria levels. Davidson Creek was also listed for depressed dissolved oxygen. These listed segments were classified as 5b, which means a review of standards for one or more parameters will be conducted before a management strategy for this segment is selected; including the possible revision to the water quality standards or 5c, which means additional information needs to be collected or evaluated for one or more parameters prior to selecting a management strategy.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Burleson, Lee, Milam and Williamson counties can be found at https://tpwd.texas.gov/gis/rtest/.

The Texas Natural Diversity Database (TXNDD) was reviewed for recorded occurrences of listed or rare species within or near the project area. This database included documented occurrences of four federally-listed species, the sharpnose shiner (*Notropis oxyrhynchus*), smooth pimpleback (*Quadrula houstonensis*), Texas fawnsfoot (*Trunchilla macrodon*), and Navasota ladies' tresses (*Spiranthes parksii*). The sharpnose shiner is listed as endangered and was documented within the proposed Milam County well field in the Brazos River. The smooth pimpleback and Texas fawnsfoot were listed as a federal candidate species and state threatened; these species were documented within the proposed Milam County well field and along the Little, Brazos, and San Gabriel Rivers in Milam and Williamson counties. Navasota ladies' tresses are federal and state listed endangered; this species was documented near the Milam County well field south of the southernmost pipeline in Milam County. The timber (canebrake) rattlesnake (*Crotalus horridus*) and false spike mussel (*Fusconaia mitchelli*) are state listed as threatened species. The timber (canebrake) rattlesnake was documented in Lee County within two miles of the proposed pipeline and the false spike mussel was documented within two miles of the proposed project pipelines in the San Gabriel and Little rivers in Milam and Williamson counties. . Several other species of concern were identified within two miles of the proposed well fields and pipelines. Species of concern are considered to be rare, but are not protected by USFWS or TPWD.

Suitable habitat for federal or state listed species may exist within the project area, however, significant impacst to these species would not be anticipated due to limited area that will be impacted by the project, the abundance of similar habit near the project area and these species ability to relocate to those areas if necessary. The presence or absence of potential habitat does not confirm the presence or absence of a listed species. No species specific surveys were conducted in the project area for this report.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). A review of Geographic Information System (GIS) shapefiles provided by the Texas Historical Commission reveals that there are two National Register Properties (the Thomas & Mary Kraitchar House in Burleson County and Dr. Nathan & Lula Cass House in Milam County), one National Register Historic District (the Hutto Commercial Historic District in Williamson County), and 13 cemeteries located within 500 feet of the proposed pipeline route or well field areas. In addition, numerous archeological surveys have occurred adjacent to and within the project area which indicate that a high probability exists for cultural resources to be present. An archeological survey of the project area should be undertaken to more accurately determine actual impacts to cultural resources.

Because the owner or controller of the project will likely be a political subdivision of the State of Texas (i.e., river authority, municipality, county, etc.), they will be required to coordinate with the Texas Historical Commission prior to project construction. If the project will affect waters of the United States or wetlands, the project sponsor will also be required to coordinate with the U.S. Army Corps of Engineers regarding impacts to these resources.

Field surveys conducted at the appropriate phase of development should be employed to minimize the impacts of construction and operations on sensitive resources. Specific project features, such as well fields, pump stations and pipelines generally have sufficient design flexibility to avoid most impacts or significantly mitigate potential impacts to geographically limited environmental and cultural resource sites.

5.3.4 Engineering and Costing

The envisioned Georgetown groundwater projects will be developed in phases as necessary to meet growing needs. At build-out, the Robertson County well field project may include up to 10 Carrizo-Wilcox (Simsboro) Aquifer wells. The Lee County well field at buildout includes 3 Carrizo-Wilcox Aquifer wells, which have already been installed. Three brackish Trinity Aquifer wells are planned to be installed in Williamson County. Other facilities include well field collection pipelines, transmission line(s), and pump station(s) to deliver the raw groundwater to a shared WTP/distribution system. For purposes of this study, the well fields are started at the beginning of the planning period to meet 2030 needs. Water treatment plant(s) will provide disinfection and cooling before the water enters the shared distribution system. Groundwater produced from the brackish wells will need desalination, and therefore a reverse osmosis treatment plant will be required for that project. When completed, the Robertson County well field will have a maximum capacity of 39,399 acft/yr and the Lee County well field will have a maximum capacity of 18,500 acft/yr. These capacities exceed the remaining groundwater availability under the MAG accounting for projected local demands. The combined capacity by 2080 for these strategies is 66,544 acft/yr. The major facilities required for this strategy are:

- Wells
- Well field collection pipeline(s)
- Transmission Pipeline/Pump Station(s)
- Water Treatment Plant/Pump Station(s)
- Desalination plant
- Distribution system

The approximate locations of these facilities are displayed in Figure 5.3-1 to 5.3-3. For both the Robertson County and Gatehouse/Lone Star RWA projects, all of the supply will be coming from the Carrizo-Wilcox (Simsboro) Aquifer wells. Power costs were estimated by calculating the horsepower needed to operate the wells and pump the water from the well fields to the WTP. Costs were included for leasing property necessary to obtain groundwater permits, and for anticipated third party well mitigation activities to compensate for lowered pumping levels in existing wells. Based on these assumptions, it is estimated that the water obtained through the Robertson and Lee county well fields excluding the shared pipeline and associated pump stations will have a unit cost that ranges from $968 per acft/yr to $1,962 per acft/yr (Tables 5.3-1 and 5.3-3).

For the Williamson County brackish project, the supply will be coming from the brackish portion of the Trinity Aquifer. Power costs were estimated by calculating the horsepower needed to operate the wells and to pump the water to the desalination plant and the WTP. Costs were included for leasing property necessary to obtain groundwater permits, and for anticipated third party well mitigation activities to compensate for lowered pumping levels in existing wells. Based on these assumptions, it is estimated that the water obtained through the Williamson County brackish wells excluding the pipeline and associated pump stations will have a unit cost that ranges from $513 per acft/yr (Table 5.3-2).

5.3.5 Implementation Issues

Implementation of the three City of Georgetown groundwater strategies may involve limited conflicts with other planned water supply projects, in particular relating to the MAG. Major issues with these strategies include:

- Exposure to groundwater conservation district rules that may reduce groundwater production if regional drawdown exceeds allowable limits,
- Changes in regulations by groundwater conservation districts,
- Changes in the MAG,
- Impact on:
  - Endangered and threatened wildlife species,
  - Water levels in the aquifer,
  - Baseflow in streams, and
  - Wetlands.
- Substantial drawdown in existing wells, and
- Competition with others in the area for groundwater.

These water supply options have been compared to the plan development criteria, as shown in Table 5.3-4, and 5.3-5, and the option meets each criterion.

Table 5.3-1 Cost Estimate Summary for Gatehouse Well Field for Georgetown

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Lee County – Gatehouse/Lonestar RWA- New Well(s) in the Carrizo-Wilcox	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (0 mgd)	$20,676,000
Transmission Pipeline (42 in. dia., 58.7 miles)	$232,601,000
Transmission Pump Station(s) & Storage Tank(s)	$23,997,000
Well Fields (Wells, Pumps, and Piping)	$32,277,000
Storage Tanks (Other Than at Booster Pump Stations)	$10,942,000
Integration, Relocations, Backup Generator & Other	$291,000
TOTAL COST OF FACILITIES	**$320,784,000**
- Planning (3%)	$9,624,000
- Design (7%)	$22,455,000
- Construction Engineering (1%)	$3,208,000
Legal Assistance (2%)	$6,416,000
Fiscal Services (2%)	$6,416,000
Pipeline Contingency (15%)	$34,890,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Lee County – Gatehouse/Lonestar RWA- New Well(s) in the Carrizo-Wilcox	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
All Other Facilities Contingency (20%)	$17,637,000
Environmental & Archaeology Studies and Mitigation	$2,496,000
Land Acquisition and Surveying (172 acres)	$3,732,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$13,890,000
TOTAL COST OF PROJECT	**$441,548,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$31,047,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,794,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$1,034,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (15741931 kW-hr @ 0.09 $/kW-hr)	$1,417,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$36,292,000**
Available Project Yield (acft/yr)	**18,500**
Annual Cost of Water ($ per acft), based on PF=2	**$1,962**
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	**$284**
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	**$6.02**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	**$0.87**
MP	*1/1/2025*

Table 5.3-2 Cost Estimate Summary for Hosston Wells for Georgetown

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Georgetown, Trinity Hosston - Williamson, Georgetown, New Well(s) in the Trinity-Hosston Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$32,382,000
TOTAL COST OF FACILITIES	**$32,382,000**
- Planning (3%)	$971,000
- Design (7%)	$2,267,000
- Construction Engineering (1%)	$324,000
Legal Assistance (2%)	$648,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Georgetown, Trinity Hosston - Williamson, Georgetown, New Well(s) in the Trinity-Hosston Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Fiscal Services (2%)	$648,000
All Other Facilities Contingency (20%)	$6,476,000
Environmental & Archaeology Studies and Mitigation	$596,000
Land Acquisition and Surveying (24 acres)	$352,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,452,000
TOTAL COST OF PROJECT	**$46,116,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,245,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$324,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (9580225 kW-hr @ 0.09 $/kW-hr)	$862,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$4,431,000**
Available Project Yield (acft/yr)	**8,645**
Annual Cost of Water ($ per acft), based on PF=0	**$513**
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	**$137**
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	**$1.57**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	**$0.42**
MP	*1/1/2025*

Table 5.3-3 Cost Estimate Summary for Carrizo-Wilcox Well Field in Robertson County for Georgetown

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Georgetown, Robertson - Robertson, Georgetown, New Well(s) in the Carrizo-Wilcox-Simsboro Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (0 mgd)	$19,811,000
Transmission Pipeline (54 in. dia., 45.5 miles)	$244,789,000
Transmission Pump Station(s) & Storage Tank(s)	$24,553,000
Well Fields (Wells, Pumps, and Piping)	$48,421,000
Integration, Relocations, Backup Generator & Other	$299,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Georgetown, Robertson - Robertson, Georgetown, New Well(s) in the Carrizo-Wilcox-Simsboro Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
TOTAL COST OF FACILITIES	**$337,873,000**
- Planning (3%)	$10,136,000
- Design (7%)	$23,651,000
- Construction Engineering (1%)	$3,379,000
Legal Assistance (2%)	$6,757,000
Fiscal Services (2%)	$6,757,000
Pipeline Contingency (15%)	$36,718,000
All Other Facilities Contingency (20%)	$18,617,000
Environmental & Archaeology Studies and Mitigation	$1,846,000
Land Acquisition and Surveying (135 acres)	$2,435,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$14,556,000
TOTAL COST OF PROJECT	**$462,725,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$32,537,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,983,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$991,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (18247577 kW-hr @ 0.09 $/kW-hr)	$1,642,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$38,153,000**
Available Project Yield (acft/yr)	39,399
Annual Cost of Water ($ per acft), based on PF=2	$968
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$143
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$2.97
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$0.44
MP	*1/1/2025*

Table 5.3-4 Comparison of Gatehouse Well Field for Georgetown Groundwater Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Partially meets demands

Impact Category	Comment(s)
2. Reliability	2. High
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

Table 5.3-5 Comparison of Hosston Wells for Georgetown Groundwater Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Partially meets demands
2. Reliability	2. High
3. Cost	???
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

Table 5.3-6 Comparison of Carrizo-Wilcox Well Field in Robertson County for Georgetown Groundwater Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Partially meets demands
2. Reliability	2. High
3. Cost	???
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

CHAPTER 6 CONJUNCTIVE USE

6.1 Lake Granger Augmentation

6.1.1 Description of Option

Rapid population growth and development in Williamson County require additional water supplies throughout the planning period. Much of the increased demand is in the southwestern portion of the county in and adjoining the Cities of Round Rock, Leander and Georgetown. This alternative could add up to 48,949 acft/yr (2,684 from Phase I plus up to 46,265 acft/yr from Phase II[1] in 2080) by augmenting the long-term firm yield of Lake Granger with groundwater pumped from the Trinity Aquifer (Phase I) and the Carrizo-Wilcox Aquifer or another aquifer (Phase II). In the initial phase of the project, water from the Trinity Aquifer in eastern Williamson County would be blended with treated water from the East Williamson County Regional Water Treatment Plant (EWCRWTP). In the second phase of the project, additional groundwater would be developed from the Carrizo-Wilcox Aquifer or another aquifer in areas east of Williamson County, such as Milam, Lee and/or Burleson Counties and be blended with treated Lake Granger water. At this time, specific locations for these supplies have not been identified. For the purposes of this plan, it is assumed that these supplies will come from Milam County.

Facilities for Phases I and II are depicted in Figure 6.1-1 and Figure 6.1-2, respectively. Conceptual designs for the various components of these projects are based on studies performed for the Brazos River Authority in 2005[1], 2009[2] and 2014[3].

As an alternative or complement to using blended Trinity Aquifer and Lake Granger water, the Trinity Aquifer could be used for aquifer storage and recovery (ASR). Treated surface water could be stored in the Trinity Aquifer during times of low demand or high flows and recovered for use at a later date. A Lake Granger ASR project is evaluated in Chapter 8 of Volume II.

6.1.2 Available Yield

6.1.2.1 Phase I – Conjunctive Use with the Trinity Aquifer

Phase I (Figure 6.1-1) would consist of one or more wells constructed in the Trinity Aquifer in eastern Williamson County, which would be blended with treated water from Lake Granger. Water from the Trinity Aquifer in the Lake Granger area is relatively high in dissolved solids and a ratio of 3 parts Lake Granger

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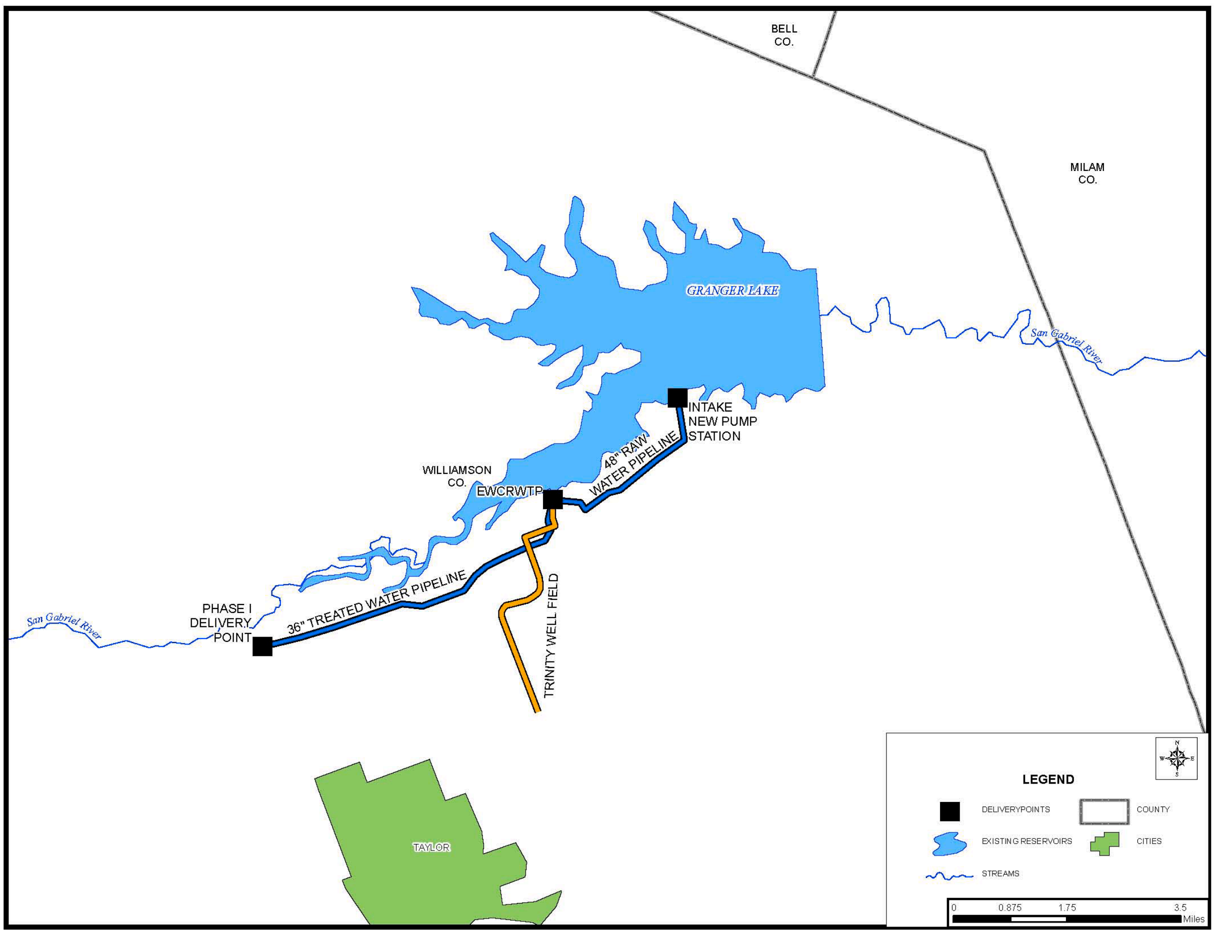
[1] Parsons Brinkerhoff Quade and Douglas, Inc. and Espey Consultants: Williamson County Water Supply Plan Groundwater Procurement, Implementation and Costs, prepared for the Brazos River Authority, July 2005.

[2] R.W. Harden and Associates and Freese and Nichols, Inc.: Assessment of the Use of Trinity Groundwater in Williamson County, Texas, prepared for the Brazos River Authority, July 2009.

[3] R.W. Harden and Associates and Freese and Nichols, Inc.: Results of Test Hole Drilling and Conceptual Design of Permanent Facilities, Trinity Aquifer, Williamson County, prepared for the Brazos River Authority, November 2014.

water to 1 part Trinity Aquifer water should meet drinking water standards; however, water from the Trinity Aquifer in Williamson County is fully allocated in Brazos G to meet existing demands and no Managed Available Groundwater (MAG) remains for use by this project. For purposes of preparing costs of the required infrastructure for this analysis, it is assumed that 2,700 acft/yr of supply from the Trinity Aquifer could be made available to Phase I of this project, although the recommended strategy will not include this supply and will not include the Phase 1 infrastructure. Note that the BRA has already constructed a Trinity well as a first step in developing this supply. Assuming sufficient MAG were made available, Phase 1 would supply 2,700 acft/yr in all planning decades.

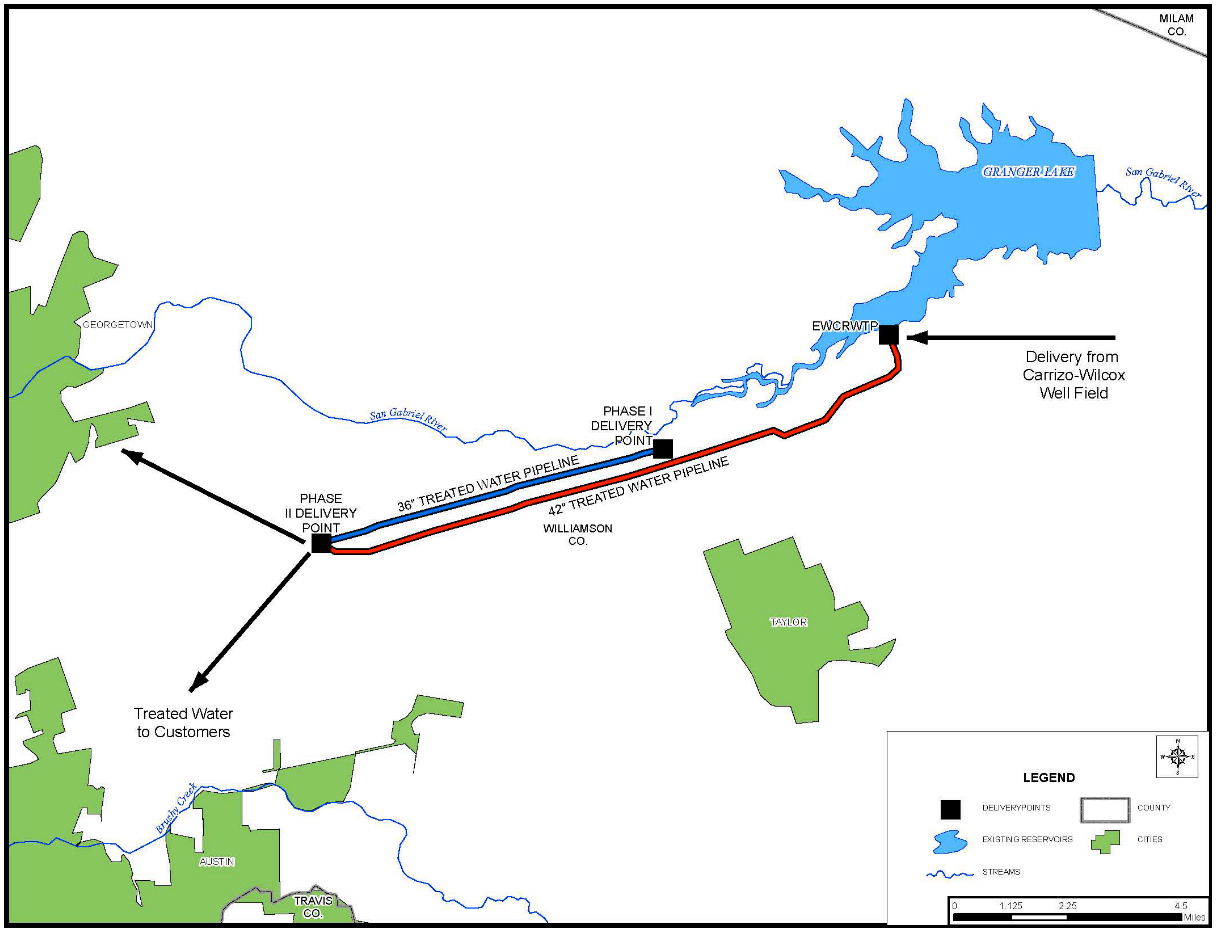
Figure 6.1-1 Phase I – Conjunctive Use with the Trinity Aquifer



6.1.2.2 Phase II – Conjunctive use with the Carrizo-Wilcox Aquifer

The second phase of the project (Figure 6.1-2) calls for overdrafting Lake Granger during times of high flow, utilizing non-firm surface water authorized by the BRA System Operations Permit. Surface water supplies will be supplemented by water from the Carrizo-Wilcox Aquifer or another aquifer when water from Lake Granger is not available. For purposes of this evaluation, it is assumed that groundwater from Milam County would be utilized.

Figure 6.1-2 Phase II – Conjunctive Use with the Carrizo-Wilcox Aquifer



The conjunctive use project would develop a total supply of up to 48,965 acft/yr (2,700 acft/yr from Phase I in 2080 plus up to 46,265 acft/year from Phase II). The 46,265 acft/year supply in Phase II was reported in the 2005 study[4]. A portion of the water from Phase II is used to firm up the 19,840 acft/yr of permitted diversions out of Lake Granger, of which only 12,190 acft/yr are firm in 2080 without the conjunctive use project. EWCRWTP customers and other water utilities who receive supply from Lake Granger are likely candidates for this additional water supply.

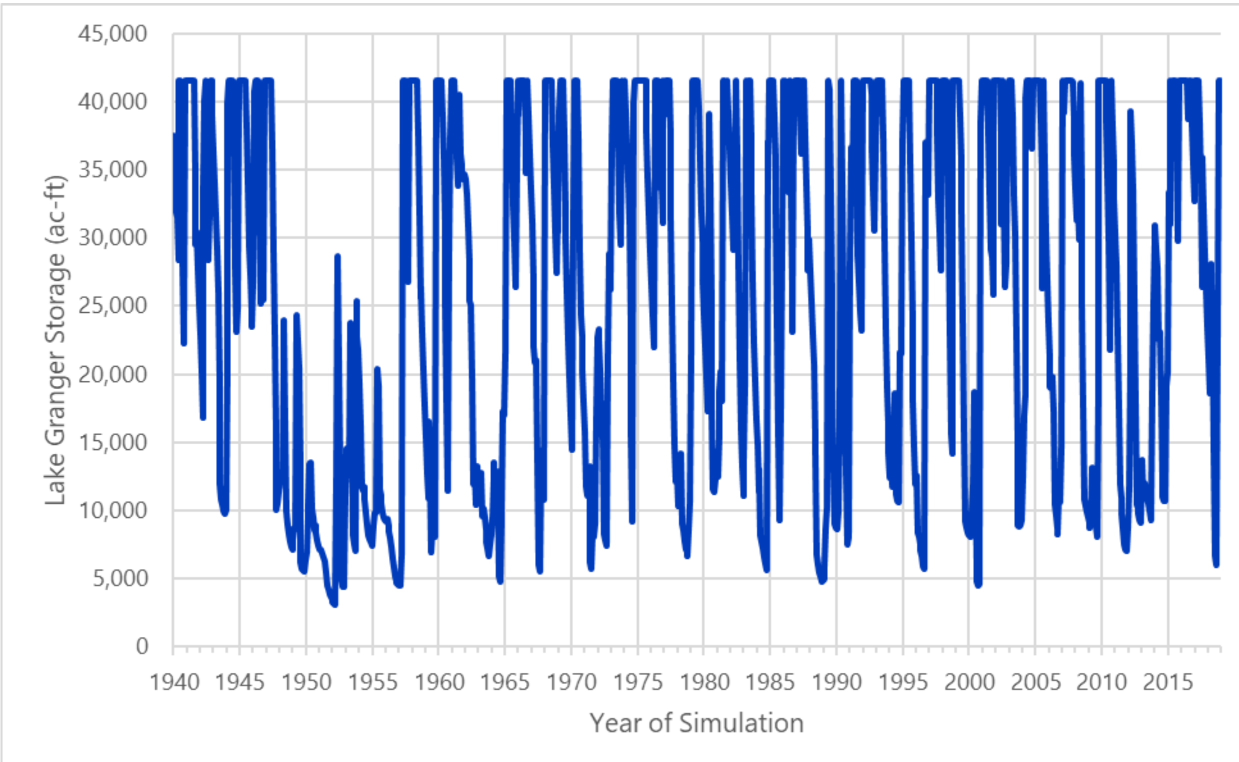
The TCEQ Brazos WAM (Run 3) was utilized to simulate operations of Lake Granger supplemented with the groundwater pumping. To evaluate this strategy, the WAM was modified to remove Lake Granger from BRA System operations and to simulate projected sediment conditions for Lake Granger in 2080 (all other reservoirs were left at their permitted storages). In the simulation, it was assumed that all of the demand (less the Trinity Aquifer water from Phase I) was taken from Lake Granger until the reservoir was drawn down to 30% of capacity. When the reservoir is 30% full or less, the demand is met by pumping

[4] Parsons Brinkerhoff Quade and Douglas, Inc. and Espey Consultants: Williamson County Water Supply Plan Groundwater Procurement, Implementation and Costs, prepared for the Brazos River Authority, July 2005.

from groundwater. Figure 6.1-3 shows the storage trace for Lake Granger modeled with these assumptions.

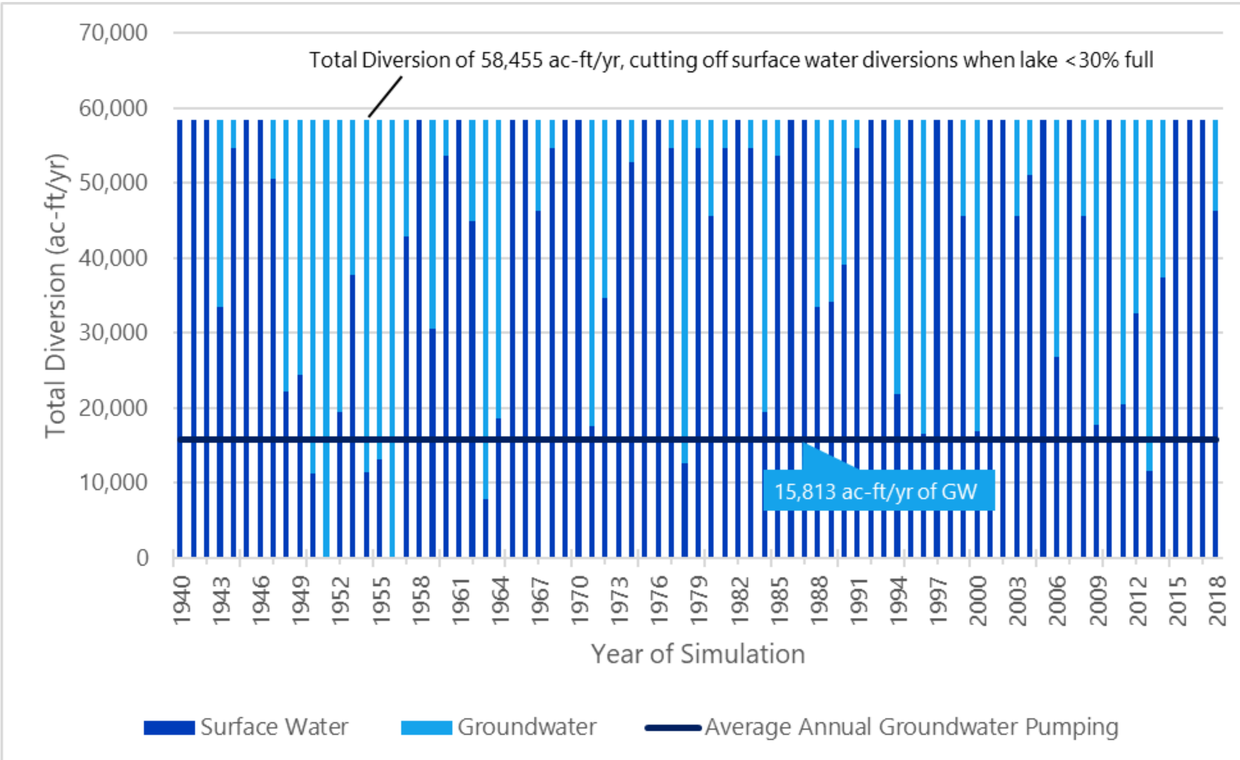
Adding the 7,650 acft/yr used to firm up the permitted (senior) diversions to a new (junior) diversion of 38,615 acft/yr gives a total new project yield of up to 46,265 acft/yr. According to the WAM simulation, this new yield can be achieved with an average annual groundwater pumping of 15,613 acft/yr (Figure 6.1-4). Maximum groundwater pumping in any single year would be equal to the total combined supply of 58,455 acft/yr, as shown in Figure 6.1-4.

Figure 6.1-3 Lake Granger Storage – 2080 Conditions



Note: Storage trace assumes a total diversion of 58,455 acft/yr, of which 19,840 acft/yr is already permitted, and surface water diversions are cutoff if Lake Granger storage drops below 30% of capacity.

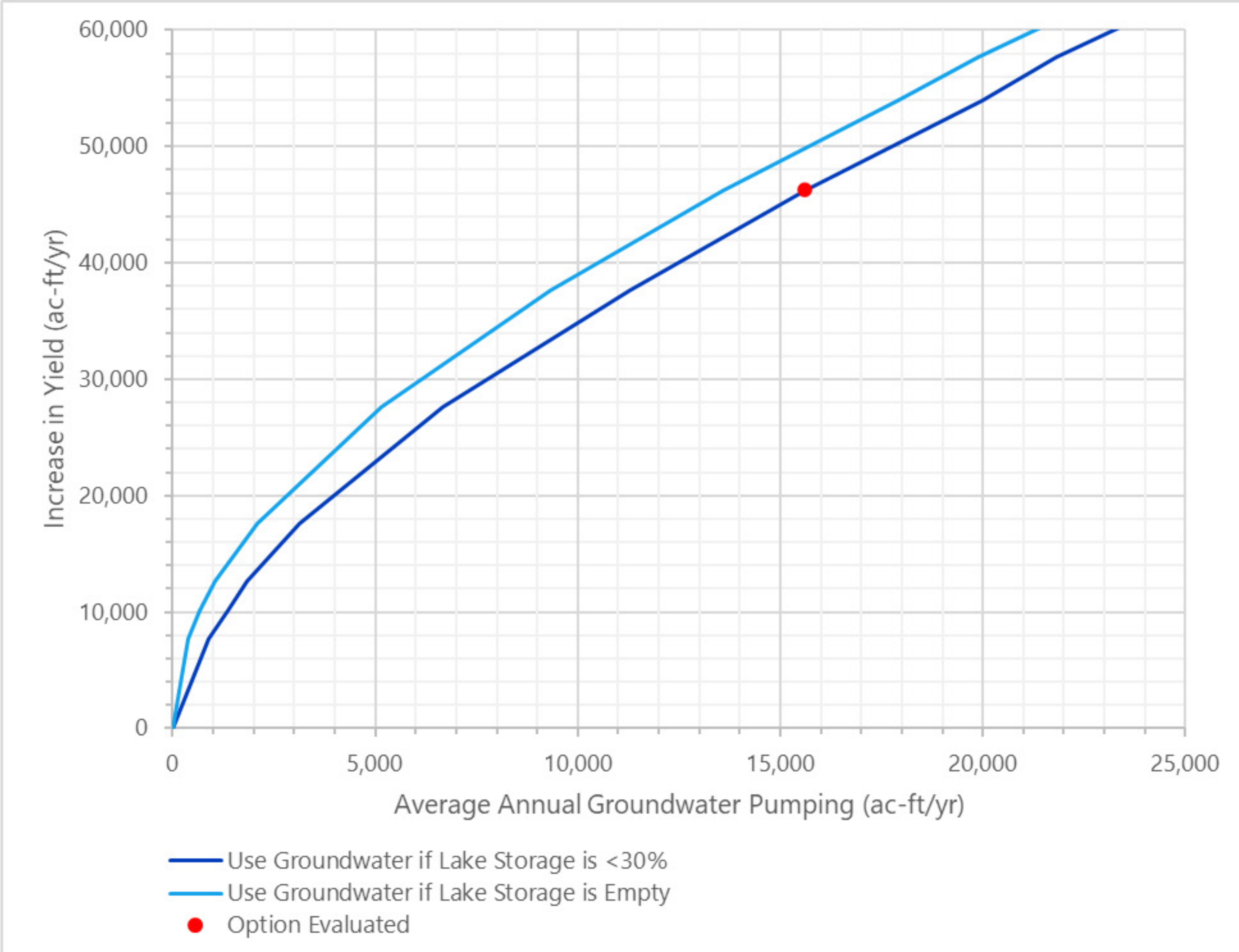
Figure 6.1-4 Distribution of Water Sources for Lake Granger Augmentation – 2080 Conditions



Note: Distribution assumes a total diversion of 58,455 acft/yr, of which 19,840 acft/yr is already permitted but only 12,190 acft/yr is firm in 2080. Surface water diversions are cutoff if Lake Granger storage drops below 30% of capacity.

Average annual pumping from groundwater would be less if the storage in Lake Granger were allowed to drop below 30 percent before switching to groundwater. Furthermore, the total annual diversion amount could be reduced depending on available groundwater supplies (Figure 6.1-5). Figure 6.1-5 shows how supply from Phase II would vary depending on how the project is operated and how much groundwater is made available. For example, if the reservoir were allowed to go empty the project would generate approximately 4,000 acft/yr of additional yield.

Figure 6.1-5 Relationship between Average Annual Groundwater Pumping and Increase in Yield for Two Operating Policies for Lake Granger Augmentation – 2080 Conditions



The above scenario, as stated, would result in a single maximum groundwater withdrawal of 57,281 acft/yr, which greatly exceeds the MAG remaining after accounting for existing uses. Regional water planning rules do not allow the MAG to be exceeded, even though the average annual groundwater withdrawn from the aquifer would be within the remaining MAG available for this project. Brazos G has previously attempted to develop a MAG Peak Factor for the Carrizo-Wilcox Aquifer in Milam County, but the issue was not supported by the Post Oak Savannah Groundwater Conservation District or Groundwater Management Area 12. Per TWDB requirements, a revised analysis was performed for this conjunctive use project limiting single-year groundwater withdrawals so that the MAG would not be exceeded in any single year. Presently there is insufficient MAG available in the Carrizo-Wilcox Aquifer in Milam County thus this strategy is presented as an alternative water management strategy. Should availability in the MAG be made available, the Lake Granger Augmentation project would provide 7,243 acft/yr of new surface water availability in conjunction with 12,840 acft/yr (maximum single year) of groundwater from the Carrizo-Wilcox Aquifer in Milam County.

6.1.3 Environmental Issues

Environmental impacts could include:

- Possible reduction in flood releases to the San Gabriel River downstream of Lake Granger
- Possible moderate impacts on riparian corridors depending on specific locations of pipelines
- Possible low impacts on instream flows due to slight decrease in groundwater discharges from the Carrizo-Wilcox Aquifer

A summary of environmental issues is presented in Table 6.1-1.

Table 6.1-1 Environmental Issues: Groundwater/Surface Water Conjunctive Use (Lake Granger Augmentation)

Issue	Description
Implementation Measures	Construction of well fields, collection systems, pump stations, pipelines, and expansion of existing water treatment plant
Environmental Water Needs/Instream Flows	Possible impacts on instream flows
Bays and Estuaries	Negligible impact
Fish and Wildlife Habitat	Possible moderate impacts on riparian corridors and upland habitats depending on specific locations of pipelines
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible low impact
Comments	Assume institutional transfer agreements among water rights owners, suppliers, and users

6.1.4 Engineering and Costing

Facilities for this option are shown in Figure 6.1-1 and Figure 6.1-2, and Table 6.1-2 and Table 6.1-3. For costing purposes, it is assumed that in Phase I potable water supply will be delivered to a point just north of the City of Taylor. In Phase II, delivery would be extended to a point between the Cities of Taylor and Georgetown.

For Phase I, the Trinity Aquifer well field is assumed to require four wells located near the EWCRWTP. Because there is little current use from the Trinity Aquifer in this area, one test well was drilled in 2013 to verify productivity and water quality. Other facilities include a well field collection system, cooling towers, expansions to the EWCRWTP, and a 3.7-mile 36-inch treated water pipeline from EWCRWTP to an existing customer delivery point.

Conceptual designs and construction costs for the various components of these projects are based on studies performed for the Brazos River Authority between 2005 and 2014. The construction costs were updated to September 2023 prices.

The total capital costs for Phase I is $68.6 million as shown in Table 6.1-2. Additional costs for professional services, land acquisition, well mitigation, and interest during construction add $28.1 million for a total project cost of $96.7 million. Annual debt service on this principal amount, calculated on the basis of 3.5 percent interest for 20-year amortization is $6.8 million. Operation and maintenance costs for pumping, transmission, and treatment to deliver a total annual supply of 13,716 acft (11,016 acft/yr from Lake Granger in 2070 plus 2,700 acft/ry from the Trinity Aquifer), as well as groundwater leasing and surface water purchase contracts must be accounted for to arrive at a unit cost of produced water. These additional costs of $4.5 million added to the annual debt service gives a total annual cost for the full project of $11.2 million. For Phase I, the unit cost of water is $819per acft/yr or $2.51 per 1,000 gallons during debt service, assuming the 2,700 acft/yr supply could be made available.

Phase II could provide up to an additional 46,265 acft/yr of supply. The location of the well field for Phase II has not been identified. For the purposes of this study, it is assumed that the well field will be located approximately 44 miles away from the EWCRWTP, located in Milam County. All or part of the required well field may be located in Milam, Burleson, Lee or other counties to the east of Williamson County, and groundwater supplies could originate from either of the Williamson County Groundwater Supply Options (North or South), from the Alcoa Property Supplies (Carrizo-Wilcox Aquifer in Milam County), or a combination of these sources. Groundwater would be gathered by a well-field collection system and transported by parallel 36-inch and 48-inch pipelines (built in phases) to a blending facility near the EWCRWTP. An additional 42-inch treated water pipeline would be built from the blending facility to the Phase I delivery point. Two parallel 38-inch and 42-inch pipelines (also built in phases) would deliver the water to a new customer delivery point between the cities of Taylor and Georgetown. Customers such as Georgetown, Round Rock or County-Other users would need to build treated water pipelines to the delivery point. Costs for Phase II are included here for the infrastructure size needed to develop the entire supply anticipated by the project sponsor. Unit costs and annual costs for water are shown assuming the smaller supply eligible under regional water planning rules.

The Phase II total capital cost is $902.1 million as shown in . Additional costs for professional services, land acquisition, well mitigation, and interest during construction add $527.6 million for a total project cost of $1.4 billion. Annual debt service on this principal amount is $96.9 million. Annual costs for the new supply of 46,265 acft/yr, as well as groundwater leasing, regulatory groundwater withdrawal fees, and surface water purchase contracts must be accounted for to arrive at a unit cost of produced water. These additional costs of $30.4 million added to the annual debt service gives a total annual cost for the full project of $127.3 million. For Phase II, the unit cost of water is $2,751 per acft or $8.44 per 1,000 gallons under the full supply. Under the reduced supply eligible under regional water planning rules, the unit cost of water is $6,337 per acft or $19.44 per 1,000 gallons. Compensation to BRA may be required if this strategy were developed by an entity other than BRA to compensate for any subordination or use of the System Operations Permit.

Table 6.1-2 Cost Estimate Summary for Phase I of Lake Granger Augmentation *(note that Phase 1 is not included in the 2026 Brazos G Plan as a recommended strategy. Costs are shown here to illustrate the project should MAG values change in the future.)*

Item	Estimated Costs for Facilities
Trinity Aquifer Well Field (4 wells)	$33,297,000
EWCRWTP Expansions (12.5 MGD)	$40,477,000
Treated water pipeline (36 in. dia., 3.7 miles)	$6,288,000
Transmission Pump Station(s)	$2,717,000
TOTAL COST OF FACILITIES	$82,779,000
Engineering, Legal Costs and Contingencies	$28,659,000
Environmental & Archaeology Studies and Mitigation	$365,000
Land Acquisition and Surveying (36 acres)	$304,000
Interest During Construction (1.5 years)	$4,625,000

Item	Estimated Costs for Facilities
TOTAL COST OF PROJECT	$116,732,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$8,214,000
Operation and Maintenance	$2,809,000
Pumping Energy Costs)	$1,279,000
Purchase of Water (13,716 acft/yr @ $76.50/acft)	$1,267,000
TOTAL ANNUAL COST	$13,569,000
Available Project Yield (acft/yr)	14,890
Annual Cost of Water ($ per acft)	$911
Annual Cost of Water ($ per 1,000 gallons)	$2.80

Table 6.1-3 Cost Estimate Summary for Phase II of Lake Granger Augmentation

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Brazos River Authority - Lake Granger Augmentation - Phase II	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (0 MGD)	$152,836,000
Transmission Pipeline (36-48 in. dia., 87.5 miles)	$160,097,000
Well Fields (Wells, Pumps, and Piping)	$396,474,000
Water Treatment Plant (83 MGD)	$176,629,000
Integration, Relocations, Backup Generator & Other	$16,029,000
TOTAL COST OF FACILITIES	**$902,065,000**
- Planning (3%)	$27,062,000
- Design (7%)	$63,144,000
- Construction Engineering (1%)	$9,021,000
Legal Assistance (2%)	$18,041,000
Fiscal Services (2%)	$18,041,000
Pipeline Contingency (15%)	$24,015,000
All Other Facilities Contingency (20%)	$148,393,000
Environmental & Archaeology Studies and Mitigation	$159,190,000
Land Acquisition and Surveying (1120 acres)	$15,722,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$44,944,000
TOTAL COST OF PROJECT	**$1,429,638,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$89,827,000
Reservoir Debt Service (3.5 percent, 40 years)	$7,078,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$5,726,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Brazos River Authority - Lake Granger Augmentation - Phase II	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intakes and Pump Stations (2.5% of Cost of Facilities)	$3,821,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$12,364,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (29839867 kW-hr @ 0.09 $/kW-hr)	$2,686,000
Purchase of Water (61878 acft/yr @ 93 $/acft)	$5,755,000
TOTAL ANNUAL COST	**$127,257,000**
Available Project Yield (acft/yr)	**20,083**
Annual Cost of Water ($ per acft), based on PF=1.26	**$6,337**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.26	**$1,511**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.26	**$19.44**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.26	**$4.64**
Note: One or more cost element has been calculated externally	
CB	*1/27/2025*

6.1.5 Implementation Issues

Early significant activity toward implementation of this strategy has been accomplished by the Brazos River Authority via its ownership of Lake Granger water supply, obtaining the System Operation Permit, ownership of the existing water treatment plant on Lake Granger, construction of a test well into the Trinity Aquifer, and pursuit of nearby groundwater supplies. Developing a suitable approach to the evaluated level of groundwater pumping requires additional cooperative agreements with local groundwater districts and landowners.

For this project to be eligible for certain types of state funding under the full supply it can develop, the MAG will need to be increased for the Trinity Aquifer in Williamson County (for Phase 1), and a MAG Peak factor likely will need to be adopted for the Carrizo-Wilcox Aquifer in Milam, Burleson and/or Lee Counties (for Phase 2) to allow the full supply to be developed within regional water planning rules.

This water supply option has been compared to the plan development criteria, as shown in Figure 6.1-4.

6.1.5.1 Potential Regulatory Requirements

Requirements for permits to use surface water and groundwater, as well as for pipeline construction, will require permits as follows:

- Local groundwater district pumping permits as needed;
- Prior to implementation, the BRA Water Management Plan that is a part of the System Operation Permit will need to be updated to address non-firm appropriations;

- U.S. Army Corps of Engineers Section 404 permits for pipeline stream crossings, discharges of fill into wetlands and waters of the U.S. for construction, and other activities;
- NPDES Stormwater Pollution Prevention Plans;
- TP&WD Sand, Shell, Gravel, and Marl permit for construction in state-owned stream beds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Table 6.1-4 Comparison of Lake Granger Augmentation to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. Uncertain, dependent on acquiring groundwater
3. Cost	3. Reasonable (moderate to high)
B. Environmental factors	
1. Environmental Water Needs	1. Low impact
2. Habitat	2. Low to moderate impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Low impact
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	Low to None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and 'County-Other' shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

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6.2 Oak Creek Reservoir

6.2.1 Description of Option

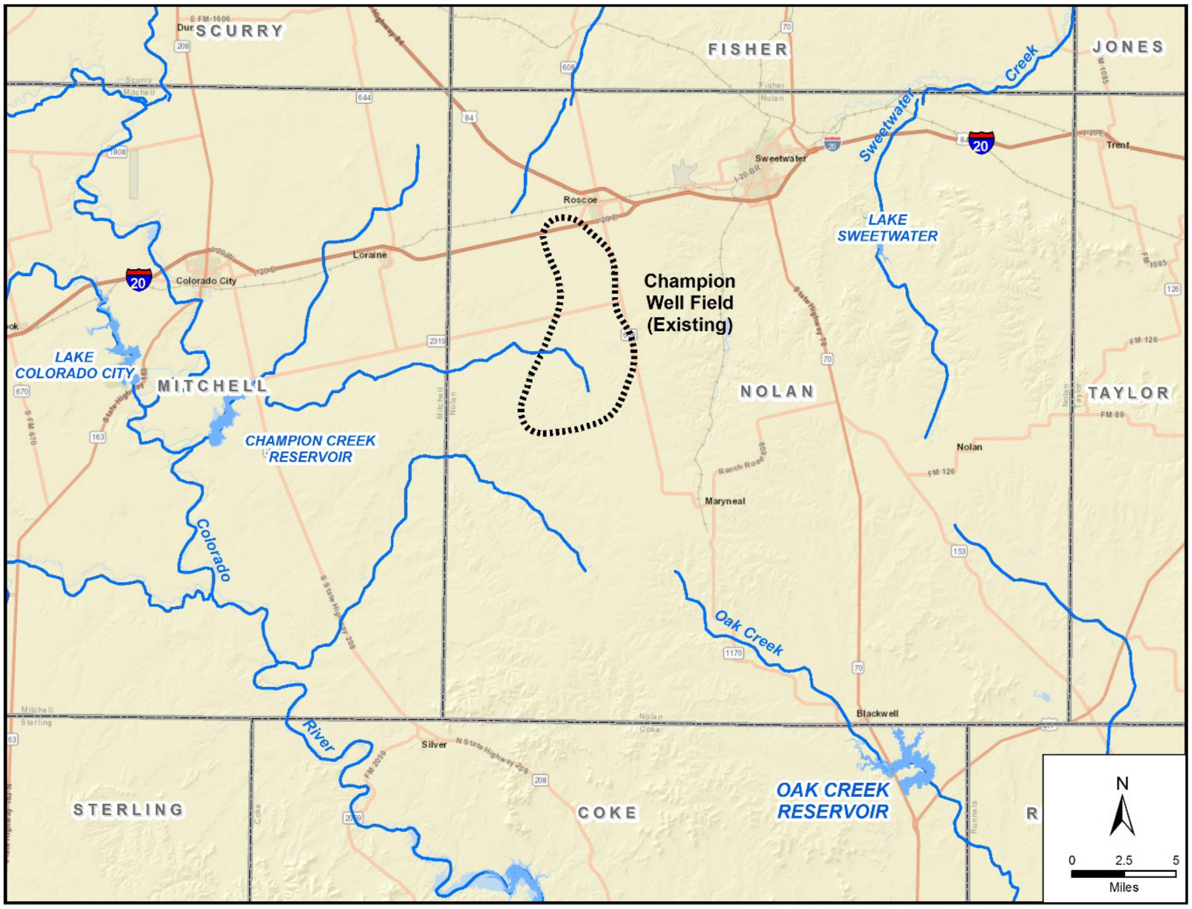
The City of Sweetwater (Sweetwater) utilizes water supplies from the Oak Creek Reservoir in Coke County and the Champion Well Field in Nolan County. The wells are in the Dockum Aquifer. Prior to the drought beginning in 1998, the primary water supply was Oak Creek Reservoir and supplemental supplies from Lake Sweetwater, Lake Trammel and about eight wells in the Champion Well Field. Because of the 1998-2007 drought, the water supplies from the lakes diminished and finally disappeared. As a result, the City installed 35 new wells in the Champion Well Field on an emergency basis. During the latter part of the drought, groundwater from the Champion Well Field was the sole source of supply. Six more wells were added in the summer of 2014, bringing the current well capacity for Sweetwater to a total of 4,142 acft/yr, which would exceed the MAG for the Dockum Aquifer in Nolan County when considered with other existing uses, such as irrigation. Based on water availability analyses performed by the Brazos G RWPG, Sweetwater is allocated 2,329 acft/yr of groundwater from the Dockum Aquifer.

To assess the long-term groundwater supplies from the Champion Well Field and in the general vicinity, a study was conducted for the Brazos G Regional Water Planning Group by HDR, Inc. (HDR) prior to the 2016 Brazos G Plan. This study was partly funded by Sweetwater and consisted of: (1) developing a local groundwater model for western Nolan and eastern Mitchell Counties, (2) evaluating four potential groundwater pumping scenarios in the vicinity of the Champion Well Field with the groundwater model, and (3) evaluating the performance of wells in the Champion Well Field.

Studies of Oak Creek Reservoir by Water Planning Groups in Region F and K have concluded that there is no firm yield for Sweetwater when considering existing senior downstream surface water rights. These studies have noted the feasibility of subordinating downstream rights from Oak Creek Reservoir in the Colorado River Basin to increase local supplies.

The conjunctive management concept for Sweetwater is to use Oak Creek Reservoir and Champion Well Field as parallel supplies. Both the reservoir and the well field will contribute on an average month, but either may be over-drafted when the other supply is low. The maximum annual use of groundwater from the Dockum must remain within the MAG and cannot be surpassed in any given year. This strategy will not involve any new facilities but will be composed of an operational strategy to balance supplies. The locations of Champion Well Field, Oak Creek Reservoir, and Sweetwater are shown in Figure 6.2-1.

Figure 6.2-1 Existing Champion Well field and Oak Creek Reservoir Locations



6.2.2 Available Yield

The Champion Well field has a production capacity of 4,142 acft/yr after the 2014 expansion. However, for regional water planning purposes, the supply availability to Sweetwater is limited to 2,329 acft/yr, consisting of supplies from both the Brazos Basin and Colorado Basin portions of the Dockum Aquifer in Nolan County. An analysis of Sweetwater's demands and water supply contracts shows the maximum demand during the planning period is greater than the City's available supply. Sweetwater also utilizes water supplies from the Oak Creek Reservoir; however, the reservoir is not a reliable drought supply and has no firm yield without subordination agreements with downstream senior water right holders.

A preliminary analysis was conducted to determine the potential yield increase from operating the City's well field and Oak Creek Reservoir in conjunction to meet demands, with the requisite subordination agreements in place. The analysis balances the use of groundwater and surface water to maximize supplies from the two sources without exceeding the long-term groundwater supply of 2,329 acft/yr. With the proposed subordination agreement assumed in place, conjunctive operation of Oak Creek Reservoir and the Champion Well Field can create an additional yield increase of 1,500 acft/yr without overdrafting the MAG volumes for the Dockum Aquifer in Nolan County.

In the analysis, Oak Creek Reservoir is operated as the primary supply source and is overdrafted during wet periods and underutilized during drought periods. The Champion Well Field is operated as a backup supply source to supplement supplies from the reservoir during drought periods. The storage level in Oak Creek Reservoir was used to determine the commencement of groundwater supplies to supplement surface water supplies. Groundwater supplies commence when reservoir storage levels drop below 40 percent of the storage capacity provides the maximum firm yield of 3,829 acft/yr.

Figure 6.2-2 shows the temporal distribution of annual diversions and annual pumpage to meet the conjunctive use firm yield of 3,829 acft/yr and assumes groundwater supplies commence when storage levels drop below 40% of capacity in the reservoir. The long-term average groundwater use for this strategy is 1,188 acft/yr.

Figure 6.2-2 Simulated Annual Distribution of Water Sources for Conjunctive Use Operations

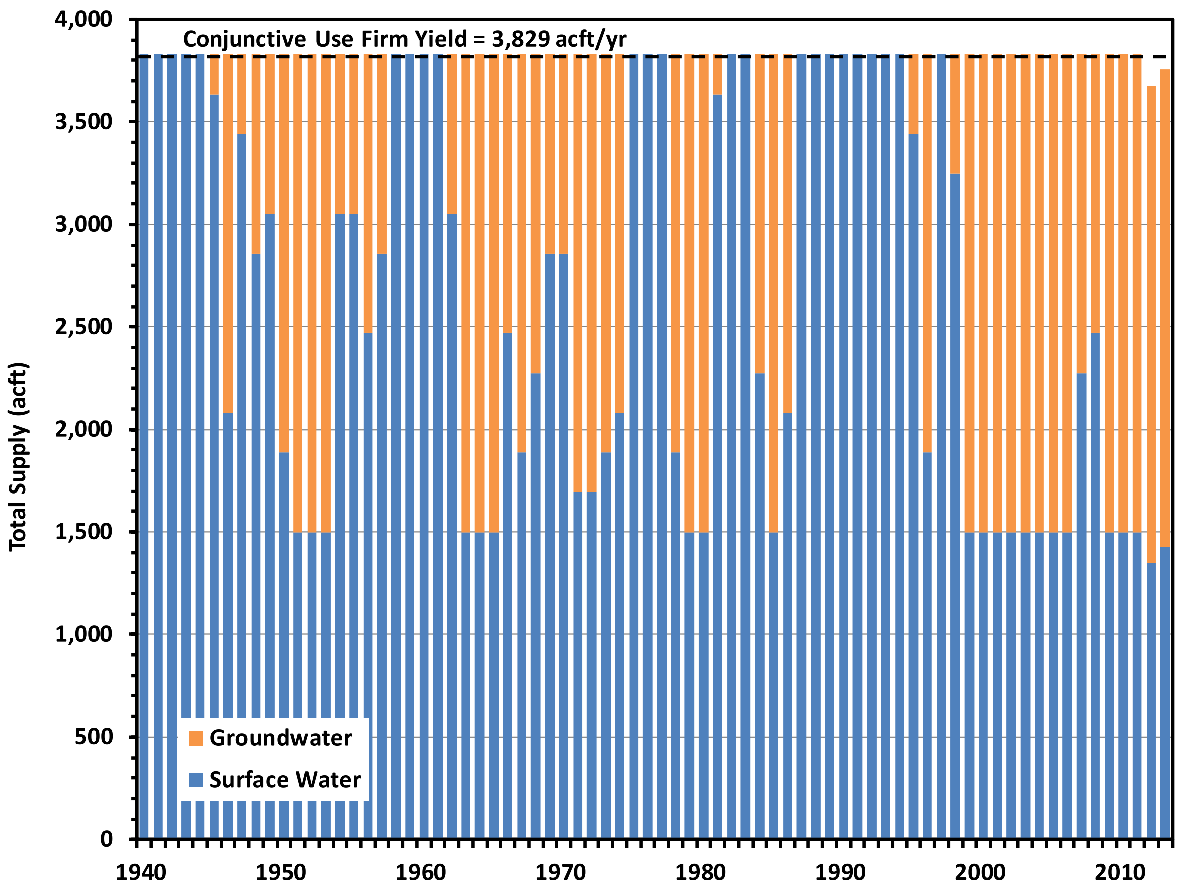


Figure 6.2-2shows the temporal distribution of annual diversions and annual pumpage to meet the conjunctive use firm yield of 3,829 acft/yr and assumes groundwater supplies commence when storage levels drop below 40% of capacity in the reservoir. The long-term average groundwater use for this strategy is 1,188 acft/yr.

Figure 6.2-3 shows the resulting storage trace for Oak Creek Reservoir under the conjunctive use firm yield demand of 3,829 acft/yr and Figure 6.2-4 provides the resulting storage frequency. The figures show that storage in the reservoir remains less than half full in the simulation for about 75 percent of the time due to the overdrafting of surface water supplies to maximize the conjunctive use yield. The storage trace figure also shows that storage levels were reduced to near zero during the drought conditions occurring the last two decades of the simulation.

Figure 6.2-3 Oak Creek Reservoir Simulated Storage under Conjunctive Use Operations

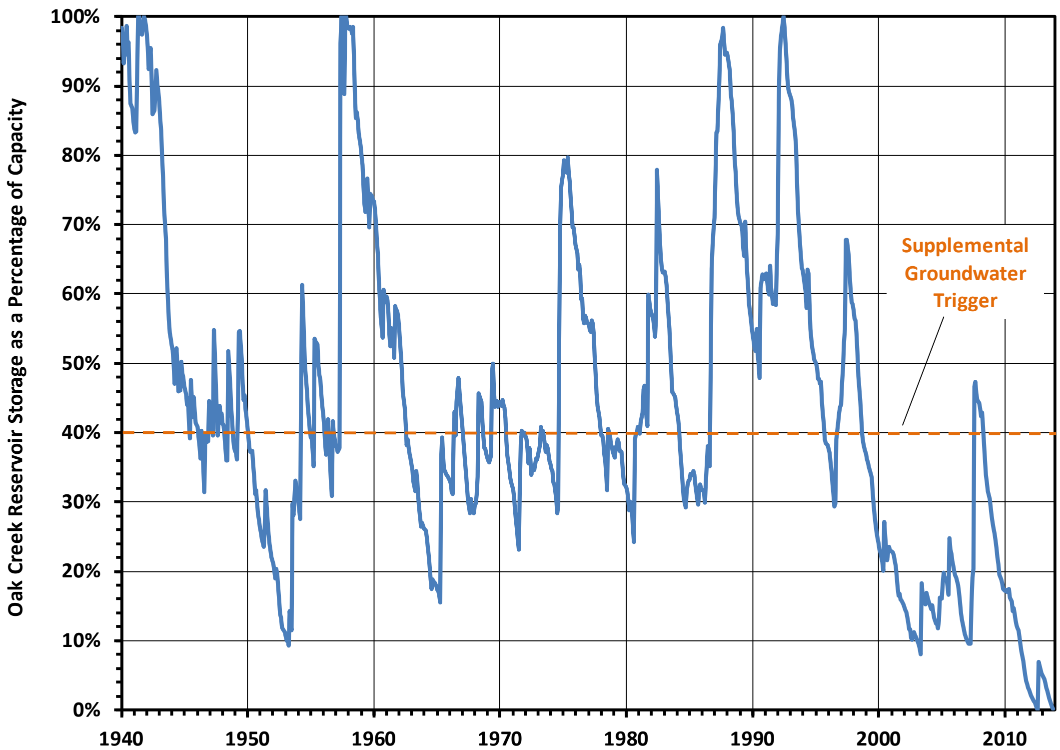
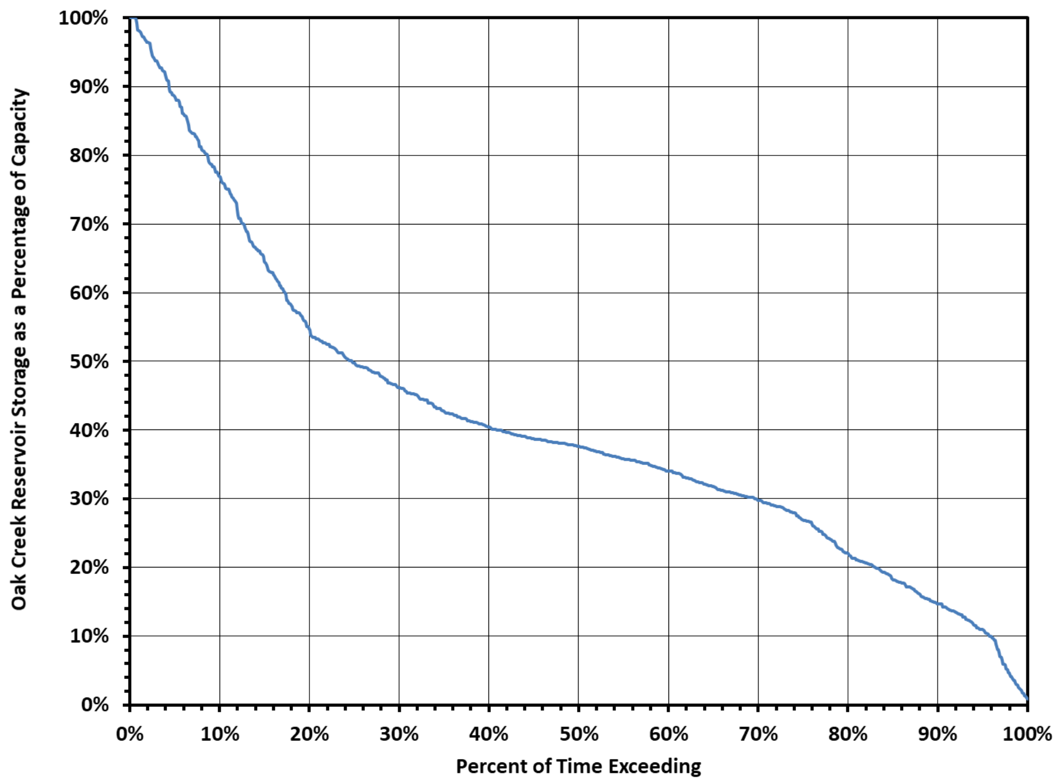


Figure 6.2-4 Oak Creek Reservoir Simulated Storage Frequency under Conjunctive Use Operations



6.2.3 Environmental Issues

There are no new environmental impacts associated with this strategy. No wells, pipelines or other infrastructure is required for this strategy.

6.2.4 Engineering and Costing

No wells, pipelines or other infrastructure is required for this strategy. As a result, there are no costs associated with this strategy.

6.2.5 Implementation Issues

Development of this water management strategy requires the subordination of the senior water rights that are downstream of Oak Creek Reservoir.

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CHAPTER 7 AQUIFER STORAGE AND RECOVERY (ASR)

7.1 City of Bryan ASR

7.1.1 Description

The City of Bryan (Bryan) currently has 12 water supply wells in the Simsboro and Sparta Aquifers with a combined permitted supply of 33,540 acft/yr. Eleven of these wells are permitted under historical use with an annual permitted production amount of 28,702 acft/yr. The current capacity of these wells is limited to 19,872 acft/yr as estimated by Brazos G, assuming 95 percent of one-half of the well production rate. According to the City of Bryan's engineering consultant, the total current annual water supply based on permitted amounts meets the City's annual supply needs until 2056; however, pumping capacity from these wells prevents them from meeting the maximum day demands beyond 2040. Additionally, the Brazos County Modeled Available Groundwater (MAG) developed for the City of Bryan only allows for a supply of 16,657 acft/yr in 2030. Although the MAG allowable supply increases over time (maxing out at the pumping capacity of 19,872 acft/yr by 2040), the supply is not enough to meet demands beyond 2030.

Using TWDB methodology, the calculated total water supply, total water demand and water balance (surplus and shortage) is presented in Table 7.1-1 by decade. This analysis shows Bryan will need an additional 33,011 acft/yr by 2080. A groundwater strategy that is described in Section 5.1 will provide 17,474 acft/yr from the Carrizo Aquifer in Brazos and Robertson Counties. Remaining supplies will be developed by the ASR strategy.

An ASR conjunctive use strategy was developed to meet demands out to 2080 that includes ASR and production wells. A spreadsheet model was developed that simulates the storage and use of ASR water to determine when ASR wells and additional production wells are needed over time.

The ASR aspect of this conjunctive use strategy would fully utilize the MAG or well capacities by pumping at the allowable rate or capacities year-round. During times when water demand is less than the amount of water being produced from the production wells, the excess water would be directed from the City's Well Field Pump Station to a new ASR well field for aquifer storage. This water would be recovered from the ASR wells when Bryan's demand exceeds the allowable use from the MAG or when peak day use exceeds the current system capacity. The recovered water would be delivered back to the Well Field pump station for cooling and disinfection and then into the distribution system. Additional production wells are added over time according to the modeling. The model was also used to determine when each of the ASR wells in the proposed ASR well field would need to come online.

This conjunctive use strategy requires four new ASR wells and four recovery wells. The ASR strategy will make available 14,626 acft/yr of the City's supplies that are not currently accessible. The modeling of the strategy is discussed further in Section 7.1.2.

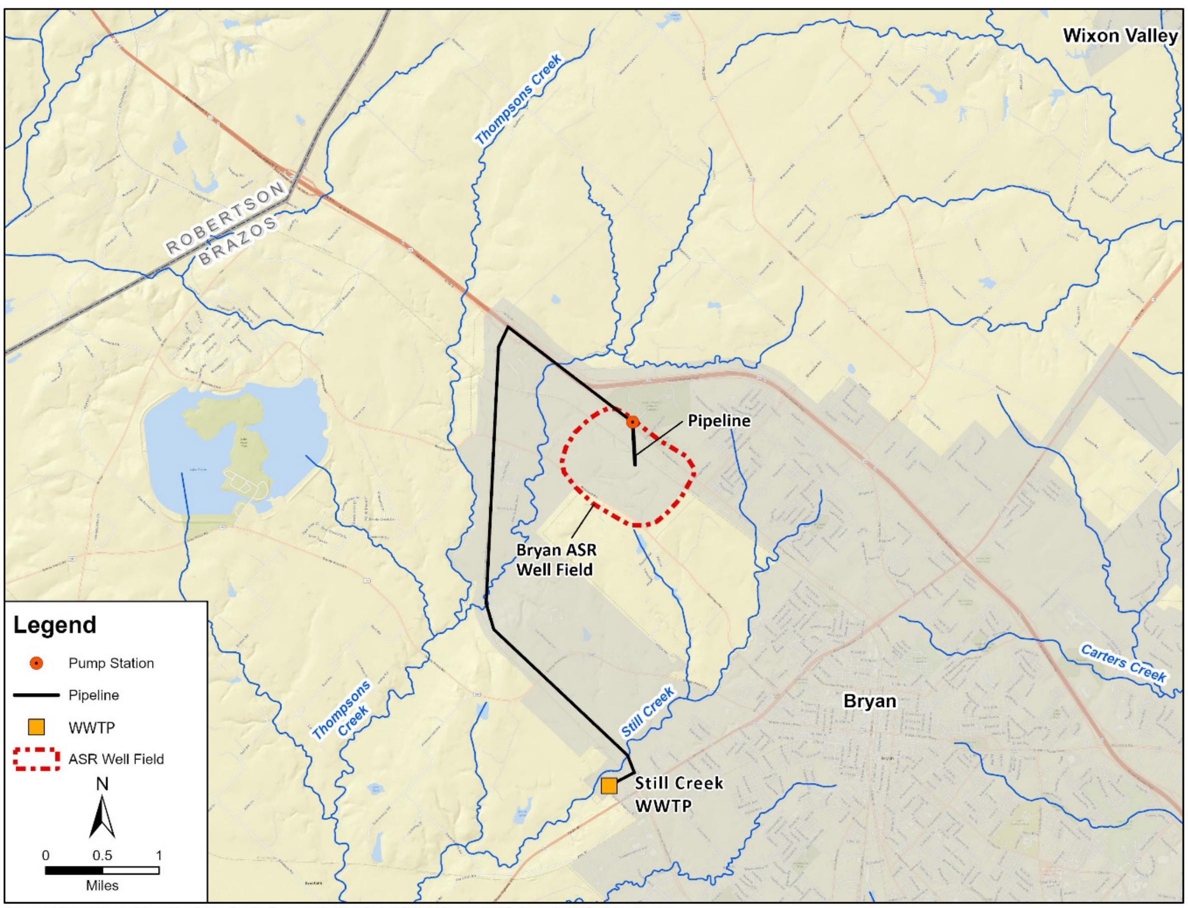
In addition to the wells required for this strategy, two-way pipelines between the ASR well field and the Well Field Pump Station, an ASR pump station at Well Field Pump Station, and an interconnect into the storage tanks are needed. A map showing the locations of the well fields is shown in Figure 7.1-1. For the purposes of this strategy, the target aquifer for storing the water is the brackish water zone of the Simsboro unit of the Wilcox Group.

Table 7.1-1 Bryan's Water Supply and Demand (acft/yr)

Year	Total Supply	Total Demand(1)	Balance
2030	16,657	22,269	-5,612
2040	19,872	25,611	-5739
2050	19,872	29,640	-9,768
2060	19,872	34,467	-14,595
2070	19,872	42,576	-22,704
2080	19,872	52,883	-33,011

Note:
(1) - Includes sales to other entities.

Figure 7.1-1 Bryan's Existing Well Field and Proposed ASR Well Field



Document Path: C:\Users\BGates\OneDrive - Carollo Engineers\Desktop\Project Folders\Region G\ASR_Strategies\ASR_Strategies.aprx

7.1.2 Modeling and Available Supply

A probabilistic model was developed by consultants to the City of Bryan that simulates water demand over the available hydrologic record (1948 to 2014) to determine when ASR water may be stored or used. For the 2021 planning process this model was used to determine how much water could be stored over time starting in 2020 and then adding production and ASR wells so as not to completely deplete the ASR supply out to 2070. For the current planning process, it is assumed that the supply from the previous analysis can still be produced if the start decade is 2030, however the yield may be impacted by the increased demand projections.

The first step in developing the model was to determine a relationship between current water demand and hydrologic conditions to simulate the monthly variations in demand. Water production data from 2000 to 2014 was converted to per capita demand and related to variables including precipitation, evaporation, and temperature. Evaporation was found to be the best indicator of water demand when considering each variable individually. The relationship was improved slightly by adding precipitation. Different relationships were then developed for each season or month to further improve the prediction.

Evaporation was the best indicator, but records from TWDB in the region are only available back to 1954. It was important to include the 1950's drought in the simulation; therefore, temperature data was used to extend the record. The relationship between evaporation and temperature was developed using all available data from 1954 to 2014. This relationship was used to extend the evaporation time series back to 1948.

Figure 7.1-2 shows a scatter plot of the production-based demand versus the final modeled demand based on the relationship developed between per capita demand and evaporation and precipitation for monthly values from 2000 to 2014.

Using the demand relationship that was developed, per capita water demand was predicted on a monthly time step from 1948 to 2014 using the available and extended evaporation and precipitation data. The Brazos G population projections were applied to the predicted monthly per capita water demands. Each decade was simulated over the entire period of record to determine the likelihood of ASR storage or use. It was found that water is likely to accumulate given 2020 and 2030 demands. By 2040, ASR water would likely be used at a greater rate than could be accumulated without adding additional supply. This agrees with the deficit predictions shown in Table 7.1-1.

To determine how much water is likely to be available through ASR over time as population increases, the median value of ASR storage or use on an annual basis was extracted for each of the simulated decades. These median storage/use values were applied to each decade from 2020 to 2070, and values between each decade were linearly interpolated. The cumulative volume was then calculated over time, applying an unrecoverable (loss) factor of 10 percent. This analysis was used to determine how long the ASR supply would last given the MAG predicted supplies. Next, additional production wells and ASR wells were added to the strategy when needed to avoid depleting the supply and/or creating deficits. The resulting graph of cumulative supply is shown in Figure 7.1-3. The inflection points at 2030, 2040, and 2050 indicate when increases in the MAG allowed for additional pumping.

Figure 7.1-2 Fit of Demand Model

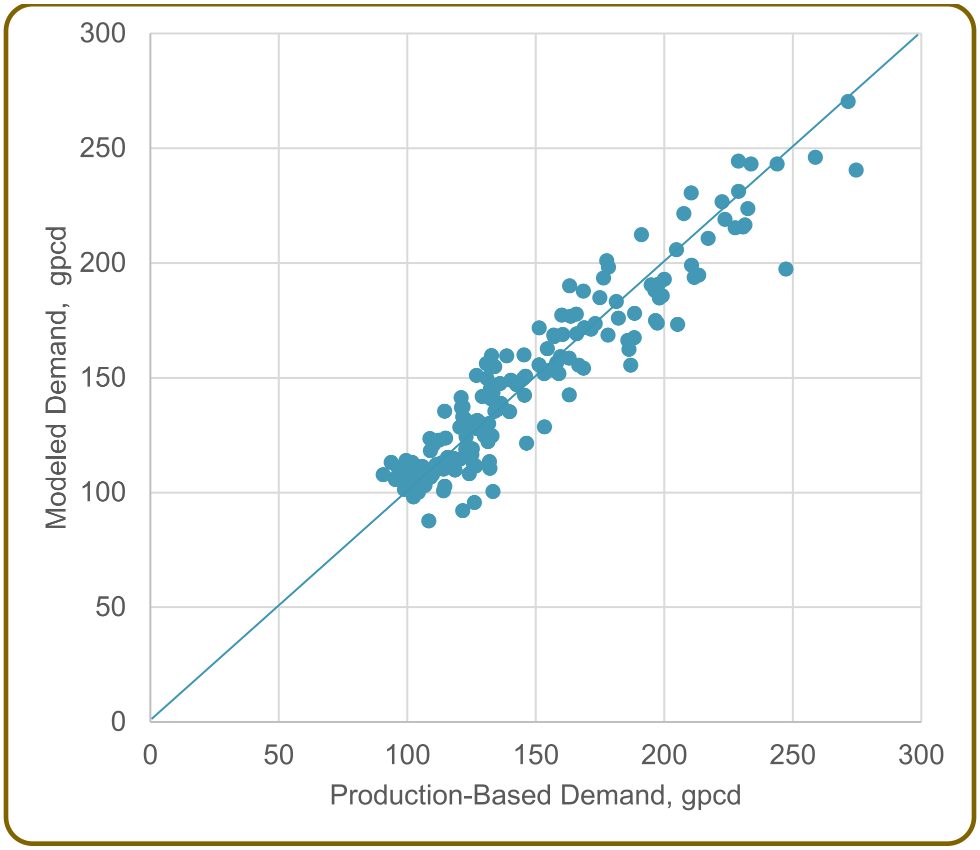
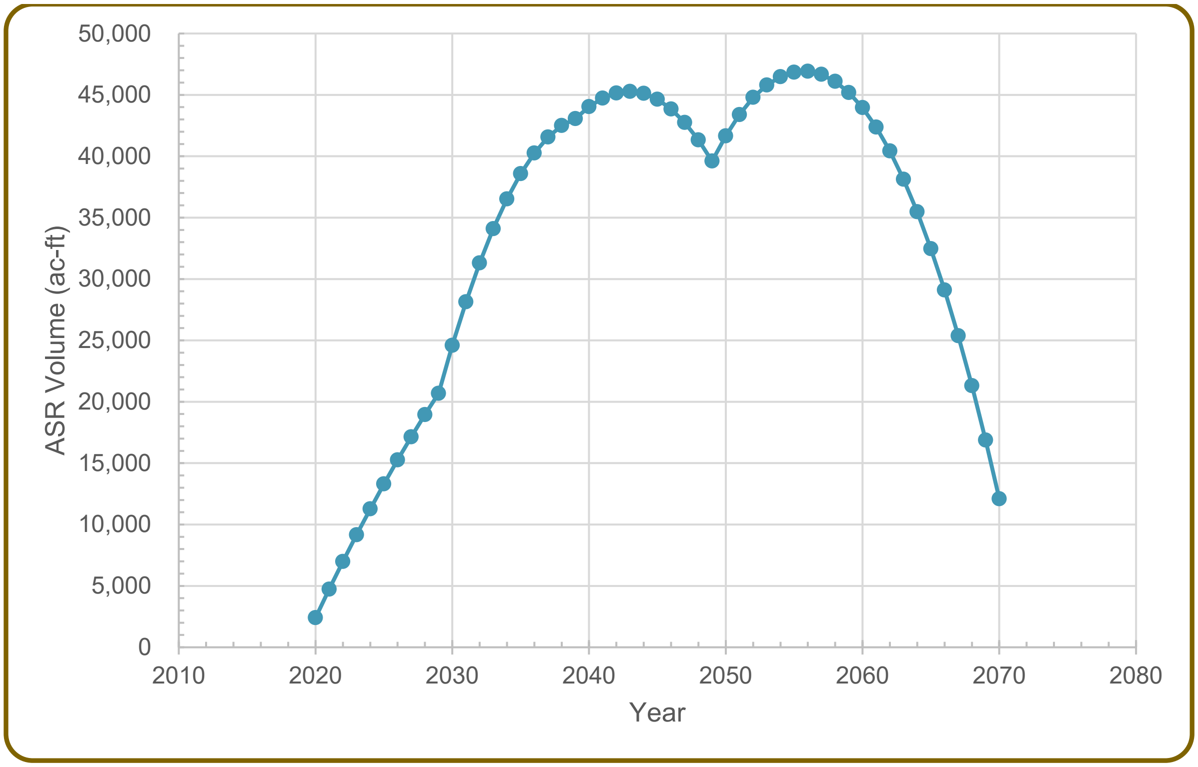


Figure 7.1-3 Time series Plot of ASR Recoverable Volume

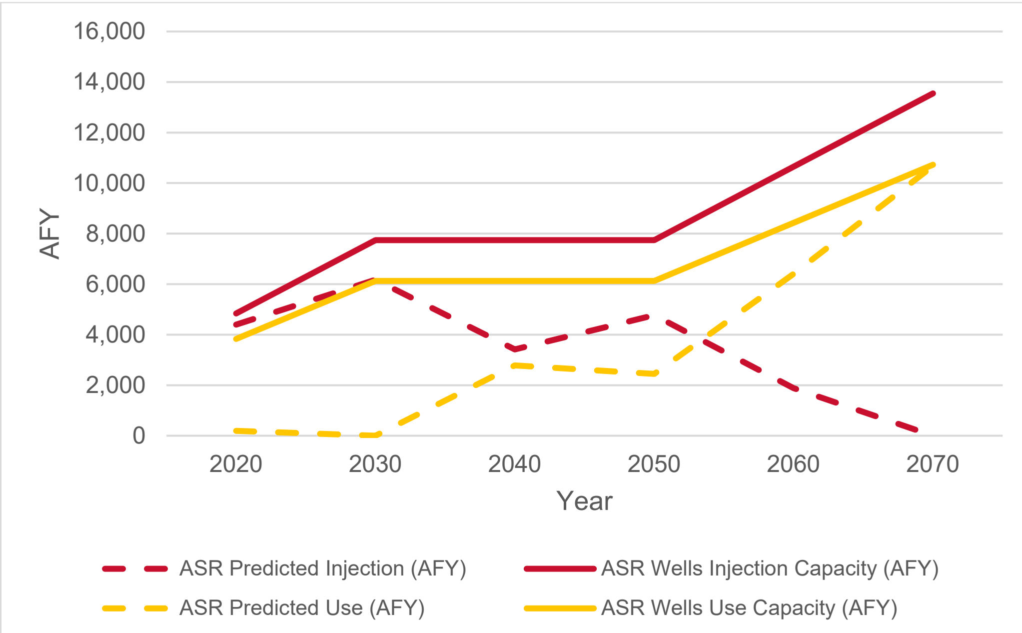


7.1.3 Infrastructure Timing

Translation of the modeling results from the 2021 plan for use in the current plan suggests that by starting ASR by 2030, Bryan's current water production well infrastructure maybe sufficient until 2050, contingent on Bryan's recommended production well WMSs. It is recommended that Bryan construct two new production wells in Brazos County by 2050. Each new production well is assumed to have a rated capacity of 3,000 gpm. Production estimates assume that the wells need to meet a maximum day factor of 2 and that the wells are 95 percent reliable.

Results from the modeling were used to determine the timing of ASR wells. For each simulated decade, the maximum annual amount stored and used was compared to the total ASR injection and use capacities, respectively. The ASR injection capacity is assumed to be 60 percent of the rated production capacity of the well. The use capacity assumes the same factors as for the production wells. Figure 7.1-4 shows the model predicted ASR injection and ASR use versus the ASR injection capacity and ASR use capacity. Predicted ASR use decreases each decade that additional production is recommended and increases in other decades. Predicted ASR injection follows opposite trends. To meet the predicted ASR injection and ASR use needs, Bryan should begin storing ASR water using Well #10 and one new ASR well prior to 2030. Then one new ASR well is needed each in 2030, 2060, and 2070. Additionally, piloting of Well #10 as an ASR well should begin as soon as possible.

Figure 7.1-4 ASR Injection, Capacity and Use Curves over Time



7.1.4 ASR Aquifer

The target area for ASR wells near Bryan is over the Carrizo-Wilcox aquifer. Major water-bearing formations in the Carrizo-Wilcox consist of the Carrizo Sands and Simsboro Formation. The wells would be installed in the Simsboro, which is 450 ft thick. Bryan's current wells are in the Sparta and Simsboro and are about 600 and 2,800 ft deep, respectively. High capacity Simsboro wells typically yield up to 3,000 gallons per minute (gpm). The water temperature for Simsboro wells in this locale is about 115 deg F and requires cooling before discharging into the distribution system.

The groundwater supply for the ASR project is currently permitted with the Brazos Valley Groundwater Conservation District. Expected recovery from this project is estimated to be at least 75 percent.

7.1.5 Environmental Issues

Environmental issues for the proposed City of Bryan ASR Project are described below. This project includes the pumping of existing production wells nearly year round and utilizing any excess water for aquifer storage. This water would be recovered, disinfected and distributed later when needed for public use. This project would include the development of an ASR well field, additional well field distribution and collection pipelines, a new two-way transmission pipeline, a water treatment plant for disinfection and an interconnect. Implementation of this project would require field surveys by qualified professionals to document vegetation/habitat types, waters of the U.S. including wetlands, and cultural resources that may be impacted. Where impacts to protected species habitat or significant cultural resources cannot be avoided, additional studies would be necessary to evaluate habitat use and/or value, or eligibility for inclusion in the National Register of Historic Places, respectively. The project sponsor would also be required to coordinate with the U.S. Army Corps of Engineers regarding impacts to wetland areas and compensation would be required for unavoidable adverse impacts involving net losses of wetlands.

The pipelines and wells needed for the ASR project's well field would occur in close proximity to Still Creek and a tributary of Still Creek which includes several small stock ponds/impoundment areas. Coordination with the U.S. Army Corps of Engineers would be required for construction within any waters of the U.S. Any impacts from this proposed project which would result in a loss of less than 0.5 acres of waters of the U.S. could be covered under Nationwide Permit #12 for Utility Line Activities.

The project occurs within the East Central Texas Plains Ecoregion[1] and lies within the Texan Biotic Province.[2] Vegetation types within the City of Bryan ASR well field area and transmission pipelines as described by the Texas Parks and Wildlife Department (TPWD)[3] include urban and other areas. These areas include portions of the city and wooded areas adjacent to cleared pasture areas. Avoidance of riparian areas near the creeks, impounded areas or heavily wooded areas would help minimize potential impacts to existing area species from project construction activities.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Brazos County can be found at https://tpwd.texas.gov/gis/rtest/.

Because the project will use previously allocated water from existing wells to inject into the aquifer no significant impacts to existing stream flows or aquatic species are anticipated. Potential impacts to listed species within the project area are anticipated to include disturbance of existing habitat resulting from the construction of well fields and their associated pipelines, transmission pipelines and a new water treatment plant. However, most of these disturbances would be minimized by the small areas generally required for well field and pipeline construction. After construction is completed most of the disturbed areas will return to their previous habitat types excluding areas where maintenance activities are required.

A survey of the project area would be required prior to project construction to determine whether populations of or potential habitats used by listed species occur in the area to be affected. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291).

Based on the review of publically available Geographic Information System (GIS) records obtained from the Texas Historical Commission, there are no State Historic Sites, National Register Properties or Districts, or cemeteries within the project area. However five historical markers occur near the proposed pipeline route from the ASR well field to the Tabor Road pump station. A review of archaeological resources in the proposed project area should be conducted during the project planning phase. Because the owner or

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[1] Griffith Glenn, Sandy Bryce, James Omernik, and Anne Rogers. 2007. Ecoregions of Texas. Texas Commission on Environmental Quality.
[2] Blair, W. Frank. 1950. The Biotic Provinces of Texas. Texas Journal of Science 2(1):93-117.
[3] McMahan, Craig A., Roy G. Frye and Kirby L. Brown. 1984. The Vegetation Types of Texas. Wildlife Division, Texas Parks and Wildlife Department, Austin, Texas.

controller of the project will likely be a political subdivision of the State of Texas (i.e., municipality), they will be required to coordinate with the Texas Historical Commission prior to project construction.

7.1.6 Engineering and Costing

This ASR conjunctive use strategy recommends a total of four recovery wells and four storage and recovery (ASR) wells. The timing of the recovery and ASR wells is summarized in Table 7.1-2.

Table 7.1-2 Timing of ASR Wellfield Infrastructure

Year	Recovery Wells	ASR Wells
2030		1
2040		1
2050		
2060	1	
2070	1	1
2080	2	1

Available records indicate that the ASR wells in the Simsboro, where proposed, would average about 3,200 ft deep. A typical injection and recovery rate is estimated to be 1,800 gpm and 3,000 gpm, respectively. The well field design has the wells spaced about 1,320 ft apart. The annual yield of the ASR and recovery wells is around 14,626 acft.

The major facilities required for these projects include:

- Pump station,
- Pipeline,
- ASR and Recovery wells,
- Collector pipelines, and
- Disinfection water treatment, and
- Interconnect.

Estimates were prepared for capital and project costs, annual debt service, operation and maintenance, power, land, and environmental mitigation. These costs are summarized in . The annual costs, including debt service, operation and maintenance, and power, is estimated to be $445 per acft.

7.1.7 Implementation

Implementation of the ASR conjunctive use water management strategy for Bryan includes the following issues:

- Acquiring permits from TCEQ for ASR construction and operations;
- Initial cost; and
- Development of a management and implementation of plan to efficiently balance utilization of production and ASR wells.

This water supply option has been compared to the plan development criteria, as shown in Table 7.1-4, and the option meets each criterion.

Table 7.1-3 Cost Estimate Summary: City of Bryan ASR

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
City of Bryan - Bryan ASR Option	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (0 mgd)	$4,553,000
Transmission Pipeline (30 in. dia., 2.5 miles)	$1,835,000
Well Fields (Wells, Pumps, and Piping)	$68,316,000
Water Treatment Plant (13.1 mgd)	$898,000
Integration, Relocations, Backup Generator & Other	$2,419,000
TOTAL COST OF FACILITIES	**$78,021,000**
- Planning (3%)	$2,341,000
- Design (7%)	$5,461,000
- Construction Engineering (1%)	$780,000
Legal Assistance (2%)	$1,560,000
Fiscal Services (2%)	$1,560,000
Pipeline Contingency (15%)	$275,000
All Other Facilities Contingency (20%)	$15,237,000
Environmental & Archaeology Studies and Mitigation	$636,000
Land Acquisition and Surveying (39 acres)	$750,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$3,461,000
TOTAL COST OF PROJECT	**$110,082,000**
ANNUAL COST	x
Debt Service (3.5 percent, 20 years)	$7,735,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$726,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$114,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$539,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (12345590 kW-hr @ 0.09 $/kW-hr)	$1,111,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$10,225,000**
Available Project Yield (acft/yr)	**14,626**
Annual Cost of Water ($ per acft), based on PF=1	**$699**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$170**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$2.15**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$0.52**

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
City of Bryan - Bryan ASR Option	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Note: One or more cost element has been calculated externally	
JS	*1/29/2025*

Table 7.1-4 Comparison of City of Bryan ASR to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Adequate supply with other strategies to meet needs
2. Reliability	2. High reliability
3. Cost	3. Low
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

7.2 City of Bryan ASR of Still Creek WWTP IPR

7.2.1 Description

The City is considering an ASR conjunctive use strategy to develop additional water supplies to meet future demands. This ASR strategy is an indirect potable-reuse strategy utilizing effluent discharges from Still Creek WWTP to deliver Type 1 treated wastewater for use in the City's current ASR project.

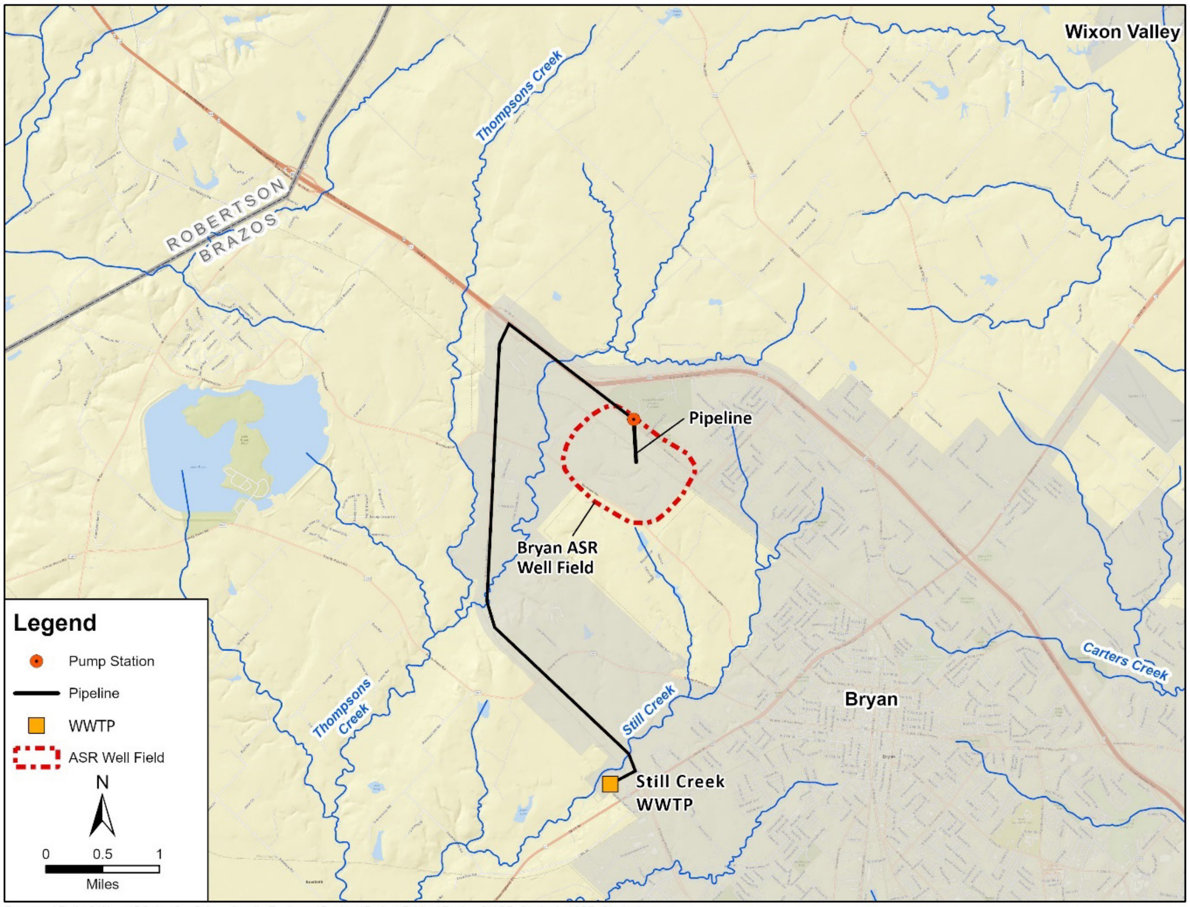
It is estimated that reuse supplies will be delivered at a uniform rate of 4.8 mgd which is treated at an advanced water treatment facility consisting of low-pressure membranes, reverse osmosis and advanced oxidation. The location of the WTP has not been selected and would be subject to availability of land.

7.2.2 Available Supply

The water supply that would be potentially available for Bryan would be the effluent discharges from Still Creek WWTP. The annual average effluent flow from the Still Creek WWTP for the year 2022 was 5,396 acft/yr (4.81 mgd). Based on water demand projections for 2080, the future Year 2080 estimated WWTP effluent discharge is 14,727 acft/yr (13.1 mgd). This conjunctive use strategy requires an 4.8 mgd advanced water treatment facility, an ASR pumpstation at the WTP and an interconnect into the storage tanks are needed. It is assumed that two additional ASR wells will be required to implement utilization of the reuse water. There is the possibility that future expansions of treatment facilities as well as two additional ASR wells and recovery wells will be required to maximize potential future increases in return flows. The ASR strategy could yield 5,377 acft/yr with the possibility upgrading to up to 14,727 acft/yr by the year 2080. Expected recovery from this project is estimated to be at least 75%.

A map showing the locations of the well fields is shown in Figure 7.2-1. For the purposes of this strategy, the target aquifer for storing the water is the brackish water zone of the Simsboro unit of the Wilcox Group.

Figure 7.2-1 ASR of Bryan Reuse (Still creek WWTP)



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7.2.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible high negative impact to fish and wildlife habitat with substantially reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 7.2-1.

Table 7.2-1 Environmental Issues: Bryan Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible high negative impact to fish and wildlife habitat with substantially reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

7.2.4 Engineering and Costing

The required improvements to implement a wastewater reuse supply for ASR use are summarized in Table 7.2-2. Costs presented in Table 7.2-3 provide the total costs for developing a wastewater reuse supply to ASR. System integration costs are not included in the estimate.

Table 7.2-2 Required Facilities – ASR of Still Creek WWTP Reuse

Facility	Description
Treatment Upgrade	4.8 mgd; existing WWTP requires additional tertiary treatment to meet type 1 standards and addition of chlorine for distribution
Pump Station	330 hp (Booster); 5.1 mgd capacity to deliver peak capacity at uniform rate
Storage Tank	None
Pipeline	31,000 ft of 18-inch pipe
Available Project Yield	4.8 mgd (5,377 acft/yr), potential upgrade up to 13.1 mgd (14,727 acft/yr) by the year 2080

Table 7.2-3 Cost Estimate Summary: ASR of Still Creek WWTP IPR

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
City of Bryan - Bryan ASR of Still Creek WWTP IPR	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (5.1 mgd)	$5,103,000
Transmission Pipeline (18 in. dia., 5.9 miles)	$15,956,000
Well Fields (Wells, Pumps, and Piping)	$12,194,000
Water Treatment Plant (4.8 mgd)	$349,000
Advanced Water Treatment Facility (4.8 mgd)	$41,187,000
Integration, Relocations, Backup Generator & Other	$155,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
City of Bryan - Bryan ASR of Still Creek WWTP IPR	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
TOTAL COST OF FACILITIES	**$74,944,000**
- Planning (3%)	$2,248,000
- Design (7%)	$5,246,000
- Construction Engineering (1%)	$749,000
Legal Assistance (2%)	$1,499,000
Fiscal Services (2%)	$1,499,000
Pipeline Contingency (15%)	$2,393,000
All Other Facilities Contingency (20%)	$11,797,000
Environmental & Archaeology Studies and Mitigation	$655,000
Land Acquisition and Surveying (39 acres)	$1,139,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$3,316,000
TOTAL COST OF PROJECT	**$105,485,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$7,411,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$283,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$128,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$209,000
Advanced Water Treatment Facility	$5,362,000
Pumping Energy Costs (6017399 kW-hr @ 0.09 $/kW-hr)	$559,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$13,952,000**
Available Project Yield (acft/yr)	**5,377**
Annual Cost of Water ($ per acft), based on PF=1	**$2,595**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$1,216**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$7.96**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$3.73**
JMP	*2/1/2025*

7.2.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 7.2-4, and the option meets each criterion.

Before pursuing ASR of Still Creek Reuse, Bryan will need to investigate concerns that would include at a minimum:

- Amount of treated effluent available, taking into consideration downstream water commitments and discharge permit restrictions;
- Capital costs of constructing needed distribution systems connecting the treatment facilities to the ASR facility;
- Public acceptance and regulatory approval of this water management strategy; and
- Integration of surface water source into a groundwater system which may affect water quality and disinfection compatibility.

Table 7.2-4 Comparison of Bryan Reuse Options 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. Potentially 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. Potential 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 Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

Requirements specific to pipelines needed to link wastewater treatment facilities to the ASR facility may include:

- U.S. Army Corps of Engineers 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;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

7.3 City of College Station ASR of Direct Potable Reuse

7.3.1 Description

The concept for the City of College Station (College Station) ASR project is to:

- Utilize existing wastewater effluent as the source of water for direct potable reuse and ASR. For the 5-year period from 2018 through 2022, the average effluent discharges from Carters Creek WWTP and Lick Creek WWTP were 6.7 and 1.7 million gallons per day (mgd), respectively.
- A new Advanced Water Treatment Plant (AWTP) would be located near the Carters Creek WWTP. Effluent from the smaller Lick Creek WWTP would be transported to the AWTP through a new pipeline.
- The AWTP would treat the wastewater effluent with: (1) Low Pressure Membrane, (2) Reverse Osmosis, and (3) Oxidation before the water would be discharged to the potable distribution system or injected to the aquifer.
- New Sparta and Queen City ASR wells would be located southeast of the AWTP. The Sparta and Queen City wells would be about 1,700 and 2,225 ft deep, respectively. An estimated 20 wells would be required at 10 sites.
- The recharge cycle of ASR would occur from October to March. Recovery would occur from April to September to supplement summer peaking demands.
- Recovered water would be disinfected before being delivered to the existing potable water distribution system.

A schematic showing the location of the project is shown in Figure 7.3-1. New facilities required for this option are the ASR wells, well field distribution and collection pipelines, pump station and wastewater transmission pipeline from Lick Creek WWTP and Carters Creek WWTP, advanced water treatment plant, interconnects between AWTP and the ASR well field and the AWTP and College Station's distribution system, a two-way pipeline between the AWTP and the ASR well field, and a chlorine disinfection facility.

As of 2024, combined WWTP discharges are greater than 8.6 mgd, thus, an assumed supply of 7.0 mgd of treated wastewater would be made available for storage in the ASR project during the months of October to March and recovery would be at a rate up to 7.0 mgd during April to September providing a combined total of up to 14 mgd.

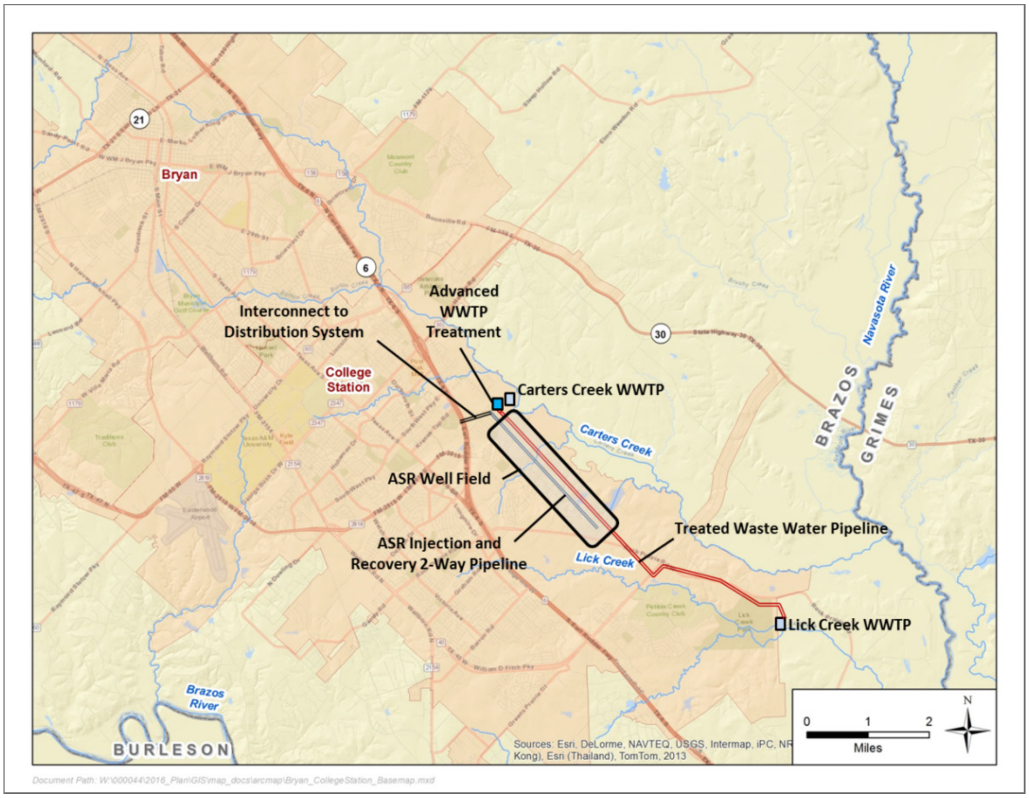

Figure 7.3-1 Location of College Station's ASR Project

7.3.2 Available Yield

The target area for ASR wells in College Station's project area has four minor and major aquifers, including, from youngest to oldest: Yegua-Jackson, Sparta, Queen City, and Carrizo-Wilcox. Water-bearing formations in the Carrizo-Wilcox consist of the Carrizo Sands and Simsboro Formation. A geologic profile showing the approximate depth and thickness of the geologic formations is shown in Figure 7.3-2. The Jackson Group and Yegua Formation, called the Yegua-Jackson Aquifer, are the shallowest, but rather poor productivity limits well capacity. The Sparta Sands are about 250 ft thick and extend from about 1,450 to 1,700 ft below land surface. The Queen City Sands appear to be about 425 ft thick and range in depth from about 1,800 to 2,225 ft. The Carrizo Sands appear to be about 100 ft thick. The Simsboro is estimated to be about 450 ft thick and extend from about 4,500 to 4,950 ft below land surface.

Electric geophysical logs[1] for a geologic cross-section suggest that the Sparta and Queen have rather extensive sands with fresh to brackish water. Electric geophysical logs[2] for another geologic cross-section provide picks for the Simsboro Formation. These logs suggest that the water quality in the Simsboro is brackish to saline. Native groundwater temperatures at these depths for the Sparta, Queen City, and Simsboro at these locations are about 95, 105, and 150 deg F, respectively. For purposes of this study, the

[1] Follett, C.R., 1974, Ground-water resources of Brazos and Burleson Counties, Texas: Texas Water Development Board Report 185.
[2] Thorkildsen, D., and Price, R.D., 1991, Ground-water resources of the Carrizo-Wilcox Aquifer in the Central Texas Region: Texas Water Development Board Report 332.

Sparta and Queen City Aquifers were selected for the storage because of depths and native groundwater temperature. This approach allows two wells to be constructed at each well site. Average well yields for both formations are estimated to be about 300 gpm. One advantage of this well field is that there are few, if any, water wells in the target water-bearing zones. Expected recovery from this project is estimated to be at least 75 percent.

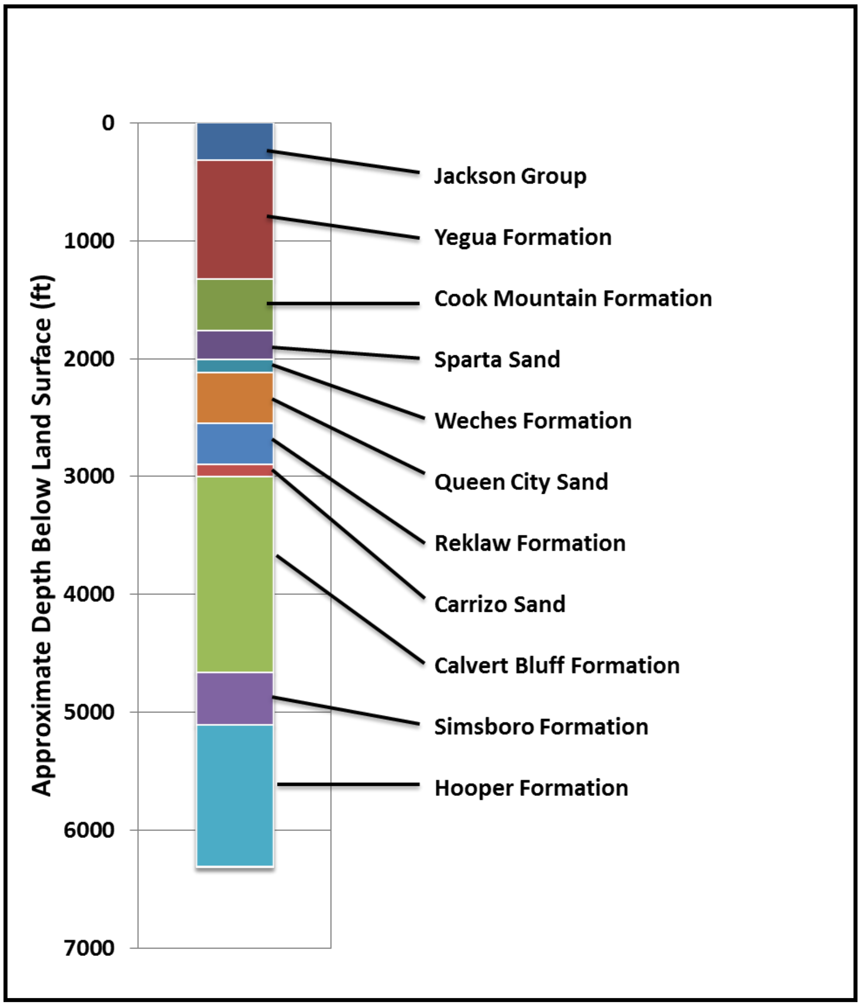

Figure 7.3-2 Geologic Profile in Target Area for ASR Well

7.3.3 Environmental Issues

Environmental issues for the proposed College Station ASR Project are described below. This project includes the development of an ASR well field, additional well field distribution and collection pipelines, a pump station and wastewater transmission pipeline, an advanced water treatment plant, and interconnects to existing transmission pipelines. The water source for this project would be existing wastewater effluent from local wastewater treatment plants which would be treated at a new AWTP planned near the existing Carters Creek WWTP. In addition, effluent water from the Lick Creek WWTP would be transported through a pipeline to the new AWTP for treatment and injection into the ASR wells. Recovered water from the ASR would be treated before delivery to the existing water distribution system. Implementation of this project would require field surveys by qualified professionals to document vegetation/habitat types, waters of the U.S. including wetlands, and cultural resources that may be impacted. Where impacts to protected species habitat or significant cultural resources cannot be avoided, additional studies would be necessary to evaluate habitat use and/or value, or eligibility for inclusion in the National Register of Historic Places, respectively. The project sponsor would also be required to coordinate with the U.S. Army Corps of Engineers regarding impacts to wetland areas and compensation would be required for unavoidable adverse impacts involving net losses of wetlands.

The pipelines and wells needed for the ASR project well field would occur in close proximity to Carters, Bee, Lick and Alum Creeks. Coordination with the U.S. Army Corps of Engineers would be required for construction within any waters of the U.S. Any impacts from this proposed project which would result in a loss of less than 0.5 acres of waters of the U.S. could be covered under Nationwide Permit #12 for Utility Line Activities.

The project occurs within the East Central Texas Plains Ecoregion[3] and lies within the Texan Biotic Province.[4] Vegetation types within the ASR well field area and transmission pipelines as described by the Texas Parks and Wildlife Department (TPWD)[5] include Post Oak Woods, Forest, and Post Oak Woods, Forest and Grassland Mosaic areas. These areas include portions which have been developed or disturbed and now include homes, business, and farms. Avoidance of riparian areas near the creeks or heavily wooded areas would help minimize potential impacts to existing area species from project construction activities.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Brazos County can be found at https://tpwd.texas.gov/gis/rtest/.

Because the project will use treated existing wastewater effluent to inject into the aquifer no significant impacts to existing stream flows or aquatic species are anticipated. Potential impacts to listed species within the project area are anticipated to include disturbance of existing habitat resulting from the construction of well fields and their associated pipelines, transmission pipelines and a new water treatment plant. However, most of these disturbances would be minimized by the small areas generally required for well field and pipeline construction. After construction is completed the majority of the disturbed areas will return to their previous habitat condition excluding the AWTP site or areas where maintenance activities are required.

A survey of the project area would be required prior to project construction to determine whether populations of or potential habitats used by listed species occur in the area to be affected. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

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3 Griffith Glenn, Sandy Bryce, James Omernik, and Anne Rogers. 2007. Ecoregions of Texas. Texas Commission on Environmental Quality.
4 Blair, W. Frank. 1950. The Biotic Provinces of Texas. Texas Journal of Science 2(1):93-117.
5 McMahan, Craig A., Roy G. Frye and Kirby L. Brown. 1984. The Vegetation Types of Texas. Wildlife Division, Texas Parks and Wildlife Department, Austin, Texas.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291).

Based on the review of publicly available Geographic Information System (GIS) records obtained from the Texas Historical Commission, there are no State Historic Sites, National Register Properties or Districts, cemeteries or Historical Markers within the project area. A review of archaeological resources in the proposed project area should be conducted during the project planning phase. Because the owner or controller of the project will likely be a political subdivision of the State of Texas (i.e., river authority, municipality, county, etc.), they will be required to coordinate with the Texas Historical Commission prior to project construction.

7.3.4 Engineering and Costing

Available records indicate that the ASR well depths in the Sparta and Queen City in an area southeast of College Station would average about 1,700 and 2,225 ft. A typical recharge and recovery rate is estimated to be about 300 gpm. For a 7 mgd injection rate, 10 Sparta and 10 Queen City wells would be required. The wells would be spaced about 1,000 ft apart.

The major facilities required for these projects include:

- Pump Station at Lick Creek WWTP,
- Advance Water Treatment Plant,
- Pump Station at AWTP for distribution to ASR wells and existing distribution system,
- ASR well field,
- Collector pipelines,
- Transmission pipeline between AWTP and distribution system,
- Interconnect to existing distribution system, and
- Chlorine disinfection water treatment plant.

Estimates were prepared for capital and project costs, annual debt service, operation and maintenance, power, land, and environmental mitigation. These costs are summarized in 7.3-1. The annual costs, including debt service, operation and maintenance, and power, is estimated to be $2,524 per acft.

Table 7.3-1 Cost Estimate Summary: College Station ASR Project Option

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
College Station - College Station Using Carters Ck and Lick Ck WWTP Effluent	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (14 mgd)	$5,605,000
Transmission Pipeline (10-20 in. dia., 7.1 miles)	$10,810,000
Transmission Pump Station(s) & Storage Tank(s)	$2,741,000
Well Fields (Wells, Pumps, and Piping)	$36,824,000
Water Treatment Plant (7 mgd)	$491,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
College Station - College Station Using Carters Ck and Lick Ck WWTP Effluent	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Advanced Water Treatment Facility (7 mgd)	$55,236,000
Integration, Relocations, Backup Generator & Other	$377,000
TOTAL COST OF FACILITIES	**$112,084,000**
- Planning (3%)	$3,363,000
- Design (7%)	$7,846,000
- Construction Engineering (1%)	$1,121,000
Legal Assistance (2%)	$2,242,000
Fiscal Services (2%)	$2,242,000
Pipeline Contingency (15%)	$1,622,000
All Other Facilities Contingency (20%)	$20,255,000
Environmental & Archaeology Studies and Mitigation	$893,000
Land Acquisition and Surveying (64 acres)	$1,155,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$4,963,000
TOTAL COST OF PROJECT	**$157,786,000**
ANNUAL COST	x
Debt Service (3.5 percent, 20 years)	$11,093,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$492,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$180,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$295,000
Advanced Water Treatment Facility	$7,341,000
Pumping Energy Costs (4321729 kW-hr @ 0.09 $/kW-hr)	$389,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$19,790,000**
Available Project Yield (acft/yr)	**7,842**
Annual Cost of Water ($ per acft), based on PF=2	**$2,524**
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	**$1,109**
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	**$7.74**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	**$3.40**
JS	*1/29/2025*

7.3.5 Implementation

Implementation of the ASR water management strategy for College Station includes the following issues:

- Acquiring permits from the Brazos Valley Groundwater Conservation District.
- Acquiring permits from TCEQ for Advanced Water Treatment Plant and ASR facilities construction and operations.
- Chemical and geochemical compatibility of native aquifer water and materials and imported water are chemically compatible.
- Lack of experience to develop confidence in the ability to inject and recover water from an aquifer, which includes the uncertainty about the compatibility of the injected water with native groundwater and aquifer materials.
- Initial and operational cost.
- Development of a management plan to efficiently use the ASR wells with a balance of injection and recovery cycles.

This water supply option has been compared to the plan development criteria, as shown in Table 7.3-2, and the option meets each criterion.

Table 7.3-2 Comparison of College Station ASR Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Does not fully meet shortages
2. Reliability	2. High reliability
3. Cost	3. High
B. Environmental factors	
1. Environmental Water Needs	1. Low impact
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. Low impact
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

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7.4 Lake Georgetown ASR

7.4.1 Description of Option

The concept for the Lake Georgetown ASR project is to:

- Utilize existing BRA contractual water supply in Lake Georgetown of 45,707 acft/yr.
- Utilize spare treatment capacity at the Lake Water Treatment Plant (WTP), which has a total production capacity of 35.5 million gallons per day (mgd).
  - Utilize Lake Georgetown flood storage, when available, to assist in meeting growing demand.
- Install new Trinity Aquifer ASR wells and associated infrastructure.
- Operate recharge cycle during wet months when there is excess supply, decreased demand, and spare treatment capacity at the Lake WTP. Recovery could be at any time, but typically would be during the summer when demand is relatively high or during periods of drought. The recovered water would be minimally treated before being discharged back into distribution pipelines along with other supplies from the Lake WTP.

New facilities required for this option are ASR wells (dual-purpose wells that are designed for injection and recovery), well field distribution and collection pipelines, additional WTP capacity, and chlorination facilities. The general location of the proposed ASR and production well field, pipeline, and Lake Water Treatment Plant (LWTP) are shown in Figure 7.4.-1.

The City of Georgetown is experiencing rapid increases in water demand, due primarily to unprecedented levels of residential and commercial growth. Projected supplies and demands are illustrated in Figure 7.4-2. The City of Georgetown's BRA contract supply of 45,707 acft/yr becomes insufficient to meet demand of 48,810 acft/yr in 2040. An ASR system can provide a means to utilize BRA contract water while supply still exceeds demand, and bank that water until need arises. Additionally, as shown in Figure 7.4-2, utilizing water in the Lake Georgetown flood pool has the potential to significantly increase water supply. ASR can utilize this excess water, when available, to assist in meeting growing demand and provide a more robust water supply system.

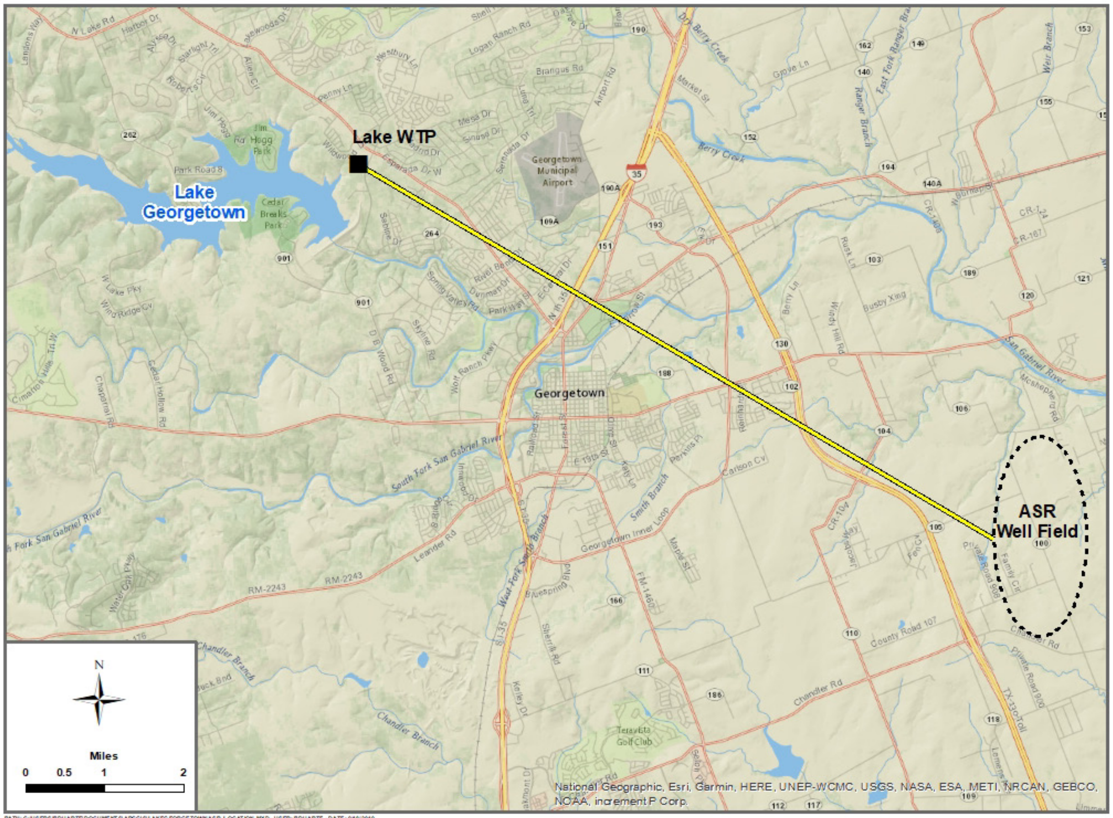

Figure 7.4-1 Possible Location of Lake Georgetown ASR Project

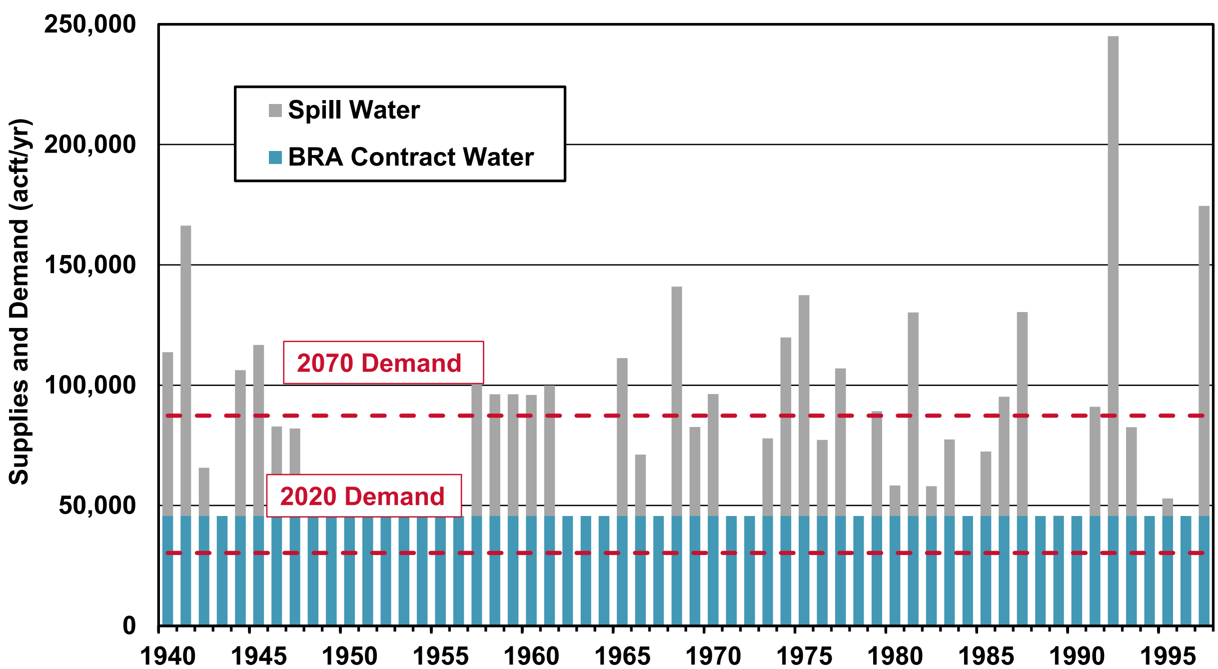

Figure 7.4-2 Lake Georgetown Water Supplies and Projected Demand

7.4.1 Available Yield

In Williamson County, the Lower Trinity Aquifer system is a productive ground water formation. In general, the most hydraulically transmissive (i.e., sand-rich) portions occur around 3,300 ft deep, and wells are expected to have yields from 800-2,000 gpm. For purposes of this analysis, the ASR wells were assumed to have a capacity of 1,500 gpm (200 acft/mo) during recovery and 1,200 gpm (160 acft/mo) during injection. The nearby production wells are assumed to have a capacity of 1,500 gpm (200 acft/mo). The long-term impact on the Trinity Aquifer is considered to be minimal on a county-wide basis because the strategy for this project is to balance the recharge and recovery of water. However, there is expected to be local variations in groundwater levels due to varying times of recharge and recovery and the location of ASR and nearby production wells.

The TCEQ Brazos Water Availability Model (WAM) Run 3 with Senate Bill 3 (SB3) environmental flow standards was used to determine the average magnitude and timing of Lake Georgetown overflow. This average modeled overflow along with BRA contractual water supply and projected municipal water demands serve as the basis for estimating ASR availability at Lake Georgetown, as shown in Table 7.4-1. Under the assumptions and constraints detailed in Table 7.4-2, an average of approximately 10,200 acft/yr are available for recharge from 2020 through 2079.

The source of water available for ASR, BRA contractual supply or Lake Georgetown flood water, varies through time, as shown in Figure 7.4-3.

Prior to 2030, all ASR water would be obtained from spare BRA contract water. As demand and LWTP capacity increase after 2030, a mix of BRA and Lake Georgetown flood water is recharged for ASR. After 2040, annual water demand exceeds BRA contract supply and ASR water is sourced entirely from Lake Georgetown flood water.

Figure 7.4-4 and Figure 7.4-5 illustrate the magnitude and timing of simulated monthly recharge from 2020 through 2070.

In the 2020 and 2030 decades, the ASR recharge cycle operates annually during wet months when there is excess supply, decreased demand, and spare treatment capacity at the Lake WTP. However, as projected demand outpaces BRA contractual supply and the ASR recharge cycle becomes wholly reliant on water temporarily stored in the Lake Georgetown flood pool, the timing of recharge becomes less predictable and generally less frequent. In order to maintain a similar annual average recharge volume to previous decades, the ASR system must expand its capacity by 2040 to account for the more sporadic recharge cycle.

Assuming an 85 percent recovery rate, the Lake Georgetown ASR project has the potential to increase the area's supply by about 8,600 acft/yr.

Table 7.4-1 Lake Georgetown ASR Availability

Decade	Average Annual BRA Contract Water Recharged	Average Annual Flood Water Recharged	Average Annual Water Recharged	Maximum Monthly Recharge	Maximum Annual Recharge
	acft/yr	acft/yr	acft/yr	acft/mo	acft/yr
2020	9,700	0	9,700	1,400	9,700
2030	6,400	4,500	10,900	2,500	20,500

Decade	Average Annual BRA Contract Water Recharged	Average Annual Flood Water Recharged	Average Annual Water Recharged	Maximum Monthly Recharge	Maximum Annual Recharge
	acft/yr	acft/yr	acft/yr	acft/mo	acft/yr
2040	0	10,100	10,100	4,100	27,800
2050	0	10,100	10,100	4,100	27,400
2060	0	10,100	10,100	4,100	27,800
2070	0	10,100	10,100	4,100	28,100

Table 7.4-2 Lake Georgetown ASR Availability Assumptions and Constraints

Decade	Treatment Plant Capacity		Annual BRA Contract	Annual Demand	Recharge Rate	Number of Recharge Wells
	mgd	acft/yr	acft/yr	acft/yr	gpm	
2020	35.5	39,765	45,707	30,325	1,200	15
2030	70	78,410	45,707	39,266	1,200	15
2040	100	112,014	45,707	48,810	1,200	25
2050	110	123,216	45,707	60,087	1,200	25
2060	130	145,619	45,707	72,781	1,200	25
2070	156	174,742	45,707	87,365	1,200	25

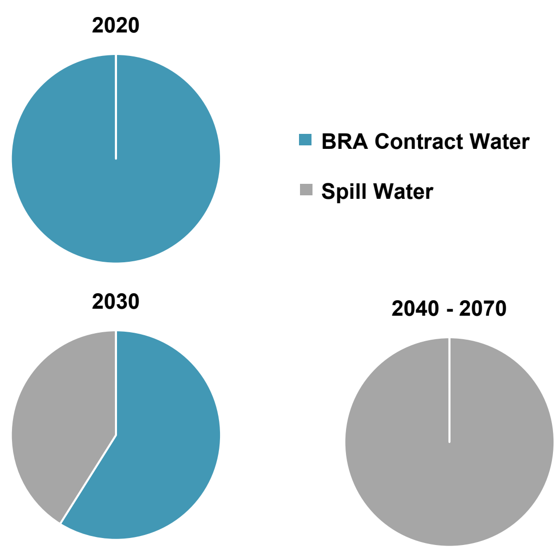

Figure 7.4-3 Source of Lake Georgetown ASR Recharge Water by Decade

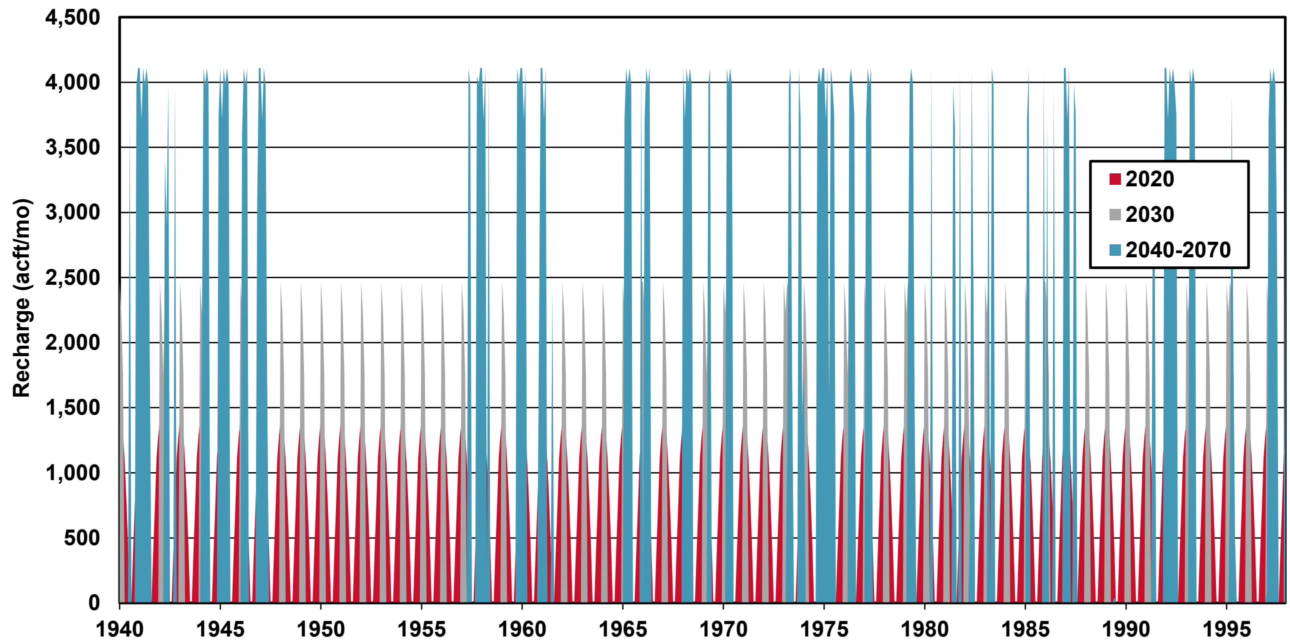

Figure 7.4-4 Simulated Timeline of Recharge by Planning Decade

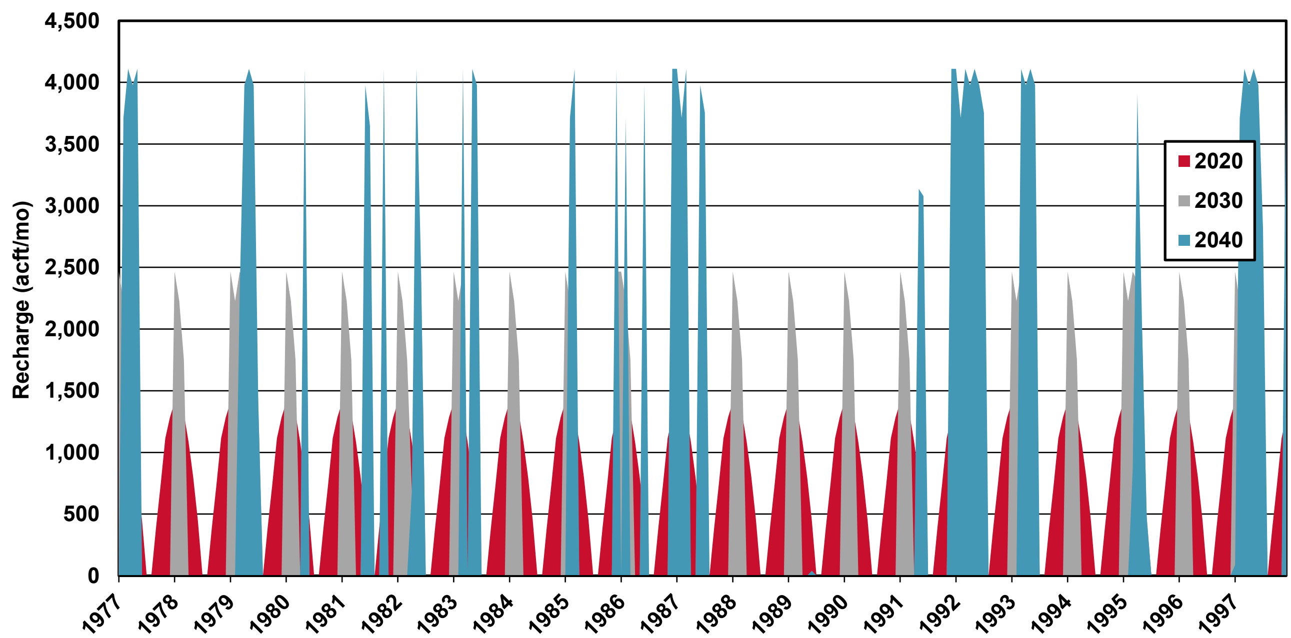

Figure 7.4-5 Zoomed-In Simulated Timeline of Recharge by Planning Decade

7.4.2 Environmental Issues

Environmental issues for the proposed Lake Georgetown ASR Project in Williamson County are described below. This project includes the development of a well field, production wells, well field distribution and collection pipelines, and an interconnect to a water treatment plant east of Lake Georgetown. Implementation of this project would require field surveys by qualified professionals to document vegetation/habitat types, waters of the U.S. including wetlands, and cultural resources that may be impacted. Where impacts to protected species habitat or significant cultural resources cannot be avoided, additional studies would be necessary to evaluate habitat use and/or value, or eligibility for inclusion in the National Register of Historic Places, respectively. The project sponsor would also be required to coordinate with the U.S. Army Corps of Engineers regarding impacts to wetland areas and compensation would be required for unavoidable adverse impacts involving net losses of wetlands.

The pipelines and wells needed for the Lake Georgetown ASR project well field would occur in close proximity to Lake Georgetown, a number of tributaries to the San Gabriel River, and the San Gabriel River, a Traditional Navigable Water. Coordination with the U.S. Army Corps of Engineers would be required for construction within any waters of the U.S. Any impacts from this proposed project which would result in a loss of less than 0.5 acres of waters of the U.S. could be covered under Nationwide Permit 12 for Utility Line Activities.

The project occurs within the Cross Timbers and Prairies and Blackland Prairies Ecoregions[1] and lies within the Texan Biotic Province.[2] Vegetation types within the Lake Georgetown ASR well field area as described by the Texas Parks and Wildlife Department (TPWD)[3] includes disturbed or tame grasslands, floodplain deciduous shrubland, floodplain hardwood forest, floodplain herbaceous vegetation, riparian deciduous shrubland, evergreen shrubland, riparian hardwood evergreen forest, riparian hardwood forest, riparian herbaceous vegetation, evergreen motte and woodland, hardwood motte and woodland, savanna grassland, deciduous woodland, juniper shrubland, mesquite shrubland, crops, urban high intensity cover, and urban low intensity cover. Avoidance of riparian areas near creeks and other relatively undisturbed natural habitats within the well field areas would help minimize potential impacts to existing area species.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Williamson County can be found at https://tpwd.texas.gov/gis/rtest/.

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[1] Griffith Glenn, Sandy Bryce, James Omernik, and Anne Rogers. 2007. Ecoregions of Texas. Texas Commission on Environmental Quality.

[2] Blair, W. Frank. 1950. The Biotic Provinces of Texas. Texas Journal of Science 2(1):93-117.

[3] McMahan, Craig A., Roy G. Frye and Kirby L. Brown. 1984. The Vegetation Types of Texas. Wildlife Division, Texas Parks and Wildlife Department, Austin, Texas.

Information received from the TPWD Texas Natural Diversity Database (TXNDD) shows documented occurrences of Bone Cave harvestman (SGCN), cave myotis bats (SGCN), Georgetown salamander (LE), Golden-cheeked warbler (LE/E), gravelbar brickellbush (SGCN), Guadalupe bass (SGCN), Jollyville Plateau salamander (LT), Kretschmarr Cave mold beetle (LE), Plateau loosestrife (SGCN),Redell harvestman (LT), Salado Springs salamander (LT), Texas shiner (SGCN),and western hog-nosed skunk (SGCN) within three miles of the project area.

No significant impacts to existing stream flows or aquatic species are anticipated. Potential impacts to listed species within the project area are anticipated to include disturbance of existing habitat resulting from the construction of well fields and their associated pipelines. However, these disturbances would be minimized by the small areas generally required for well field and pipeline construction. After construction is completed most of the disturbed areas will return to their previous habitat condition, excluding areas where maintenance activities are required.

Element occurrence records for the Coffin Cave mold beetle and western hog-nosed skunk intersect the proposed project area. A survey of the project area would be required prior to well field and pipeline construction to determine whether populations of or potential habitats used by listed species occur in the area to be affected. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291).

Based on the review of publicly available Geographic Information System (GIS) records obtained from the Texas Historical Commission, there are no State Historic Sites, National Register Properties, National Register Districts, cemeteries or Historical Markers within the potential well field or pipeline area. Avoidance of any cultural resource areas discovered during project surveys should be possible by careful selection of the areas for well sites and their associated pipelines. A review of archaeological resources in the proposed project area should be conducted during the project planning phase. Because the owner or controller of the project will likely be a political subdivision of the State of Texas (i.e., river authority, municipality, county, etc.), they will be required to coordinate with the Texas Historical Commission prior to project construction.

7.4.3 Engineering and Costing

This ASR strategy recommends a total of 25 storage and recovery (ASR) wells, with 15 installed by 2030 and an additional 10 installed in 2040. Available records indicate that Trinity Aquifer wells in eastern Williamson County average 3,300 feet deep. A typical injection and recovery rate is estimated to be 1,200 gpm and 1,500 gpm. The well field design would space the wells about 3,000 ft apart. The recharge water will be pumped from Lake Georgetown, to the LWTP, and then to the well field (Figure 7.4-1) through a 42”, 12 mile long, two-way transmission pipeline. The existing pump station at the treatment plant would deliver the treated water to the ASR well field. A chlorination facility would be built at or near the well field for minimal treatment of extracted water and connected to existing transmission pipelines for direct delivery to users.

The major facilities required for these projects include:

- ASR wells,
- Well field collector and transmission pipelines,
- Chlorination facility, and
- Water treatment plant interconnect and upgrades.

Estimates were prepared for capital and project costs, annual debt service, operation and maintenance, power, land, and environmental mitigation. These costs are summarized in Table 7.4-3.

Table 7.4-3 Cost Estimate Summary: Lake Georgetown ASR Option

Item	Estimated Costs for Facilities
Transmission Pipeline (42 in dia., 12 miles)	$50,154,000
Well Fields (Wells, Pumps, and Piping)	$112,405,000
Two Water Treatment Plants (74.4 mgd and 7.7 mgd)	$164,616,000
TOTAL COST OF FACILITIES	**$327,175,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$112,004,000
Environmental & Archaeology Studies and Mitigation	$3,019,000
Land Acquisition and Surveying (59 acres)	$3,407,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$14,478,000
TOTAL COST OF PROJECT	**$460,083,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$32,361,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,627,000
Water Treatment Plant	$11,797,000
Pumping Energy Costs (20,416,759 kW-hr @ 0.08 $/kW-hr)	$1,250,000
TOTAL ANNUAL COST	**$47,035,000**
Available Project Yield (acft/yr)	**8,645**
Annual Cost of Water ($ per acft), based on PF=1	**$5,441**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$1,697**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$16.69**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$5.21**

7.4.4 Implementation

Implementation of the Lake Georgetown ASR water management strategy for BRA includes the following issues:

- Regulations (30 Texas Administrative Code Section 331.19(a) "Injection Into or Through the Edwards Aquifer") currently do not allow injection of water through wells that transect the environmentally sensitive Edwards Aquifer in Williamson County and special legislative consideration is likely necessary to allow this project to proceed;
- Agreements between BRA and participants;
- Acquiring permits from TCEQ for ASR construction and operations and for storage of surface water in the Trinity Aquifer;
- Chemical and geochemical compatibility of native aquifer water and materials and imported water are chemically compatible;
- Lack of experience to develop confidence in the ability to inject water from a lake, which includes the uncertainty about the compatibility of the injected water with native groundwater and aquifer materials and failure of the ASR well;
- Controlling the loss of the injected water to others;
- Initial cost;
- Ability to add ASR wells as needed as the frequency of recharge events decreases and the magnitude increases;
- Ability to increase WTP capacity as needed to reflect changes in recharge events;
- Experience in operating the facilities; and
- Development of a management plan to efficiently use the ASR wells.

This water supply option has been compared to the plan development criteria, as shown in Table 7.4-4, and the option meets each criterion.

Table 7.4-4 Comparison of Lake Georgetown ASR Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. High
2. Reliability	2. High
3. Cost	3. Moderate - High
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

7.5 Acton MUD ASR

7.5.1 Description of Option

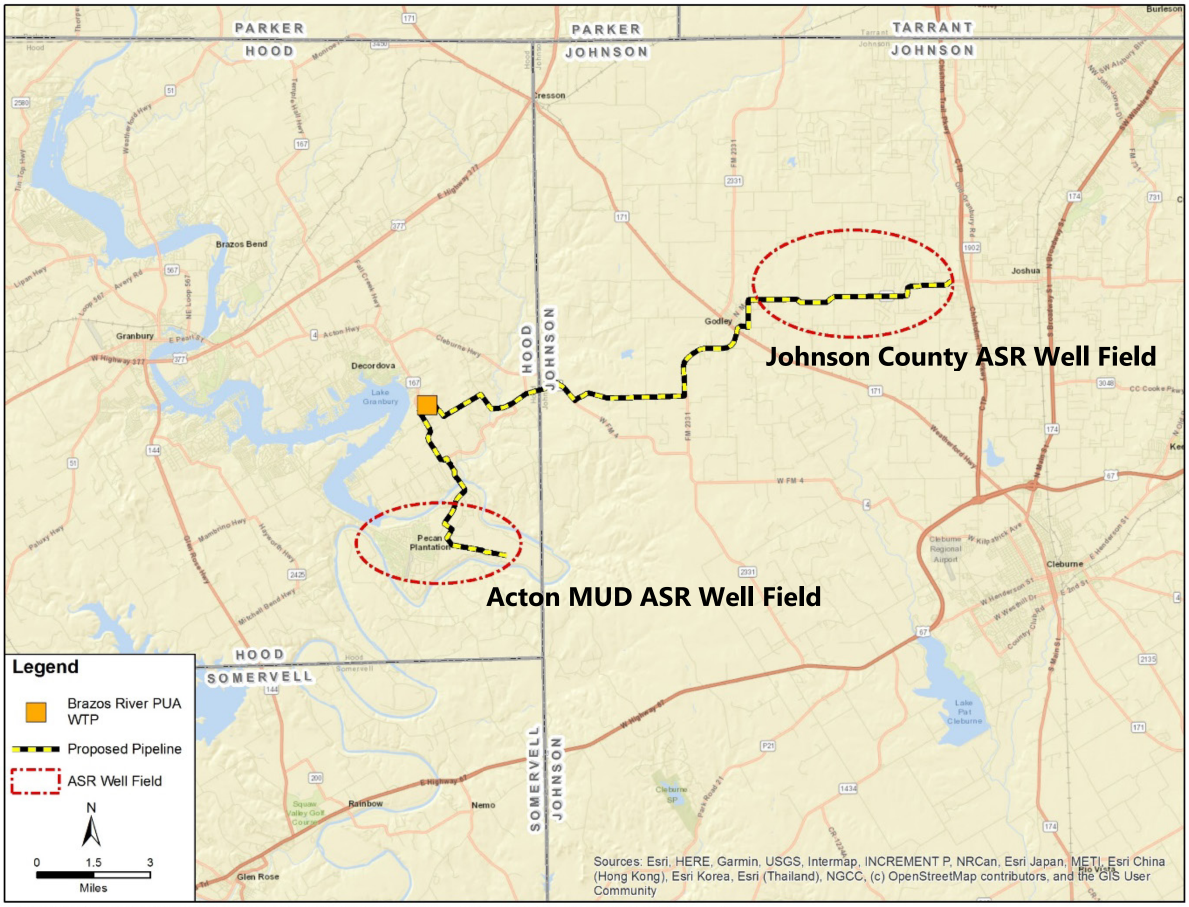
The concept for the Acton MUD ASR project is:

- Utilize existing 7,000 acft/yr surface water rights in Lake Granbury that are owned by the BRA and purchased by Acton MUD (AMUD) under a supply contract.
- Utilize Brazos Regional Public Utility Agency (BRPUA) water treatment facility, which has a total rated production capacity of 13 million gallons a day (mgd). AMUD is a co-owner of BRPUA.
- For AMUD, new Trinity Aquifer ASR wells would be located near their existing treated water pipeline between Granbury and their distribution system. Treated drinking water would be injected through the ASR wells then subsequently recovered in later months. It is assumed that this pipeline has sufficient capacity to convey treated water for ASR injection.
- The recharge cycle of ASR would occur from October to May and would coincide when there is excess capacity in the BRPUA WTP. Recovery would be during June through September when demand is relatively high. The recovered water would be discharged back into the treated water pipeline for eventual distribution to participants along with other supplies from the BRPUA WTP.

A schematic showing the location of the project facilities is shown in Figure 7.5-1 (note that the Johnson County SUD portion has been determined to be infeasible). New facilities required for this option are ASR wells, well field distribution and collection pipelines, a chlorination facility, and interconnects between the pipeline and ASR well field.

AMUD's water supplies include groundwater and purchased surface water in Lake Granbury. The ASR project is assumed to provide an additional 2,526 acft/yr supply derived from an estimate of excess capacity in the BRPUA WTP during low water demand months and contract water available.

Figure 7.5-1 Location of Johnson County and Acton MUD ASR Projects

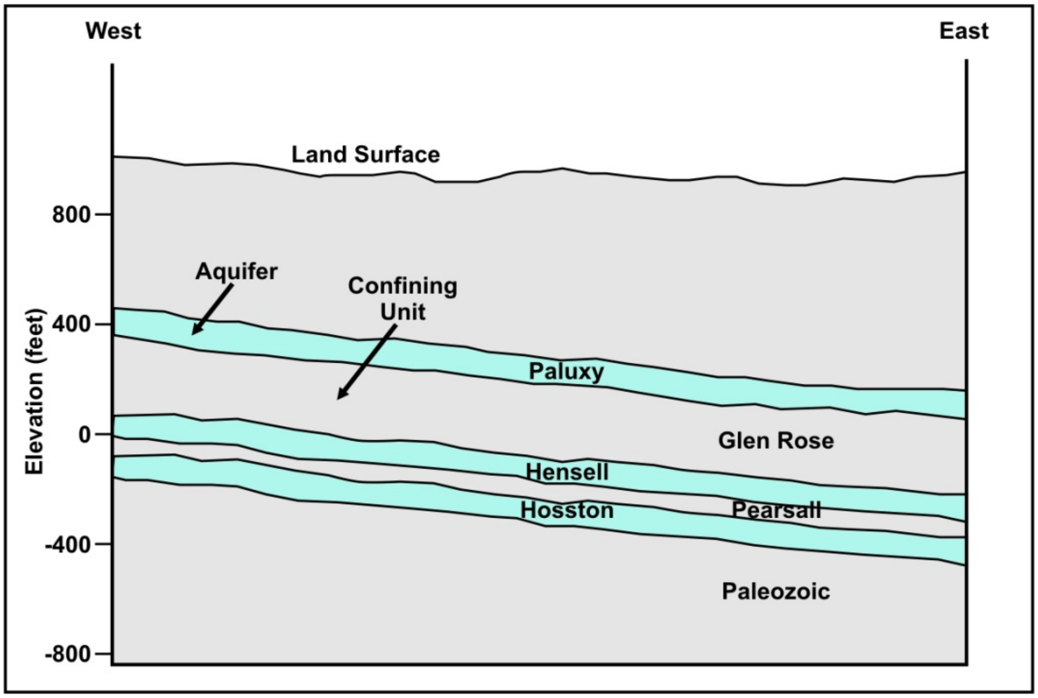


7.5.2 Available Yield

In Hood County, the Trinity Aquifer system is composed of three sandy aquifer units that are confined and separated by nearly impermeable clay units. These aquifer units include, from youngest to oldest: the Paluxy, Hensell, and Hosston (Figure 7.5-2). In the proposed ASR well field, the water-bearing units are confined with artesian pressures generally rising several hundred feet above the top of the aquifer(s). The geometry and hydraulic properties of the hydrogeologic units of the Trinity Aquifer units vary throughout Hood County. In general, the most hydraulically transmissive (i.e., sand-rich) portions of the units vary from 50 to 100 feet in thickness. High-capacity production wells typically yield from 150 to 250 gallons per minute (gpm). Expected recovery from this project is estimated to be at least 75%.

The long-term impact on the Trinity Aquifer is considered insignificant because the intent for this project is to balance the recharge and recovery of water. In the short-term, the impact will be a noticeable, but temporary, rise in groundwater levels during the recharge cycle and a similar decline during the recovery cycle.

Figure 7.5-2 Hydrogeological Profile in ASR Well Field



7.5.3 Environmental Issues

Environmental issues for the proposed Acton MUD project are described below. This project includes the development of the ASR well field along the border of Hood and Johnson Counties south of Granbury. Additional well field distribution and collection pipelines and interconnects to existing transmission pipelines would also be required for the project. Implementation of this project would require field surveys by qualified professionals to document vegetation/habitat types, waters of the U.S. including wetlands, and cultural resources that may be impacted. Where impacts to protected species habitat or significant cultural resources cannot be avoided, additional studies would be necessary to evaluate habitat use and/or value, or eligibility for inclusion in the National Register of Historic Places, respectively. The project sponsor would also be required to coordinate with the U.S. Army Corps of Engineers regarding impacts to wetland areas and compensation would be required for unavoidable adverse impacts involving net losses of wetlands.

The pipelines and wells needed for the Acton MUD ASR well field would occur in close proximity to the Brazos River. The Texas Parks & Wildlife Department (TPWD) has identified a number of stream segments throughout the state as ecologically significant on the basis of biological function, hydrologic function, riparian conservation, exceptional aquatic life uses, and/or threatened or endangered species. The portion of the Brazos River near the proposed ASR well field is listed by the TPWD as ecologically significant. This segment of the Brazos River is considered to have outstanding wildlife values, high water quality, exceptional aquatic life, and high aesthetic value. Coordination with the U.S. Army Corps of Engineers would be required for construction within any waters of the U.S. Any impacts from this proposed project which would result in a loss of less than 0.5 acres of waters of the U.S. could be covered under Nationwide Permit #12 for Utility Line Activities.

The project occurs within the Central Oklahoma/Texas Plains Ecoregion[1] and lies within the Texan Biotic Province.[2] Vegetation types within the Johnson County ASR well field as described by the Texas Parks and Wildlife Department (TPWD)[3] includes areas of crops, and Post Oak Woods, Forest and Grassland Mosaic. The Acton MUD ASR well field occurs primarily within the Oak-Mesquite-Juniper Parks/Woods vegetation type but also contains a small area of Bluestem grassland vegetation type in the southeastern section of the area. The well field area contains large areas that have been developed or disturbed and include homes, business, and farms. Avoidance of the remaining areas of riparian and woods habitat within the well field areas would help minimize potential impacts to existing area species.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Hood and Johnson counties can be found at https://tpwd.texas.gov/gis/rtest/.

Because the project will result in an equal exchange of water to the aquifer, no significant impacts to existing stream flows or aquatic species are anticipated. Potential impacts to listed species within the project area are anticipated to include disturbance of existing habitat resulting from the construction of well fields and their associated pipelines. However, these disturbances will be minimized by the small areas generally needed for well field and pipeline construction. After construction is completed most of the disturbed areas will return to their previous condition excluding areas where maintenance activities are required.

A survey of the project area would be required prior to well field and pipeline construction to determine whether populations of or potential habitats used by listed species occur in the area to be affected. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291).Based on the review of publicly available Geographic Information System (GIS) records obtained from the Texas Historical Commission, there are no State Historic Sites, National Register Properties, or National Register Districts within the well field areas. However, one cemetery is located within the Acton MUD ASR well field area. Avoidance of these cultural resource areas should be possible by careful selection of the areas for well sites and their associated pipelines. A review of archaeological resources in the proposed project area should be conducted during the project planning phase. Because the owner or controller of the project will likely be

1 Griffith Glenn, Sandy Bryce, James Omernik, and Anne Rogers. 2007. Ecoregions of Texas. Texas Commission on Environmental Quality.
2 Blair, W. Frank. 1950. The Biotic Provinces of Texas. Texas Journal of Science 2(1):93-117.
3 McMahan, Craig A., Roy G. Frye and Kirby L. Brown. 1984. The Vegetation Types of Texas. Wildlife Division, Texas Parks and Wildlife Department, Austin, Texas.

a political subdivision of the State of Texas (i.e., river authority, municipality, county, etc.), they will be required to coordinate with the Texas Historical Commission prior to project construction.

7.5.4 Engineering and Costing

The actual number of wells and land required for the well field is dependent upon local depth to water, and the thickness and character of sands present at each well field site. This site-specific information would need to be acquired through a research or a test drilling and field-testing program prior to implementation of an ASR system in the region.

Available records indicate that wells near Acton MUD typically are 500-600 ft deep. Based on existing wells in central Johnson County, the maximum recovery rate is 250 gpm, and a recovery rate of 180 gpm is assumed. The ASR wells would be used for recharge from October through May and for recovery from June through September. For a 2,526 acft/yr system for Acton MUD, 13 ASR wells are required during the injection phase of operation while 19 wells are needed during the production phase. Because the ASR wells should recover only previously stored treated ASR water, the larger number of 19 ASR wells is required. Three additional wells have been included for contingency.

The well field design has the wells spaced about 1,000 feet apart and in the vicinity of the treated water transmission pipeline. The relatively close well spacing is based on seasonal ASR operations.

A chlorination facility is included at the well field to chlorinate the recovered treated drinking water prior to discharge into the treated water transmission line. In addition, O&M costs for treatment of the additional 2,526 acft/yr surface water at the BRPUA water treatment facility have been included.

The major facilities required for this project includes:

- ASR wells,
- Collector Pipelines,
- Chlorination Facility, and
- Interconnect.

Estimates were prepared for capital and project costs, annual debt service, operation and maintenance, power, land, and environmental mitigation. These costs are summarized in . The annual costs, including debt service, operation and maintenance, and power, are estimated to be $662 per acft for the AMUD project.

Table 7.5-1 Acton MUD ASR Cost Summary

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Acton MUD - Acton MUD ASR Option	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$21,698,000
Two Water Treatment Plants (6.8 mgd and 3.4 mgd)	$478,000
Integration, Relocations, Backup Generator & Other	$150,000
TOTAL COST OF FACILITIES	**$22,326,000**
- Planning (3%)	$670,000
- Design (7%)	$1,563,000
- Construction Engineering (1%)	$223,000
Legal Assistance (2%)	$447,000
Fiscal Services (2%)	$447,000
All Other Facilities Contingency (20%)	$4,465,000
Environmental & Archaeology Studies and Mitigation	$1,297,000
Land Acquisition and Surveying (111 acres)	$886,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,051,000
TOTAL COST OF PROJECT	**$33,375,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,348,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$218,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$1,553,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (3797201 kW-hr @ 0.09 $/kW-hr)	$342,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$4,461,000**
Available Project Yield (acft/yr)	**2,526**
Annual Cost of Water ($ per acft), based on PF=1	**$1,766**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$837**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$5.42**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$2.57**
JS	*2/5/2025*

7.5.5 Implementation

Implementation of the ASR water management strategy for Acton MUD includes the following issues:

- Permits from TCEQ for ASR construction and operations and for storage of surface water in the Trinity Aquifer can be obtained;
- Chemical and geochemical compatibility of native aquifer water and materials and imported water are chemically compatible;
- Lack of experience to develop confidence in the ability to inject and recover water from an aquifer, which includes the uncertainty about the compatibility of the injected water with native groundwater and aquifer materials;
- Controlling the loss of the injected water to others;
- Initial cost;
- Experience in operating the facilities; and
- Development of a management plan to efficiently use the ASR wells with a balance of recharge and recovery cycles.

This water supply option has been compared to the plan development criteria, as shown in Table 7.5-2, and the option meets each criterion.

Table 7.5-2 Comparison of Acton MUD ASR Options to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Meets shortages
2. Reliability	2. High
3. Cost	3. Moderate to High
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
D. Impact on Other State Water Resources	None
E. Threats to Agriculture and Natural Resources	None
F. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and industrial shortages
G. Requirements for Interbasin Transfers	Not applicable
H. Third Party Social and Economic Impacts from Voluntary Redistribution	None

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7.6 Lake Granger ASR

7.6.1 Description of Option

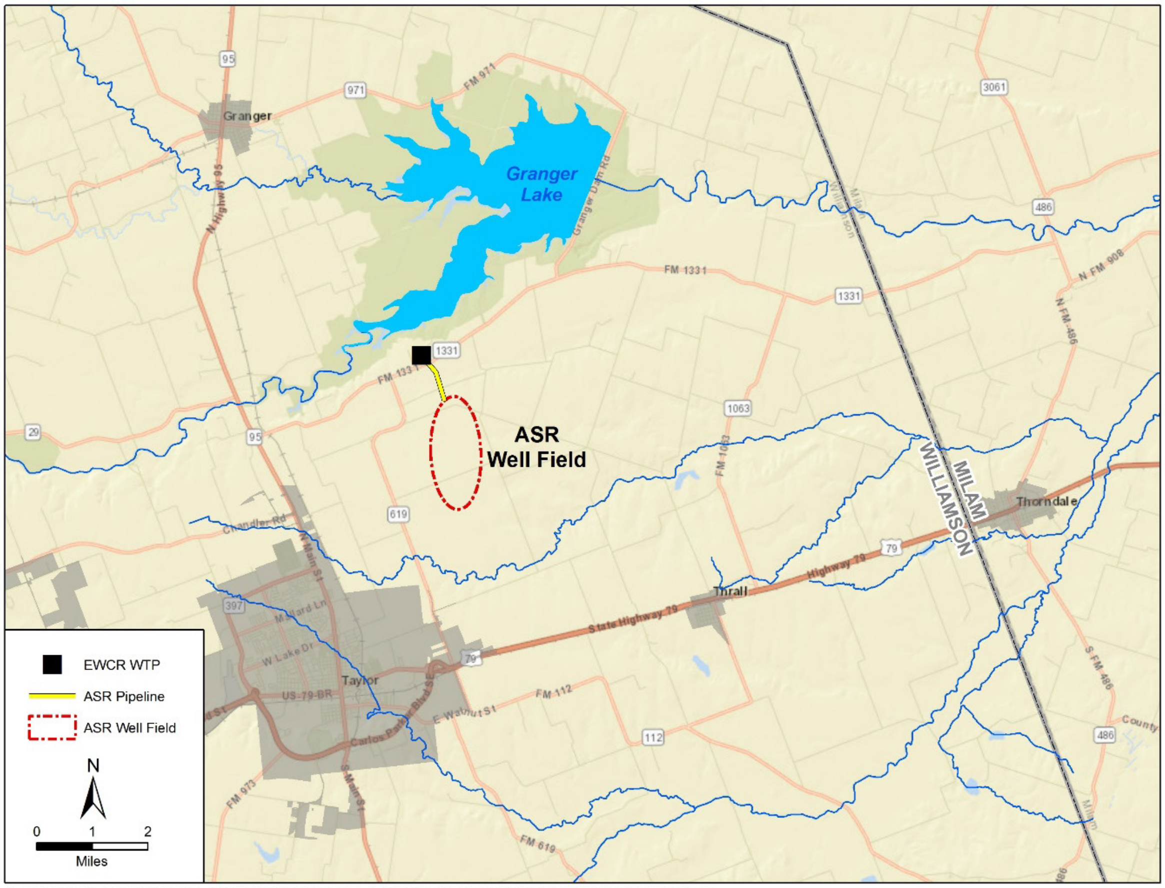
The concept for the Lake Granger and ASR conjunctive use project is to:

- Supply local Lake Granger demands of 13,015 acft/yr, referred to herein as the "base rights."
- Overdraft Lake Granger to supply an additional 11,900 acft/yr, and recharge up to 11,520 acft/yr, when available.
- Install new Trinity Aquifer ASR and production wells and associated infrastructure.
- Operate the recharge cycle of ASR system when the reservoir is at greater than 70% capacity. Recover stored water with ASR and production wells when reservoir level drops to a volume equivalent to one-year supply of the lakeside demands.

New facilities required for this option are ASR wells (dual-purpose wells that are designed for injection and recovery), production wells to provide additional recovery capacity, well field distribution and collection pipelines, and interconnect to the water treatment plant. The general location of the proposed ASR and production well field, pipeline, and East Williamson County Regional Water Treatment Plant (EWCRWTP) are shown in Figure 7.6-1.

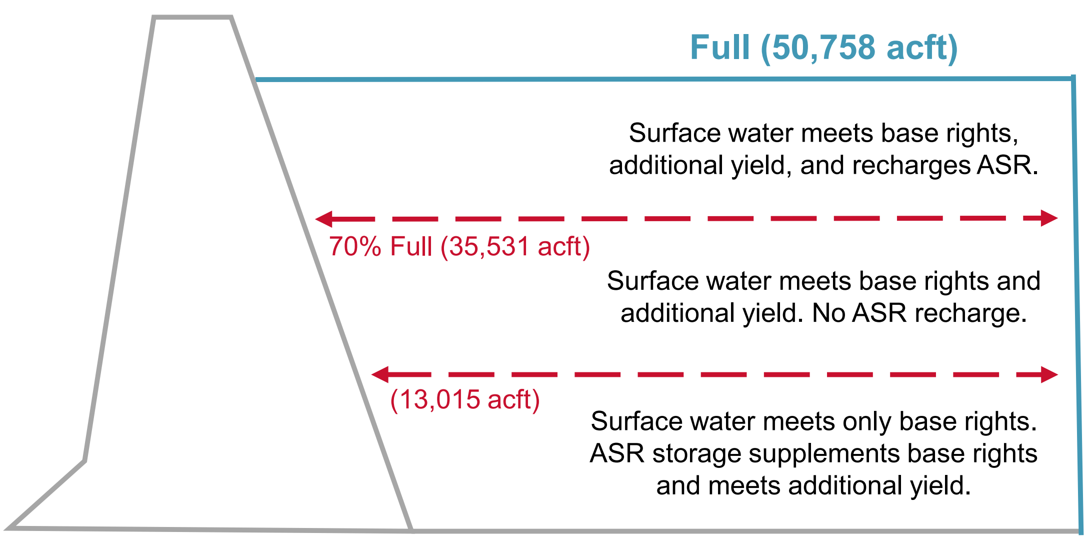
Operation of Lake Granger and the ASR project will be controlled by the available storage in the reservoir. When reservoir storage is at 70 percent (35,531 acft) or greater, water from the reservoir (stored water and inflows) will be used to meet the base rights and the additional yield created by the project (overdraft of Lake Granger), and supply water to the ASR system for recharge. When storage drops below 70 percent, diversion to the ASR project ceases, and reservoir storage and inflows are used to meet the base rights and additional yield. As storage drops below a volume equivalent to one year of the base rights (13,015 acft), reservoir storage and inflows are constrained to meet only the existing demand from base rights and water stored in the ASR project is used to meet the additional yield. If necessary, the ASR storage is also used to supplement the base rights. A schematic showing the operation of the project is shown in Figure 7.6-2.

Figure 7.6-1 Lake Granger ASR Project Location



Document Path: \\dalctxsrv01\Texas_GIS_Projects\10029705_036_Brazos_G_2021_Plan\Map_Docs\MXDs\ASR_Strategy\Lake_Granger_ASR.mxd

Figure 7.6-2 Operational Schematic of Lake Granger and ASR Project



7.6.2 Available Yield

In Williamson County, the Lower Trinity Aquifer system is a productive ground water formation. In general, the most hydraulically transmissive (i.e., sand-rich) portions occur around 3,300 ft deep, and wells are expected to have yields from 800-2,000 gpm. For purposes of this analysis, the ASR wells were assumed to have a capacity of 1,200 gpm (160 acft/mo) during injection and 1,500 gpm (200 acft/mo) during recovery. The nearby production wells are assumed to have a capacity of 1,500 gpm (200 acft/mo). The long-term impact on the Trinity Aquifer is considered to be minimal on a county-wide basis because the strategy for this project is to balance the recharge and recovery of water. However, local variations in groundwater levels are expected because of the varying times of recharge and recovery and the location of ASR and nearby production wells.

The TCEQ Brazos Water Availability Model (WAM) Run 3 with Senate Bill 3 (SB3) environmental flow standards was used to determine the potential additional yield that could be reliably supplied by conjunctive operation of Lake Granger with the proposed ASR well field. The ASR well field was assumed to require 6,200 acft of dead storage and was capped for analysis purposes at 80,000 acft of stored ASR water, including dead storage. The model was run with year 2020 sediment conditions for Lake Granger. The additional reliable yield available through the proposed conjunctive operation with the ASR well field was determined to be 11,900 acft/yr, increasing the total BRA water supply from Lake Granger to about 25,000 acft/yr. Figure 7.6-3 shows the annual source of diversions (Lake Granger or ASR storage) over the modeled time period. Figure 7.6-4 shows the combined storage trace for both Lake Granger and the ASR facility. Expected recovery from this project is estimated to be at least 75%.

A storage frequency plot of Lake Granger with and without the ASR system illustrates the effect that conjunctive use has on the reservoir (Figure 7.6-5). As expected, Lake Granger would be full less often under the increased demands of the additional firm supply and diversions to the ASR facility. Under conjunctive operation of the reservoir and ASR system, the reservoir supplies the existing and additional firm yield roughly 90% of the time and can contribute to ASR storage about 60% of the time. A storage trace of Lake Granger alone, shown in Figure 7.6-6, illustrates a chronological record of the simulated lake levels and a visual representation of how long the lake would be under various operating conditions for this conjunctive use project.

This additional, interruptible surface water supplied from Lake Granger for this strategy would be authorized by the BRA’s System Operations Permit.

Figure 7.6-3 Utilization of Lake Granger and ASR Facility to Meet Lake Granger Demands and Provide Additional ASR Yield (13,015 acft/yr base plus 11,900 acft/yr additional)

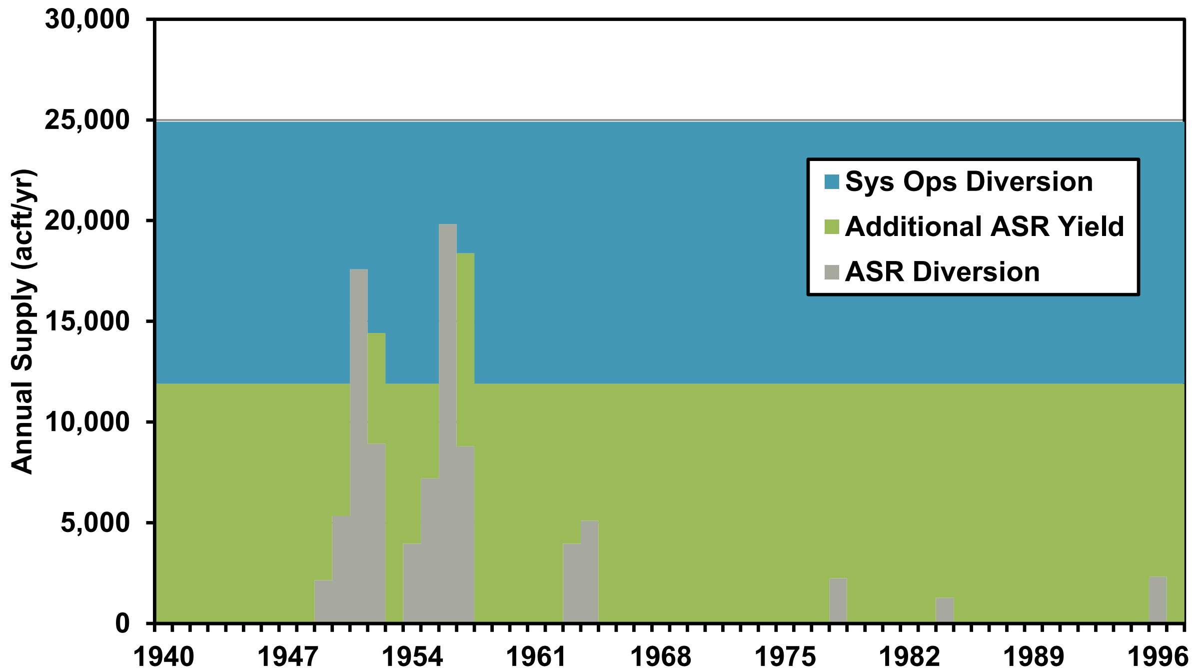


Figure 7.6-4 Combined System Storage for Lake Granger and ASR

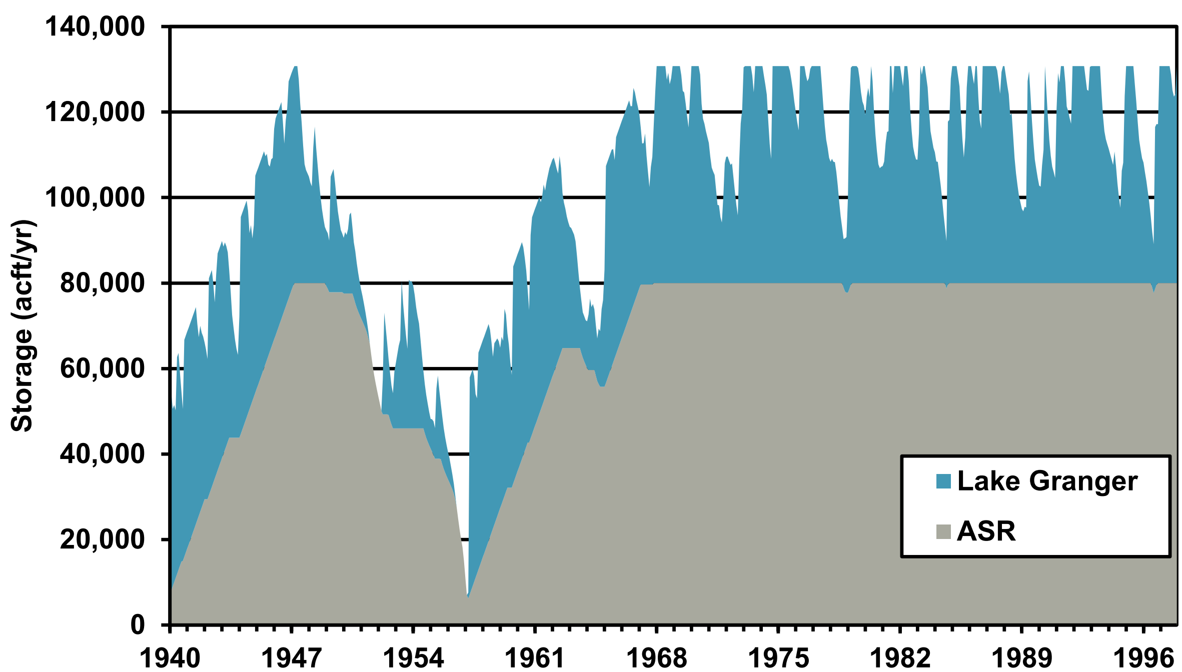


Figure 7.6-5 Lake Granger Storage Frequency

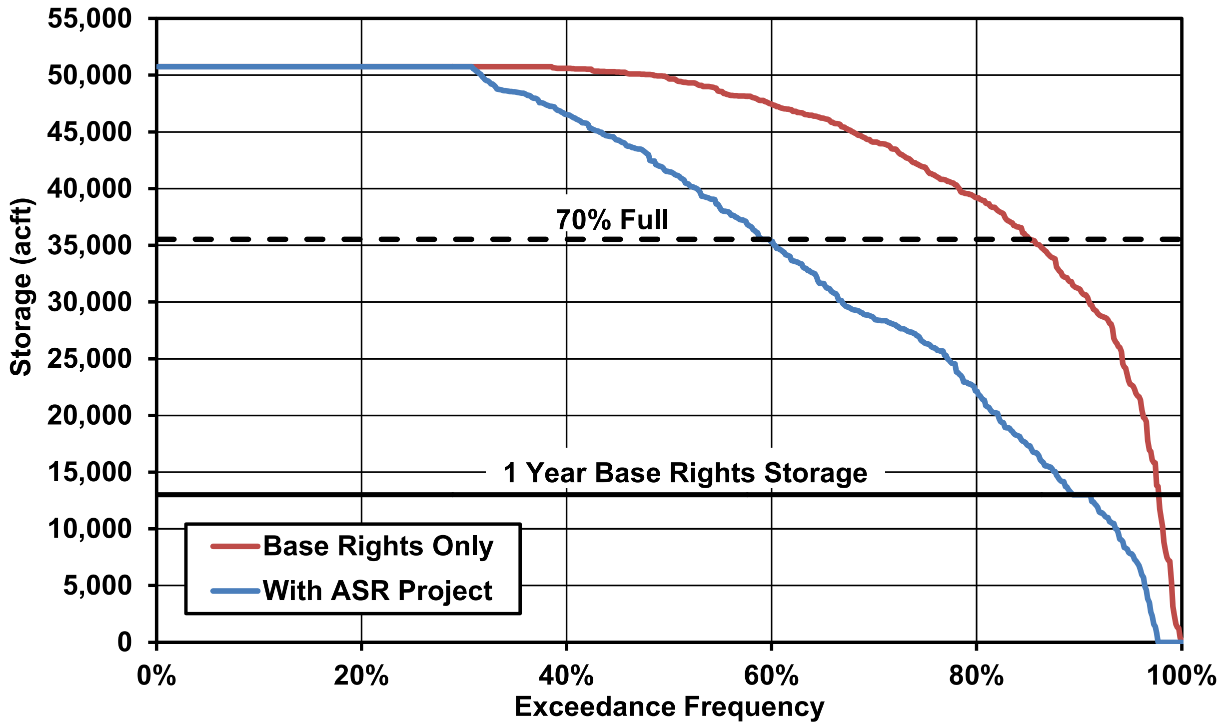
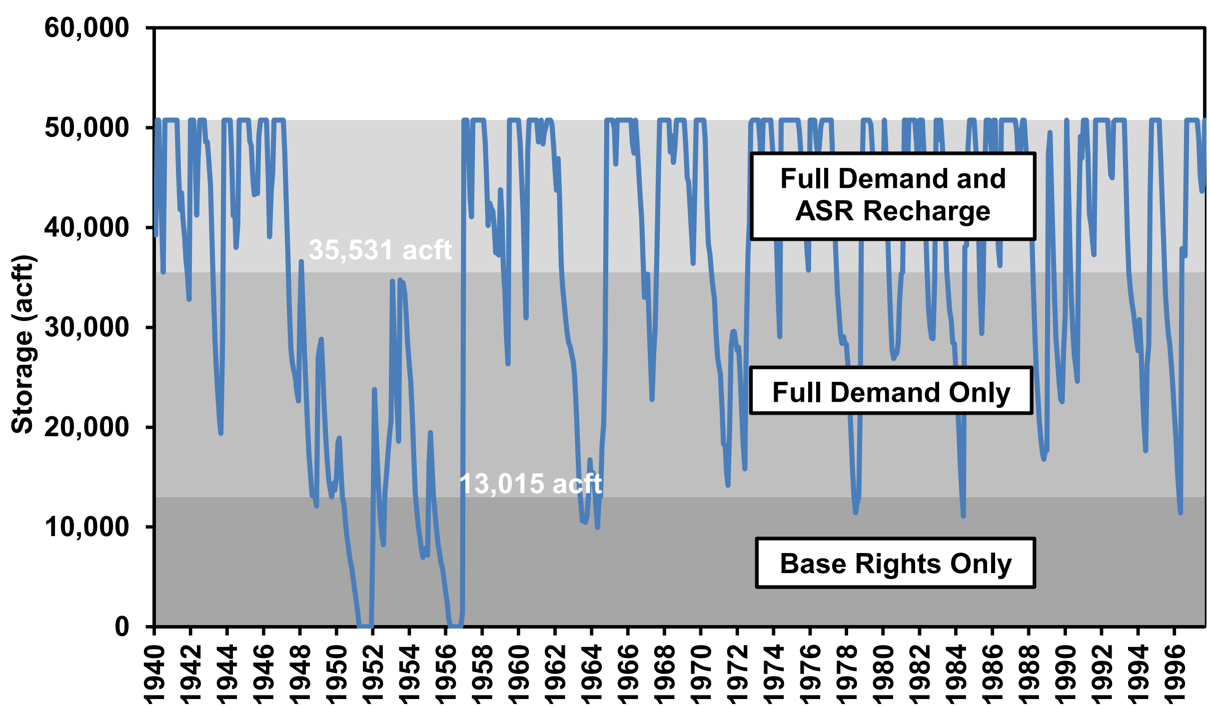


Figure 7.6-6 Lake Granger Storage Trace Operated Conjunctively with ASR Project



7.6.3 Environmental Issues

Environmental issues for the proposed Lake Granger ASR Project in Williamson County are described below. This project includes the development of an ASR well field, production wells, well field distribution and collection pipelines, and an interconnect to an existing water treatment plant. Implementation of this project would require field surveys by qualified professionals to document vegetation/habitat types, waters of the U.S. including wetlands, and cultural resources that may be impacted. Where impacts to protected species habitat or significant cultural resources cannot be avoided, additional studies would be necessary to evaluate habitat use and/or value, or eligibility for inclusion in the National Register of Historic Places, respectively. The project sponsor would also be required to coordinate with the U.S. Army Corps of Engineers regarding impacts to wetland areas and compensation would be required for unavoidable adverse impacts involving net losses of wetlands.

The pipelines and wells needed for the Lake Granger ASR project well field would occur near Lake Granger, Pecan Creek and a tributary of Turkey Creek. Coordination with the U.S. Army Corps of Engineers would be required for construction within any waters of the U.S. Any impacts from this proposed project which would result in a loss of less than 0.5 acres of waters of the U.S. could be covered under Nationwide Permit #12 for Utility Line Activities.

The project occurs within the Texas Blackland Prairies Ecoregion[1] and lies within the Texan Biotic Province.[2] Vegetation types within the ASR well field area as described by the Texas Parks and Wildlife Department (TPWD)[3] as crops. Avoidance of riparian areas near creeks and other relatively undisturbed natural habitats within the well field areas would help minimize potential impacts to existing area species.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Williamson County can be found at https://tpwd.texas.gov/gis/rtest/.

Information received from the TPWD Texas Natural Diversity Database (TXNDD) shows documented occurrences of two species of concern, the mountain plover and Texas garter snake within three miles of the project area.

Since the project will result in an equal exchange of water to the aquifer, no significant impacts to existing stream flows or aquatic species are anticipated. Potential impacts to listed species within the project area are anticipated to include disturbance of existing habitat resulting from the construction of well fields and their associated pipelines. However, these disturbances would be minimized by the small areas generally required for well field and pipeline construction. After construction is completed the majority of the

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[1] Griffith Glenn, Sandy Bryce, James Omernik, and Anne Rogers. 2007. Ecoregions of Texas. Texas Commission on Environmental Quality.

[2] Blair, W. Frank. 1950. The Biotic Provinces of Texas. Texas Journal of Science 2(1):93-117.

[3] McMahan, Craig A., Roy G. Frye and Kirby L. Brown. 1984. The Vegetation Types of Texas. Wildlife Division, Texas Parks and Wildlife Department, Austin, Texas.

disturbed areas will return to their previous habitat condition, excluding areas where maintenance activities are required.

A survey of the project area would be required prior to well field and pipeline construction to determine whether populations of or potential habitats used by listed species occur in the area to be affected. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291).

Based on the review of publicly available Geographic Information System (GIS) records obtained from the Texas Historical Commission, there are no State Historic Sites, National Register Properties, National Register Districts, cemeteries or Historical Markers within the potential well field or pipeline area. Avoidance of any cultural resource areas discovered during project surveys should be possible by careful selection of the areas for well sites and their associated pipelines. A review of archaeological resources in the proposed project area should be conducted during the project planning phase. Because the owner or controller of the project will likely be a political subdivision of the State of Texas (i.e., river authority, municipality, county, etc.), they will be required to coordinate with the Texas Historical Commission prior to project construction.

7.6.4 Engineering and Costing

Available records indicate that Trinity Aquifer wells in eastern Williamson County average 3,300 feet deep. For an 11,900 acft/yr ASR system in Williamson County that accommodates existing water rights and operational constraints on Lake Granger, there is a considerable imbalance between peak injection water supply and peak recovery demands. In consideration of this imbalance, six (6) ASR wells are needed to meet the peak injection rates, and 22 wells are required for recovery and production. Sixteen of the wells would be nearby production (recovery-only) wells, and six would be dual-purpose ASR wells. The number of wells is based on an assumption that an ASR well’s recharge rate is 1,200 gpm, and ASR and production wells have a recovery capacity of 1,500 gpm. The water will be pumped from the well field to the EWDRWTP through a 48”, 1.4 miles long, two-way transmission pipeline. The existing pump station at the treatment plant would deliver the treated water to the ASR well field and through transmission pipelines to east Williamson County.

The major facilities required for these projects include:

- ASR and production wells,
- Well field collector and transmission pipelines, and
- Water treatment plant interconnect and upgrades.

Estimates were prepared for capital and project costs, annual debt service, operation and maintenance, power, land, and environmental mitigation. These costs are summarized in Table 7.6-1 through Table 7.6-3.

The cost estimate below assumes that only the six ASR wells and associated pipelines and connections would be required in an initial phase. Subsequent phases are assumed to occur after a cumulative 10 years and 15 years, where eight recovery-only wells would be constructed in each of the two later phases. The second phase includes only these additional wells, while the final phase considers the eight recovery-only wells plus associated well field pipelines and a second transmission pipeline. The timing for the construction of the recovery wells could vary considerably from these assumptions because the wells would not be constructed until needed to produce peak demands of previously stored ASR water during a prolonged drought period. The annual costs, including debt service, operation and maintenance, and power, are estimated to be $1,551 per acft during the third phase if all of the phases are constructed in a single decade. Phased implementation results in unit costs of water over the life of the project to range from $4,146 per acft in 2030 to $291 per acft by 2070 and 2080.

Table 7.6-1 Cost Estimate Summary: Lake Granger ASR Phase 1

Cost Estimate Summary Water Supply Project Option September 2023 Prices BRA - Lake Granger ASR Phase 1 Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (0 mgd)	$2,661,000
Transmission Pipeline (36 in. dia., 1.4 miles)	$6,611,000
Well Fields (Wells, Pumps, and Piping)	$46,356,000
Water Treatment Plant (16.2 mgd)	$40,473,000
Integration, Relocations, Backup Generator & Other	$76,000
TOTAL COST OF FACILITIES	**$96,177,000**
- Planning (3%)	$2,885,000
- Design (7%)	$6,732,000
- Construction Engineering (1%)	$962,000
Legal Assistance (2%)	$1,924,000
Fiscal Services (2%)	$1,924,000
Pipeline Contingency (15%)	$992,000
All Other Facilities Contingency (20%)	$17,913,000
Environmental & Archaeology Studies and Mitigation	$469,000
Land Acquisition and Surveying (16 acres)	$244,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$4,230,000
TOTAL COST OF PROJECT	**$134,452,000**
ANNUAL COST	x
Debt Service (3.5 percent, 20 years)	$9,455,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$530,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$67,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0

Cost Estimate Summary Water Supply Project Option September 2023 Prices BRA - Lake Granger ASR Phase 1 Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Water Treatment Plant	$2,833,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (3557711 kW-hr @ 0.09 $/kW-hr)	$320,000
Purchase of Water (3245 acft/yr @ 76.5 $/acft)	$248,000
TOTAL ANNUAL COST	**$13,453,000**
Available Project Yield (acft/yr)	3,245
Annual Cost of Water ($ per acft), based on PF=1	$4,146
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$1,232
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$12.72
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$3.78
JS	*1/30/2025*

Table 7.6-2 Cost Estimate Summary: Lake Granger ASR Phase 2

Cost Estimate Summary Water Supply Project Option September 2023 Prices BRA - Lake Granger ASR Phase 2 Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	$34,375,000
TOTAL COST OF FACILITIES	**$34,375,000**
- Planning (3%)	$1,031,000
- Design (7%)	$2,406,000
- Construction Engineering (1%)	$344,000
Legal Assistance (2%)	$687,000
Fiscal Services (2%)	$687,000
All Other Facilities Contingency (20%)	$6,875,000
Environmental & Archaeology Studies and Mitigation	$81,000
Land Acquisition and Surveying (4 acres)	$88,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,514,000
TOTAL COST OF PROJECT	**$48,088,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,384,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$344,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0

Cost Estimate Summary Water Supply Project Option September 2023 Prices BRA - Lake Granger ASR Phase 2 Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (8500192 kW-hr @ 0.09 $/kW-hr)	$765,000
Purchase of Water (8655 acft/yr @ 76.5 $/acft)	$662,000
TOTAL ANNUAL COST	**$5,155,000**
Available Project Yield (acft/yr)	8,655
Annual Cost of Water ($ per acft), based on PF=1	$596
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$205
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.83
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.63
JS	*1/30/2025*

Table 7.6-3 Cost Estimate Summary: Lake Granger ASR Phase 3

Cost Estimate Summary Water Supply Project Option September 2023 Prices BRA - Lake Granger ASR Phase 3 Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Transmission Pipeline (42 in. dia., 1.4 miles)	$8,167,000
Well Fields (Wells, Pumps, and Piping)	$40,305,000
Integration, Relocations, Backup Generator & Other	$81,000
TOTAL COST OF FACILITIES	**$48,553,000**
- Planning (3%)	$1,457,000
- Design (7%)	$3,399,000
- Construction Engineering (1%)	$486,000
Legal Assistance (2%)	$971,000
Fiscal Services (2%)	$971,000
Pipeline Contingency (15%)	$1,225,000
All Other Facilities Contingency (20%)	$8,077,000
Environmental & Archaeology Studies and Mitigation	$533,000
Land Acquisition and Surveying (29 acres)	$520,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$2,149,000
TOTAL COST OF PROJECT	**$68,341,000**
ANNUAL COST	x
Debt Service (3.5 percent, 20 years)	$4,803,000

Cost Estimate Summary Water Supply Project Option September 2023 Prices BRA - Lake Granger ASR Phase 3 Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$486,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (11044136 kW-hr @ 0.09 $/kW-hr)	$994,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$6,283,000**
Available Project Yield (acft/yr)	13,015
Annual Cost of Water ($ per acft), based on PF=2	$483
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$114
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$1.48
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$0.35
JS	*1/30/2025*

7.6.5 Implementation

Implementation of the Lake Granger ASR strategy for BRA includes the following issues:

- Agreements between BRA and participants;
- Acquiring permits from TCEQ for ASR construction and operations and for storage of surface water in the Trinity Aquifer;
- Chemical and geochemical compatibility of native aquifer water and materials and imported water are chemically compatible;
- Lack of experience to develop confidence in the ability to inject water from a lake, which includes the uncertainty about the compatibility of the injected water with native groundwater and aquifer materials and failure of the ASR well;
- Controlling the loss of the injected water to others;
- Initial cost;
- Ability to add recovery wells as needed as reservoir reaches critical levels;
- Experience in operating the facilities; and
- Development of a management plan to efficiently use the ASR wells.

This water supply option has been compared to the plan development criteria, as shown in Table 7.6-4, and the option meets each criterion.

Table 7.6-4 Comparison of Lake Granger ASR Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. High
2. Reliability	2. High
3. Cost	3. Moderate
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable

7.7 Bell County Water Control and Improvement District No. 1/Fort Cavazos ASR

7.7.1 Description

Bell County WCID#1 has identified an Aquifer Storage and Recovery (ASR) project for emergency water supplies for the Fort Cavazos military reservation, near Killeen. The ASR system would store potable water from the Belton Lake Water Treatment Plant in the Cretaceous Hosston Formation of the Northern Trinity Aquifer; stored water would be recovered for use during drought conditions.

The project would utilize nine ASR wells to store 2 mgd of treated drinking water in the Hosston Formation approximately 930 to 990 ft below ground surface. Injection would occur during the winter months with a total recharge volume of up to 934 acft/yr.

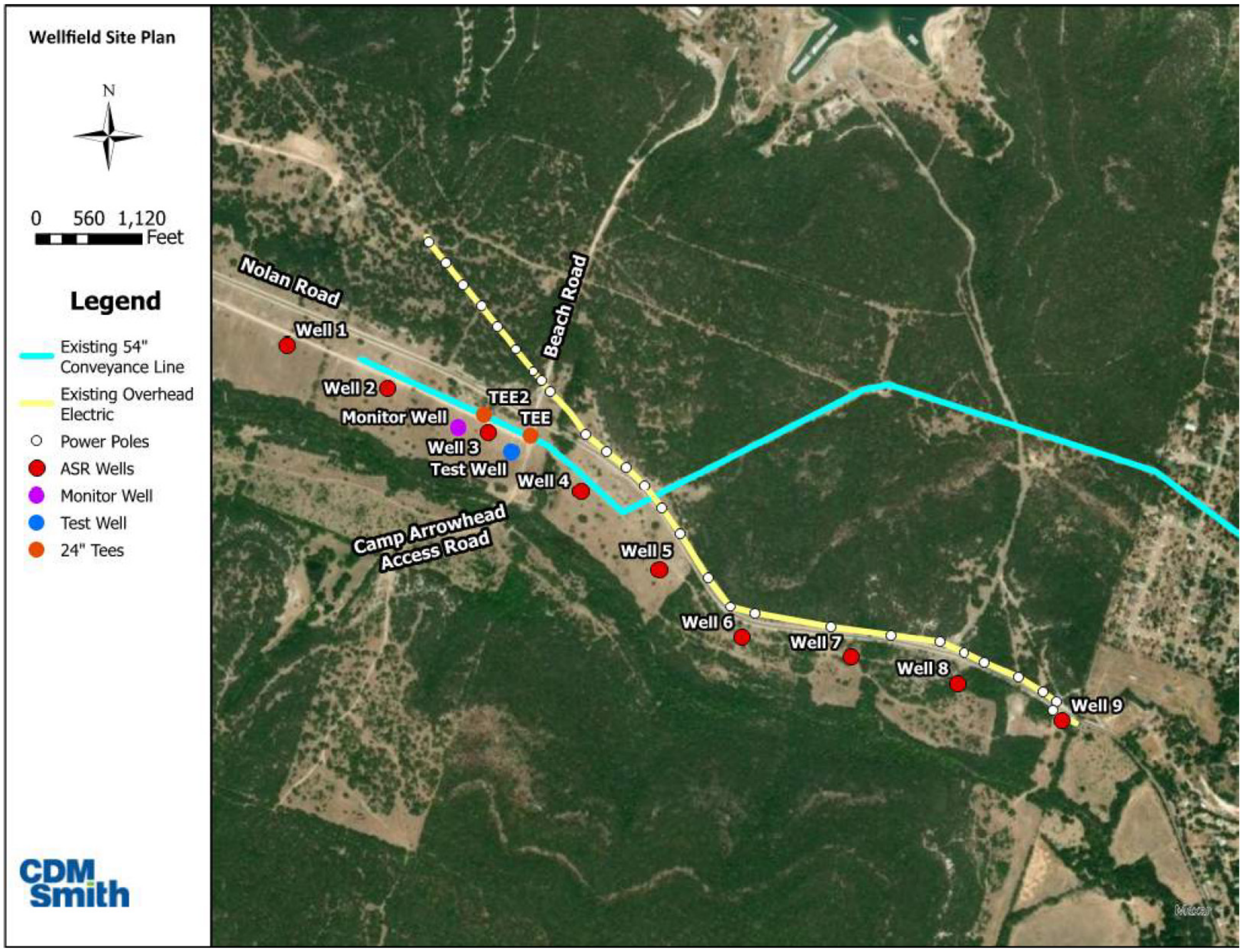
Stored water would be used to supplement water supply during drought (2 mgd for 150 days) or to provide an emergency supply (4 mgd for 15 days). A conceptual design evaluation of the well field indicates that nine ASR wells spaced 1,000 ft apart in a roughly linear configuration along Nolan Road would be suitable to meet the specified storage and recovery design criteria (CDM Smith and INTERA, 2025). The well field would be located adjacent to an existing 48-inch Bell County WCID #1 potable water transmission line with overhead electric lines.

Major components of the ASR system include:

- Nine ASR injection and recovery wells drilled to about 1,100 ft bgs with 12-inch pump casing set to 900 ft bgs in the Hosston Formation. The nominal yield of each well is 350 gpm.
- A bidirectional conveyance line connecting the wells to facilitate recharge and recovery operations. The line will receive potable water from the existing transmission line during recharge and will deliver recovered stored water to an on-site ground storage tank (GST). The conveyance line and GST will be connected to the transmission line through separate existing 24-inch tees.
- A 200,000 gallon GST to provide contact time to achieve a 4-log removal of viruses for disinfection and storage to allow discharge at up to 6 mgd to the transmission line.
- A 6 mgd booster pump station that includes two 2 mgd pumps and one 4 mgd pump, with one of the 2 mgd pumps serving as a standby.
- Chemical building with chlorine and liquid ammonium sulfate (LAS) rooms and an electrical building.

Figure 7.7-1 Conceptual Wellfield Layout for Fort Cavazos ASR Project

(provided courtesy of CDM Smith, 2025)



7.7.2 Available Yield

As envisioned, the ASR project would provide a supplemental supply of up to 934 acft (2 mgd for 5 months) or an emergency supply of 184 acft (4 mgd for 15 days). Expected recovery from this project is estimated to be at least 75 percent.

7.7.3 Environmental Issues

Environmental issues for the proposed Fort Cavazos ASR Project are described below. This project includes the development of an ASR well field, additional well field distribution and collection pipelines, GST with disinfection facilities, a pump station, and interconnects to the existing Bell County WCID #1 transmission pipeline. The water source for this project would be existing potable water from the Belton Lake Water Treatment Plant. Recovered water from the ASR would be disinfected prior to delivery to the existing water transmission line. Implementation of this project would require field surveys by qualified professionals to document vegetation/habitat types, waters of the U.S. including wetlands, and cultural resources that may be impacted. Where impacts to protected species habitat or significant cultural resources cannot be avoided, additional studies would be necessary to evaluate habitat use and/or value, or eligibility for inclusion in the National Register of Historic Places, respectively. The project sponsor would also be required to coordinate with the U.S. Army Corps of Engineers regarding impacts to wetland areas and compensation would be required for unavoidable adverse impacts involving net losses of wetlands.

The existing site is in Fort Cavazos military reservation, near Killeen, Texas. The terrain is characterized by a mix of sparse and dense vegetation, along with natural drainage features. The pipelines and wells needed for the ASR project well field would occur in close proximity to North Nolan Creek. Coordination with the U.S. Army Corps of Engineers would be required for construction within any waters of the U.S. Any impacts from this proposed project which would result in a loss of less than 0.5 acres of waters of the U.S. could be covered under Nationwide Permit #12 for Utility Line Activities.

The project occurs within the Cross Timbers Ecoregion[1] and lies within the Texan and Balconian Biotic Provinces.[2] Vegetation types within the ASR well field area and transmission pipelines as described by the Texas Parks and Wildlife Department (TPWD)[3] include Oak-Mesquite-Juniper Woods and Mesquite Lotebush Brush areas. Avoidance of riparian areas near the creeks or heavily wooded areas would help minimize potential impacts to existing area species from project construction activities.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Bell County can be found at https://tpwd.texas.gov/gis/rtest/.

Because the project will use potable water to inject into the aquifer, no significant impacts to existing stream flows or aquatic species are anticipated. Potential impacts to listed species within the project area are anticipated to include disturbance of existing habitat resulting from the construction of well fields and their associated pipelines, the GST, and pump station. However, most of these disturbances would be minimized by the small areas generally required for well field and pipeline construction. After construction is completed the majority of the disturbed areas will return to their previous habitat condition excluding the GST site or areas where maintenance activities are required.

A survey of the project area would be required prior to project construction to determine whether populations of or potential habitats used by listed species occur in the area to be affected. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291).

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1 Griffith Glenn, Sandy Bryce, James Omernik, and Anne Rogers. 2007. Ecoregions of Texas. Texas Commission on Environmental Quality.
2 Blair, W. Frank. 1950. The Biotic Provinces of Texas. Texas Journal of Science 2(1):93-117.
3 McMahan, Craig A., Roy G. Frye and Kirby L. Brown. 1984. The Vegetation Types of Texas. Wildlife Division, Texas Parks and Wildlife Department, Austin, Texas.

Based on the review of publicly available Geographic Information System (GIS) records obtained from the Texas Historical Commission, there are no State Historic Sites, National Register Properties or Districts, cemeteries or Historical Markers within the project area. A review of archaeological resources in the proposed project area should be conducted during the project planning phase. Because the owner or controller of the project will likely be a political subdivision of the State of Texas (i.e., river authority, municipality, county, etc.), they will be required to coordinate with the Texas Historical Commission prior to project construction.

7.7.4 Engineering and Costing

Available records indicate that the ASR well depths in the Hosston Formation in the project area would average about 1,100 ft. A typical recharge and recovery rate is estimated to be about 350 gpm. The meet the design objectives, nine ASR wells would be required. The wells would be spaced about 1,000 ft apart.

The major facilities required for these projects include:

- ASR well field,
- Collector pipelines,
- GST and disinfection facility;
- Pump station, and
- Interconnect to existing distribution system.

Estimates were prepared for capital and project costs, annual debt service, operation and maintenance, power, land, and environmental mitigation. These costs are summarized in Table 7.7-1. The annual costs, including debt service, operation and maintenance, and power, is estimated to be $3,515 per acft.

Table 7.7-1 Cost Estimate Summary: College Station ASR Project Option

Item	Estimated Costs for Facilities
GST, Disinfection, and Pump Station	$6,999,000
ASR Well Field (Wells, Pumps, and Piping)	$19,274,000
TOTAL COST OF FACILITIES	**$26,273,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$9,195,000
Environmental & Archaeology Studies and Mitigation	$52,000
Interest During Construction (3.5% for 1 years with a 1% ROI)	$1,154,000
TOTAL COST OF PROJECT	**$36,674,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,578,000
Operation and Maintenance	
Pipelines, Wells, and Storage Tanks (1% of Cost of Facilities)	$243,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$39,000

Item	Estimated Costs for Facilities
Chlorine Disinfection Water Treatment Plant	$256,000
Pumping Energy Costs (1,829,154 kW-hr @ 0.09 $/kW-hr)	$165,000
TOTAL ANNUAL COST	**$3,281,000**
Available Project Yield (acft/yr)	**934**
Annual Cost of Water ($ per acft)	**$3,513**
Annual Cost of Water ($ per 1,000 gallons)	**$10.78**

7.7.5 Implementation

Implementation of the For Cavazos ASR water management strategy includes the following issues:

- Acquiring permits from TCEQ for ASR wells and water treatment facilities;
- Chemical and geochemical compatibility of native aquifer water and materials and imported water are chemically compatible;
- Lack of experience to develop confidence in the ability to inject and recover water from an aquifer, which includes the uncertainty about the compatibility of the injected water with native groundwater and aquifer materials;
- Initial and operational cost; and
- Development of a management plan to efficiently use the ASR wells with a balance of injection and recovery cycles.

This water supply option has been compared to the plan development criteria, as shown in Table 7.7-2, and the option meets each criterion.

Table 7.7-2 Comparison of College Station ASR Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Meets shortage during drought
2. Reliability	2. High reliability
3. Cost	3. High
B. Environmental factors	
1. Environmental Water Needs	1. Low impact
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	None

Impact Category	Comment(s)
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet drought supply shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

CHAPTER 8 REGIONAL WATER SUPPLY PROJECTS

8.1 Bosque County Regional Project

8.1.1 Description of Option

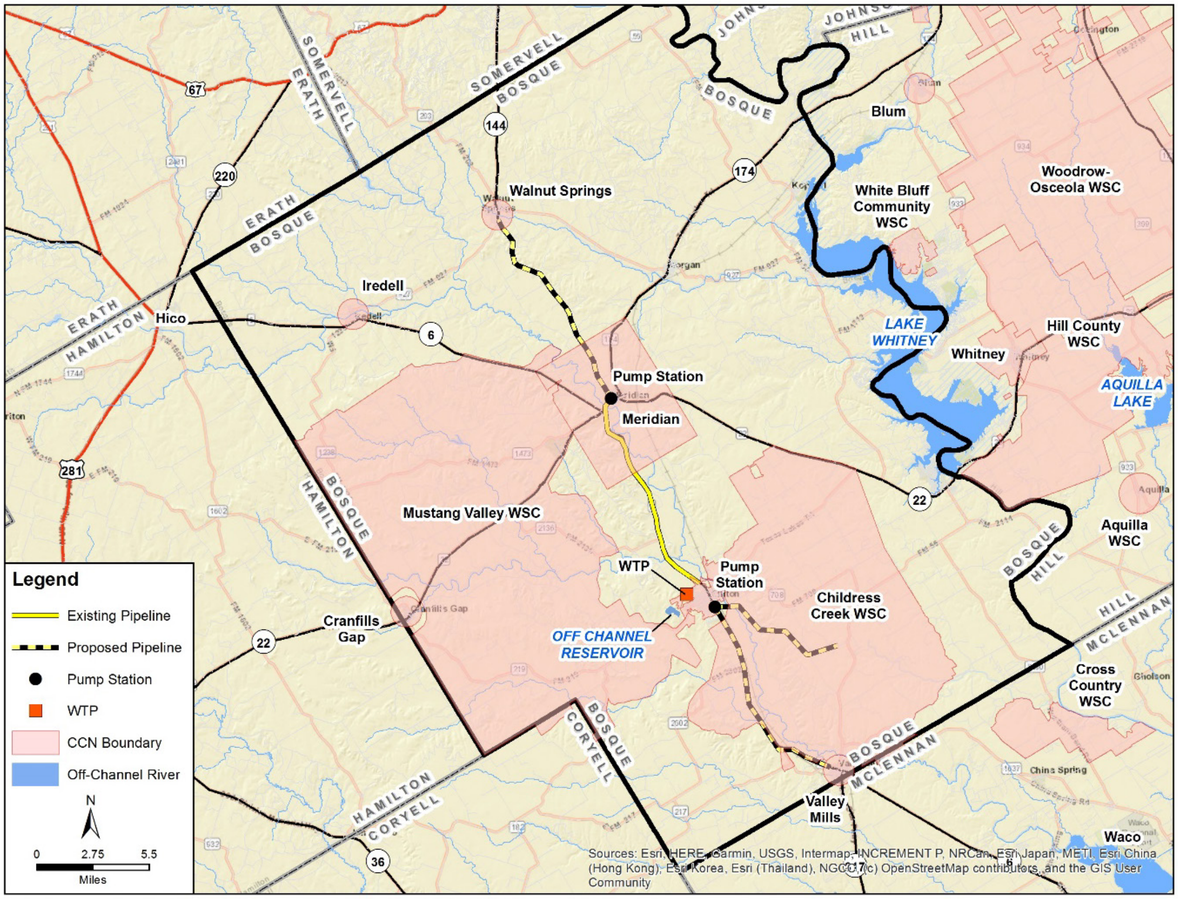
The Bosque County Regional Project has been a recommended water management strategy in the 2011, 2016 and 2021 the regional water plans to address municipal water needs in Bosque County. Groundwater reliability remains a significant concern for the WUGs due to the large groundwater declines anticipated with the Desired Future Conditions (DFC) as developed by the groundwater districts for the Trinity Aquifer in Groundwater Management Area 8 (GMA-8). The project was originally identified through a jointly sponsored study[1] by the Brazos River Authority, Texas Water Development Board, and the Cities of Clifton and Meridian to determine the regional water needs and to evaluate existing and proposed water facilities.

The project envisioned the City of Clifton expanding its water system to provide treated surface water to the cities of Meridian, Valley Mills, Childress Creek Water Supply Corp. (WSC), and Bosque County Other. Bosque County Manufacturing demands could also be partially supplied through this project. The project would consist of expansion of the Clifton off-channel reservoir (OCR), expansion of Clifton's water treatment plant (WTP), and treated water transmission systems to nearby utilities. The 500 acft Clifton OCR was constructed in 1998 as the initial phase of the project with subsequent phases to increase it up to 2,000 acft of storage to meet local and regional water needs.

Figure 8.1-1 shows the planned interconnection of the four water utilities with the regional facility at Clifton. An 11 mile, 8-inch diameter water transmission pipeline has been recently constructed between Clifton and Meridian.

[1] Carter-Burgess, "Bosque County Regional Water Treatment and Distribution Facilities Plan," Final Report to the Brazos River Authority, March 2004.

Figure 8.1-1 Interconnection of Bosque County Systems



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8.1.2 Available Yield

The City of Clifton holds two water rights on the North Bosque River. The first right with a priority date of March 14, 1963 allows the City to divert 600 acft/yr for municipal use. The second water right dated December 13, 1996 allows the City to divert and impound 2,000 acft/yr at a maximum rate of 12 cfs. Lake Waco rights are subordinated to Clifton's rights through the 1994 Windup Agreement between BRA and former Lake Bosque project participants. The Windup Agreement provides for 3,340 acft/yr for Clifton and Meridian from the North Bosque River watershed to be senior to rights in Lake Waco.

A previous yield analysis[2] for the Clifton OCR on the North Bosque River subject to instream flow conditions is included in Table 8.1-1.

Table 8.1-1 Summary of Clifton OCR Yield

Reservoir Capacity (acft)	Yield (acft/yr)
500	730
1,150	1,133
2,000	1,523

The yield of the City of Clifton's surface water system (Bosque River diversion into an off-channel reservoir) is currently 730 acft/yr, but future enlargement of the reservoir could increase the yield up to 1,523 acft/yr. Based on projected demands, Clifton would have up to 1,070 acft/yr of supply available to sell in 2080 if its current water treatment plant were expanded and the reservoir were enlarged. This strategy, as formulated, would provide a total of 1,070 acft/yr to the five WUGS (203 acft/yr to Childress WSC; 224 acft/yr to Meridian; 182 acft/yr to Valley Mills; 64 acft/yr to Bosque County Other; and 397 acft/yr to Clifton. New water supplies for WUGs could also be used to meet Bosque County Manufacturing demands. Ongoing groundwater level declines in the Trinity Aquifer could result in a practical reduction in groundwater supplies to any of these entities in the future, necessitating either rehabilitation or replacement of existing wells or implementation of this water supply strategy.

8.1.3 Environmental

The Bosque County Regional Project includes an expansion of the existing Clifton off-channel reservoir and water treatment plant, and the construction of several treated water transmission pipelines and associated accoutrements. Expansion of the City of Clifton water system would allow this system to provide treated surface water to the cities of Meridian, Valley Mills, Childress Creek, and Bosque County Other. Environmental concerns associated with this water management strategy include impacts from expansion of the water treatment plant and ground storage tanks, inundation of habitat resulting from the expansion of the existing reservoir and impacts from the construction of pump stations and transmission pipelines.

With numerous miles of treated water transmission pipelines, four crossings of jurisdictional waters would occur. These crossings include two intermittent tributary streams and two perennial streams including the North Bosque River, and Neils Creek. Impacts to these waters from pipelines would be temporary and occur during construction. Any potential impacts to these areas would be restorable. Avoidance and minimization measures, such as horizontal directional drilling, construction best management practices (BMPs), and avoiding perennial and/or sensitive aquatic habitats would reduce potential impacts to these areas.

Coordination with the U.S. Army Corps of Engineers would be required for construction within waters of the U.S. Impacts from this proposed project resulting in a loss of less than 0.5 acres of waters of the U.S. could be covered under Nationwide Permit 12 for Utility Line Activities unless there are significant impacts to the aquatic environment by other project components.

[2] HDR, February 1997. City of Clifton Water Supply Plan. Preliminary Engineering Report

The Texas Parks & Wildlife Department (TPWD) has identified a number of stream segments throughout the state as ecologically significant on the basis of biological function, hydrologic function, riparian conservation, exceptional aquatic life uses, and/or threatened or endangered species. Neils Creek is considered to be ecologically significant based on high aesthetic value for an ecoregion stream, high water quality, and diverse benthic macroinvertebrate community.[3]

The proposed project would occur in the Cross Timbers Ecoregion of Texas.[4] This ecoregion is a transitional area between the original prairie regions to the west and the low mountains or hills of eastern Oklahoma and Texas. The project area includes two major vegetation types as defined by Texas Parks and Wildlife (TPWD),[5] including Bluestem Grassland and Oak-Mesquite-Juniper Parks/Woods. Bluestem Grassland commonly includes plants such as bushy bluestem (*Andropogon glomeratus*), slender bluestem (*Schizachyrium tenerum*), little bluestem (*Schizachyrium scoparium*), buffalograss (*Bouteloua dactyloides*), southern dewberry (*Rubus trivialis*), live oak (*Quercus virginiana*), mesquite (*Prosopis pubescens*) and huisache (*Acacia farnesiana*). Oak-Mesquite-Juniper Parks/Woods associated plants include post oak (*Q. stellata*), Ashe juniper (*Juniperus ashei*), shin oak (*Q. havardii*), blackjack oak (*Q. marilandica*), cedar elm (*Ulmus crassifolia*), Mexican persimmon (*Diospyros texana*), purple three-awn (*Aristida purpurea*), sideoats grama (*Bouteloua curtipendula*) and curly mesquite (*Hilaria belangeri*).

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Bosque County can be found at https://tpwd.texas.gov/gis/rtest/.

There are no areas of critical habitat designated within or near the project area.[6]

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[3] TPWD, "Ecologically Significant River and Stream Segments," https://tpwd.texas.gov/landwater/water/conservation/water_resources/water_quantity/sigsegs/regiong.phtml. Accessed July 18, 2019.

[4] Grifffith, Glenn, Sandy Bryce, James Omernik and Anne Rogers. 2007. Ecoregions of Texas. Texas Commission on Environmental Quality and Environmental Protection Agency, Austin, Texas.

[5] McMahan, Craig A., Roy G. Frye and Kirby L. Brown. 1984. The Vegetation Types of Texas Including Cropland. Texas Parks and Wildlife Department, Austin, Texas.

[6] USFWS. Critical Habitat Portal. Accessed online at http://ecos.fws.gov/crithab/ July 18, 2019.

The project area may provide potential habitat to endangered or threatened species found in Bosque County. A survey of the project area may be required prior to pipeline and facility construction to determine whether populations of or potential habitats used by listed species occur in the area to be affected. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

No designated critical habitat for the endangered golden-cheeked warbler occurs within the project area. The majority of the pipeline for this project will occur in previously disturbed areas such as existing road right-of-way or crop areas, therefore no impacts to these avian species is anticipated from the project.

Populations of the endangered smalleye and sharpnose shiner occur within the upper Brazos River basin above Lake Whitney. Although these shiner species were once found throughout the Brazos River and several of its major tributaries within the watershed, they are currently restricted almost entirely to the contiguous river segments of the upper Brazos River basin in north-central Texas.[7]

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available geographic information systems (GIS) datasets provided by the Texas Historical Commission (TAC), there are four national register properties, eight cemeteries, 17 historical markers, and a total of 20 archeological survey areas within one mile of the proposed pipelines, pump stations or other facilities.

Based on a review of soils, geology, and aerial photographs, there is a high probability for undocumented significant cultural resources within the alluvial deposits and terrace formations associated with waterways, specifically the intermittent and perennial aquatic resources. The probability of pipelines crossing areas which may include cultural resources increases near waterways and associated landforms.

Increasing the amount of water stored by the existing reservoir would inundate a limited amount of habitat; however, this action is not anticipated to result in significant impacts to area species due to the abundance of similar habitat located nearby. Impacts resulting from the construction and maintenance of the associated pipelines, pump stations or water treatment facilities are anticipated to be minimal if avoidance measures are implemented. It is anticipated that the pipelines, pump stations and other necessary facilities will be positioned to avoid impacts to known cultural resources, sensitive habitats, wetlands or stream crossings as much as reasonably possible.

8.1.4 Engineering and Costing

The City of Clifton is the primary supplier used for the Bosque County Regional Project to interconnect its system into a regional and community system. The following facilities would be needed to connect the City of Clifton to Childress WSC, Valley Mills, Meridian and Bosque County Other:

- Enlargement of off-channel storage;
- Expansion Clifton's Water Treatment Plant and Ground Storage;
- Treated Water Pump Station at Clifton and Meridian; and
- Treated Water Transmission Pipelines.

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[7] USFWS Ecological Services. Sharpnose and smalleye shiners. Accessed online at http://www.fws.gov/southwest/es/arlingtontexas/shiner.htm, on May 29, 2014.

The channel dam, off-channel reservoir, and water treatment facilities would form the hub of the regional water system. At Clifton, a central pump station would be built. From here separate pipelines would connect to distribution points in the Childress WSC and Valley Mills, and to a pump station at Meridian. From the Meridian pump station, treated water would be pumped to a distribution point in the Meridian and Bosque County Other systems.

In January 2013, HDR evaluated the costs to expand the Clifton OCR and expand the WTP capacity to 2 million gallons per day (mgd). The off-channel reservoir is designed for staged construction with an initial capacity of 500 acre-feet. Increasing the height of the zoned earthfill dam will increase the storage capacity of the off-channel reservoir. Due to limited availability of on-site borrow material, off-site borrow material will need to be imported to increase the height of the dam. Additional geotechnical studies will be required to investigate the strength and water retention ability of the higher elevation abutments and to determine if pressure grouting will be required. The cost estimate includes modifications to appurtenant structures including the intake tower and emergency spillway to accommodate the increased capacity and height of the off-channel reservoir. No improvements are required for the intake pump station or raw water pipeline. Similarly, upgrades to clearwell storage and the finished water pipeline are not required for expansion of the water supply system.

The water treatment plant is also designed for expansion with a current treatment capacity of 1 mgd. The water treatment plant building is sized to accommodate the equipment required to increase the capacity of the plant to 2 mgd. The principal cost to expand the water treatment plant is the purchase of two additional modular package units. Improvements will also be required to increase the capacity of the chemical feed systems, construct appropriate access platforms, and connect the new treatment units to the plant piping system and plant SCADA and control system.

The costs for four participating communities in Bosque County to connect to the City of Clifton's water system are summarized in Table 8.1-2. The capital and other project costs have been estimated using TWDB's Unified Costing Model for Regional Planning. The total project cost, including capital, engineering, legal costs, contingencies, environmental studies, land acquisition and surveying, for the regional interconnections is $72.3 million. These costs were determined based on dedicated infrastructure to each entity and shared infrastructure costs based on prorated supplies.

Taking into consideration debt service on a 40-year loan for the OCR expansion and 20 year debt service on all other capital costs, operation and maintenance costs, and pumping energy costs, the total annual costs are $6 million and by entity: Childress, $1,131,000; Valley Mills, $1,014,000; Meridian, $1,249,000; Bosque County Other, $356,000; and Clifton, $2,212,000.

8.1.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 8.1-3, and the option meets each criterion.

The participating entities must negotiate a regional water service contract to build and operated the system and to equitably share costs. This would probably include the need for a cost of service study.

Requirements specific to pipelines needed to link existing sources to users will include:

- U.S. Army Corps of Engineers Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the U.S. for construction; and other activities;

- NPDES Storm Water Pollution Prevention Plan;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Mitigation requirements would vary depending on impacts, but could include vegetation restoration, wetland creation or enhancement, or additional land acquisition.

Table 8.1-2 Cost Estimate Summary: Bosque County Regional Project

Item	Estimated Costs for Facilities	Childress Creek WSC	Valley Mills	Meridian	Bosque County Other	Clifton
Dam and Reservoir (Conservation Pool acft, acres)	$11,410,000	$2,165,000	$1,941,000	$2,389,000	$682,000	$4,233,000
Intake Pump Stations (0.2 mgd)	$2,201,000	$418,000	$374,000	$461,000	$132,000	$817,000
Transmission Pipeline (6-8 in. dia., 39.2 miles)	$23,860,000	$4,527,000	$4,058,000	$4,995,000	$1,427,000	$8,853,000
Transmission Pump Station(s) & Storage Tank(s)	$2,085,000	$396,000	$355,000	$436,000	$125,000	$774,000
Water Treatment Plant (2 mgd)	$9,889,000	$1,876,000	$1,682,000	$2,070,000	$591,000	$3,669,000
Integration, Relocations, Backup Generator & Other	$13,000	$2,000	$2,000	$3,000	$1,000	$5,000
TOTAL COST OF FACILITIES	**$49,458,000**	**$9,384,000**	**$8,412,000**	**$10,354,000**	**$2,958,000**	**$18,351,000**
- Planning (3%)	$1,484,000	$282,000	$252,000	$311,000	$89,000	$551,000
- Design (7%)	$3,462,000	$657,000	$589,000	$725,000	$207,000	$1,284,000
- Construction Engineering (1%)	$495,000	$94,000	$84,000	$104,000	$30,000	$184,000
Legal Assistance (2%)	$989,000	$188,000	$168,000	$207,000	$59,000	$367,000
Fiscal Services (2%)	$989,000	$188,000	$168,000	$207,000	$59,000	$367,000
Pipeline Contingency (15%)	$3,579,000	$679,000	$609,000	$749,000	$214,000	$1,328,000
All Other Facilities Contingency (20%)	$5,120,000	$971,000	$871,000	$1,072,000	$306,000	$1,900,000
Environmental & Archaeology Studies and Mitigation	$1,175,000	$223,000	$200,000	$246,000	$70,000	$436,000
Land Acquisition and Surveying (211 acres)	$1,119,000	$212,000	$190,000	$234,000	$67,000	$415,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$4,413,000	$837,000	$751,000	$924,000	$264,000	$1,637,000
TOTAL COST OF PROJECT	**$72,283,000**	**$13,715,000**	**$12,294,000**	**$15,133,000**	**$4,323,000**	**$26,820,000**
ANNUAL COST						
Debt Service (3.5 percent, 20 years)	$3,932,000	$746,000	$669,000	$823,000	$235,000	$1,459,000
Reservoir Debt Service (3.5 percent, 40 years)	$768,000	$146,000	$131,000	$161,000	$46,000	$285,000
Operation and Maintenance						
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$260,000	$49,000	$44,000	$54,000	$16,000	$96,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$55,000	$10,000	$9,000	$12,000	$3,000	$20,000
Dam and Reservoir (1.5% of Cost of Facilities)	$171,000	$32,000	$29,000	$36,000	$10,000	$63,000

Item	Estimated Costs for Facilities	Childress Creek WSC	Valley Mills	Meridian	Bosque County Other	Clifton
Water Treatment Plant	$759,000	$144,000	$129,000	$159,000	$45,000	$282,000
Advanced Water Treatment Facility	$0					
Pumping Energy Costs (210501 kW-hr @ 0.09 $/kW-hr)	$19,000	$4,000	$3,000	$4,000	$1,000	$7,000
Purchase of Water (acft/yr @ $/acft)	$0					
TOTAL ANNUAL COST	**$5,964,000**	**$1,131,000**	**$1,014,000**	**$1,249,000**	**$356,000**	**$2,212,000**
Available Project Yield (acft/yr)	**1,070**	**203**	**182**	**224**	**64**	**397**
Annual Cost of Water ($ per acft), based on PF=1.5	**$5,574**	**$5,571**	**$5,571**	**$5,576**	**$5,563**	**$5,572**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	**$1,181**	**$1,177**	**$1,176**	**$1,183**	**$1,172**	**$1,179**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	**$17.10**	**$17.10**	**$17.10**	**$17.11**	**$17.07**	**$17.10**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	**$3.62**	**$3.61**	**$3.61**	**$3.63**	**$3.60**	**$3.62**

Table 8.1-3 Comparison of Bosque County Interconnections Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
Quantity	1. Sufficient to meet needs
Reliability	2. High reliability
Cost	3. High
B. Environmental factors	
Environmental Water Needs	1. Low impact
Habitat	2. Low impact
Cultural Resources	3. Low impact
Bays and Estuaries	4. Negligible impact
Threatened and Endangered Species	5. Low impact
Wetlands	6. Low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

8.2 Managed Aquifer Recharge Project at Haskell and Knox Counties

8.2.1 Description of Option

Widespread groundwater depletion that is reflected by declining groundwater levels has rendered many areas previously used for irrigated farming uneconomical, forcing agricultural producers to confront diminishing water availability, including Haskell and Knox counties in the Brazos G Regional Water Planning Area (RWPA) and Baylor County (Region B RWPA). Small municipal wellfields are similarly affected, with declining water levels making traditional solutions like drilling replacement wells and well deepening unsustainable. The Rolling Plains Groundwater Conservation District (RPGCD) is in the process of implementing a managed aquifer recharge (MAR) project, with a goal of addressing the challenges mentioned above by reducing aquifer drawdown trends, offering a sustainable approach to groundwater management.

This MAR project is expected to mitigate water needs of Brazos G and Region B entites. This section will only describe the project components within the Brazos G RWPA unless specified otherwise. Refer to the Region B Regional Water Plan for the project components within Region B, i.e., the sites within Baylor County. This project is expected to benefit agricultural producers and groundwater-dependent. By restoring groundwater availability, the MAR Project supports agricultural resilience, mitigates the risks of water scarcity, and provides a foundation for long-term regional water sustainability. Stakeholder outreach is underway to shift perspectives and encourage adoption of sustainable practices.

8.2.2 Available Yield

Table 8.2-1 summarizes the expected online decade and projected yields for the four MAR sites in Haskell County and one MAR site in Knox County. Once the sites become operational, it is anticipated that approximately five years will be needed to replenish the aquifer before an increase in yield can be realized.

Table 8.2-1 Project Status and Yields by Recharge Sites

County	Site	Projected Yield (ac-fr/yr)						
		2035	2040	2045	2050	2060	2070	2080
Haskell	Myers	Online	4,500	4,500	4,500	4,500	4,500	4,500
Haskell	Bettis 1	Online	4,500	4,500	4,500	4,500	4,500	4,500
Haskell	Bettis 2	N/A	Online	4,500	4,500	4,500	4,500	4,500
Haskell	Carter	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Knox	Gilliland	N/A	Online	1,000	1,000	1,000	1,000	1,000
Total			**10,000**	**15,500**	**15,500**	**15,500**	**15,500**	**15,500**

8.2.3 Environmental Issues

As outlined below, the MAR project is expected to convert approximately 2,300 acre-feet of land into recharge basins for sites in Haskell, Knox, and Baylor counties.

- Years 0–5: The District plans to operationalize three recharge facilities, each with a capacity of 200 acre-feet (600 acre-feet total), and one larger facility with a capacity of over 700 acre-feet. This results in a total of approximately 1,300 acre-feet of recharge capacity in the first five years, pending funding availability.
- Years 5–10: The District intends to construct one 200 acre-foot recharge facility each year, adding five facilities and 1,000 acre-feet of capacity over this period.
- Total Capacity (Years 0–10): Approximately 2,300 acre-feet of recharge capacity is planned, subject to land acquisition, site assessment, and funding.

The water used to replenish the groundwater basin will come from stormwater runoff, which could affect groundwater quality. Runoff often carries contaminants like pesticides, fertilizers, heavy metals, and other pollutants from agricultural or urban areas. When this water is directed into recharge systems, there is a risk that these contaminants may enter the groundwater but would typically be filtered during the infiltration process. The impact depends on factors such as the quality of the runoff, how well the recharge system works, and the soil's ability to filter the water. Since the project is still in the early stages, some uncertainties remain. Therefore, the environmental impacts are expected to be low to medium.

8.2.4 Engineering and Costing

The capital cost to fully implement this project is estimated at $7.05 million dollar. Costs for development, construction, and annual operation and maintanance of the project are shown in Table 8.2-2.

8.2.5 Implementation Issues

Construction of the pipeline may have temporary impacts on agricultural or rural users whose land is temporarily disrupted but no permanent impacts are anticipated. The exact locations of the recharge sites are unknow as of January 2025. However, RPGCD is actively evaluating the sites that are suitable for the MAR project. To date, no significant implementation issues have been identified.

This strategy is evaluated relative to plan development criteria in Table 8.2-3.

Table 8.2-2 Cost Estimate Summary for the MAR Project (Haskell and Knox Counties)

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
County-Other, Haskell (Rolling Plains GCD) - Managed Aquifer Recharge in Haskell and Knox Counties	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
CAPITAL COST	
Five MAR Sites (Myers, Bettis 1 &2, Carter, Gilliland)	$4,905,000
TOTAL COST OF FACILITIES	**$4,905,000**
Engineering:	
- Planning (3%)	$147,000
- Design (7%)	$343,000
- Construction Engineering (1%)	$49,000
Legal Assistance (2%)	$98,000
Fiscal Services (2%)	$98,000
Pipeline Contingency (15%)	$0
All Other Facilities Contingency (20%)	$981,000
Environmental & Archaeology Studies and Mitigation	$0
Land Acquisition and Surveying (0 acres)	$0
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$431,000
TOTAL COST OF PROJECT	**$7,052,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$496,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
MAR Project O&M	$17,000
TOTAL ANNUAL COST	**$513,000**
Available Project Yield (acft/yr)	**15,000**
Annual Cost of Water ($ per acft), based on PF=0	**$34**
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	**$1**
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	**$0.10**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	**$0.00**
QZ	*1/24/2024*

Table 8.2-3 Comparison of West Texas Water Partnership to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Exceeds identified unmet irrigation needs in Haskell and Knox Counites
2. Reliability	2. High
3. Cost	3. Low
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. Low impact
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	Positive (Replenishing groundwater basin)
D. Threats to Agriculture and Natural Resources	Low
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and irrigation shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

8.3 East Williamson County Water Supply Project

8.3.1 Description of Option

Lone Star Regional Water Authority (RWA) has connected a water supply transmission system to deliver supplies from Lake Granger to meet growing demands in Williamson County. The Lone Star RWA was created by the 82nd Legislature and authorized to design, finance, construct and operate wholesale water and wastewater infrastructure projects for public and private retail water providers. Member entities of Lone Star RWA include Sonterra MUD, City of Jarrell, and Williamson County.

The East Williamson County Water Supply Project is a transmission system to convey treated water from the Brazos River Authority East Williamson County Regional Water System water treatment plant at Lake Granger to area water user groups. This infrastructure strategy utilizes current supplies and new supplies that may be delivered at Lake Granger.

Treated supplies from BRA's WTP at Lake Granger will be delivered to Lone Star RWA and customers as indicated in Figure 8.3-1, which includes existing and proposed transmission systems. The proposed transmission system will connect to the existing delivery pipeline near Circleville and deliver supplies northwest to Jarrell.

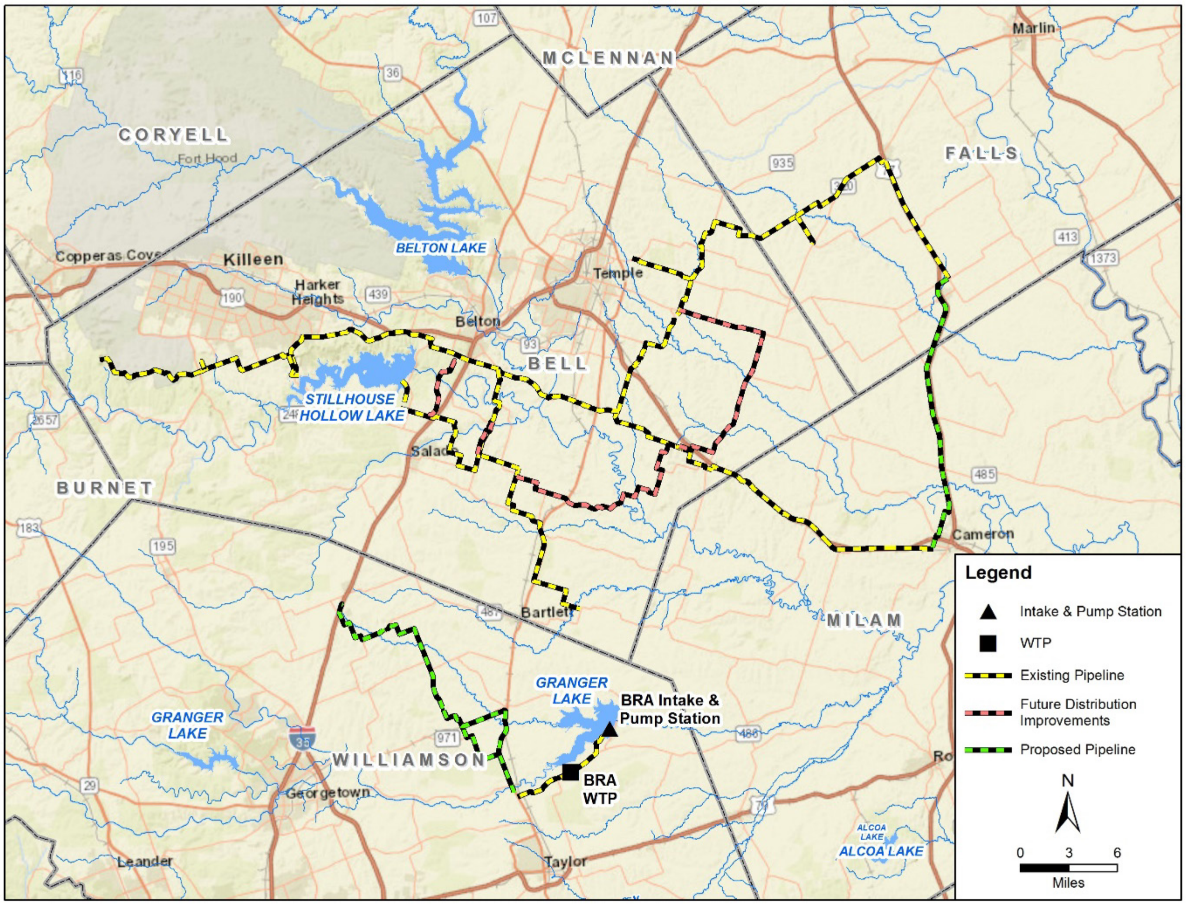
The transmission infrastructure will be designed with a 1.2 peaking factor. Lone Star RWA has contracted with BRA for 11,760 acft/yr (10.5 mgd) of Lake Granger supplies.

8.3.2 Available Supply

The supply for the East Williamson County Water Supply Project is treated Lake Granger water from the 13 mgd East Williamson County Regional Water Treatment Plant (WTP) located near the City of Taylor. The City of Taylor originally built and operated the WTP and sold it to Brazos River Authority in 2004. A new intake and WTP expansion have recently expanded the capacity from 5.5 mgd to 13 mgd to provide for increasing regional demands. Customers currently served through this system include Taylor, Hutto, Thrall, Noack WSC and Jonah Water SUD.

Lake Granger has a projected yield of 15,140 acft/yr under 2080 sediment conditions. This project could be supplied by other potential new supplies developed and delivered to near Lake Granger including the Lake Granger Augmentation strategy and Lake Granger ASR.

Figure 8.3-1 East Williamson County Water Supply Project



8.3.3 Environmental Issues

There would be limited environmental impacts along the transmission system route, provided all terms and conditions of the permits are met. Environmental impacts could include:

- Possible minor impacts to riparian corridors, depending on location of pipelines
- Other possible minor impacts from pipeline development

The impacts of pipeline development will be minimized to the extent possible by following existing roadway corridors and by avoiding environmentally sensitive areas where feasible. A summary of environmental issues is presented in Table 8.3-1. No adverse impacts to federally-listed threatened or endangered species are anticipated.

Table 8.3-1 Environmental Issues: East Williamson County Water Supply Project

Issue	Description
Implementation Measures	Water treatment plant expansion, pump stations, and pipelines
Environmental Water Needs/Instream Flows	Negligible impact.
Bays and Estuaries	Negligible impact.
Fish and Wildlife Habitat	Possible minor impacts on riparian corridors, depending on specific location of pipelines.
Cultural Resources	Possible low impact.
Threatened and Endangered Species	Possible low impact.

8.3.4 Engineering and Costing

Cost estimates were prepared using the TWDB Unified Costing Model. Cost tables were updated to September 2023 with energy cost set at $0.09 per kWh, to be consistent with State regional water planning efforts. Cost projections were prepared using the proposed facilities and alignment described above. The cost summary is included in Table 8.3-2.

The transmission system is sized with a 1.2 peaking factor. Operating and maintenance and energy costs are projected based on the average annual operation of 11,762 acft per year. Entities would need to contract for treated supplies at the BRA WTP, and those purchase costs are not included here. The total project cost for treatment and delivery of 11,762 acft of potable water to the project participants is $41,630,504. The associated debt service and annual operating cost are projected at $3,173,000, yielding a finished water cost of $270 per acft, or $0.83 per thousand gallons.

8.3.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 8.3-3, and the option meets each criterion.

8.3.5.1 Potential Regulatory Requirements:

Implementation of this water management strategy will require the following permits for pipeline construction:

- U.S. Army Corps of Engineers Section 404 permit for pipeline stream crossings and discharges of fill into wetlands and waters of the U.S. during construction.
  - Stream crossings could be authorized under Nationwide Permit 12 (NWP-12), Utility Line Activities, if all terms and conditions are met, which is likely.
- A TPDES General Permit for Construction Activity is required for construction activities that disturb more than one acre, and a Storm Water Pollution Prevention Plan is required for any project that disturbs five acres or more.
- TP&WD Sand, Shell, Gravel, and Marl permits for construction in state-owned stream beds may be required.

- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.
- Appropriate permits have been and will be obtained for TxDOT highway crossings.

Table 8.3-2 Cost Summary of East Williamson County Water Supply Project

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Granger - East Williamson County Water Supply Plan	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
CAPITAL COST	
Contract No 1 - 24" Water Line "A" (Part of)	$7,935,538
Contract No 2- 30" San Gabriel River Bore	$1,061,833
Contract No 3 - 24" Water Line "A" (Part of) and Water Line "B"	$7,732,988
Contract No. 4- 10.5 mgd Pump Station No. 1	$2,761,484
Contract No. 5 - 10.5 mgd Pump Station No. 2	$2,977,097
Contract No. 6A - 0.5 mgd Ground Storage Tank No. 1	$914,756
Contract No. 6B - 0.5 mgd Ground Storage Tank No. 2	$790,560
Contract No. 7 - 0.5 mgd Elevated Tank	$1,500,521
Contract No. 8 - 12" Water Line "C"	$1,679,124
Contract No. 8 - 12" Water Line "D"	$536,329
Contract No. 8 - 12" Water Line "E"	$477,275
TOTAL COST OF FACILITIES	**$28,367,504**
Engineering:	
- Planning	$3,361,000
- Design	$335,000
- Construction Engineering	$854,000
Legal Assistance	$473,000
Fiscal Services	$1,013,000
Pipeline Contingency	$2,913,000
All Other Facilities Contingency	$1,789,000
Environmental & Archaeology Studies and Mitigation	$120,000
Land Acquisition and Surveying	$1,150,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,255,000
TOTAL COST OF PROJECT	**$41,630,504**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,804,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	x

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Granger - East Williamson County Water Supply Plan	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$226,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$143,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs	$0
Purchase of Water	$0
TOTAL ANNUAL COST	**$3,173,000**
Available Project Yield (acft/yr)	**11,762**
Annual Cost of Water ($ per acft), based on PF=0	**$270**
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	**$31**
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	**$0.83**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	**$0.10**
Note: One or more cost element has been calculated externally	
CB	*1/16/2025*

Table 8.3-3 Comparison of East Williamson County Water Supply Project to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient
2. Reliability	2. High reliability
3. Cost	3. Relatively high, but reasonable for a county-wide system
B. Environmental factors	
1. Environmental Water Needs	1. Low impact
2. Habitat	2. Low impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Low impact
5. Threatened and Endangered Species	5. Negligible impact
6. Wetlands	6. Low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed	Done
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

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8.4 Lake Belton to Lake Stillhouse Hollow Pipeline

8.4.1 Description of Option

A pipeline is proposed to connect Lake Belton to Lake Stillhouse Hollow (Figure 8.4-1) to supplement supplies from Lake Stillhouse Hollow and Lake Georgetown. Lake Belton is on the Leon River in Bell and Coryell Counties. Lake Stillhouse Hollow is on the Lampasas River in Bell County. Both reservoirs are located near the Cities of Killeen, Belton and Temple. The reservoirs are owned by the U.S. Army Corps of Engineers and are part of the Brazos River Authority (BRA) system. The reservoirs provide water for the Cities of Temple, Belton, Killeen, Gatesville, Copperas Cove, Lampasas and a number of other water supply districts and corporations in the area, as well as water to BRA customers downstream. In addition, Lakes Stillhouse Hollow and Georgetown are connected by the Williamson County Regional Raw Water Pipeline, which transfers water from Lake Stillhouse Hollow to Lake Georgetown to be used in the Williamson County area. Table 8.4-1 summarizes storage and diversion authorizations for the reservoirs. Included in the table are the reach diversion limits, which are the maximum volume that can be diverted in a year using the System Operation Permit (Permit No. 5851, priority date October 15, 2004).

The Belton to Stillhouse Hollow pipeline project is primarily designed to delay the need for development of new sources of water by making use of surplus Lake Belton water in the decades prior to 2080. For the purposes of this plan, the proposed pipeline was assumed to transfer up to 30,000 acft/yr to Lake Stillhouse Hollow. From Stillhouse Hollow, some of the Lake Belton water could be transferred to Lake Georgetown via the existing Williamson County Regional Raw Water Pipeline. The Belton to Stillhouse Hollow Pipeline will allow the BRA to operate these three lakes as a system, increasing the reliability of the supplies to the area. In the future, supplementing the supply at Lake Stillhouse Hollow with water transferred from Lake Belton limits drawdowns in Lake Stillhouse Hollow and prevents shortages.

The locations of facilities and a pipeline route for this project have not been established and are not available for this plan. It is expected that the intake and pump station will be located in deep water near the Lake Belton Dam. The outlet structure in Lake Stillhouse Hollow would most likely be located somewhere on the north shore of the lake in the downstream part of the reservoir.

Figure 8.4-1 Connection between Lakes Belton and Stillhouse Hollow

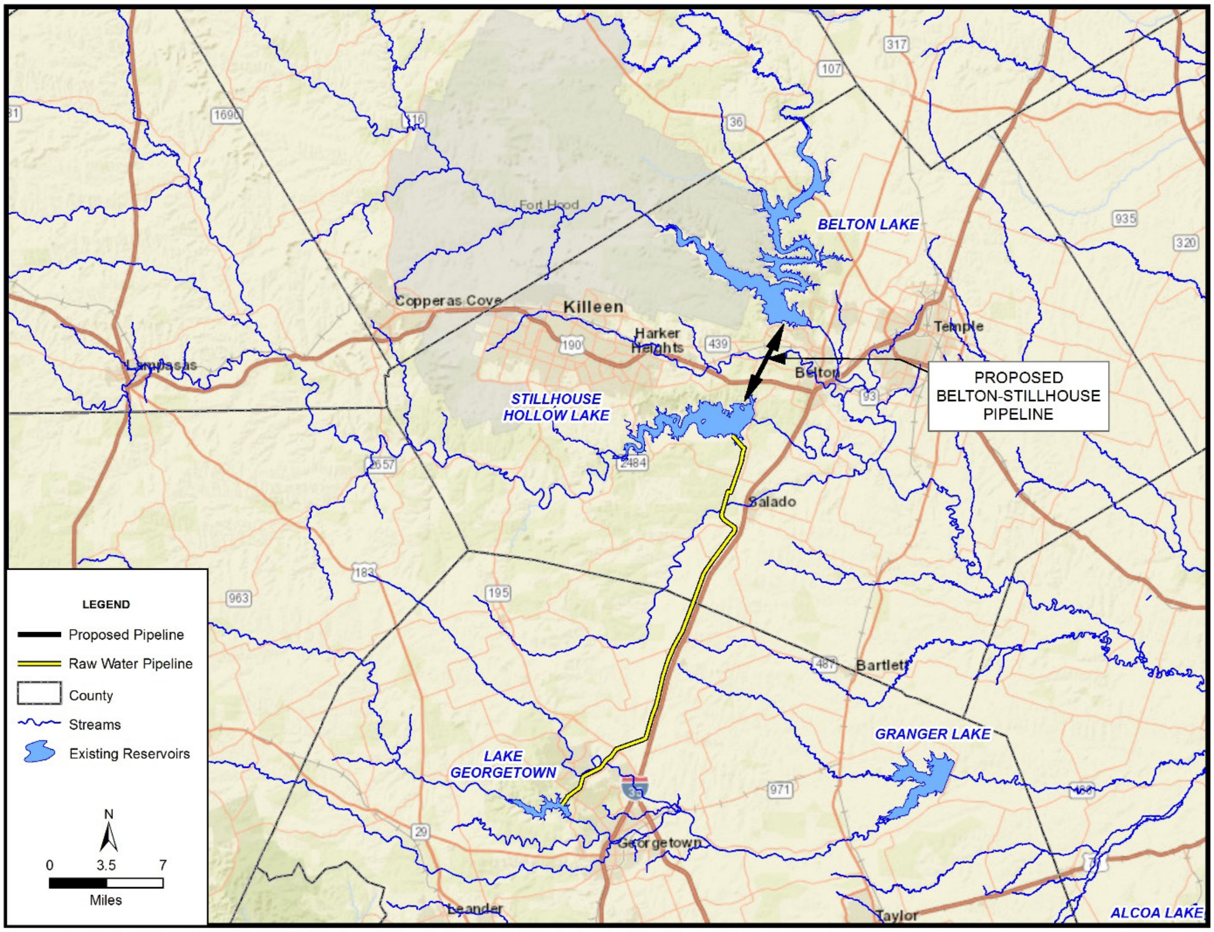

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Table 8.4-1 Diversion and Storage Data for Lakes Belton, Stillhouse Hollow and Georgetown

Reservoir Name	Water Right	Authorized Storage (acft)	Authorized Priority Diversion (acft/yr)	Priority Date	SysOps Reach Diversion Limit (acft/yr)
Belton	CA 12-5160	457,600	100,257	12/16/1963	22,523
Stillhouse Hollow	CA 12-5161	235,700	67,768	12/16/1963	12,808
Georgetown	CA 12-5162	37,100	13,610	2/12/1968	10,059

Notes:
(1) CA – Certificate of Adjudication.
(2) The priority date of the System Operations Permit is 3/1/2012.

8.4.2 Available Yield

The project is expected to deliver around 30,000 acft/yr from Lake Belton to Lake Stillhouse Hollow based on an estimate of the need in the area served by Lakes Stillhouse Hollow and Georgetown. The primary benefit of the pipeline will be the delay in developing expensive new sources of water to meet anticipated future demands. The supply for this project is authorized under the existing BRA water right for Lake Belton and Lake Stillhouse Hollow and represents existing supplies. For purposes of planning guidelines and the development of unit cost, this strategy is considered to yield 5,000 acft/yr of existing supplies. However, the actual yield of the project is zero considering it is transporting existing supplies.

Under this strategy, the demands at Lake Georgetown can be met by water pumped from Lake Stillhouse Hollow through the Williamson County Regional Raw Water Line that connects Lake Stillhouse to Lake Georgetown and from Lake Belton through the Lake Belton to Lake Stillhouse Hollow pipeline. The proposed Belton to Stillhouse Hollow pipeline would allow the BRA to use supplies from Lake Belton to meet demands at the other two reservoirs.

8.4.3 Environmental Issues

The intake and discharge structures could have low to moderate environmental impacts depending on the final location of the structures. The pipeline route is expected to avoid sensitive areas, so the construction and operation of the pipeline is expected to have low environmental impacts.

The pipeline would have a minimal impact on the frequency of time that these reservoirs are full and spilling because pumping would not occur until Lake Stillhouse Hollow has been drawn down significantly. The project would have minimal impact on instream flows or bays and estuaries because the frequency and volume of spills would be about the same with and without the pipeline.

Lakes Belton and Stillhouse Hollow are located in adjacent watersheds on tributaries of the Little River that join a short distance below the reservoirs. Both reservoirs are expected to have similar biological communities and water quality. There are no anticipated impacts associated with blending water for the two reservoirs, although this may need to be verified by studies.

8.1.1 Engineering and Costing

For the purposes of this plan, it is assumed that the pipeline will be about 7 miles long with a diameter of 48 inches. summarizes the costs for this option. About 12 percent of the pipeline route is assumed to be in a relatively urbanized area. The intake structure and pump station are assumed to be located near the Lake Belton Dam and the discharge structure is located on the north shore of Lake Stillhouse Hollow in the lower portion of the lake. Using these assumptions, the estimated capital cost of the pipeline is about $73.6 million. Total project costs, including engineering, contingencies, permitting, mitigation and interest during construction are an additional $28 million for a total project cost of $101.6 million. Annual costs, including debt service, power cost and operation and maintenance are approximately $8.6 million per year. The resulting unit costs are $1,719 per acre-foot or $5.27 per thousand gallons, based on planning use only supply 5,000 acft/yr.

8.1.2 Implementation Issues

This water supply options have been compared to the plan development criteria, as shown in Table 8.4-2, and the option meets each criterion. Implementation steps for the project are presented below.

Potential Regulatory Requirements:

- Texas Commission on Environmental Quality (TCEQ) Water Right and Storage permits.
- U.S. Army Corps of Engineers (USACE) Permits will be required for discharges of dredge or fill into wetlands and waters of the U.S. for dam construction, and other activities (Section 404 of the Clean Water Act).
- TCEQ administered Texas Pollution Discharge Elimination System (TPDES) Permit and Storm Water Pollution Prevention Plan.
- General Land Office Easement if State-owned land or water is involved.
- Texas Parks and Wildlife Department Sand, Shell, Gravel and Marl permit if State-owned streambeds are involved.
- Agreement with USACE for discharge into Lake Stillhouse Hollow.

State and Federal Permits may require the following studies and plans:

- Possible analysis of impact of blending Lake Belton water in Lake Stillhouse Hollow.
- Environmental impact or assessment studies.
- Wildlife habitat mitigation plan that may require acquisition and management of additional land.
- Flow releases downstream to maintain aquatic ecosystems.
- Assessment of impacts on Federal- and State-listed endangered and threatened species.
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.
- Cultural resources studies in coordination with the Texas Historical Commission to determine resources impacts and appropriate mitigation plan that may include cultural resource recovery and cataloging.

Land Acquisition Issues:

- Land acquired for the project could include market transactions or other local landowner agreements.
- Additional acquisition of rights-of-way and/or easements may be required.
- Possible relocations or removal of residences, utilities, roads, or other structures.

Table 8.4-2 Estimated Costs for the Lake Belton to Lake Stillhouse Hollow Pipeline

Cost Estimate Summary Water Supply Project Option September 2023 Prices Brazos River Authority - Lake Belton to Stillhouse Pipeline Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Intake Pump Stations (33 mgd)	$42,174,000
Transmission Pipeline (48 in. dia., 6.8 miles)	$31,363,000
Integration, Relocations, Backup Generator & Other	$57,000
TOTAL COST OF FACILITIES	**$73,594,000**
Engineering:	
- Planning (3%)	$2,208,000
- Design (7%)	$5,152,000
- Construction Engineering (1%)	$736,000
Legal Assistance (2%)	$1,472,000
Fiscal Services (2%)	$1,472,000
Pipeline Contingency (15%)	$4,704,000
All Other Facilities Contingency (20%)	$8,446,000
Environmental & Archaeology Studies and Mitigation	$241,000
Land Acquisition and Surveying (46 acres)	$376,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$3,197,000
TOTAL COST OF PROJECT	**$101,598,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$7,144,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$314,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$1,054,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (927273 kW-hr @ 0.09 $/kW-hr)	$83,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$8,595,000**
Available Project Yield (acft/yr)	5,000
Annual Cost of Water ($ per acft), based on PF=7.4	$1,719
Annual Cost of Water After Debt Service ($ per acft), based on PF=7.4	$290
Annual Cost of Water ($ per 1,000 gallons), based on PF=7.4	$5.27
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=7.4	$0.89
CB	*1/24/2025*

Table 8.4-2 Comparison of Lake Belton to Lake Stillhouse Hollow Pipeline to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Low to medium impact
2. Habitat	2. Low impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Low impact due to distance from coast
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Low impact
C. Impact on Other State Water Resources	Possible negative impacts on state water resources from water quality changes; no effect on navigation
D. Threats to Agriculture and Natural Resources	Low to none
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	None
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

8.5 Lake Whitney Water Supply Project (Cleburne)

8.5.1 Description of Option

The City of Cleburne has contracts with the BRA totaling 9,700 acre-feet per year with a Lake Whitney diversion location but does not currently have the infrastructure to access this water. A proposed pipeline option would allow Cleburne access to its Lake Whitney water.

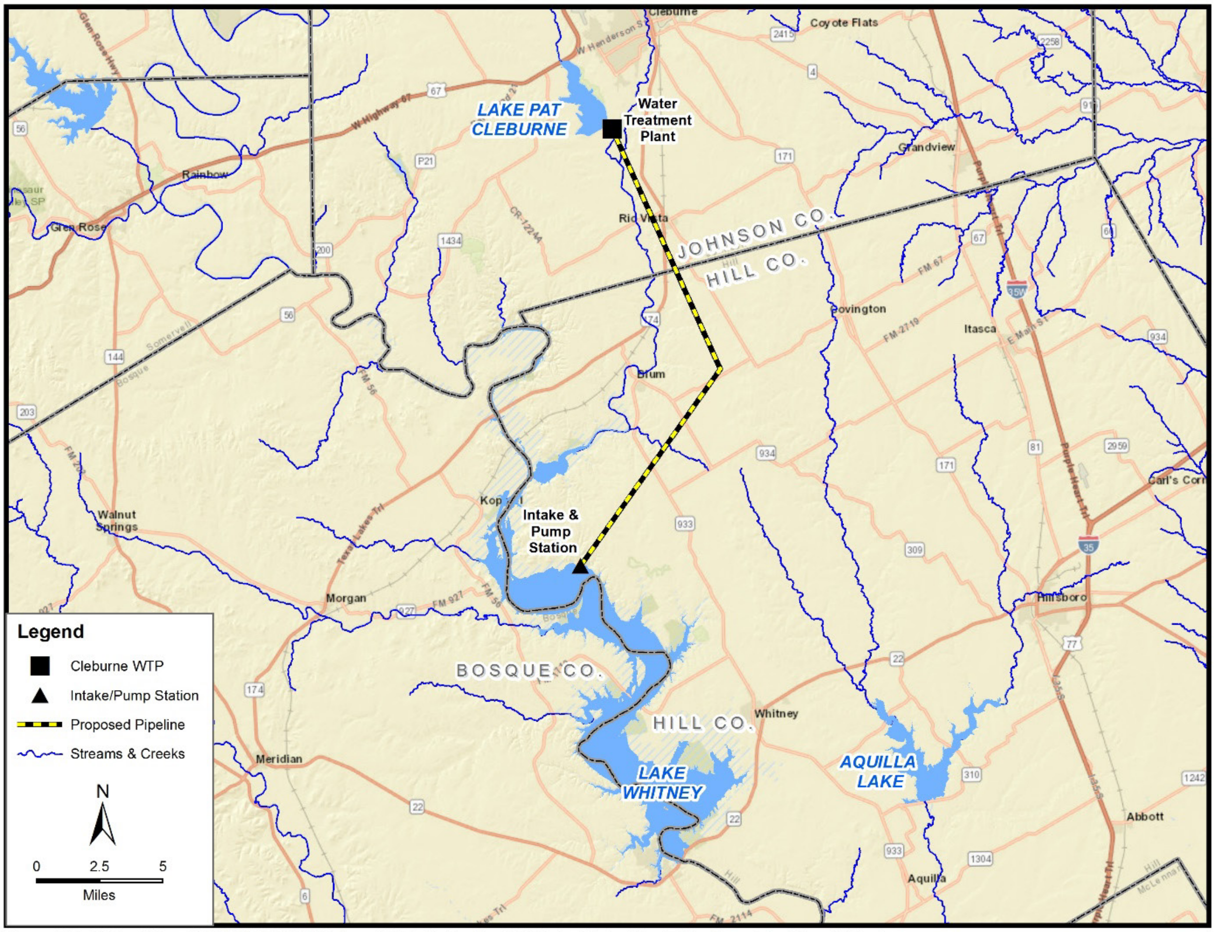
The project would require a deep water intake, diversion pump station to take water out of Lake Whitney, an advanced water treatment facility for the Lake Whitney water, blending tanks, a booster pump station, and a pipeline to Cleburne, and all associated appurtenances for a fully functional and operational water supply delivery and treatment system. This project would supply the City of Cleburne and possibly Johnson County mining, manufacturing, steam electric, and irrigation water though Cleburne.

The main stem of the Brazos River in the vicinity of Lake Whitney has relatively high levels of total dissolved solids (TDS). From 1993 to 2006, Lake Whitney averaged about 845 mg/L TDS, while water in Lake Aquilla averaged about 228 mg/L TDS. The relatively high salt concentration in the main stem water will need to be mitigated either by blending with better quality water (such as Lake Aquilla water) or have the salt concentration reduced by advanced treatment.

The proposed project includes advanced treatment to remove dissolved solids from a portion of the water from Lake Whitney. Approximately 70 to 85 percent of the water will need to be treated to remove sufficient salt loads to maintain acceptable water quality. For costing purposes, it was assumed that the brine reject will be discharged back into Lake Whitney.

Previous versions of the Brazos G Plan have included alternatives to this strategy that included bringing water from Lake Whitney to supplement supplies from Lake Aquilla. These options used additional water from the BRA system to meet the needs of other Lake Aquilla users. At this time the City of Cleburne is not considering the joint strategy, so it is not considered in the current plan.

Figure 8.5-1 Lake Whitney Water Supply Project



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8.5.2 Available Yield

Although the City of Cleburne holds contracts for 9,700 acft/yr, water diverted from Lake Whitney requires desalination or blending for municipal use. For this strategy, approximately 24 percent of the water will be lost in the desalination process, resulting in an available supply of about 7,400 acft/yr. The water from the project would come from Lake Whitney and other water supply sources in the BRA system.

8.5.3 Environmental Issues

A potential concern is the return of reject brine water resulting from the TDS treatment to Lake Whitney. Lake Whitney is a very large reservoir with more than 550,000 acft of storage and a significant amount of flow-through due to hydropower operations. As a result, the return of reject brine water to this reservoir is anticipated to have minimal impact on the existing water quality. Additional studies may be required to verify this assumption. If it is determined that the reject brine water cannot be returned to the reservoir, deep-well injection or evaporation ponds could be used to dispose of this product. However, the addition of either of these options will result in increased costs to the project and additional environmental concerns.

The specific locations of facilities and pipeline routes have not been identified at this time. It is anticipated that pipelines, pump stations and other necessary facilities will be positioned to avoid impacts to known cultural resources, sensitive habitats, wetlands or stream crossings.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Bosque, Hill and Johnson counties can be found at https://tpwd.texas.gov/gis/rtest/. There are no areas of critical habitat designated within or near the project area.

The project area may provide potential habitat to endangered or threatened species found in Bosque, Hill or Johnson counties. A survey of the project area may be required prior to pipeline and facility construction to determine whether populations of or potential habitats used by listed species occur in the area to be affected. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

No designated critical habitat for the rare black-capped vireo or endangered golden-cheeked warbler occurs within the project area. Populations of the endangered smalleye and sharpnose shiner occur within the upper Brazos River basin above Lake Whitney. Although these shiner species were once found throughout the Brazos River and several of its major tributaries within the watershed, they are currently restricted almost entirely to the contiguous river segments of the upper Brazos River basin in north-central Texas.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available geographic information systems (GIS) datasets, there are no national register properties, national register district properties, or historical markers located within a 0.5-mile buffer of the proposed pipeline routes, pump stations or other facilities. Several small cemeteries are located within the areas proposed for the pipeline routes and should be avoided during the siting of pipelines, pump stations or other facilities.

Impacts resulting from this project could include changes in salinity of the water within Lake Whitney or impacts from the construction and maintenance of the associated pipelines, pump stations or water treatment facilities. If no reject brine water is returned to Lake Whitney impacts to aquatic species from this project would be anticipated to be minor and associated with the water intake facilities. Changes in TDS levels could result in additional environmental impacts to aquatic species.

Impacts from pipelines, pump stations and water treatment facilities would be anticipated to include temporary construction impacts and maintenance activities if their siting is based on the avoidance of impacts to cultural resources, sensitive habitats, wetlands, or stream crossings.

The project is expected to have low to medium impacts to environmental flows and no impacts to bays and estuaries.

8.1.1 Engineering and Costing

The strategy was evaluated to determine required infrastructure and costs to develop water supplies from Lake Whitney. The strategy includes pretreatment of Lake Whitney water before it is delivered to Cleburne. The project could be implemented in two phases. The first phase delvers an average of 3.8 mgd and includes a lake pump station, desalination plant, booster pump station and main transmission line. The second phase includes expansion of existing pump stations and treatment facilities for an additional supply of 2.8 mgd.

Based on preliminary examination of the Lake Whitney reservoir topography, an intake and pump station from Lake Whitney could be located on the eastern shore of the lake. Other diversion locations may be evaluated, and other future take points identified. Lake Whitney water would be treated at an advanced water treatment plant located on the eastern shore. The water would not be disinfected to meet drinking water standards, but the TDS and chlorides would be reduced to match the target water quality in Lake Pat Cleburne and Lake Aquilla. The partially treated water would then be blended with water from Lake Aquilla or Lake Pat Cleburne before full treatment at the city’s water treatment plant. Future options may include full treatment at the take point. The total capital cost for Phase I of the Lake Whitney to Cleburne project is $107.9 million with total annual costs of $13 million. The second phase of the project is $39.7 million with total annual cost increase of $7.7 million. A summary of the costs for this option is provided in Table 8.5-1.

Table 8.5-1 Cost Estimate for Phase I and II Lake Whitney Diversion to Cleburne

Item	Estimated Phase I Costs	Estimated Phase II Costs	Estimated Total Costs for Facilities
CAPITAL COST			
Desal to City (24 in dia., 19.2 miles)	$18,833,314	$0	$18,833,314
Primary Pump Stations (9.9 mgd)	$3,807,954	$2,645,284	$6,453,238
Transmission Pump Station(s) & Storage Tank(s)	$4,733,984	$2,817,934	$7,551,919
Intake to desal (30 in dia., 0.4 miles)	$626,610	$0	$626,610
Intake Pump Stations (13 mgd)	$15,950,183	$2,351,900	$18,302,084
Brine discharge (14 in dia., 0.4 miles)	$283,725	$0	$283,725
Primary Pump Stations (3.1 mgd)	$709,917	$470,863	$1,180,780
Transmission Pump Station(s) & Storage Tank(s)	$2,176,836	$1,087,814	$3,264,650
Storage Tanks (Other Than at Booster Pump Stations)	$1,864,135	$932,067	$2,796,202
Water Treatment Plant (11 mgd)	$24,277,215	$17,580,094	$41,857,308
TOTAL COST OF FACILITIES	**$73,263,872**	**$27,885,957**	**$101,149,829**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$24,655,112	$9,761,353	$34,416,465
Environmental & Archaeology Studies and Mitigation	$1,010,544	$0	$1,010,544
Land Acquisition and Surveying (173 acres)	$3,344,335	$0	$3,344,335
Interest During Construction (3% for 2 years with a 0.5% ROI)	$5,625,002	$2,071,797	$7,696,799
TOTAL COST OF PROJECT	**$107,898,866**	**$39,719,107**	**$147,617,973**

Item	Estimated Phase I Costs	Estimated Phase II Costs	Estimated Total Costs for Facilities
ANNUAL COST			
Debt Service (3.5 percent, 20 years)	$7,591,761	$2,794,995	$10,386,755
Operation and Maintenance			
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$261,993	$32,598	$294,591
Intakes and Pump Stations (2.5% of Cost of Facilities)	$569,865	$176,272	$746,137
Water Treatment Plant	$3,728,269	$4,082,020	$7,810,290
Pumping Energy Costs (6,730,780 kW-hr @ 0.08 $/kW-hr)	$347,714	$301,835	$649,550
Purchase of Water (9,700 acft/yr @ 70.5 $/acft)	$479,314	$346,507	$825,821
TOTAL ANNUAL COST	**$12,978,917**	**$7,734,227**	**$20,713,144**
Available Project Yield (acft/yr)	**4,300**	**3,100**	**7,400**
Annual Cost of Water ($ per acft)	**$3,018**	**$2,495**	**$2,799**
Annual Cost of Water After Debt Service ($ per acft)	**$1,253**	**$1,593**	**$1,395**
Annual Cost of Water ($ per 1,000 gallons)	**$9.26**	**$7.66**	**$8.59**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	**$3.84**	**$4.89**	**$4.28**

8.1.2 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 8.5-2, and the option meets each criterion.

A summary of the implementation steps for the project is presented below.

- Pilot study to evaluate RO treatment of Lake Whitney water.
- Analysis of potential impact of disposal of brine reject.

Potential Regulatory Requirements

- Texas Commission on Environmental Quality Water Right and Storage permits;
- U.S. Army Corps of Engineers Permits will be required for discharges of dredge or fill into wetlands and waters of the U.S. for dam construction, and other activities (Section 404 of the Clean Water Act);
- Texas Commission on Environmental Quality administered Texas Pollutant Discharge Elimination System Storm Water Pollution Prevention Plan;
- Texas General Land Office Easement if State-owned land or water is involved;
- Texas Parks and Wildlife Department Sand, Shell, Gravel and Marl permit if state-owned streambed is involved; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

State and Federal Permits may require the following studies and plans

- Environmental impact or assessment studies;
- Wildlife habitat mitigation plan that may require acquisition and management of additional land;
- Flow releases downstream to maintain aquatic ecosystems;
- Assessment of impacts on Federal- and State-listed endangered and threatened species; and
- Cultural resources studies to determine resources impacts and appropriate mitigation plan that may include cultural resource recovery and cataloging; requires coordination with the Texas Historical Commission.

Land Acquisition Issues

- Land acquired for reservoir and/or mitigation plans could include market transactions or other local landowner agreements;
- Additional acquisition of rights-of-way and/or easements may be required; and
- Possible relocations or removal of residences, utilities, roads, or other structures.

Table 8.5-2 Comparison of Transportation of Raw Water from Lake Whitney to Lake Aquilla to Plan Development Criteria

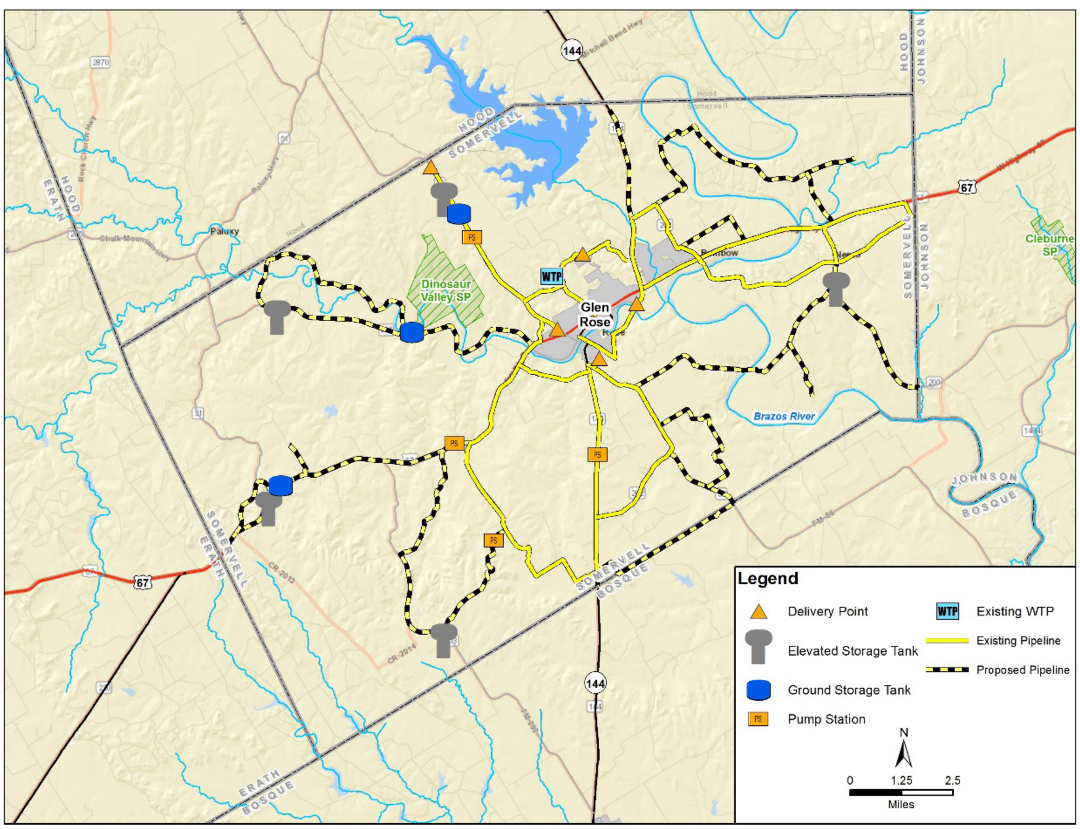
Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. High
B. Environmental factors	
1. Environmental Water Needs	1. Low to medium impact
2. Habitat	2. Low impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Low impact due to distance from coast
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Low impact
C. Impact on Other State Water Resources	Possible negative impacts on state water resources from water quality changes; no effect on navigation
D. Threats to Agriculture and Natural Resources	Low to none
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	None
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

8.6 Somervell County Water Supply Project

8.6.1 Description of Option

The Somervell County Water District (SCWD) completed the first part of their surface water supply system in October 2016. Previously, Somervell County obtained all of its water from the Trinity Aquifer, which was not able to sustain current and future uses. SCWD is currently supplying water to the City of Glen Rose and Comanche Peak Steam Electric Station as wholesale customers and to many retail commercial and residential customers in the county. The components of the project that have been completed include the Paluxy River channel dam and reservoir, the raw water pump station, a 36-inch raw water pipeline, the 4,118 acre-foot off-channel Wheeler Branch Reservoir, a 2.5 mgd membrane filtration water treatment plant, two treated water pump stations and elevated storage tanks, and part of the distribution piping system. A 1.25 mgd water treatment plant expansion and additional distribution system piping will allow SCWD to deliver water to more commercial and residential customers within Somervell County. The SCWD plans to complete the project by 2030. When complete, the project will provide 2,000 acre-feet per year of surface water supplies to water users in Somervell County. Figure 8.6-1 shows SCWD's existing and proposed infrastructure and major delivery points.

Figure 8.6-1 Proposed Phases of the Somervell County Water Supply Project



8.6.2 Available Supply

The Somervell County Water District has a water right for 2,000 acre-feet per year from the Wheeler Branch Reservoir, which is operated in conjunction with a channel dam on the Paluxy River (CA-12-5744)[1]. The District has an agreement with the Brazos River Authority (BRA) that makes the 2,000 acre-feet per year available on a reliable basis by subordinating BRA's water right in Lake Whitney (CA 12-5157). The existing components of the Somervell County Water Supply Project provide 1,400 acre-feet per year. The planned water treatment plant expansion in 2030 will allow the SCWD to use the full yield of the project[2].

8.6.3 Environmental Issues

There would be limited environmental impacts due to the water treatment plant expansion, provided all terms and conditions of the permits are met. Environmental impacts could include:

- Possible minor impacts to riparian corridors, depending on location of distribution pipelines
- Other possible minor impacts from distribution pipeline development

The impacts of pipeline development will be minimized to the extent possible by following existing roadway corridors and by avoiding environmentally sensitive areas where feasible. A summary of environmental issues is presented in Table 8.6-1. The water treatment plant expansion would occur at the existing plant, which does not provide suitable habitat for the black-capped vireo (in recovery) or the golden-cheeked warbler. The piping plover, red knot and the whooping crane could be present in the project area during migration, but in the past have not been observed in the proposed construction areas. No adverse impacts to federally-listed threatened or endangered species are anticipated[2].

Table 8.6-1 Environmental Issues: Somervell County Water Supply Project

Issue	Description
Implementation Measures	A 1.25 mgd water treatment plant expansion and distribution pipelines.
Environmental Water Needs/Instream Flows	Negligible impact.
Bays and Estuaries	Negligible impact.
Fish and Wildlife Habitat	Possible minor impacts on riparian corridors, depending on specific location of pipelines.
Cultural Resources	Possible low impact.
Threatened and Endangered Species	Possible low impact.
Water Management Option	Somervell County Water Supply Project.

[1] Certificate of Adjudication 12-5744
[2] Somervell County Water District, Engineering Feasibility Report Phase 5, 6, 8a, and 8b Distribution System. Prepared for TWDB by Freese and Nichols, Inc. Updated March 2013.

8.6.4 Engineering and Costing

Figure 8.6-1 shows the facilities included in the Somervell County Water Project. Water from Wheeler Branch Reservoir is treated at the water treatment plant below the dam and distributed to the county by a system of pump stations, ground and elevated storage tanks, and pipelines. Completed phases include a 2.5 mgd water treatment plant and high service pump station, a raw water pump station, 2 booster pump stations, 4 ground storage tanks, 2 elevated tanks, and 100 miles of pipeline ranging from 6 inches to 18 inches in diameter. Future phases will include expanding the water treatment plant and high service pump station to 3.75 mgd, 3 booster pump stations, 2 ground storage tanks, 3 elevated tanks, and 75 miles of pipeline ranging from 6 inches to 12 inches in diameter.

Financing was identified as a possible implementation issue in the 2011 and 2016 Brazos G Plans. To date, the phases of the Somervell County Water Supply Plan that have been built have been financed through multiple loan requests, including: TWDB's Water Infrastructure Fund (WIF) construction loan ($9.4 million), WIF rural loan ($9.5 million), Economically Distressed Areas Program (EDAP) Rural State Water Plan Grant ($9.5 million), EDAP State Water Plan Grant ($1.3 million), and the EDAP State Water Plan Loan ($1.3 million), among others.

Table 8.6-2 summarizes the capital costs for the phases that have yet to be constructed (i.e., Phases 7A and 9 through 17), which total $33,592,000 in September 2023 dollars. Contingencies, professional services, land costs, and interest during construction will add $13,423,000, for a total project cost of $47,015,000. With 3.5 percent interest and 20-year bonds, the annual debt service is $3,308,000. Operation and maintenance costs for pumping, transmission and treatment add $916,000 per year, for a total annual cost of $4,224,000 for delivery of 600 acre-feet. All costs are for retail, as opposed to wholesale, facilities. The cost of treated water delivered is $7,040 per acre-foot, or $21.60 per thousand gallons. The development of a new surface water supply and retail distribution system in a rural area results in relatively high costs per unit of water. The cost for this strategy is especially high because it is calculated by dividing the total cost for the remainder of the project by the total amount of water made available by the remainder of the project. The WTP expansion in Phase 7A increases the total supply by 600 acft/yr because 1,400 acft/yr was made available by earlier phases and the water right limits the project to 2,000 acft/yr. The costs of Phases 9-17 are associated with a retail distribution system in a rural area where the density of customers is low. Considering the entire project (Phases 1-17) and the full permitted amount of water (2,000 acft/yr), the annual cost of water is about $13.93 per thousand gallons.

Table 8.6-2 Cost Estimate Summary for Somervell County Water Supply Project Phases 7A & 9-17

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Somervell County Water District	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Primary Pump Station	$127,000
Transmission Pipeline	$24,474,000
Transmission Pump Station(s) & Storage Tank(s)	$758,000
Water Treatment Plant (1.3 mgd)	$8,233,000
TOTAL COST OF FACILITIES	**$33,592,000**
- Planning (3%)	$1,008,000
- Design (7%)	$2,351,000
- Construction Engineering (1%)	$336,000
Legal Assistance (2%)	$672,000
Fiscal Services (2%)	$672,000
Pipeline Contingency (15%)	$3,671,000
All Other Facilities Contingency (20%)	$1,824,000
Environmental & Archaeology Studies and Mitigation	$9,000
Land Acquisition and Surveying (1 acres)	$10,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$2,870,000
TOTAL COST OF PROJECT	**$47,015,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,308,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$245,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$22,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$649,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$4,224,000**
Available Project Yield (acft/yr)	**600**
Annual Cost of Water ($ per acft), based on PF=2	**$7,040**
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	**$1,527**

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
Somervell County Water District	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	**$21.60**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	**$4.68**
Note: One or more cost element has been calculated externally	
CJM	1/19/2025

8.6.5 Implementation Issues

Four sites with potentially significant cultural resources were identified in the vicinity of the proposed pipeline route[3]. The Somervell County Water District plans to preserve all four sites by completely avoiding each site and following the recommendations specified in the report. No impact to cultural resources is expected. Financing will continue to be an implementation issue, and financing vehicles similar to those used to fund the first part of the project are expected to be used to complete the project. Table 8.6-3 compares this water management strategy to the plan development criteria.

Table 8.6-3 Comparison of Somervell County Water Supply Project to Plan Development Criteria

Impact Category		Comment(s)	
A.	Water Supply		
1.	Quantity	1.	Sufficient to meet needs
2.	Reliability	2.	High reliability
3.	Cost	3.	Relatively high, but reasonable for a county-wide system
B.	Environmental factors		
1.	Environmental Water Needs	1.	Low impact
2.	Habitat	2.	Low impact
3.	Cultural Resources	3.	Low impact
4.	Bays and Estuaries	4.	Low impact
5.	Threatened and Endangered Species	5.	Low impact
6.	Wetlands	6.	Low impact
C.	Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation	
D.	Threats to Agriculture and Natural Resources	None	
E.	Equitable Comparison of Strategies Deemed Feasible	Done	
F.	Requirements for Interbasin Transfers	Not applicable	
G.	Third Party Social and Economic Impacts from Voluntary Redistribution	None	

[3] An Archaeological Survey of the Proposed Somervell County Water District Pipeline Route. Prepared by AR Consultants, Inc. for Somervell County Water District. January 2012.

8.6.6 Potential Regulatory Requirements:

Implementation of this water management strategy will require the following permits for pipeline construction:

- U.S. Army Corps of Engineers Section 404 permit for pipeline stream crossings and discharges of fill into wetlands and waters of the U.S. during construction.
- Stream crossings could be authorized under Nationwide Permit 12 (NWP-12), Utility Line Activities, if all terms and conditions are met, which is likely.
- A TPDES General Permit for Construction Activity is required for construction activities that disturb more than one acre, and a Storm Water Pollution Prevention Plan is required for any project that disturbs five acres or more.
- TP&WD Sand, Shell, Gravel, and Marl permits for construction in state-owned stream beds may be required.
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.
- Appropriate permits have been and will be obtained for TxDOT highway crossings.

8.7 West Texas Water Partnership

8.7.1 Description of Option

In December 2010, the cities of Abilene, Midland and San Angelo met to discuss cooperative strategies in response to a developing drought. As the drought intensified a cooperative response could not be timely implemented, and the cities constructed and brought on-line individual strategies to provide adequate water supplies for their customers. Recognizing the benefits of working together to address future water supplies, the three cities continued to meet and evaluate long-term water supplies for the West Texas region. Through an Interlocal Agreement, the cities formed the West Texas Water Partnership (Partnership or WTWP) to pursue water management strategies that could be jointly developed by the Partnership. In May 2020, the three cities announced a 50-year agreement with Fort Stockton Holdings (FSH) for the purchase and use of their groundwater rights in Pecos County. This agreement for untreated groundwater is based on a take-or-pay basis with each city paying their proportional share of the entire agreement volume.

The WTWP contracted for groundwater from the Edwards-Trinity Plateau Aquifer in Pecos County (GMA 7). The total contracted supply is 28,400 acre-feet per year (acft/yr), allocated as follows: Abilene – 8,400 acft/yr; Midland – 15,000 acft/yr; and San Angelo – 5,000 acft/yr.

To provide 28,400 acft/yr, nine (9) groundwater supply wells are anticipated to be constructed. Produced groundwater from the FSH wellfield will be transported through a 48-inch pipe from Fort Stockton to the City of Midland's Terminus Site and eventually to San Angelo using a 27-inch transmission pipeline.

Advanced treatment will be required for a portion of the groundwater flow to meet regulatory standards. Preliminary evaluations indicate about 60% of the flow will undergo treatment using ultrafiltration followed by reverse osmosis. Final treatment requirements will be determined during preliminary design. To maximize use of this groundwater source, a recovery stage is proposed for both the ultrafiltration and reverse osmosis processes. Waste from the treatment process is expected to be approximately 5 percent, which is comparable to conventional treatment. Waste will be disposed using evaporation ponds. The treatment plant will be located on Midland's Terminus Site.

From the Terminus Site in Midland, the water will be transported to San Angelo through a direct 27-inch pipeline. No groundwater will be delivered directly to Abilene. Abilene will receive its share of the WTWP through an exchange of contracted supplies in Lake Ivie from Midland and San Angelo. This water will be transported to Abilene through existing infrastructure.

8.7.2 Available Yield

The total quantity of supply from this strategy is 28,400 acre-feet. Elevated levels of total dissolved solids, notably chloride, will require a portion of the supply to undergo advanced treatment. The reliability for this source is high.

To minimize the size and cost of the transmission pipeline between Midland and San Angelo, the Partnership anticipates developing a cooperative use strategy for its collective supplies in O.H. Ivie Reservoir (Ivie). Each of the three of the WTWP cities contract with the Colorado River Municipal Water District (CRMWD) for 16.54 percent of the safe yield from Ivie. Under the anticipated cooperative use strategy, Abilene would utilize Midland's Ivie allocation in exchange for a portion of Abilene's Edwards-Trinity Plateau groundwater allocation. Abilene would also use a portion of San Angelo's Ivie allocation in exchange for a portion of Abilene's Edwards Plateau groundwater to reach their total of 8,400 acre-feet per year of supply from the WTWP. This approach reduces the quantity of groundwater to be transported beyond Midland and infrastructure requirements. Abilene's share of the Edwards-Trinity groundwater is then used by Midland and San Angelo to offset the Ivie supplies sent to Abilene. The Partnership will need to reach agreement with CRMWD to implement a cooperative use strategy of the Partnership's collective Ivie supplies. Implementation in such a manner is dependent upon all parties reaching mutually agreeable terms. The cost sharing agreement does not change, and the total project costs would be shared by the three participants. The supplies allocated to each member of the WTWP is shown in Table 8.7-1.

Table 8.7-1 Supply to Each User from the West Texas Water Partnership (acft/yr)

	Supply 2030	Supply 2040	Supply 2050	Supply 2060	Supply 2070	Supply 2080
Midland Ivie Water to Abilene	5,524	5,367	5,210	5,111	5,012	4,908
San Angelo Ivie Water to Abilene	2,876	3,033	3,190	3,289	3,388	3,492
Total WTWP Supply to Abilene	*8,400*	*8,400*	*8,400*	*8,400*	*8,400*	*8,400*
San Angelo Original Groundwater Share	5,000	5,000	5,000	5,000	5,000	5,000
Groundwater to San Angelo to Replace Ivie Water Sent to Abilene	2,876	3,033	3,190	3,289	3,388	3,492
Total Groundwater to San Angelo	*7,876*	*8,033*	*8,190*	*8,289*	*8,388*	*8,492*
Midland Original Groundwater Share	15,000	15,000	15,000	15,000	15,000	15,000
Groundwater to Midland to Replace Ivie Water Sent to Abilene	5,524	5,367	5,210	5,111	5,012	4,908
Total Groundwater to Midland	20,524	20,367	20,210	20,111	20,012	19,908
Total Groundwater Supply	*28,400*	*28,400*	*28,400*	*28,400*	*28,400*	*28,400*

8.7.3 Environmental Issues

The environmental issues associated with this strategy are expected to be low. It is assumed that the new pipelines would be routed around sensitive environmental areas to limit potential impacts. The conceptual design for this project includes evaporation ponds for the disposal of treatment waste stream. A properly designed and maintained facility should have minimal environmental impact.

8.7.4 Engineering and Costing

The capital cost to fully implement this strategy is $1,205,826,000 in September 2023 dollars. These costs would be allocated based on each participant's share of the supply.

More detailed information regarding the groundwater, transmission and treatment facilities can be found in the 2026 Region F Regional Water Plan, as all associated facilities will be located in Region F.

8.7.5 Implementation Issues

Construction of the pipeline may have temporary impacts on agricultural or rural users whose land is temporarily disrupted but no permanent impacts are anticipated. The treatment facility and evaporation ponds are anticipated to be built on the Midland T-Bar Ranch which is property already owned by the City so it will not cause further impacts to agricultural land.

The current conceptual design for this project uses evaporation ponds to dispose of the brine waste stream. If this were to change and the brine was released to a stream, impacts to the receiving water body would need to be evaluated.

This strategy is compared to plan development criteria in Table 8.7–2.

Table 8.7–2 Cost Estimate Summary for the West Texas Water Partnership (from Region F Plan)

	Cost
Capital Cost:	$ 1,205,826,000
Annual Cost	$ 3,310 per acre-foot
(During Amortization):	$ 10.16 per 1,000 gal
Annual Cost	$ 456 per acre-foot
(After Amortization):	$ 1.40 per 1,000 gal

Note: See the 2026 Region F Regional Water Plan for additional details.

Table 8.7-3 Comparison of West Texas Water Partnership to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Only Partly Meets Demands
2. Reliability	2. Moderate to High
3. Cost	3. Moderate
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. None
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	Moderate
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

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8.8 Brushy Creek Regional Utility Authority System

8.8.1 Description of Option

The Lower Colorado River Authority (LCRA) owns and operates five reservoirs which, along with Lake Austin, are known as the Highland Lakes. Two of the Highland Lakes, Lakes Buchanan and Travis, are water supply reservoirs and have dedicated conservation storage. The other four reservoirs in the Highland Lakes chain are constant level lakes and are not considered water supply reservoirs. The LCRA, which supplies water primarily in the Colorado River Basin (Region K), has contracts with two cities in Williamson County to supply raw water from Lake Travis. These contracts include 23,000 acft/yr of raw water to the City of Cedar Park, and 31,000 acft/yr of raw water to the City of Leander. The City of Round Rock has a contract with BRA for supply of 20,928 acft/yr of raw water from the LCRA. Until recently, infrastructure was not in place to transport this water to Round Rock.

The cities of Round Rock, Cedar Park and Leander have entered into agreements to participate in the Brushy Creek Regional Utility Authority (BCRUA) that would ultimately provide 105.8 million gallons per day (mgd) of treated water capacity and 144.7 mgd of raw water. Portions of this project have been constructed. This project will provide peaking capacity for system demands including 15 mgd to Cedar Park, 40.8 mgd to Round Rock and 50 mgd to Leander. Although, the system will be designed for peaking capacity, average annual supplies from this project will be approximately 50 percent of the peaking capacity. In addition, the project will provide 26.9 mgd of raw water to Cedar Park's existing water treatment plant and 12 mgd to Leander's water treatment plant.

The BCRUA will utilize an existing 17 mgd, expandable to 32.5 mgd, interim floating intake structure located near the Cedar Park WTP, until a deep water 144.7 mgd intake structure can be constructed near Volente. The deep water intake will provide physical access to Lake Travis water during a severe drought. The floating intake conveys raw water through a new pipeline to the regional water treatment plant, with initial and ultimate capacities of 17 mgd and 105.8 mgd, respectively, which is located near the western edge of Cedar Park and Leander. Treated water is delivered to Cedar Park (15 mgd), Leander (50 mgd) and Round Rock (40.8 mgd). The general locations of the facilities are shown in Figure 8.8-1.

. The allocation of capacity for the proposed regional system is detailed in Table 8.8-1.

8.8.2 Available Yield

Under the provisions of HB 1437[1] and by agreement between the Brazos River Authority (BRA) and LCRA, 25,000 acft/yr of stored water in the Highland Lakes can be sold by LCRA (through the BRA) to entities in Williamson County in addition to the existing contracts with Cedar Park and Leander. Current contracts commit 24,700 acft/yr (20,928 acft/yr to Round Rock, 2,572 acft/yr to Liberty Hill, and 1,200 acft/yr to Georgetown). However, the 25,000 acft/yr available under HB 1437 does not meet the 2080 needs in Williamson County. However, for Williamson County to acquire this water, either HB 1437 has to be amended by the legislature to allow the sale of additional water, or other administrative measures such as a TCEQ interbasin transfer permit would be required to deliver any quantity above 25,000 acft/yr.

[1] House Bill 1437, 76th Session, Texas Legislature.

HB 1437 also provides that a 25 percent surcharge be added to the cost of water from the Colorado River basin delivered to Williamson County to pay for development of replacement supplies in the Colorado River Basin. This is subject to an adjustment by the LCRA Board of Directors.

Several entities have already committed to purchase the original 25,000 acft/yr designated by HB 1437. Table 8.8-1 presents the projected allocation of water under the original 25,000 acft/yr, and an additional allocation of water of 47,000 acft/yr. Cedar Park and Leander would obtain additional supply above the original HB 1437 amount.

Figure 8.8-1 Brushy Creek Regional Utility Authority System

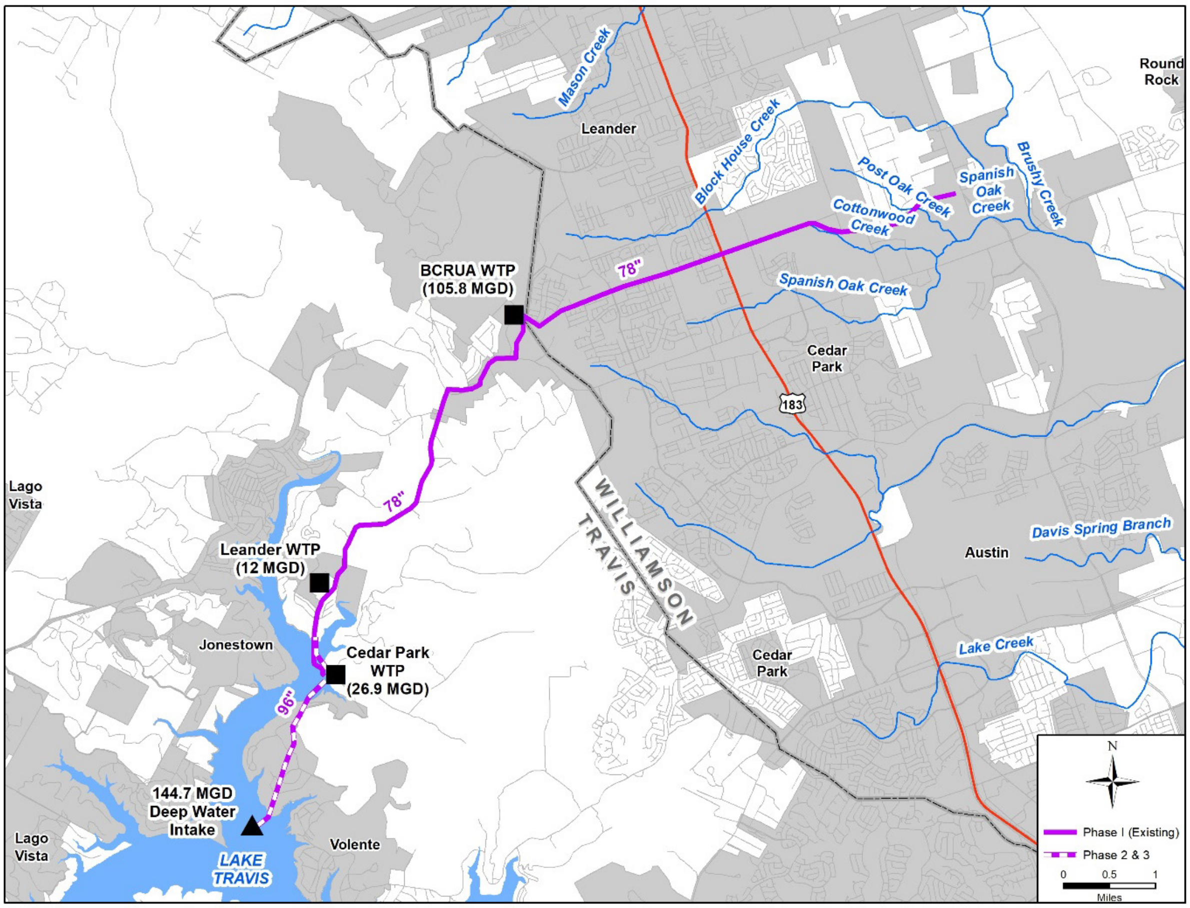

Table 8.8-1 Brushy Creek Regional Utility Authority System Participation with Peaking Capacity

	Cedar Park	Round Rock	Leander	Total
Treated Water Allocation (mgd)	15	40.8	50	105.8
Treated Water Allocation (%)	14.18%	38.56%	47.26%	100%
With Deep Water Intake (mgd)	41.9	40.8	62	144.7
Deep Water Intake Allocation (%)	28.96%	28.20%	42.85%	100%

Table 8.8-2 Allocation of New Highland Lakes Supply in Williamson County

Entity	Previous (2010) HB 1437 Allocation (acft/yr)	Current HB 1437 Allocation (acft/yr)	Additional Highland Lakes Supply (acft/yr)	Current Allocation + Additional Highland Lakes Supply (acft/yr)
Cedar Park	0	0	23,000	23,000
Chisholm Trail SUD[1]	2,540	0	0	0
Liberty Hill	600	2,572	0	2,572
Round Rock	11,444	20,928	0	20,928
Leander	0	0	31,000	31,000
Georgetown	6,944	1,200	0	1,200
Unallocated	3,472	300	0	300
Total	25,000	25,000	54,000	79,000

Notes:
(1) Chisholm Trail SUD and Georgetown have merged.

8.8.3 Environmental Issues

This alternative includes the construction of a new deep water intake structure on Lake Travis and connection to an existing transmission pipeline to Williamson County. The project contains an intake assembly at the mouth of the Sandy Creek arm of Lake Travis, a maintenance building in the Village of Volente, a pump station adjacent to Sandy Creek Park and a tunneled pipeline from the deep water intake assembly to the pump station and from there to existing Phase 1 facilities on Trails End Road.

The proposed project is not anticipated to impact land use, density, or type of development beyond that already planned in the BCRUA Regional Water system within the project area. Permanent land use impacts in the project area would be limited to the pump station and intake assembly sites. The pump station site is located adjacent to a LCRA public park and an existing industrial facility (the City of Cedar Park WTP). The park will be able to remain open to park users during construction, and the proposed site does not limit any waterfront access to park users. The proposed maintenance building site is located within the Village of Volente. Construction of the intake assembly would have minimal impacts to area recreational use with the exception of a restricted area which is required around a raw water intake. The pipeline will be bored underground resulting in minimal disturbance to area land use.

Environmental issues for the proposed Regional Surface Water Supply to Williamson County from Lake Travis are described below. An Environmental Assessment submitted to the Brushy Creek Regional Utility Authority was completed for this project in March 2014. The project occurs within the Cross Timbers and Prairies vegetational area[2] and is within the Balconian biotic province.[3] Vegetation within the project area is defined as Live Oak-Ashe Juniper Parks by the Texas Parks and Wildlife Department.[4]

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[2] Gould, F.W. 1975. The Grasses of Texas. Texas A&M University Press. College Station, Texas.
[3] Blair, W.F., "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117, 1950.
[4] McMahan, C. A., R. G. Frye and K. L. Brown, " The Vegetation Types of Texas -- Including Cropland," Texas Parks and Wildlife Department – PWD Bulletin 7000-120. 1984.

Chiefly found on level to gently rolling uplands and ridge tops of the Edwards Plateau, this vegetation type commonly includes trees such as live oak (*Quercus virginiana*), Texas oak (*Q. buckleyi*), shin oak (*Q. havardii*), cedar elm (*Ulmus crassifolia*), and netleaf hackberry (*Celtis reticulata*) in addition to other species including saw greenbrier (*Smilax bona-nox*), little bluestem (*Schizachyrium scoparium*), curly mesquite (*Hilaria belangeri*) and Texas grama (*Bouteloua rigidiseta*).

Vegetation impacts would include the clearing of small areas for the construction of the pump station, maintenance building and a portion of the temporary construction easement for construction of the pump station building and tunnel shaft. The raw water pipeline would be tunneled instead of open-cut to avoid vegetation clearing, crossing waters of the U.S., and impacts to endangered species habitat found along the pipeline alignment.

The pipeline would occur underneath or adjacent to Lake Travis and would not impact any existing rivers creeks or tributaries. The deep location of the water intake structure would have minimal impact to existing aquatic resources within the lake. The Federal Emergency Management Administration (FEMA) oversees the delineation of 100-year floodplain zone on the flood insurance rate maps (FIRMs) across the United States. The term 100-year flood refers to areas that have a one percent chance of flooding in any given year. The FEMA 100-year floodplain zones within the project fall along the perimeter of Lake Travis. A small portion of the proposed project including the water intake structure occurs within this zone.

The delineation of wetlands by the National Wetland Inventory indicates that within the project area, the perimeter of Lake Travis is delineated as palustrine, emergent, persistent, seasonally flooded, and diked. Coordination with the U.S. Army Corps of Engineers would be required for construction within waters of the U.S. Impacts from this proposed project resulting in a loss of less than 0.5 acres of waters of the U.S. could be covered under Nationwide Permit #12 for Utility Line Activities.

The TCEQ 2012 *Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)* states that Lake Travis (Segment 1404) is fully supporting of its designated uses and contains no water quality concerns.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available Geographic Information System (GIS) datasets, there are no cemeteries, historical markers, national register properties or national register districts located within a one-mile buffer of the proposed project area.

A review of archaeological resources in the proposed project area should be conducted during project planning. The owner or controller of the project will be required to coordinate with the Texas Historical Commission regarding impacts to cultural resources.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Travis County can be found at https://tpwd.texas.gov/gis/rtest/.

The Texas Natural Diversity Database (TXNDD), maintained by TPWD, which documents the occurrence of rare species within the state, was included in this project area analysis. TXNDD shows documented occurrences of the rare Black-capped vireo and endangered golden-cheeked warbler within a one mile buffer of the project area.

The project area may provide potential habitat to endangered or threatened species found in Travis County. A survey of the project area may be required prior to construction to determine whether populations of or potential habitats used by listed species occur in the area to be affected. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

The project area does not include suitable habitat for any of the spring, cave or karst dwelling species listed for Travis County. However, the project could negatively impact terrestrial species like the plains spotted skunk, Texas garter snake and Texas horned lizard by causing these species to relocate to less suitable habitat areas or to compete with other species for remaining habitat. The river water intake has a low potential to have a negative impact on mollusks and other aquatic species although the deep location precludes the occurrence of most species. The pipelines, pump station and maintenance station are anticipated to have a nominal impact on all species due to the small area of construction impact and permanent maintenance.

8.8.4 Engineering and Costing

The project is planned in three phases. The first phase is operational, the second phase is under construction and assumed complete for purposes of the 2026 Brazos G Plan, and the third phase is planned for future development.

The first phase of the project provides 32.5 mgd of treated water. The major facilities constructed as Phase I of this project are:

- Construction of 17 mgd floating raw water pump station and subsequent pump station expansion;
- Raw water transmission pipeline from Lake Travis to Regional Water Treatment Plant;
- Construction of a new 17 mgd water treatment plant and subsequent expansions to 32.5 mgd treatment capacity; and
- Treated water transmission pipelines to Cedar Park, Leander and Round Rock.

The second phase provides a treated water capacity of 67 mgd. The major facilities for Phase II of the project are:

- Construction of a new deep water intake near Volente and raw water pump station;
- Raw water transmission tunnels from the deep water intake; and
- Two Expansions of the regional water treatment plant; the first expansion will increase treatment plant capacity to 42 mgd; the second expansion following completion of the deep water intake will expand treatment capacity to 67 mgd.

The third and final phase of the project will increase the deep water intake capacity and regional water treatment plant to meet ultimate needs by 2050. Total projected costs for Phase III are $115,655,000. Major facilities include:

- Expansion at the regional water treatment plant by 38.8 mgd, for total capacity of 105.8 mgd.

Costs for the regional system and the share of the facilities costs have been developed from the BCRUA Regional Water Supply Project Environmental Assessment, March 2014.

Table 9.3-3 summarizes the estimated cost Phase III based on September 2023 prices.

8.8.5 Implementation Issues

This water supply option has been compared to the plan development criteria, and the option meets each criterion.

The transfer of water from Lake Travis to Williamson County in excess of the 25,000 acft/yr specified in HB 1437 would constitute an interbasin transfer, but would be exempted from interbasin transfer rules if supplied to Cedar Park. TCEQ permit amendments might be needed to add a point of diversion at Lake Travis.

Requirements Specific to Pipelines

1. Necessary permits:
    a. U.S. Army Corps of Engineers Section 404 dredge and fill permit for stream crossings and lake intake impacting wetlands or navigable water of the United States.
    b. GLO Sand and Gravel Removal permits.
    c. TPWD Sand, Gravel and Marl permit for construction in state-owned streambeds.
    d. Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.
    e. Right-of-way and easement acquisition.
2. Crossings:
    a. Highways and Railroads.
    b. Creeks and Rivers.
    c. Other Utilities.
3. Mitigation requirements would vary depending on impacts, but could include vegetation restoration, wetland creation or enhancement, or additional land acquisition.

Table 8.8-3 Summary of Costs for BCRUA Water Supply Project (Phase III)

Cost Estimate Summary Water Supply Project Option September 2023 Prices	
BCRUA - BCRUA Water Supply Project Phase III	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Water Treatment Plant (38.8 mgd)	$82,974,000
TOTAL COST OF FACILITIES	**$82,974,000**
Planning (3%)	$2,489,000
Design (7%)	$5,808,000
Construction Engineering (1%)	$830,000
Legal Assistance (2%)	$1,659,000
Fiscal Services (2%)	$1,659,000
All Other Facilities Contingency (20%)	$16,595,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$3,641,000
TOTAL COST OF PROJECT	**$115,655,000**
	ANNUAL COST
Debt Service (3.5 percent, 20 years)	$8,138,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$5,808,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$13,946,000**
Available Project Yield (acft/yr)	**21,731**
Annual Cost of Water ($ per acft), based on PF=0	**$642**
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	**$267**
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	**$1.97**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	**$0.82**
JMP	2/5/2025

Table 8.8-4 Comparison of Brushy Creek Regional Utility Authority System to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient
2. Reliability	2. High reliability
3. Cost	3. Relatively high, but reasonable for a county-wide system
B. Environmental factors	
1. Environmental Water Needs	1. Low impact
2. Habitat	2. Low to medium impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Low impact
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Low to medium impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed	Done
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

CHAPTER 9 AUGMENTATION OF EXISTING RESERVOIR SUPPLIES

9.1 Aquilla WSD - Lake Aquilla Storage Reallocation

9.1.1 Description of Option

Figure 10.1-1 is a map of Lake Aquilla showing the water surface area at the current conservation pool elevation of 537.5 feet above mean sea level (ft-msl), as well as at an alternative pool elevation at 542 ft-msl. According to a July 2014 volumetric survey, Aquilla Lake has 43,279 acre-feet of storage and a surface area of 3,084 acres at the current conservation elevation of 537.5 feet[1]. The flood storage in the reservoir extends up to elevation 556.0 feet (Table 10.1-1).

[1] Texas Water Development Board, Volumetric Survey of Aquilla Lake July 2014 Survey, June 2015.

Figure 9.1-1 Map of Lake Aquilla with Elevation Contour of Reallocation

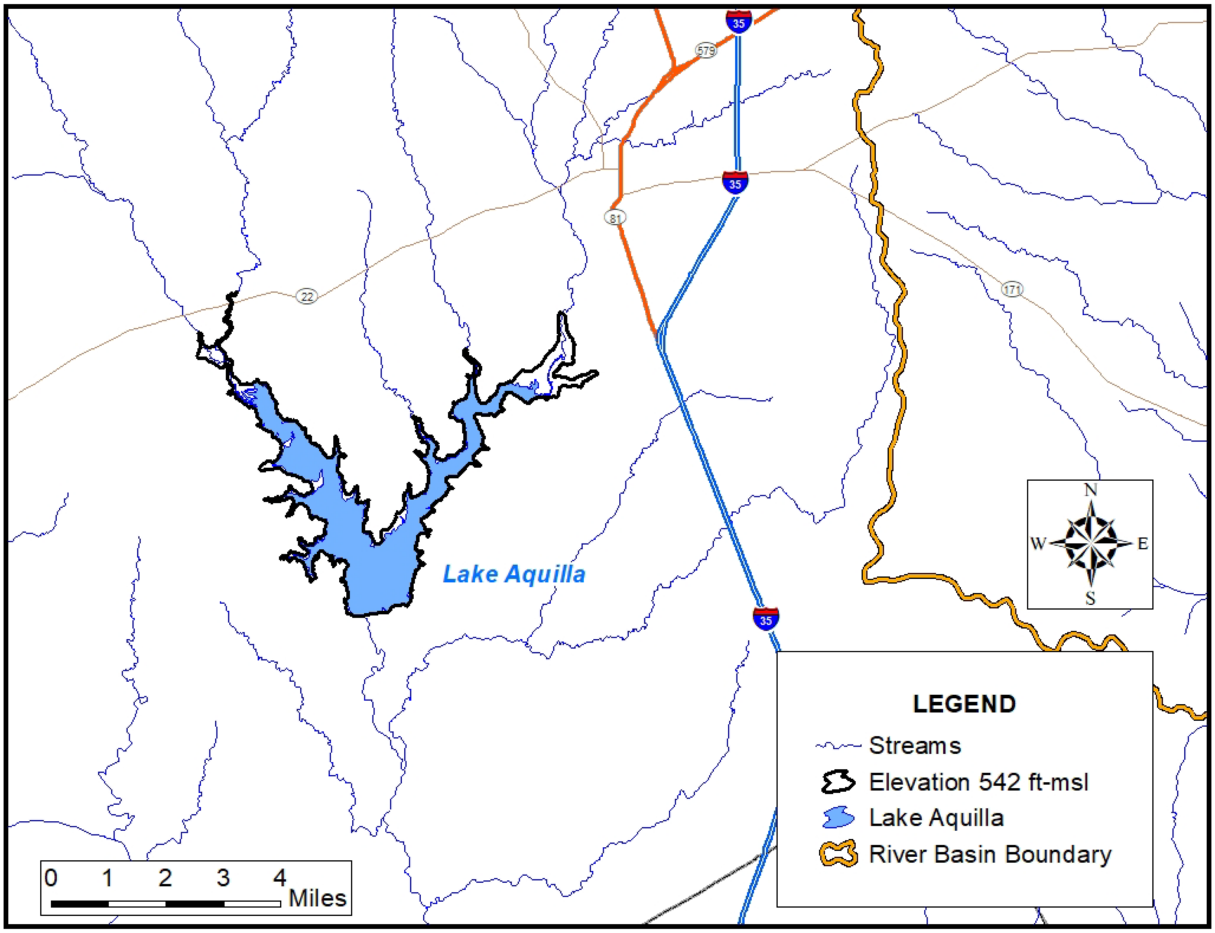


Table 9.1-1 Lake Aquilla Characteristics[2]

Ownership	
Reservoir Owner	U.S. Army Corps of Engineers
Water Supply Contract	
Owner	Brazos River Authority
Storage amount	100% of conservation storage
Texas Water Right	
Number	Certificate of Adjudication 12-5158
Owner	Brazos River Authority
Diversion	13,896 acft/yr
Storage	52,400 acft at elevation 537.5 ft-msl
Priority date	October 25, 1976
Flood Pool	
Top elevation	556 ft
Storage[3]	93,600 acft
Conservation Pool	
Top elevation	537.5 ft
Surface area	3,084 ac
Storage	43,279 acft
Sediment Pool[4]	
Top elevation	503 ft
Storage	acft

9.1.2 Available Yield

In its 2017 draft report on the reallocation of Lake Aquilla, the U.S. Army Corps of Engineers (USACE) said "the recommended plan is to increase the top of conservation by 4.5 feet" to 542 ft-msl[5]. As part of the 2026 Brazos G Regional Water Plan, the Texas Commission on Environmental Quality (TCEQ) Brazos Water Availability Model (WAM) Run 3 was used to calculate yields for Lake Aquilla under the following two scenarios:

- Existing – Current conservation storage elevation of 537.5 ft-msl
- Raise conservation elevation to 542.0 feet, an increase of 4.5 ft-msl

[2] Certificate of Adjudication 12-5158
[3] Storage within flood pool based on original volumetric survey, October 1983
[4] Texas Water Development Board, Volumetric Survey of Aquilla Lake July 2014 Survey, June 2015.
[5] Middle Brazos Systems Assessment, Phase II: Aquilla Water Supply Reallocation Report and Environmental Assessment. Prepared by the U.S. Army Corps of Engineers, Southwest Division, Fort Worth District. February 28, 2018.

Yield increases were computed as junior water right diversions subject to downstream senior rights and having to pass inflows to meet environmental flow standards associated with Senate Bill 3 (SB3).

Figure 10.1-1 shows the elevation contours for the proposed conservation storage elevation if flood storage in Lake Aquilla were to be reallocated to conservation storage. Table 10.1-2 is a summary of the yield studies conducted for the 2026 Brazos G Plan.

Table 9.1-2 Comparison of Firm Yield of Lake Aquilla with Flood Storage Reallocation using TCEQ Brazos WAM for 2030 and 2080 Conditions

Scenario	Top of Conservation Elevation (feet)	2030 Conditions			2080 Conditions		
		Storage (acft)	Firm Yield (acft/yr)	Yield Increase (acft/yr)	Storage (acft)	Firm Yield (acft/yr)	Yield Increase (acft/yr)
Existing	537.5	39,656	11,873	0	29,153	9,886	0
4.5 ft increase	542.0	56,651	13,888	2,012	46,148	11,836	1,950

The USACE has the authority to reallocate at its own discretion up to 50,000 acre-feet or 15 percent of the total flood storage, whichever is less. Additional reallocation of flood storage to conservation storage requires the approval of the U.S. Congress. Raising the conservation pool 4.5 feet to 542 ft-msl is within this discretionary authority, and therefore would not require congressional approval[6].

By 2080 the estimated storage of Lake Aquilla decreases to 29,153 acre-feet. The calculated firm yield in 2080 from the TCEQ Brazos WAM at the current conservation storage of elevation of 537.5 feet is 9,886 acre-feet per year. If the conservation pool elevation was increased to 542.0 feet, the yield of Lake Aquilla would be 11,836 acre-feet per year, resulting in 1,950 acre-feet per year of additional yield in 2080. This is a nearly 20 percent increase over the existing scenario yield. Figure 10.1-2 and Figure 10.1-3 show the storage trace in the year 2080 for Lake Aquilla under existing conditions and with a 4.5-foot pool raise, respectively.

This strategy evaluation models Lake Aquilla as a stand-alone reservoir that does not participate in System Operations because most of the supply from Lake Aquilla is committed locally and very little is available for system operation. Entities other than the BRA who sponsor and pursue this strategy may be required to have a contract agreement with the BRA due to existing contracts between the USACE and BRA.

[6] Middle Brazos Systems Assessment, Phase II: Aquilla Water Supply Reallocation Report and Environmental Assessment. Prepared by the U.S. Army Corps of Engineers, Southwest Division, Fort Worth District. February 28, 2018.

Figure 9.1-2 2080 Lake Aquilla Storage Trace, Current Conservation Elevation (537.5 ft-msl)

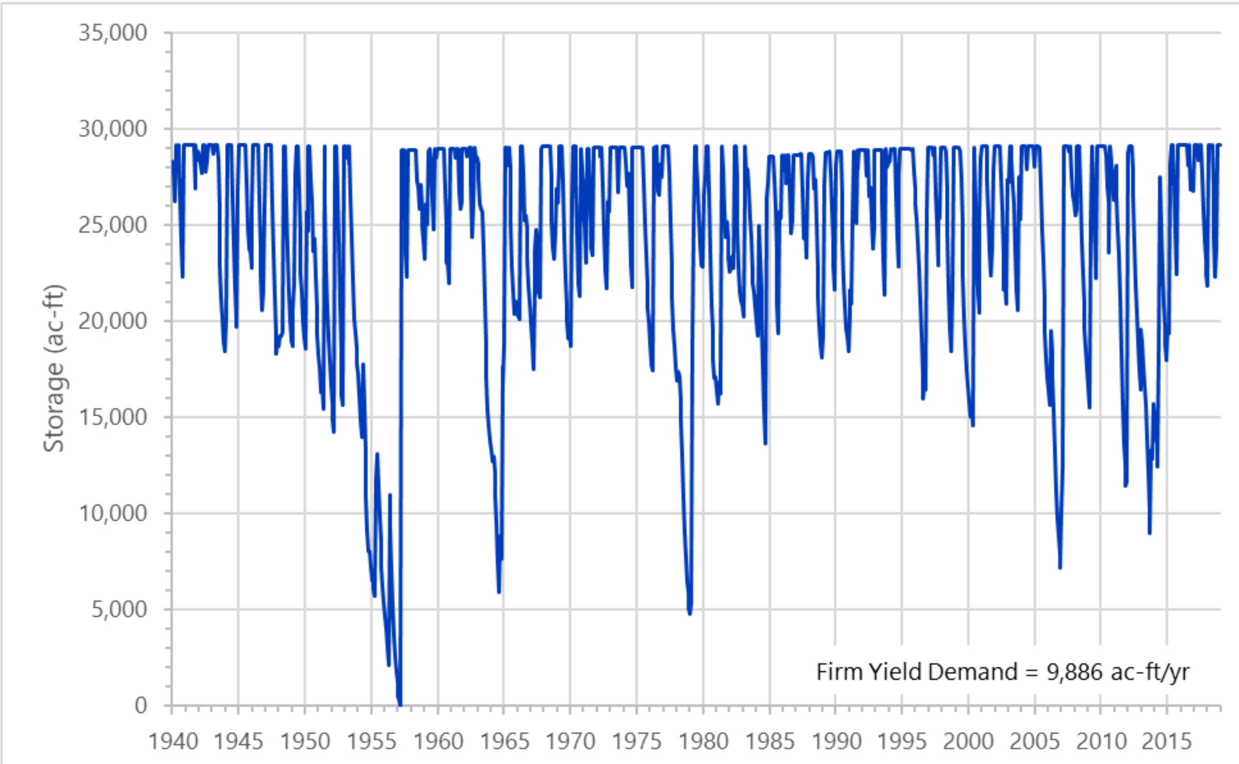
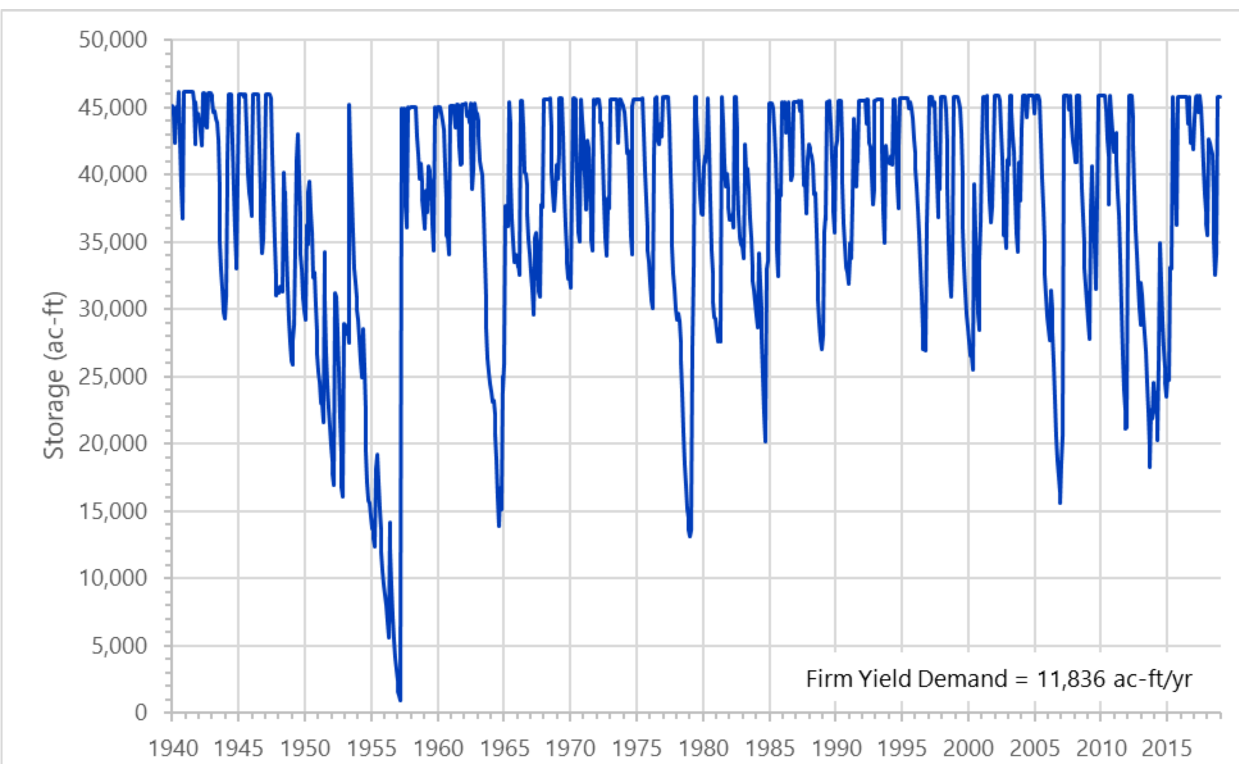


Figure 9.1-3 2080 Lake Aquilla Storage Trace for Conservation Elevation at 542 ft-msl



9.1.3 Environmental Issues

The greatest impact on the environment from the reallocation of storage in Lake Aquilla is the loss of terrestrial habitat due to higher lake levels. Wetlands and bottomland hardwoods located in the upper reaches of the lake will be impacted by raising the conservation elevation.

The water surface area at conservation under current conditions is 3,084 acres according to TWDB's most recent volumetric survey. If the conservation pool elevation were increased to 542 ft-msl, the maximum surface area would be 3,905 acres[7], and the reservoir would inundate an additional 821 acres when full. All of the land up to the flood pool elevation around Lake Aquilla is owned by the USACE. The USACE manages the area around the lake as a wildlife management area.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD frequently updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Hill County can be found at https://tpwd.texas.gov/gis/rtest/.

The USACE did not encounter any habitats that appeared suitable for the rare black-capped vireo or endangered golden-cheeked warbler in the affected area. It is possible that whooping cranes may temporarily use the affected habitat during their annual migration but an encounter would be rare. The USACE did not find evidence of either the smalleye shiner or sharpnose shiner within the study area.

9.1.4 Engineering and Costing

Increasing the conservation pool elevation of Lake Aquilla to 542 ft-msl is the plan recommended by USACE because it maximizes yield at the lowest marginal cost. The cost of minor improvements to Lake Aquilla dam is included in the cost estimate. Studies on the slope stability, seepage, and geotechnical aspects of the project have already been conducted and so are not included in the estimate. Additional costs include storage reallocation from USACE ($17,365,480), water rights permitting from TCEQ ($1,525,000), and administrative cost for USACE storage reallocation ($1,464,000)—all of which were categorized as "Environmental & Archaeology Studies and Mitigation" for costing purposes. The total project costs for the reallocation of storage to an elevation of 542 ft-msl is $29.2 million. For a firm yield of 1,950 acft/yr, the cost per acft would be $774 ($2.38 per 1,000 gallons). Detailed costs are shown in Table 10.1-3.

Very few recreational facilities are located at Lake Aquilla, so the reallocation of flood storage will have a low impact on recreation. Other infrastructure that may be affected and needing relocation are utility lines, petroleum pipelines and roads. Another cost is the mitigation of the loss of terrestrial habitat, which is potentially high for this project.

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[7] Texas Water Development Board, Volumetric Survey of Aquilla Lake March 2008 Survey Recalculated July 2014, June 2015.

Table 9.1-3 Cost Estimate Summary for Lake Aquilla Pool Reallocation

Item	Estimated Costs for Facilities
Dam and Reservoir (Conservation Pool acft, acres)	$3,839,000
Integration, Relocations, Backup Generator & Other	$2,012,000
TOTAL COST OF FACILITIES	**$5,851,000**
Engineering:	x
- Planning (3%)	$176,000
- Design (7%)	$410,000
- Construction Engineering (1%)	$59,000
Legal Assistance (2%)	$117,000
Fiscal Services (2%)	$117,000
All Other Facilities Contingency (20%)	$1,170,000
Environmental & Archaeology Studies and Mitigation	$20,354,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$919,000
TOTAL COST OF PROJECT	**$29,173,000**
ANNUAL COST	x
Debt Service (3.5 percent, 20 years)	$197,000
Reservoir Debt Service (3.5 percent, 40 years)	$1,235,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$20,000
Dam and Reservoir (1.5% of Cost of Facilities)	$58,000
TOTAL ANNUAL COST	**$1,510,000**
Available Project Yield (acft/yr)	**1,950**
Annual Cost of Water ($ per acft), based on PF=0	**$774**
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	**$40**
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	**$2.38**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	**$0.12**
Note: One or more cost element has been calculated externally	
CB	*1/23/2025*

9.1.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 10.1-4, and the option meets each criterion. Seepage related concerns have been expressed about Lake Aquilla dam in the past. A dam safety evaluation completed in August 2013 found that embankment stability has not been much of an issue and that seepage appears well controlled by measures implemented as part of the USACE's Risk Management Plan and is currently being monitored with a system of piezometers, relief wells and collection weirs. An assessment in June 2016 found that the risks associated with Aquilla Dam are considered to be low, and that a pool increase would not change that conclusion; although the dam should continue to be monitored if a pool raise is implemented. The habitat lost to inundation will have to be mitigated. Mitigation property has not yet been identified. A summary of the implementation steps for the project is presented below.

9.1.5.1 Potential Regulatory Requirements

- Texas Commission on Environmental Quality (TCEQ) Water Right and Storage permits
- U.S. Army Corps of Engineers (USACE) Permits will be required for discharges of dredge or fill into wetlands and waters of the U.S. for dam construction, and other activities (Section 404 of the Clean Water Act)
- USACE Section 404 permits for pipeline stream crossings, discharges of fill into wetlands and waters of the U.S. for construction, and other activities
- TCEQ administered Texas Pollutant Discharge Elimination System Storm Water Pollution Prevention Plan
- Texas General Land Office Easement if State-owned land or water is involved
- Texas Parks and Wildlife Department Sand, Shell, Gravel and Marl permit if a state-owned streambed is involved
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

9.1.5.2 State and Federal Permits may require the following studies and plans

- Environmental impact or assessment studies
- Wildlife habitat mitigation plan that may require acquisition and management of additional land
- Flow releases downstream to maintain aquatic ecosystems
- Assessment of impacts on Federal- and State-listed endangered and threatened species
- Cultural resources studies to determine resources impacts and appropriate mitigation plan that may include cultural resources recovery and cataloging, which would require coordination with the Texas Historical Commission

9.1.5.3 Land Acquisition Issues

- Land acquired for reservoir and/or mitigation plans could include market transactions or other local landowner agreements
- Additional acquisition of rights-of-way and/or easements may be required
- Possible relocations or removal of residences, utilities, roads, or other structures

Table 9.1-4 Comparison of Reallocation of Storage in Lake Aquilla Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Low impact
2. Habitat	2. Low to moderate impacts on bottomland hardwood and fish and wildlife resources. Lake sedimentation may create significant amounts of shallow wetlands that might benefit migratory water fowl.
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Low impact due to distance from coast
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Low to moderate impacts on wetlands
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

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9.2 Lake Granger Storage Reallocation

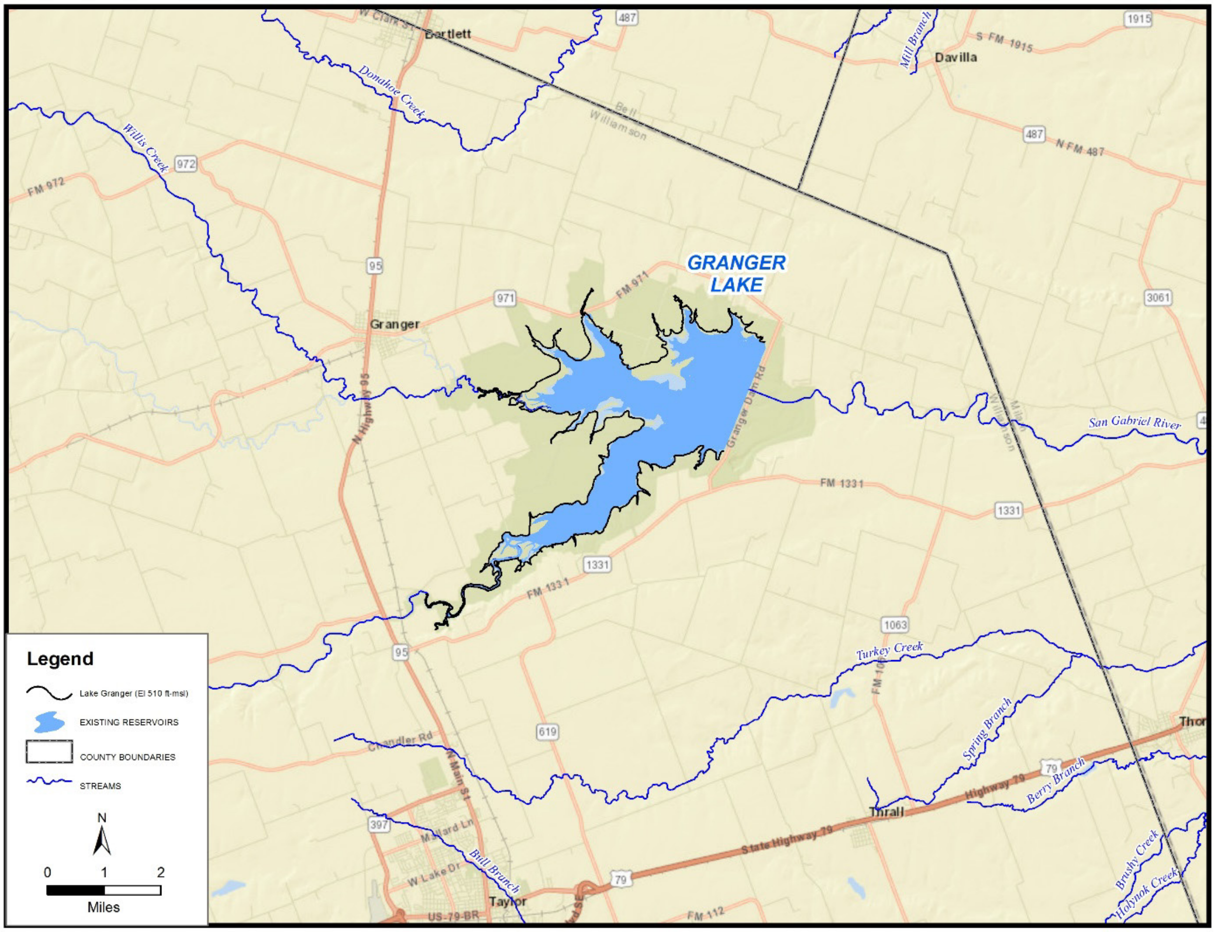
9.2.1 Description of Option

Reservoirs owned by the United States Army Corps of Engineers (USACE) typically serve multiple functions, including flood control, water supply and recreation. Most USACE reservoirs contain a significant amount of storage dedicated to flood control. This flood control storage is used to temporarily hold flood waters in the top few feet of the reservoir to reduce flooding downstream. It is possible to increase the available water supply from these reservoirs by changing some of the flood control storage to the reservoir storage dedicated to water supply, or conservation storage. This process is commonly called reallocation. The USACE has the authority to reallocate at its own discretion up to 50,000 acre-feet or 15 percent of the total flood storage, whichever is less. Additional reallocation of flood storage to conservation storage requires the approval of the U.S. Congress. The Brazos River Authority (BRA) and the USACE have been continuing an evaluation of the feasibility of reallocating storage in several federal reservoirs. This section evaluates reallocation in Lake Granger as a potential water management strategy.

Lake Granger is located in Williamson County, Texas approximately seven miles east of the City of Granger and 10 miles northeast of Taylor (Figure 9.2-1). The Flood Control Act of 1953 authorized the construction of Granger Lake for flood control, water conservation, fish and wildlife habitat, and recreation. Construction of Granger Dam began in 1972 and it began impounding the San Gabriel River in the Brazos River Basin in 1980. The original conservation storage capacity was 65,500 acft at elevation 504 ft-msl, but has since been reduced by sedimentation to 51,822 acft (Table 9.2-1). The total useable storage in Lake Granger is approximately 230,522 acft, with 77.5 percent of the storage reserved for flood control, and 22.5 percent for water supply (Table 9.2-1).

Lake Granger was intended to be one of three lakes on the San Gabriel River. However, the proposed South Fork Lake, upstream of Lake Granger, was never constructed. Granger Dam was originally designed to support a conservation pool elevation of 512 ft-msl, so that when the South Fork Lake was completed the conservation pool at Lake Granger could be raised eight feet above its current level. This unique history makes Lake Granger an appealing option for reallocation because it requires few dam improvements and relocations, and the USACE already owns the necessary real estate.

Figure 9.2-1 Map of Lake Granger showing Contour at 510 ft



Document Path: \\dalctxsrv01\Texas_GIS_Projects\10029705_036_Brazos_G_2021_Plan\Map_Docs\MXDs\Existing_Reservoir_Augmentation_Strategy\Lake_Granger_Storage_Reallocation.mxd

9.2.2 Available Supply

The Brazos Water Availability Model (WAM) Run 3 with Senate Bill 3 environmental flows and the Brazos River Authority's System Operation permit was used to calculate yields for Lake Granger. The firm yield of Lake Granger was evaluated for 2030 and 2080 conditions under the following two scenarios:

- Existing – Current conservation storage elevation of 504.0 ft-msl
- Raise conservation elevation to 510.0 ft-msl, an increase of 6 feet

The USACE has the authority to reallocate at its own discretion up to 50,000 acft or 15 percent of the total flood storage, whichever is less. Additional reallocation of flood storage to conservation storage requires the approval of the U.S. Congress. The 6-foot pool raise proposed by this strategy is within the discretionary authority of the USACE.

Table 9.2-1 Lake Granger Characteristics

Ownership	
Reservoir Owner	U.S. Army Corps of Engineers
Water Supply Contract	
Owner	Brazos River Authority
Storage amount	100% of conservation between 440 and 504 ft-msl
Texas Water Right	
Number	CA 12-5163
Owner	Brazos River Authority
Diversion	19,840 acft/yr
Storage	65,500 acft
Priority date	February 12, 1968
Flood Pool[1]	
Top elevation	528 ft-msl
Storage	178,700 acft
Conservation Pool[2]	
Top elevation	504 ft-msl
Surface area	4,159 ac
Storage	51,822 acft
Inactive Storage[3]	
Storage	0 acft

Notes:
(1) Based on original 1980 survey. Represents volume of flood pool only (i.e., volume between 504 ft-msl and 528 ft-msl assuming no sedimentation in flood pool).
(2) Based on 2013 TWDB volumetric survey. Represents volume from 528 ft-msl and below.
(3) Based on 2013 TWDB volumetric survey. Invert elevation (outlet works) at 457 ft-msl.

Figure 9.2-1 shows the surface area of the reservoir after reallocation. Table 9.2-2 is a summary of the firm yield analyses. The current storage in Lake Granger is expected to decrease from 49,187 to 41,549 acft by 2080 due to sedimentation. Based on the WAM, the estimated firm yield in 2080 at the current conservation storage of elevation of 504.0 feet is 12,180 acft/yr. If the conservation pool were raised to elevation 510.0 feet, the yield of Lake Granger would be 13,400 acft/yr, resulting in 1,220 acft of additional yield in 2080, or a 10 percent increase over the existing scenario yield.

This strategy could potentially provide additional supply under the recently approved BRA System Operation permit. However, because of local commitments, the extent to which the reservoir could participate in system operation is uncertain, so this analysis evaluates only the increase in the stand-alone yield of the reservoir. If an entity other than the BRA were to sponsor and pursue this strategy, then an agreement with the BRA would be required to address concerns related to the potential subordination of the System Operation strategy.

Table 9.2-2 Storage Capacities and Yields for Existing and Reallocation Scenarios in Lake Granger

Scenario	Top of Conservation Elevation (feet)	2030 conditions			2080 conditions		
		Storage (acft)	Firm Yield (acft/yr)	Yield Increase (acft/yr)	Storage (acft)	Firm Yield (acft/yr)	Yield Increase (acft/yr)
Existing	504.00	49,187	14,260	0	41,549	12,180	0
6 ft increase	510.00	77,016	14,387	127	67,775	13,400	1,220

9.2.3 Environmental Issues

Raising the conservation pool elevation of the reservoir from 504 ft-msl to 510 ft-msl would inundate an additional 1,586 acres approximately. Most of the property around the lake consists of farm fields, but there is wildlife habitat in the floodplain above the lake and in other government property around the lake which would be adversely affected by the pool raise. The impacts could be significant due to the lack of available habitat in this area.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Williamson County can be found at https://tpwd.texas.gov/gis/rtest/.

According to the USACE's Phase I Information Paper[1], suitable habitat for threatened and endangered species is unlikely to be found at Lake Granger. A more detailed study of the expected habitat loss needs to be conducted in order to determine mitigation requirements.

According to the Phase I Information Paper, there are currently 98 known cultural resources sites at Lake Granger. These sites need to be evaluated to determine if they are eligible for inclusion in the National Register of Historic Places. A complete survey of impacted cultural resources needs to be conducted to determine the full extent of cultural resources within the flood pool of Lake Granger.

9.2.4 Engineering and Costing

Table 9.2-3 summarizes the estimated cost for this option. The dam improvements costs include minor improvements to Granger Dam to store the additional capacity as well as slope stability, seepage and geotechnical studies. There are few recreational facilities located at Lake Granger, so the reallocation of flood storage will have a low impact on recreation. The USACE owns the land up to 533 ft-msl, which is above the top of the flood pool at 528 ft-msl, so the land acquisition costs are zero. The estimated cost for water supply storage was based on the updated investment cost of the reallocated flood control storage as a proportion of the additional storage to total useable storage. The updated investment cost for the reallocated water supply storage in Lake Granger was estimated to be about $32,107,000 in 2023 dollars. The estimate for annual operation and maintenance (O&M) cost was based on a 3-year

[1] Draft Information Paper for Brazos River Basin Systems Assessment Interim Feasibility Study, Phase 1. Updated July 2008. Prepared by U.S. Army Corps of Engineers, Fort Worth District.

average (2013-2015) O&M bill for the BRA. Given the increase in storage, the increase in their O&M bill was estimated to be about $819,000 per year. The total project costs for the reallocation of storage to an elevation of 510 ft-msl is $40.4 million. Given a yield of 1,220 acft/yr and a cost of $3,663,000 per year, the annual cost of water is $3,002 per acre-foot ($9.21 per 1,000 gallons).

Table 9.2-3 Cost Estimate Summary for Reallocation of Storage in Lake Granger

Cost Estimate Summary Water Supply Project Option September 2023 Prices BRA - Lake Granger Storage Reallocation Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Dam and Reservoir (Conservation Pool acft, acres)	$4,708,000
Integration, Relocations, Backup Generator & Other	$505,000
TOTAL COST OF FACILITIES	**$5,213,000**
- Planning (3%)	$156,000
- Design (7%)	$365,000
- Construction Engineering (1%)	$52,000
Legal Assistance (2%)	$104,000
Fiscal Services (2%)	$104,000
All Other Facilities Contingency (20%)	$1,043,000
Environmental & Archaeology Studies and Mitigation	$32,107,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,274,000
TOTAL COST OF PROJECT	**$40,418,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,844,000
Operation and Maintenance	
Dam and Reservoir (1.5% of Cost of Facilities)	$819,000
TOTAL ANNUAL COST	**$3,663,000**
Available Project Yield (acft/yr)	**1,220**
Annual Cost of Water ($ per acft), based on PF=0	**$3,002**
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	**$671**
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	**$9.21**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	**$2.06**
Note: One or more cost element has been calculated externally	
CB	*1/23/2025*

9.2.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 9.2-4, and the option meets each criterion.

Table 9.2-4 Comparison of Reallocation of Storage in Lake Granger Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Low impact
2. Habitat	2. Low to moderate impacts possible
3. Cultural Resources	3. Low to moderate impact
4. Bays and Estuaries	4. Low impact due to distance from coast
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	Low to none
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal shortages
F. Requirements for Interbasin Transfers	None
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

9.2.6 Potential Regulatory Requirements

Implementation of reallocation of storage in Lake Granger will require several steps including a detailed reallocation study performed by the U.S. Army Corps of Engineers. An outline of the reallocation process is provided below:

1. Local sponsor requests the U.S. Army Corps of Engineers perform a reallocation study. Indicate local interest, purpose, financial capability, etc.
2. Reallocation studies are performed in two phases and follow the General Investigation Process consisting of a Reconnaissance Report and a Feasibility Study. Specific funding would be required for a reallocation study. A reallocation study includes the following:
    a. Define existing project
    b. Define current and projected water supply needs
    c. Alternative solutions considered
    d. Analysis of alternatives
        i. Reallocation of flood control storage
        ii. Raise top of flood control pool

        iii. Reallocate existing conservation pool/power pool
        iv. Hydropower compensation and other hydropower issues
        v. Other
        vi. No action
        vii. Screening of alternatives
        viii. Selection rationale and selection of a plan
    e. Selected plan
        i. Value of storage reallocation
        ii. Impacts of reallocation
        iii. Public involvement
        iv. Environmental impacts
        v. Hydropower compensation and other hydropower issues
    f. Recommended plan
3. NEPA Compliance
4. U.S. Army Corps of Engineers Headquarter Approval of Reallocation Study
5. Authorization from U.S. Congress, if necessary
6. U.S. Army Corps of Engineers and Local Sponsor execute water supply contract based on Water Supply Storage Reallocation
7. Water Rights Permits from the Texas Commission on Environmental Quality (TCEQ)

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9.3 Lake Whitney Reallocation

9.3.1 Description of Options

Lake Whitney is a major impoundment located on the Brazos River approximately 30 miles north of the City of Waco in Hill and Bosque Counties. The location of Lake Whitney is shown in Figure 9.3-1. Lake Whitney was completed in 1951 by the U.S. Army Corps of Engineers for the primary purposes of flood control, water supply, and production of hydroelectric power. According to a 1959 volumetric survey, the total storage in Lake Whitney was 1,999,500 acft, making it the largest reservoir in the Brazos River Basin. The vast majority of storage in Lake Whitney is for flood control, comprising 1,372,400 acft (68.6 percent of the total reservoir storage). The original conservation storage capacity was 627,100 acft at elevation 533 ft-msl, but it has since been reduced by sedimentation to 554,203 acft as of 2005[1]. The capacity below elevation 520 ft-msl is reserved for power head and sediment storage, and has a capacity of 320,711 acft according to the 2005 survey (Table 9.3-1). In 1972, the top of the power pool was raised from 520 ft-msl to 533ft-msl, and the top of power head reserve (i.e. the bottom of the power pool) was raised from 510 ft-msl to 520 ft-msl, making 248,000 acft of storage available to hydropower[2]. In 1982, approximately 20 percent of the hydropower storage (50,000 acft) was reallocated to water conservation storage (water supply). A water right was issued to the Brazos River Authority (BRA) that authorizes the BRA to divert and use 18,336 acft/yr from the water conservation storage (Table 9.3-1). By 2005, the amount stored between elevations 520 ft-msl and 533 ft-msl, which includes both the hydropower pool and BRA's storage, was 233,492 acft.

Hydroelectric power generation from Lake Whitney is administered through the Southwestern Power Administration (SWPA), a federal agency. The Whitney Dam powerhouse uses two generators that originally had a capacity of 30 megawatts (MW) but were upgraded in 2014 and now have a capacity of 43 MW. According to the 2005 TWDB volumetric survey, the average annual power production was 73.1 million kilowatt-hours.

The potential for reallocation of the hydropower storage and inactive storage at Lake Whitney to water conservation storage has been studied in various forms in the past and is an option for developing additional water supply in the Brazos River Basin[3]. The conversion of storage to water supply purposes at Lake Whitney can produce a significant supply of water that could be utilized by a number of entities throughout the Brazos River Basin. Potential users include entities in Bosque County and Johnson County, as well as entities downstream in Region H.

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[1] Volumetric Survey of Lake Whitney. June 2005 Survey. Prepared by The Texas Water Development Board, September 2006.

[2] Whitney Reservoir Section 216 Initial Appraisal Report. Prepared by the U.S. Army Corps of Engineers. December 2014.

[3] Texas Water Resources Institute, "Reservoir/River System Reliability Considering Water Rights and Water Quality," (TR-165) Texas A&M University, March 1994.

In addition to Lake Whitney reallocation, a project was evaluated to deliver supply from the reallocated storage at Lake Whitney downstream towards Milam County to deliver water to Williamson County. This water would be diverted through an intake on the Brazos River, treated and delivered to various water users with needs in Williamson County. Figure 9.3-2 displays the suggested route and strategy.

Figure 9.3-1 Map of Lake Whitney

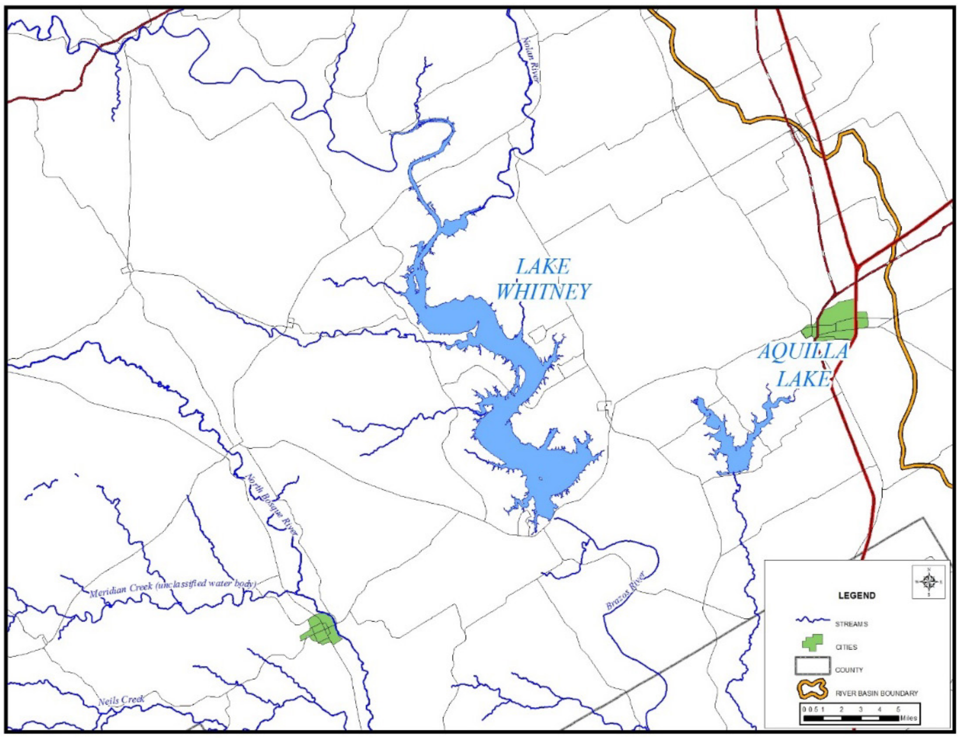


Figure 9.3-2 Map of Lake Whitney Option to Meet Needs in Williamson County

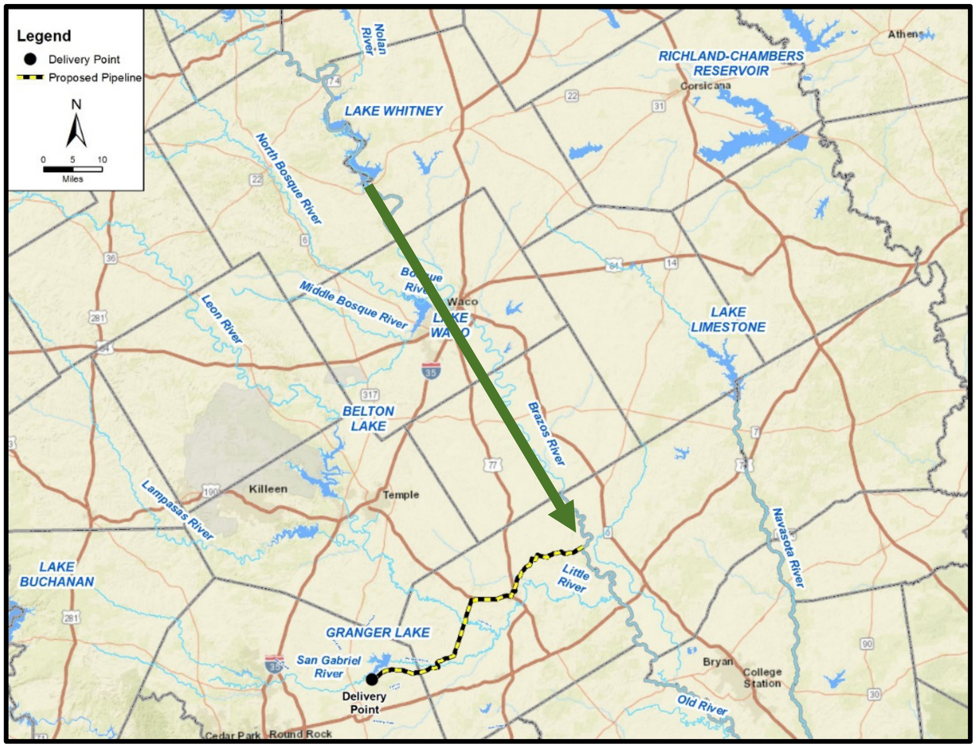


Table 9.3-1 Lake Whitney Characteristics

Ownership	
Reservoir Owner	U.S. Army Corps of Engineers
Water Supply Contract	
Owner	Brazos River Authority
Storage amount	22.017% of conservation storage
Texas Water Right	
Number	CA 12-5157
Owner	Brazos River Authority
Diversion	18,336 acft/yr
Storage	50,000 acft between 520 ft and 533 ft-msl
Priority date	August 30, 1982
Flood Pool[1]	
Top elevation	571 ft
Storage	1,372,400 acft
Conservation Pool[2]	
Top elevation	533 ft
Surface area	23,220 ac
Storage	554,203 acft
Inactive Storage[3]	
Top elevation	520 ft
Storage	320,711 acft

Notes:
(1) Based on original 1959 survey. Represents volume of flood pool only (i.e., volume between 533ft and 571ft assuming no sedimentation in flood pool).
(2) Based on 2005 TWDB volumetric survey. Represents volume from 533ft and below.
(3) Based on 2005 TWDB volumetric survey. Capacity from 520ft and below is reserved for sediment and power-head storage space.

9.3.2 Available Supply

The firm yield for the reallocation of Lake Whitney was estimated using the Brazos Water Availability Model (WAM) Run 3 with Senate Bill 3 environmental flows and the BRA's System Operation permit. The sedimentation conditions for Lake Whitney were updated to projected storage capacities in 2030 and 2080, while all other reservoirs in the basin remained at their original permitted storage amounts. The WAM simulates streamflows, reservoir operations, and existing water rights for the historical period of 1940-2018. This evaluation does not consider converting flood storage to water supply storage at Lake Whitney, but rather evaluates the reallocation of hydropower storage and a portion of the inactive storage in Lake Whitney to water supply storage. This reallocation could produce a considerable firm yield. Since most of the supply from this strategy would be used as part of the BRA system, this analysis determines the increase in BRA system yield made available from the additional storage. The increase in system yield was measured as the increase in firm diversions at a downstream point in the basin (i.e. Rosharon Gage) as a result of the reallocation project. The increase in system yield for reallocation of the hydropower storage in Lake Whitney was found to be 93,355 acft/yr for 2080 conditions assuming use of the total storage between elevations 520 feet and 533 feet (Table 9.3-1). If ten feet of previously inactive storage were reallocated to water supply, the increase in yield would be 110,025 acft/yr for 2080 conditions assuming use of the total storage between elevations 510 feet and 533 feet (Table 9.3-2). If an entity other than the BRA were to sponsor and pursue this strategy, then an agreement with the BRA would be required to address concerns related to the potential subordination of the System Operation strategy. The available supply could also be less unless the new supplies are operated as part of the BRA system. The available supply could be used to meet needs in Williamson County.

Table 9.3-2 Storage Capacities and the Increase in System Yields for Existing, Hydropower Reallocation, and Hydropower plus Inactive Storage Reallocation

Bottom of Conservation Elevation (feet)	Top of Conservation Elevation (feet)	2030 conditions		2080 conditions	
		Conservation Storage (acft)	System Yield Increase (acft/yr)	Conservation Storage (acft)	System Yield Increase (acft/yr)
520.00	533.00	50,000	0	50,000	0
520.00	533.00	259,318	93,600	254,930	93,355
510.00	533.00	393,875	110,025	386,112	110,400

9.3.3 Environmental Issues

Reallocation of hydroelectric and inactive storage in Lake Whitney could reduce hydroelectric generation and downstream streamflows and may impact reservoir pool levels. The effect on downstream flows would be greater if the diversions from Lake Whitney were taken lakeside. However, as modeled in this evaluation, it is more likely that the lake will continue to be used to meet system demands downstream, so reservoir releases would mitigate some impacts to hydroelectric generation and downstream flows.

The reallocation of hydroelectric storage in Lake Whitney could possibly have moderate impacts on environmental water needs/instream flows in the Brazos River below the reservoir to the extent those impacts are not mitigated by reservoir releases. The evaluation summarized in Table 9.3-3 was based on a wide range of natural resource databases on threatened and endangered species, and on riparian (stream bank) and littoral (lake side) habitats. Potential effects on aquatic and riparian habitats could result from reduction in stream flow, particularly in the summer months when flows are naturally lower and oxygen depletion in the water is greater. Reduced releases may increase the downstream concentration of pollutants from wastewater treatment plants and other sources, potentially impairing water quality in the stream. Seasonally reduced flows downstream from Lake Whitney could also adversely affect riparian vegetation and habitat, including bottomland hardwoods and wetlands. Changes in reservoir pool elevations could possibly have low impacts on bank vegetation, wildlife habitat, and cultural resources sites. These issues will be evaluated closely by federal permitting agencies including the U.S. Army Corps of Engineers (for wetlands permitting), and the Federal Energy Regulatory Commission (for hydroelectric permitting).

Table 9.3-3 Environmental Issues: Lake Whitney Reallocation

Water Management Options	Implementation Measures	Environmental Water Needs / Instream Flows	Bays and Estuaries	Fish and Wildlife Habitat	Cultural Resources	Threatened and Endangered Species
Reallocation of Hydroelectric Storage to Conservation Storage in Lake Whitney	Reduced Hydroelectric Discharges to Brazos River below Lake Whitney[1]	Possible Moderate Impacts on Brazos River below Lake Whitney(1)	Possible Low Impacts	Possible Moderate Impacts on Brazos River Segment below Lake Whitney(2)	Possible Low Impacts	Negligible Impacts

Notes:
(1) Assumes decrease in average annual instream flows below Lake Whitney as a result of reduced hydroelectric generation. Does not account for cumulative effects of decreased regional stream flows.
(2) Impacts would be variable depending on resulting change in flows. Adverse impacts would be possible for bottomland hardwood forests and wetlands.

This preliminary identification of environmental issues is based on an evaluation of the general characteristics of the water management options. Site specific investigations of the potentially affected environments would be necessary to provide detailed evaluations of possible habitat and cultural resources impacts from the reallocation. A quantitative estimate of magnitude and seasonal distribution of potentially reduced downstream flows caused by the reallocation would be needed to assess the effects on environmental water needs/instream flow and on fish and wildlife in the Brazos River below Lake Whitney.

Environmental impacts of the delivery pipeline are equivalent to those of the pipeline from the Williamson County Groundwater Supply – North Option, because the same pipeline route is followed.

9.3.4 Engineering and Costing

Development of the increase in system yield from reallocation of storage in Lake Whitney will not require major facilities for implementation. However, implementation of this alternative requires a detailed evaluation of various issues that will require mitigation of adverse impacts. In addition to these costs, a detailed U.S. Army Corps of Engineers reallocation study is required. The final cost for implementation of this alternative will be dependent on the results of that study.

Table 9.3-4 summarizes the estimated cost for this option. The estimated cost for water supply storage in Lake Whitney is the maximum of two numbers: 1) the updated investment cost of the reallocated hydropower storage as a proportion of the reallocated storage to total useable storage, or 2) the amount of money needed to compensate for lost hydropower revenue. The updated total investment cost for Lake Whitney was estimated to be $244,974,000. The increase in cost for water supply storage was estimated to be $24,258,000. This corresponds to the first number referred to above. The impact to hydroelectric power generation will vary from year to year depending on hydrologic conditions. Based on the WAM simulations and releases from the reservoir to increase the system yield, the impact to hydroelectric power generation could be around 12 percent of the annual power generation amount. The mitigation cost for the reduction in hydroelectric power generation was based on a replacement cost of $0.08 per kWh, which results in an annual cost of $701,760. This amount was converted from an annual value to a present value of $22,052,000 by assuming a 50-year planning horizon and an inflation rate of 2 percent. This corresponds to the second number referred to above. Because $24.3 million is larger than

$22.1 million, the cost for the increase in storage, rather than hydropower compensation, was taken as the cost for reallocated storage. The total annual cost for this reallocation strategy is estimated to be $2,173,000. Based on the increase in firm yield of 93,355 acft/yr in 2080, this results in a unit cost of raw water of $23 per acft ($0.07 per 1,000 gallons).

Table 9.3-4 summarizes the costs associated with delivering a portion of the Lake Whitney Reallocation supply to Williamson County. This includes an intake, pipeline and a water treatment plant. Those facility costs would be borne by Williamson County-Other entities.

Compensation to BRA may be required if this strategy were developed by an entity other than BRA to compensate for any subordination of the System Operations strategy. The available supply could be less if the new supplies were not operated as part of the BRA system.

Table 9.3-4 Cost Estimate Summary for Reallocation of Hydropower Storage in Lake Whitney

Item	Estimated Costs for Facilities
Dam and Reservoir (Conservation Pool acft, acres)	$5,422,000
TOTAL COST OF FACILITIES	**$5,422,000**
Engineering:	
- Planning (3%)	$163,000
- Design (7%)	$380,000
- Construction Engineering (1%)	$54,000
Legal Assistance (2%)	$108,000
Fiscal Services (2%)	$108,000
All Other Facilities Contingency (20%)	$1,084,000
Environmental & Archaeology Studies and Mitigation	$35,952,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,407,000
TOTAL COST OF PROJECT	**$44,678,000**
ANNUAL COST	
Reservoir Debt Service (3.5 percent, 40 years)	$2,092,000
Operation and Maintenance	
Dam and Reservoir (1.5% of Cost of Facilities)	$81,000
TOTAL ANNUAL COST	**$2,173,000**
Available Project Yield (acft/yr)	**93,355**
Annual Cost of Water ($ per acft), based on PF=0	**$23**
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	**$1**
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	**$0.07**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	**$0.00**
Note: One or more cost element has been calculated externally	
CB	*1/24/2025*

Table 9.3-5 Cost Estimate Summary for Delivery of Lake Whitney Reallocation Supplies to Williamson County

Item	Estimated Costs for Facilities
Intake Pump Stations (27.8 mgd)	$61,501,000
Transmission Pipeline (42 in. dia., 51.5 miles)	$287,273,000
Water Treatment Plant (27.8 mgd)	$142,770,000
Integration, Relocations, Backup Generator & Other	$1,318,000
TOTAL COST OF FACILITIES	**$492,862,000**
Engineering:	
- Planning (3%)	$14,786,000
- Design (7%)	$34,500,000
- Construction Engineering (1%)	$4,929,000
Legal Assistance (2%)	$9,857,000
Fiscal Services (2%)	$9,857,000
Pipeline Contingency (15%)	$43,091,000
All Other Facilities Contingency (20%)	$41,118,000
Environmental & Archaeology Studies and Mitigation	$1,786,000
Land Acquisition and Surveying (331 acres)	$4,645,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$21,324,000
TOTAL COST OF PROJECT	**$678,755,000**
ANNUAL COST	x
Debt Service (3.5 percent, 20 years)	$47,665,000
Operation and Maintenance	x
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,886,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$1,538,000
Water Treatment Plant	$9,994,000
Pumping Energy Costs (21623527 kW-hr @ 0.09 $/kW-hr)	$1,946,000
Purchase of Water (26000 acft/yr @ 100 $/acft)	$2,600,000
TOTAL ANNUAL COST	**$66,629,000**
Available Project Yield (acft/yr)	**26,000**
Annual Cost of Water ($ per acft), based on PF=1.2	**$2,563**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.2	**$729**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.2	**$7.86**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.2	**$2.24**
CB	*1/24/2025*

9.3.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 9.3-6, and the option meets each criterion.

Table 9.3-6 Comparison of Lake Whitney Reallocation Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Significant quantity available for regional use or in Region H
2. Reliability	2. High reliability
3. Cost	3. Low
B. Environmental factors	
1. Environmental Water Needs	1. Moderate impacts possible downstream
2. Habitat	2. Moderate impacts possible
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. Low impact
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Low impact
C. Impact on Other State Water Resources	Reduction in intentional hydropower releases, but few other negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	No threats to agriculture; possible changes in downstream flows
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

9.3.6 Potential Regulatory Requirements

Implementation of reallocation of storage in Lake Whitney will require several steps including a detailed reallocation study performed by the U.S. Army Corps of Engineers and potentially an authorization from the U.S. Congress. An outline of the reallocation process is provided below:

1. Local sponsor requests the U.S. Army Corps of Engineers perform a reallocation study. Indicate local interest, purpose, financial capability, etc.
2. Reallocation studies are performed in two phases and follow the General Investigation Process consisting of a Reconnaissance Report and a Feasibility Study. Specific funding would be required for a reallocation study. A reallocation study includes the following:
   a. Define existing project
   b. Define current and projected water supply needs
   c. Alternative solutions considered

   d. Analysis of alternatives
      i. Reallocation of flood control storage
      ii. Raise top of flood control pool
      iii. Reallocate existing conservation pool/power pool
      iv. Hydropower compensation and other hydropower issues
      v. Other
      vi. No action
      vii. Screening of alternatives
      viii. Selection rationale and selection of a plan
   e. Selected plan
      i. Value of storage reallocation
      ii. Impacts of reallocation
      iii. Public involvement
      iv. Environmental impacts
      v. Hydropower compensation and other hydropower issues
   f. Recommended plan
3. NEPA Compliance
4. U.S. Army Corps of Engineers Headquarter Approval of Reallocation Study
5. Authorization from U.S. Congress
6. U.S. Army Corps of Engineers and Local Sponsor execute water supply contract based on Water Supply Storage Reallocation
7. Water Rights Permits from TCEQ
8. Coordination with BRA on any potential subordination agreements for the System Operations strategy (if implemented by others)

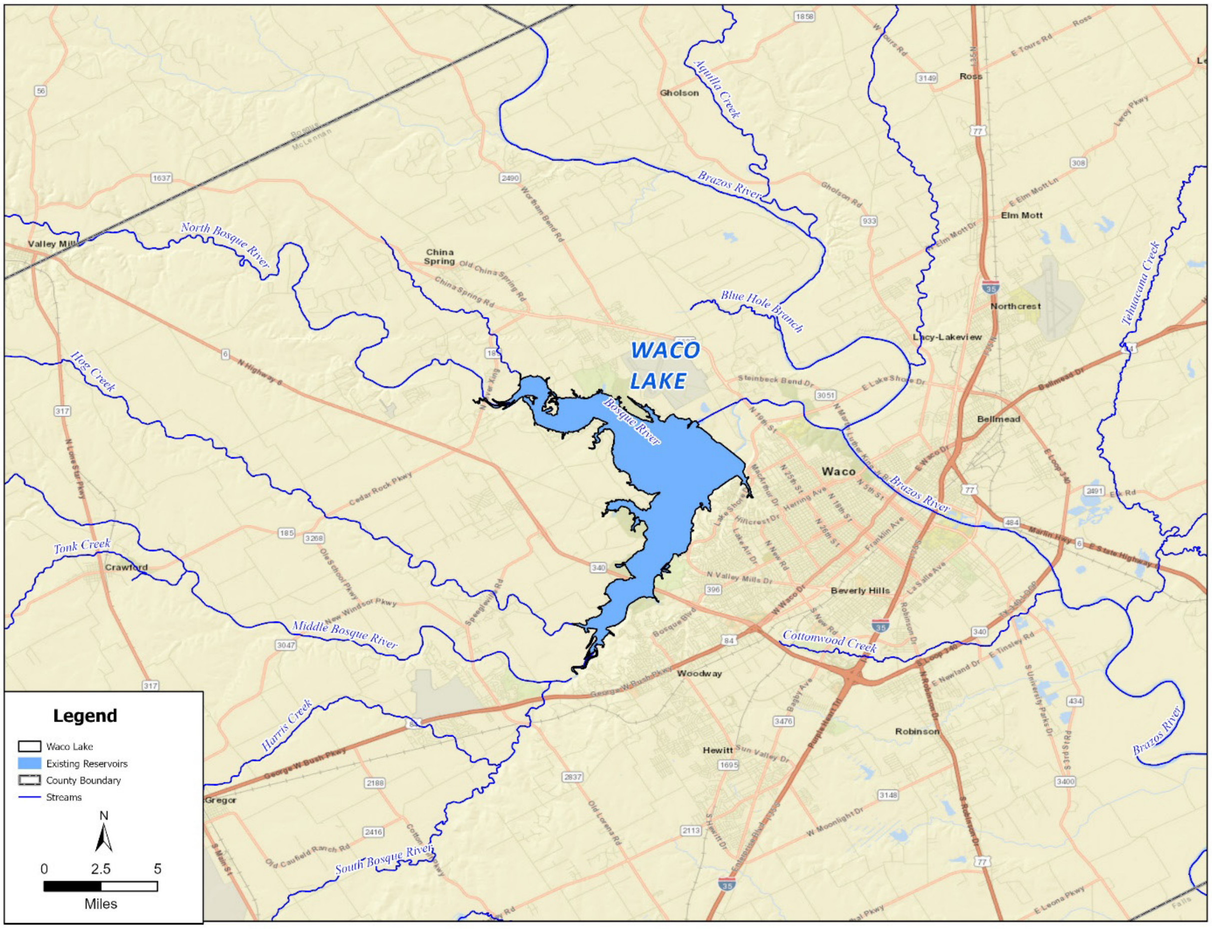
9.4 Lake Waco Storage Reallocation

9.4.1 Description of Option

Reservoirs owned by the United States Army Corps of Engineers (USACE) typically serve multiple functions, including flood control, water supply and recreation. Most USACE reservoirs contain a significant amount of storage dedicated to flood control. This flood control storage is used to temporarily hold flood waters in the top few feet of the reservoir to reduce flooding downstream. It is possible to increase the available water supply from these reservoirs by changing some of the flood control storage to the reservoir storage dedicated to water supply, or conservation storage. This process is commonly called reallocation. The USACE has the authority to reallocate at its own discretion up to 50,000 acre-feet or 15 percent of the total flood storage, whichever is less. Additional reallocation of flood storage to conservation storage requires the approval of the U.S. Congress. This section evaluates reallocation in Lake Waco as a potential water management strategy.

Lake Waco is located in McLennan County, Texas north and west of Waco (Figure 9.4-1). The Flood Control Act of 1953 authorized the construction of Waco Lake for flood control, water conservation, fish and wildlife habitat, and recreation. Construction of the Dam began in 1958 and it began impounding the Bosque River in the Brazos River Basin in 1965. The original conservation storage capacity was 205,127 acft at elevation 462 ft-msl, but has since been reduced by sedimentation to 189,773 acft (Table 9.4-1). The total useable storage in Lake Waco is approximately 657,400 acft, with 84.2 percent of the storage reserved for flood control, and 15.8 percent for water supply (Table 9.4-1).

Figure 9.4-1 Map of Lake Waco



9.4.2 Available Supply

The Brazos Water Availability Model (WAM) Run 3 with Senate Bill 3 environmental flows and the Brazos River Authority's System Operation permit was used to calculate yields for Lake Waco. The firm yield of Lake Waco was evaluated for 2030 and 2080 conditions under the following two scenarios:

- Existing – Current conservation storage elevation of 462.0 ft-msl.
- Raise conservation elevation to 465.0 ft-msl, an increase of 3 feet.

The USACE has the authority to reallocate at its own discretion up to 50,000 acft or 15 percent of the total flood storage, whichever is less. Additional reallocation of flood storage to conservation storage requires the approval of the U.S. Congress. The 3-foot pool raise proposed by this strategy is within the discretionary authority of the USACE.

Table 9.4-1 Lake Waco Characteristics

Ownership	
Reservoir Owner	U.S. Army Corps of Engineers
Water Supply Contract	
Owner	Waco
Storage amount	100% of conservation between 440 and 462 ft-msl
Texas Water Right	
Number	CA 12-2315
Owner	City of Waco
Diversion	58,200 acft/yr
Storage	104,100 acft
Priority date	1929,1958, 1979
Flood Pool(1)	
Top elevation	500 ft-msl
Storage	553,300 acft
Conservation Pool(2)	
Top elevation	462 ft-msl
Surface area	8,190 ac
Storage	189,773 acft

Notes:
(1) Based on USACE information for Lake Waco. Represents volume of flood pool only (i.e., volume between 462 ft-msl and 500 ft-msl assuming no sedimentation in flood pool).
(2) Based on 2011 TWDB volumetric survey. Represents volume from 462 ft-msl and below.

Figure 9.4-1 shows the surface area of the reservoir after reallocation. Table 9.4-2 is a summary of the firm yield analyses. The current storage in Lake Waco is expected to decrease from 183,536 to 166,837 acft by 2080 due to sedimentation. Based on the WAM, the estimated firm yield in 2080 at the current conservation storage of elevation of 462.0 feet is 73,110 acft/yr. If the conservation pool were raised to elevation 465.0 feet, the yield of Lake Waco would be 74,970 acft/yr, resulting in 1,860 acft of additional yield in 2080, or a 2.5 percent increase over the existing scenario yield.

This strategy could potentially provide additional supply under the recently approved BRA System Operation permit. However, because of local commitments, the extent to which the reservoir could participate in system operation is uncertain, so this analysis evaluates only the increase in the stand-alone yield of the reservoir. If an entity other than the BRA were to sponsor and pursue this strategy, then an agreement with the BRA would be required to address concerns related to the potential subordination of the System Operation strategy.

Table 9.4-2 Storage Capacities and Yields for Existing and Reallocation Scenarios in Lake Waco

Scenario	Top of Conservation Elevation (feet)	2080 conditions		
		Storage (acft)	Firm Yield (acft/yr)	Yield Increase (acft/yr)
Existing	462.00	166,837	73,110	0
3 ft increase	465.00	191,131	74,970	1,860

9.4.3 Environmental Issues

Raising the conservation pool elevation of the reservoir from 462 ft-msl to 465 ft-msl would inundate an additional 900 acres approximately. All of the land up to the flood pool elevation around Lake Aquilla is owned by the USACE. The USACE manages the area around the lake as a wildlife management area.

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for McLennan County can be found at https://tpwd.texas.gov/gis/rtest/.

9.4.4 Engineering and Costing

Table 9.4-3 summarizes the estimated cost for this option. The dam improvements costs include minor improvements to Waco Dam to store the additional capacity as well as slope stability, seepage and geotechnical studies. There are few recreational facilities located at Lake Waco, so the reallocation of flood storage will have a low impact on recreation. The USACE owns the land up to the flood pool at 500 ft-msl, so the land acquisition costs are zero. The estimated cost for water supply storage was based on the updated investment cost of the reallocated flood control storage as a proportion of the additional storage to total useable storage. The updated investment cost for the reallocated water supply storage in Lake Waco was estimated to be about $22 million. Given the increase in storage, the increase in the O&M bill was estimated to be about $330,000 per year. The total project costs for the reallocation of storage to an elevation of 510 ft-msl is $31.2 million. Given a yield of 1,860 acft/yr and a cost of $1,792,000 per year, the annual cost of water is $963 per acre-foot ($2.96 per 1,000 gallons).

Table 9.4-3 Cost Estimate Summary for Reallocation of Storage in Lake Waco

Cost Estimate Summary Water Supply Project Option September 2023 Prices City of Waco - Storage Reallocation of Lake Waco Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023 Item	Estimated Costs for Facilities
Dam and Reservoir (Conservation Pool 25476 acft, 8900 acres)	$22,002,000
TOTAL COST OF FACILITIES	**$22,002,000**
- Planning (3%)	$660,000
- Design (7%)	$1,540,000
- Construction Engineering (1%)	$220,000
Legal Assistance (2%)	$440,000
Fiscal Services (2%)	$440,000
All Other Facilities Contingency (20%)	$4,400,000
Land Acquisition and Surveying (8900 acres)	$534,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$983,000
TOTAL COST OF PROJECT	**$31,219,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$1,462,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$330,000
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,792,000**
Available Project Yield (acft/yr)	1,860
Annual Cost of Water ($ per acft), based on PF=0	$963
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$177
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.96
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.54
JMP	*2/5/2025*

9.4.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 9.4-4, and the option meets each criterion.

Table 9.4-4 Comparison of Reallocation of Storage in Lake Waco Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient to meet needs
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Low impact
2. Habitat	2. Low to moderate impacts possible
3. Cultural Resources	3. Low to moderate impact
4. Bays and Estuaries	4. Low impact due to distance from coast
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	Low to none
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal shortages
F. Requirements for Interbasin Transfers	None
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

9.4.6 Potential Regulatory Requirements

Implementation of reallocation of storage in Lake Waco will require several steps including a detailed reallocation study performed by the U.S. Army Corps of Engineers. An outline of the reallocation process is provided below:

Local sponsor requests the U.S. Army Corps of Engineers perform a reallocation study. Indicate local interest, purpose, financial capability, etc.

Reallocation studies are performed in two phases and follow the General Investigation Process consisting of a Reconnaissance Report and a Feasibility Study. Specific funding would be required for a reallocation study. A reallocation study includes the following:

1. Define existing project.
2. Define current and projected water supply needs.
3. Alternative solutions considered.

4. Analysis of alternatives:
    a. Reallocation of flood control storage.
    b. Raise top of flood control pool.
    c. Reallocate existing conservation pool/power pool.
    d. Hydropower compensation and other hydropower issues.
    e. Other.
    f. No action.
    g. Screening of alternatives.
    h. Selection rationale and selection of a plan.
5. Selected plan:
    a. Value of storage reallocation.
    b. Impacts of reallocation.
    c. Public involvement.
    d. Environmental impacts.
    e. Hydropower compensation and other hydropower issues.
6. Recommended plan:
    a. NEPA Compliance.
    b. U.S. Army Corps of Engineers Headquarter Approval of Reallocation Study.
    c. Authorization from U.S. Congress, if necessary.
    d. U.S. Army Corps of Engineers and Local Sponsor execute water supply contract based on Water Supply Storage Reallocation.
    e. Water Rights Permits from the Texas Commission on Environmental Quality (TCEQ).

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CHAPTER 10 BRUSH CONTROL

Brush control is a potential water management strategy that could create additional water supply in the Brazos G region. The Texas Brush Control Program, created in 1985 and operated by the Texas State Soil and Water Conservation Board (TSSWCB), served to study and implement brush control programs until September 2011. HB1808 established a new program in 2012, the Water Supply Enhancement Program (WSEP), with the purpose and intent of increasing available surface and ground water supplies through the selective control of brush species detrimental to water conservation. The WSEP program is described in the January 2017 *State Water Supply Enhancement Plan*[1].

The TSSWCB collaborates with soil water conservation districts and other local, regional, state, and federal agencies to identify watersheds across the state where it is feasible to implement brush control to enhance water supplies. The TSSWCB uses a competitive grant process to rank feasible projects and allocate WSEP grant funds, giving priority to projects that balance the most critical water needs with the highest projected water yield from brush control.

For a watershed to be considered eligible for allocation of WSEP cost-share funds, a feasibility study must demonstrate runoff increases in project post-treatment conditions. At this time, two feasibility studies have been completed in the Brazos G Region, resulting in on-going projects:

- Lake Fort Phantom Hill watershed – in FY 2018 the TSSWCB provided $250,000 in matching funds Subbasin 15.
- Lake Palo Pinto watershed – in FY 2018 the TSSWCB provided $200,000 in matching funds for Subbasin 2210808[2].

Proposed feasibility studies in Brazos G include the Carrizo-Wilcox Aquifer Recharge Zone in Burleson, Lee, Milam and Williamson Counties, Hubbard Creek Reservoir (saltcedar specific), Lake Graham, Lake Whitney including Steele Creek, Stillhouse Hollow Reservoir, Upper Brazos River above Possum Kingdom Reservoir (saltcedar specific), and the White River Reservoir (saltcedar specific).

Eligible species under the WSEP program that are of concern in the Brazos G area include:

- mesquite (*Prosopis spp*.)
- juniper (Juniperus spp.)
- saltcedar (*Tamarix spp*.)

Other species of interest that could be eligible include:

- huisache (Acacia smallii)
- Carrizo cane (Arundo donax)

[1] State Water Supply Enhancement Plan, TSSWCB, January 2017.
[2] Annual Report, January 1, 2019, Texas State Soil and Water Conservation Board.

Studies have shown that brush management can yield additional runoff from a treated watershed. However, most experts agree that this benefit is limited during an extended drought cycle when rainfall is below normal. Because the firm supply of brush control during a drought is likely to be very small, brush control generally is not included as a recommended water management strategy since it would not be able to demonstrate an actual water supply benefit on a firm yield basis. For this reason, the Brazos G Regional Water Planning Group identified brush control as a recommended water management strategy in the 2016 Brazos G Regional Water Plan but acknowledged that the firm supply benefit was zero during drought of record conditions.

10.1 General Description of Brush Control

Since the European settlement of Texas, overgrazing, fire suppression and droughts have led to the increase and dominance of noxious brush species such as juniper and mesquite over the native grasses and trees. This noxious brush utilizes much of the available water resources with little return to the watershed.[3] Brush control is a land management practice that converts land that is covered with brush (such as juniper, mesquite, and salt cedar) back to grasslands. This practice can potentially increase water availability through reduced extraction of soil water for transpiration and increased recharge to shallow groundwater and emergent springs. There is also the potential for increased runoff during rainfall events.[4]

The actual supply benefit resulting from a brush control project is site specific. Under most circumstances, the additional runoff or recharge attained from a brush control project is not sustained during a prolonged drought because recharge to shallow aquifers feeding emergent springs is greatly diminished or nonexistent during a drought. Thus, the supply benefit to be obtained from this particular water management strategy will be considered to be zero for supply purposes. However, the potential positive impacts of rangeland management during other times makes this a recommended policy by the Brazos G Water Planning Group.

An analysis of climate, evapotranspiration, and runoff in the western United States indicated that sites with tree and shrub communities need to have an evapotranspiration rate of 15 inches per year and need to receive over 18 inches of precipitation per year to yield significantly more water if converted to grassland.[5] All ecoregions in Texas have a potential evapotranspiration rate of over 15 inches per year, and the average annual rainfall in almost all of the Brazos G Region is greater than 18 inches per year, so the entire region meets the climatic requirements for brush control.

There are three primary methods to remove upland brush: mechanical removal, chemical removal, and prescribed burning. Bio-control through Asian leaf beetles is limited to salt cedar removal, which generally occurs in riparian zones and lakes, and may be an option for some areas in the upper portion of the Brazos River Basin. The rate of brush regrowth and brush control maintenance is important to maintaining stable, long-term water yield. Control methods that kill and remove the entire brush plant are more desirable than simply killing the brush.

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[3] Fort Phantom Hill Watershed: Brush Control Assessment and Feasibility Study, Prepared for TSSWCB, Brazos River Authority, 2003.
[4] Brush Control and Range Management: 2011 Brazos G Regional Water Plan.
[5] Hibbert, A.R. 1983. Water Yield Improvement by Vegetation Management on Western Range lands. Water Resources Bulletin. 19:375-381.

10.2 Brush Control in the Fort Phantom Hill Watershed

Lake Fort Phantom Hill is one of the primary sources of water for the City of Abilene. The reservoir is located on Elm Creek, a tributary of the Clear Fork of the Brazos River, in Jones County. The WSEP is currently sponsoring brush control activities in Subbasin 15 in the watershed[2]. This watershed is upstream of Lake Abilene, and most of the water supply benefit will be to that source.

10.2.1 Watershed Characteristics

In response to declining water supply the City of Abilene began a period of reservoir and diversion construction in the Clear Fork watershed beginning in 1918 and ending in 1954. The first reservoir to be constructed was Lake Abilene, a 11,868 acre-feet capacity reservoir begun in 1918. Next came Lake Kirby, constructed in 1927, the lake impounds 8,500 acre-feet of water. The final reservoir constructed in the watershed is Fort Phantom Hill. Construction on the dam began in 1937. According to the latest volumetric survey, this reservoir has a capacity of 74,300 acre-feet[6]. To supply additional water to the City, diversion facilities were constructed in 1954 to divert flows into Fort Phantom Hill Reservoir from the Clear Fork of the Brazos River and Deadman's Creek.

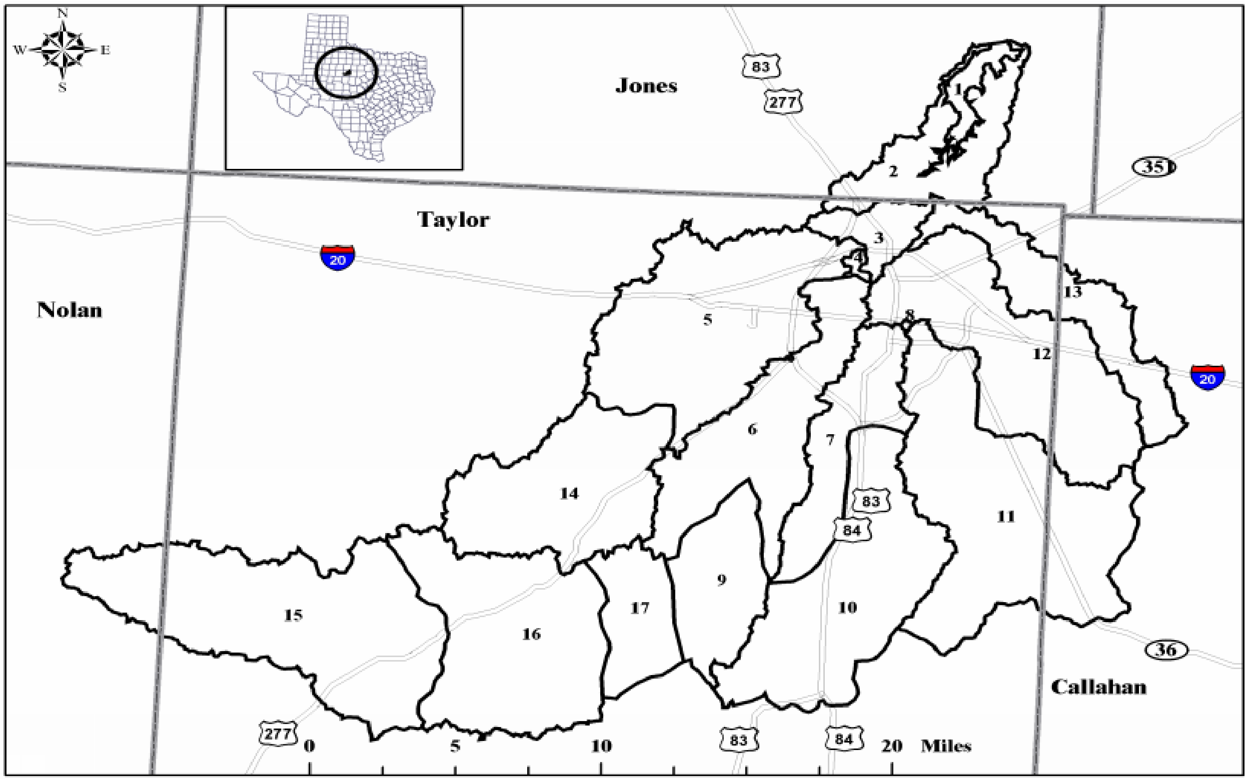
Figure 10-1 is a map of the Lake Fort Phantom hill watershed with various subbasins delineated.

10.1.1.1 Climate

The climate of the watershed is classified as subtropical sub-humid. The watershed is characterized by hot summers and dry winters. The average annual rainfall is approximately 24 inches, but the amount of rainfall varies considerably from year to year. In exceptionally wet years, much of the rain comes within short periods and causes excessive runoff. The annual rainfall distribution in the watershed has two peaks. Spring is typically the wettest season, with a peak occurring in May. These spring rains are caused by convective thunderstorms, which produce high intensity, short-duration storm events. The second peak which is generated by the tropical cyclone season is usually in September. The Fort Phantom Hill Reservoir watershed is in the region that the TSSWCB has defined as generally suitable for brush control projects, based on rainfall and brush infestation.

[6] Volumetric Survey of Fort Phantom Hill Reservoir, prepared for the City of Abilene, Texas Water Development Board, March 2003.

Figure 10.1 Sub basin Map of the Fort Phantom Hill Watershed



Large evaporative rates occur in the summer months due to high temperatures, high light intensities, low humidity, and high wind speeds. The wide range between maximum and minimum temperatures in the watershed is characteristic of the Rolling Plains. Temperature changes are rapid, especially in winter and early spring when cold, dry polar air replaces the warm, moist tropical air. Periods of very cold weather are short and fair, mild weather is frequent. High daytime temperatures prevail for a long period in the summer, but rapid cooling occurs after nightfall.[3]

10.1.1.2 Land Use

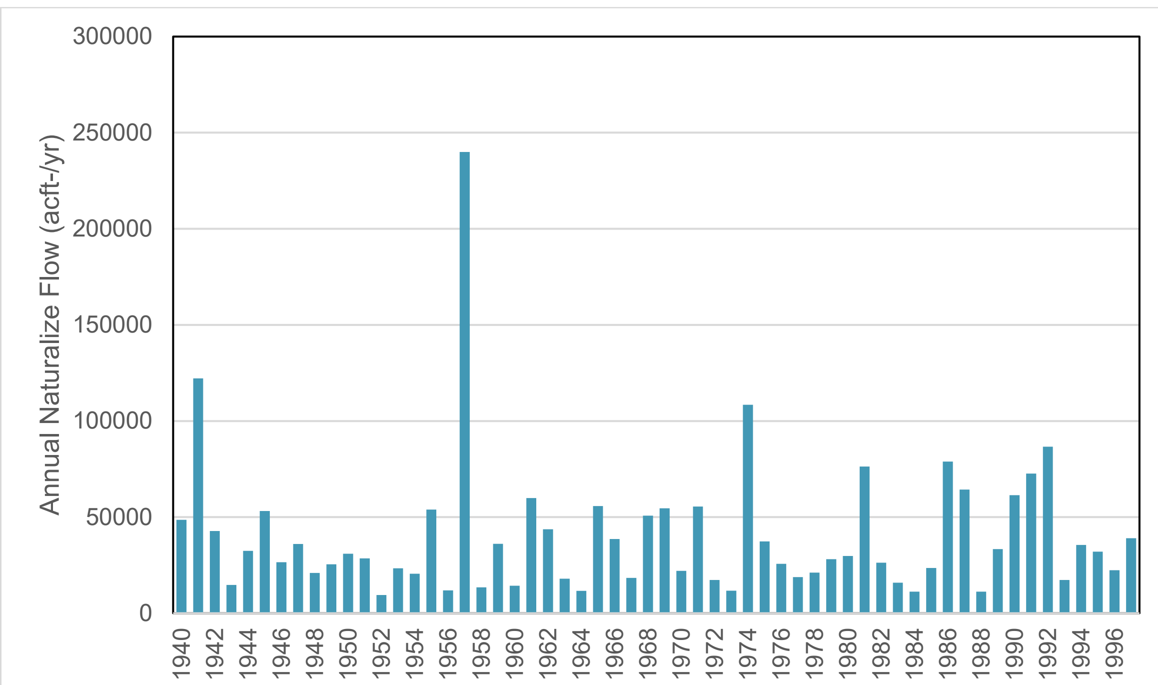
The land use in the watershed is dominated by agribusiness including feedlots, rangeland, and row-crop agriculture. Rangeland is used mainly for cattle, goats, and sheep. Crop production is largely dominated by wheat, cotton, sorghum, and hay. Urban land use includes the City of Abilene and the towns of Potosi, Buffalo Gap, and Tye. Dyess Air Force Base lies west of the City of Abilene in the watershed and the oil industry is prominent in the watershed with exploration, drilling, refining, and oil field service industries.[3]

10.1.2 Hydrology

Precipitation enters the watersheds hydrologic system as runoff or infiltrates surface soil or bedrock and recharges the underlying aquifers. Nearly all of the initial flow in the tributaries to Fort Phantom Hill Reservoir is derived from precipitation. Discharge from the watershed occurs as spills and releases from Lake Fort Phantom Hill into the Clear Fork of the Brazos River, as artificial surface water and groundwater withdrawals, as groundwater crossing the downgradient boundary of the watershed, and as returns to the atmosphere through evapotranspiration. Additionally, as alluvial water levels decline, water may flow from the streams and reservoirs into the alluvial deposits.

The hydrologic characteristics of the Fort Phantom Hill Reservoir watershed are closely linked to precipitation patterns in the river basin, especially the cycles of floods and droughts. Figure 10.2 shows the annual naturalized flow at Lake Fort Phantom Hill, which demonstrate these cycles of high and low flows. Annual flows vary from a minimum of 9,502 acft/yr in 1952 to a maximum of 240,006 acft/yr in 1957.

Figure 10.2 Annual Naturalized Flow at Lake Fort Phantom Hill



10.2.2 Potential Brush Control Project

Currently the TSSWCB is funding brush control activities in subbasin 15 of the Lake Fort Phantom Hill watershed. For this plan, a strategy evaluation was performed for a program that expands these activities to 9 more subbasins. For this project it was assumed that landowner participation would be approximately 50 percent of the total watershed. Subbasins with the highest projected amount of water generated from brush removal per acre were targeted for inclusion in the project. It was also assumed that 75 percent of the brush within the targeted subbasins would be removed. Table 10.1 shows the subbasin data from the feasibility study and the assumed acreage of treated brush. Watersheds are organized by the potential for water production, with the watersheds with the highest potential listed first.

Table 10.1 Subbasins Targeted for Potential Brush Control Project

Subbasin(1)	Total Area (acres)	Total Brush Area (acres)	Treated Brush(2) (acres)
1	2,540	537	403
8	68	28	21
15	36,789	24,241	18,181
2	12,087	3,735	2,801
3	4,451	1,114	836
10	27,797	12,690	9,518
5	30,985	9,356	7,017
9	11,914	5,931	4,448
4	453	149	112
6	21,928	7,275	5,456
16	28,340	19,218	NI
14	23,069	12,073	NI
17	8,803	6,102	NI
7	12,483	4,431	NI
12	28,282	11,245	NI
11	38,084	14,597	NI
13	13,045	5,672	NI
Total - Watershed	301,118	138,394	n/a
Total - Project	149,012	65,056	48,792

Notes:
NI – Not included in potential brush control project.
(1) Listed in order of projected water production.
(2) 75 percent of the Total Brush Area.

10.3 Environmental Issues

10.3.1 Existing Environment

The Lake Fort Phantom Hill Watershed Brush Control Study Area includes portions of Jones, Taylor, Callahan and Nolan Counties. The central and western portions of the study area are within the Edwards Plateau Vegetational Area, while the northern and eastern portions of the study area are within the Rolling Plains Vegetational Area.[7] The physiography of the study area includes recharge sands, massive limestone, caliche with some soil cover, severely eroded lands, and undissected red beds.[8]

[7] Gould, F.W., G.O. Hoffman, and C.A. Rechenthin. *Vegetational Areas of Texas*. Texas A&M University, Agricultural and Experiment Station Leaflet 492, 1960.
[8] Kier, R.S., L.E. Garner, and L.F. Brown, Jr. *Land Resources of Texas – A map of Texas Lands Classified According to Natural Suitability and Use Considerations*. University of Texas, Bureau of Economic Geology, Land Resources Laboratory Series, 1977.

Topography varies from rough, rolling hills to nearly level terrain. This diverse area contains several soil associations including the Tarrant-Tobosa association which consists of well-drained upland soils that are very shallow to steep calcareous and cobbly clays. The Tillman-Vernon association consists of deep, nearly level to sloping, well-drained upland soils that include non-calcareous to calcareous clay loams and clays. The Sagerton-Rowena-Rotan association includes deep, nearly level to gently sloping, well-drained soils that are comprised of noncalcareous to calcareous clay loams.[9] Major aquifers that are minimally represented in the study area include the Edwards-Trinity Aquifer in the western portion and the Trinity Aquifer in the eastern portion.[10] Area climate is characterized as subtropical, sub humid, with hot summers and dry winters and average annual precipitation ranges between 23 and 25 inches.[11]

Vegetation and resulting wildlife habitats within the study area have been greatly affected by human activities over the last 200 years. The prairie grasslands once covering a large portion of the area have gradually changed to shrub and brush land communities as a result of fire suppression and intensive livestock grazing. Five major vegetation types now occur in the study area,[12] including: Mesquite-Lotebush Shrub, Mesquite-Juniper Brush, Mesquite Juniper Live Oak Brush, Crops and Urban. Major land uses in the area include cattle ranches and farms, oil fields, hunting leases, and minerals.[13]

10.3.2 Potential Impacts

10.3.2.1 Threatened & Endangered Species

The Texas Parks and Wildlife Department (TPWD) maintains a list of Rare, Threatened, and Endangered Species of Texas by County. This list includes the federal and state listing status and a habitat description for each species which may be a resident or migrant through the county. TPWD regularly updates the listing status, range data, and habitat descriptions on their published county lists, based on the most recently available data. The current list of rare, threatened and endangered species for Jones, Taylor, Nolan and Callahan counties can be found at https://tpwd.texas.gov/gis/rtest/.

The endangered bird species include the whooping crane (*Grus americana*) and the least tern (*Sterna antillarum*). These birds are seasonal migrants that could pass through the project area. The whooping crane could potentially use area water sources for food acquisition and rest during their migratory trips to and from the Gulf Coast. The whooping crane would not likely be directly affected by brush control practices.

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[9] Soil Conservation Service. *Soil Survey of Taylor County, Texas*. U.S. Department of Agriculture Soil Conservation Service, 1976.
[10] Texas Water Development Board. *Major Aquifers of Texas, 1990*. A map.
[11] Larkin, T.J., and G.W. Bomar. *Climatic Atlas of Texas*. Texas Department of Water Resources LP-192, 1983.
[12] McMahan, C.A., R.G. Frye, and K.L. Brown. *The Vegetation Types of Texas including Cropland*. Texas Parks and Wildlife Department Bulletin 7000-120, 1984.
[13] Telfair, R.C. II. *Ecological Regions of Texas: Description, Land Use, and Wildlife*. In Ray C. Telfair, Editor, *Texas Wildlife Resources and Land Uses*. University of Texas Press. Austin, Texas, 1999.

According to the U.S. Fish and Wildlife Service's Information for Planning and Consultation website, the least tern should only be considered in these counties for wind energy projects[14]. Potential impacts on this species by brush control should be confirmed before initiating the project.

The sharpnose shiner (*Notropis oxyrhynchus*) and smalleye shiner (*Notropis buccula*) are listed as endangered by the USFWS.[15] These two minnows are native to the arid prairie streams of Texas and are considered to be in danger of extinction. The USFWS has designated portions of the Upper Brazos River Basin as critical habitat for these two fish. Critical habitat for the sharpnose shiner does not include the study area[16]. However, the study area does include critical habitat for the smalleye shiner[17]. Potential impacts on the smalleye shiner will need to be evaluated before initiating the proposed brush control project.

There are five additional species which are listed as threatened by the state of Texas within the project counties. These include the piping plover (*Charadrius melodus*), Texas fatmucket (*Lampsilis bracteate*), Texas fawnsfoot (*Truncilla macrodon*), Brazos water snake (*Nerodia harteri*), Texas horned lizard (*Phrynosoma cornutum*), and the Timber (canebrake) rattlesnake (*Crotalus horridus*). The piping plover is a migrant within the project area and are not anticipated to be adversely affected by the project. The Texas fatmucket and the Texas fawnsfoot are freshwater mussel species found in rivers and larger streams and are intolerant of impoundment. The Brazos water snake is known to inhabit rocky areas along waterways within the Brazos River Basin. Changes in aquatic habitat within the study area could potentially affect these three species. The Texas horned lizard is normally found in varied and sparsely vegetated uplands. Suitable habitat for the Texas horned lizard may exist within the study area and possible impacts to this species should be assessed during project planning. Timber rattlesnakes are usually found in moist lowland forest and hilly woodlands or thickets near water sources[18]. These habitats are limited in the study area, but those that do exist could be affected by the brush control project.

The information presented in this strategy evaluation is based on general data for the project area. Prior to implementing the brush control project, on-site evaluations by qualified biologists will be needed to confirm the occurrence of sensitive species or habitats within the affected area.

10.3.2.2 Wildlife Habitat

The project area is located within the Kansan biotic province. The Kansan Province is divided into three districts that include (from west to east) the short-grass plains, mixed-grass plains, and the mesquite plains. The project area is situated within the mesquite plains district. Within this district the typical vegetation community generally consists of clusters of mesquite and other shrubs interspersed with open areas of grasses.

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[14] USFWS IPaC Information for Planning and Consulting, https://ecos.fws.gov/ipac/.
[15] USFWS. 2014. *Sharpnose Shiner and Smalleye Shiner Protected under the Endangered Species Act*. News Release, August 4, 2014.
[16] U.S. Fish and Wildlife Service, ECOS Environmental Conservation Online System, Sharpnose Shiner (Notropis oxyrhynchus), available on-line at https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=6492
[17] U.S. Fish and Wildlife Service, ECOS Environmental Conservation Online System, Smalleye Shiner (Notropis buccula), available on-line at https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=1774
[18] Texas Parks and Wildlife Department, Timber Rattlesnake (Crotalushorridus), available on-line at https://tpwd.texas.gov/huntwild/wild/species/timberrattlesnake/

Common wildlife species found in the Kansan Biotic Province include the Great Plains toad (Anaxyrus cognatus), turkey vulture (Cathartes aura), scaled quail (Callipepla squamata), big brown bat (Eptesicus fuscus) and eastern collared lizard (Crotaphytus collaris) among others. Wildlife species inhabiting the project area utilize it to varying extents depending on their specific biologic needs.

10.3.2.3 Cultural Resources

Cultural resources protection on public lands in Texas is regulated by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (Pl96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of available GIS datasets provided by the Texas Historical Commission (THC), there are no State Historic Sites within the study area. However, 52 National Register Properties, 9 National Register Districts, 17 cemeteries and 38 historical markers are located within the study area. The owner or controller of the project would be required to coordinate with the Texas Historical Commission regarding potential impacts to cultural resources.

Specific project activities generally have sufficient flexibility to avoid most impacts or to mitigate unavoidable impacts to geographically limited environmental and cultural resource sites. Field surveys conducted at the appropriate phase of development should be employed to minimize the impacts of project activities on sensitive resources.

10.3.2.4 Threats to Natural Resources

Impacts of brush control can positively or negatively affect the existing terrestrial and aquatic environments depending on the type of control method used and the location, and extent of application. If brush removal is planned and implemented as part of a comprehensive range management strategy, then positive environmental benefits can result. Properly planned and applied brush control using mechanical, chemical, or prescribed fire can enhance soil conditions, increase water tables, provide greater streamflow thus improving water quantity and quality, provide higher energy and nutrient inputs, increase vegetation diversity, and enhance the quality of wildlife habitat with resulting higher abundance and diversity of wildlife species. However, removal of established of brush on uplands or removal of riparian woody vegetation along stream courses without consideration of a comprehensive long-term management strategy can be detrimental to wildlife and associated habitats. Other adverse impacts could occur depending on the type of control method employed.

Mechanical treatment using equipment to root plow, brush mow, bulldoze or scrape the ground surface could result in moderate to high levels of soil disturbance that could result in erosion and sedimentation into adjacent streams and water bodies. There would also be a change in vegetation communities toward earlier succession species. Soil disturbance would favor both re-establishment of both grasses and forbs (herbaceous) in addition to re-invasion of woody brush and shrub species, prompting the need for re-treatment in future years. Soil disturbance would also have the potential of disturbing cultural or archeological artifacts, if present, within 12 inches of the ground surface. The probability of cultural and archeological artifacts being present is higher for sites along water courses, and old homesteads and settlements.

The use of herbicides for brush control must to follow the current recommended practices for their application. Some of these chemicals are to be used only on upland areas and are not approved for use in or near water. If improperly applied, aerial or ground spraying could have possible biological impacts to wildlife through direct contact and/or potential pollution of surface water. There could also be effects to non-target plant species from broadcast applications.

The use of prescribed fire provides many ecological benefits. Historically, prairie wildfires were a major factor is suppressing invasion of woody vegetation among the prairie grassland communities. Other benefits include increased soil fertility through release of organic nutrients, stimulated growth of new plant material, and greater diversity of herbaceous plants tolerant to fire. Prescribed fire could adversely affect other vegetation such as damaging or killing established trees not intended for treatment, can be difficult to control if applied during the wrong season or during improper weather conditions, and could affect air quality regulated under federal and state laws.

10.4 Engineering and Costing

Costs associated with brush control in each subbasin were assessed using the cost estimates developed for the feasibility study, as shown in Table 10.2. The total cost for each subbasin includes costs typically attributed to the landowner, as well as State participation costs. To assess the cost for the brush control project, the total cost was amortized over a 10-year period at an annual interest rate of 3.5 percent. Ten years were selected because the removal cost includes 10 years of maintenance activities and that is equivalent to the life of the project. The yield of brush control during a drought is likely to be zero.

Table 10.2 Cost Estimate Summary for Brush Control Project

Cost Estimate Summary Water Supply Project Option September 2023 Prices Brush Control Project Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	Estimated Costs for Facilities
Chemical and Mechanical Brush Treatment (48,792 acres)	$7,877,000
TOTAL COST OF FACILITIES	**$7,877,000**
Interest During Construction (3.5% for 10 years with a 0.5% ROI)	**$3,456,000**
TOTAL COST OF PROJECT	**$11,333,000**
ANNUAL COST	
Debt Service (3.5 percent, 10 years)	**$1,694,000**
TOTAL ANNUAL COST	**$1,694,000**
Available Project Yield (acft/yr)	**0**
Annual Cost of Water ($ per acft), based on PF=0	**$0**
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	**$0**
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	**$0.00**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	**$0.00**
JMP	*1/31/2025*

10.5 Implementation Issues

The extent of implementation of brush control will depend on the amount of funding available for state cost-sharing with landowners. State funding would be contingent upon following provisions of the Water Supply Enhancement Program. Other funding may be available through federal and local agencies, which may have additional provisions. The extent of brush control that may be desired by landowners will depend on how they plan to manage their land for wildlife and how the brush control will affect the value of the land for wildlife recreation purposes. In recent years, the value of ranch lands which have sufficient brush cover to support wildlife populations, particularly white-tailed deer, wild turkey, bobwhite and scaled quail, has increased at a faster rate than the value of those lands which are void of brush or woody vegetation. Consequently, many landowners can be expected to support brush control to the extent that it does not exclude wildlife populations.

Other implementation issues for landowner participation include the perceived economic benefit of brush control. If the land is currently not actively managed for ranching or wildlife recreation the owner may chose not to participate. Decreased profitability of sheep, goat and cattle grazing systems will influence the economics of brush control by ranchers, and consequently their willingness to participate. Also, the size of the land tracts can affect the total amount of brush removed and the effectiveness of a program. Watersheds that contain many small tracts, which is likely to be the case in some of the target watersheds, are less likely to have the contiguous landowner participation that is needed to realize the water supply benefits associated with brush control. No land acquisition or relocations would be required for this water management strategy.

Brush control can positively affect the environment depending on the type of control method used, location, and extent of application. However, if brush removal is not planned properly or implemented as part of a comprehensive range management strategy, negative environmental impacts can result.

Grazing management is very important following any type of upland brush control to allow the desirable forages to exert competition with the brush plants and to maintain good herbaceous groundcover, which hinders establishment of woody plant seedlings. Continued maintenance of brush is necessary to ensure the benefits of this potential strategy.

On specific tracts where brush control would incorporate state or federal funding, regulatory compliance with the Texas Antiquities Code and National Historic Preservation Act may be required that may involve cultural resource surveys and incorporation of preservation measures. The Texas Commission on Environmental Quality has established regulations governing prescribed burning. There may also be local and county regulations associated with burning practices.

Since some of the subbasins may include urban and suburban areas, impacts to residents must be considered as well, particularly when considering chemical controls or prescribed burning. The watershed also serves as a drinking water supply, so water quality impacts must be considered as well.

The success of such a program for providing increased water supplies is dependent on climatic conditions and significant landowner participation. It should be noted that public benefit in the form of additional water depends on proper implementation and maintenance of the appropriate brush control practices. It is also important to understand that landowner participation in a brush control program can depends on the landowner's expected economic benefits from the program. The primary benefits of brush control might not lie with increased surface water runoff but with increased deep soil percolation and improved land management. Significant landowner participation will require adequate external funding on a continuous basis because the benefits of brush control are lost if the maintenance activities are not continued. Securing these funds will depend upon the success of on-going pilot studies and brush programs. Support of the on-going brush programs with continued data collection is necessary to demonstrate the realized water benefits of brush control.

This water supply option has been compared to the plan development criteria, as shown in Table 10.4.

Table 10.3 Evaluations of Brush Control Option to Enhance Water Supplies

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Uncertain
2. Reliability	2. Low reliability during drought conditions
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Negligible impact
2. Habitat	2. High positive or negative impact
3. Cultural Resources	3. Negligible to low impact
4. Bays and Estuaries	4. Negligible impact
5. Threatened and Endangered Species	5. High positive or negative impact
6. Wetlands	6. Negligible impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts	None

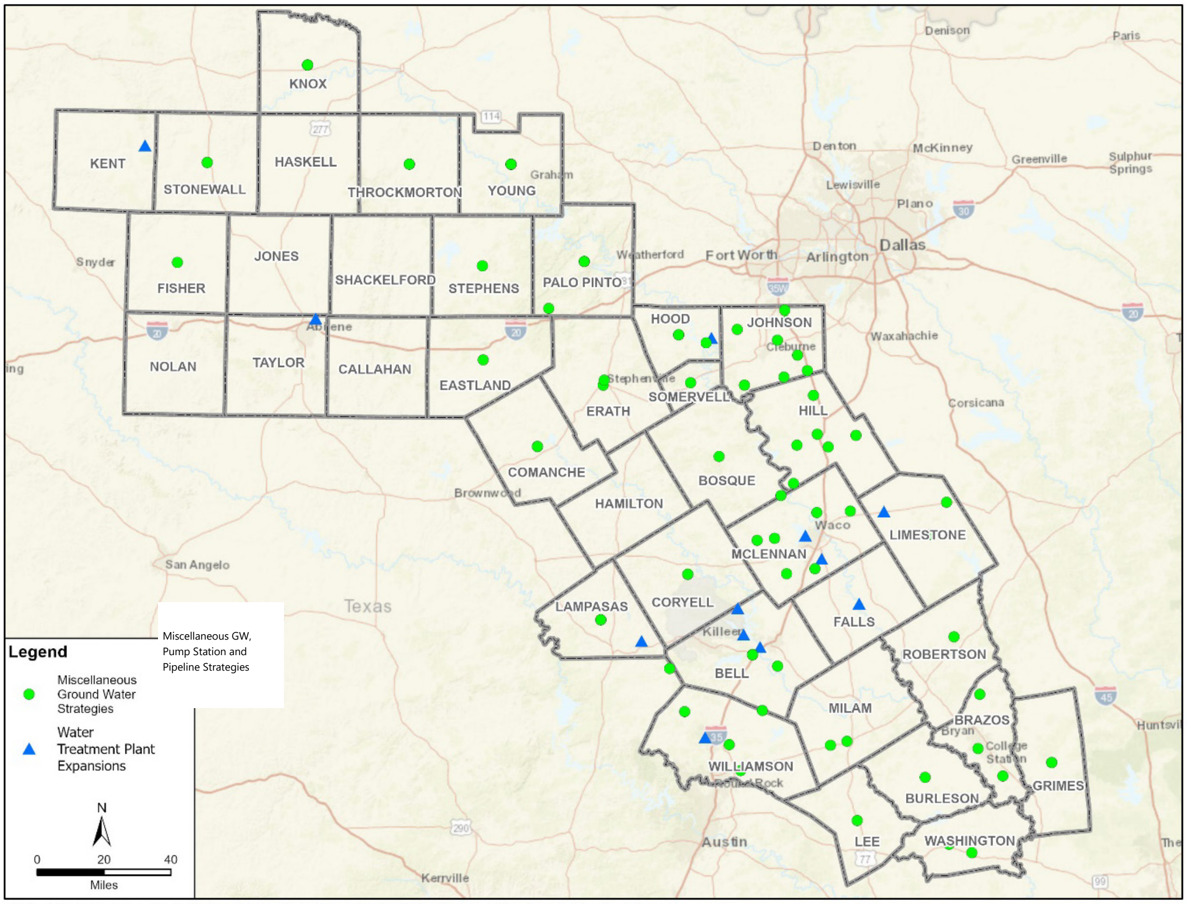
CHAPTER 11 MISCELLANEOUS STRATEGIES

11.1 Strategy Overview

Miscellaneous Strategies represent remaining strategies such as transmission projects, well field development, interconnections between water user groups, and water treatment plant expansions which are not included in any of the other water management strategies. Strategies were developed to overcome the water shortages identified between 2030 and 2080 after other specific water management strategies including conservation were applied for all WUGs. The WUGs with Miscellaneous Strategies are organized by county and are detailed in Section 13.3 through Section 13.5. Figure 11-1 shows the locations of the miscellaneous strategies recommended in the 2026 Brazos G Plan. Locations for county-aggregated WUGs are shown at the center of each county.

Strategies are summarized below by the name of the miscellaneous strategy, the source of water for the strategy, a list of the facilities necessary, costs, project yield and a short description of the strategy. Costs are consistent with the TWDB and Brazos G assumptions as described in Volume II, Chapter 1 and are priced in September 2023 dollars. Debt service is calculated at 3.5% for 20 years. Some strategies include estimates of wholesale water costs as verified through discussion with water providers or as base costs from other strategies. Not all strategies presented in this section are recommended in the 2026 Brazos G Plan.

Figure 11-1 Miscellaneous Strategies and Water Treatment Plant Expansions



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11.2 Evaluation of Miscellaneous Water Management Strategies

The miscellaneous strategies for each WUG were evaluated based on plan development criteria. Groundwater, surface water and reuse water supplies are adequate to implement these miscellaneous strategies. Environmental impacts will need to be mitigated to protect habitat, cultural resources, threatened and endangered species and wetlands. Generally, it is assumed that pipelines can be routed, well fields and water treatment plants can be located to avoid environmentally and culturally sensitive areas. Strategies were considered to meet municipal and industrial shortages in the planning area and will not have an apparent negative impact on other state water resources, or on agriculture and natural resources. The strategies do not require interbasin transfers.

Some of the miscellaneous strategies are feasible only if other recommended strategies are implemented. Other considerations for implementation of the miscellaneous strategies are summarized below:

- In general, any development of additional groundwater in the Brazos G Area must address several issues including:
  - » Competition with others for groundwater in the area;
  - » Purchase of groundwater rights;

   - Impact on water levels in the aquifer which could trigger reduction in production permits from the regulating Groundwater Conservation District; and
   - Restricted availability under the MAG.

The regulatory permits that are expected to be requirements specific to wells and pipelines include:

- Regulations and permits by the groundwater conservation districts;
- U.S. Army Corps of Engineers Sections 10 and 404 dredge and fill permits for the pipelines impacting wetlands or navigable waters of the United States;
- General Land Office easement for use of state-owned land;
- Texas Parks and Wildlife Department Sand, Gravel, and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Mitigation requirements would vary depending on impacts, but could include vegetation restoration, wetland creation or enhancement, or additional land acquisition.

11.3 Miscellaneous Pipelines, Pump Stations, and Groundwater Strategies by County

11.3.1 Bell County

WUG: Bell County, Irrigation

Strategy: Edwards-BFZ Aquifer Development

Source: Edwards-BFZ Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $721,000

Total Project Cost: $1,109,000

Total Annual Cost: $101,000

Available Project Yield: 810 acft/yr (2060)

Annual Cost of Water: $125 per acft/yr or $0.38 per 1,000 gal

This project will include six 100 gpm wells drilled to 150 ft with 900 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Bell County, Irrigation - Irrigation, Bell New Well(s) in Edwards-BFZ***
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$721,000
TOTAL COST OF FACILITIES	**$721,000**
- Planning (3%)	$22,000
- Design (7%)	$50,000
- Construction Engineering (1%)	$7,000
Legal Assistance (2%)	$14,000
Fiscal Services (2%)	$14,000
All Other Facilities Contingency (20%)	$144,000
Environmental & Archaeology Studies and Mitigation	$51,000
Land Acquisition and Surveying (3 acres)	$51,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$35,000
TOTAL COST OF PROJECT	**$1,109,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$78,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$7,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (176042 kW-hr @ 0.09 $/kW-hr)	$16,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$101,000**
Available Project Yield (acft/yr)	810
Annual Cost of Water ($ per acft), based on PF=0	$125
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$28
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.38

Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.09
MP	*1/1/2025*

WUG: Bell County WCID 2

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well Field, collection pipes, transmission and treatment

Total Capital Cost: $1,064,000

Total Project Cost: $1,523,000

Total Annual Cost: $138,000

Available Project Yield: 57 acft/yr

Annual Cost of Water: $2,421 per acft/yr or $7.43 per 1,000 gal (Maximum of Phased Costs)

This project will include two 80 gpm wells drilled to 800 ft as well as 600 ft of collection pipeline per well and disinfection treatment.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Bell County WCID 2 - Trinity Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,033,000
Water Treatment Plant (0.1 MGD)	$31,000
TOTAL COST OF FACILITIES	**$1,064,000**
- Planning (3%)	$32,000
- Design (7%)	$74,000
- Construction Engineering (1%)	$11,000
Legal Assistance (2%)	$21,000
Fiscal Services (2%)	$21,000
All Other Facilities Contingency (20%)	$213,000
Environmental & Archaeology Studies and Mitigation	$22,000
Land Acquisition and Surveying (2 acres)	$17,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$48,000

TOTAL COST OF PROJECT	**$1,523,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$107,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$10,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$19,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (19868 kW-hr @ 0.09 $/kW-hr)	$2,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$138,000**
Available Project Yield (acft/yr)	57
Annual Cost of Water ($ per acft), based on PF=0	$2,421
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$544
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$7.43
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.67
JMP	*2/9/2025*

WUG: Bell, Manufacturing

Strategy: Edwards-BFZ Aquifer Development

Source: Edwards-BFZ Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $502,000

Total Project Cost: $769,000

Total Annual Cost: $70,000

Available Project Yield: 525 acft/yr

Annual Cost of Water: $133 per acft/yr or $0.41 per 1,000 gal

This project will include three 100 gpm wells drilled to 1,300 ft with 2,500 ft of pipeline.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Bell Manufacturing - Bell, Manufacturing, New Well(s) in the Edwards BFZ

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$502,000
TOTAL COST OF FACILITIES	**$502,000**
- Planning (3%)	$15,000
- Design (7%)	$35,000
- Construction Engineering (1%)	$5,000
Legal Assistance (2%)	$10,000
Fiscal Services (2%)	$10,000
All Other Facilities Contingency (20%)	$100,000
Environmental & Archaeology Studies and Mitigation	$36,000
Land Acquisition and Surveying (2 acres)	$31,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$25,000
TOTAL COST OF PROJECT	**$769,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$54,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$5,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (124878 kW-hr @ 0.09 $/kW-hr)	$11,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$70,000**
Available Project Yield (acft/yr)	525
Annual Cost of Water ($ per acft), based on PF=0	$133
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$30

Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.41
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.09
MP	*1/1/2025*

11.3.2 Bosque County

WUG: Highland Park WSC

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well Field, collection pipes, transmission and treatment

Total Capital Cost: $2,500,000

Total Project Cost: $3,609,000

Total Annual Cost: $301,000

Available Project Yield: 77 acft/yr

Annual Cost of Water: $13,909 per acft/yr or $11.99 per 1,000 gal

This project will include two 110 gpm wells drilled to 1,280 ft as well as 1,000 ft of collection pipeline per well, 1 mile of transmission pipeline, and disinfection treatment.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Highland Park WSC - Trinity for Highland Park WSC***	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$2,469,000
Water Treatment Plant (0.1 MGD)	$31,000
TOTAL COST OF FACILITIES	**$2,500,000**
- Planning (3%)	$75,000
- Design (7%)	$175,000
- Construction Engineering (1%)	$25,000
Legal Assistance (2%)	$50,000
Fiscal Services (2%)	$50,000

All Other Facilities Contingency (20%)	$500,000
Environmental & Archaeology Studies and Mitigation	$41,000
Land Acquisition and Surveying (8 acres)	$79,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$114,000
TOTAL COST OF PROJECT	**$3,609,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$254,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$25,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$18,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (42425 kW-hr @ 0.09 $/kW-hr)	$4,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$301,000**
Available Project Yield (acft/yr)	77
Annual Cost of Water ($ per acft), based on PF=0	$3,909
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$610
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$11.99
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.87
Note: One or more cost element has been calculated externally	
Plummer	*1/27/2025*

WUG: Bosque County Irrigation

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well Field, collection pipes

Total Capital Cost: $2,714,000

Total Project Cost: $3,944,000

Total Annual Cost: $362,000

Available Project Yield: 1,175 acft/yr (2070)

Annual Cost of Water: $308 per acft/yr or $0.95 per 1,000 gal

This project will include four 280 gpm wells drilled to 930 ft with 1,000 ft of transmission pipeline per well.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Bosque County Irrigation - Trinity for Bosque County Irrigation***	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$2,714,000
TOTAL COST OF FACILITIES	**$2,714,000**
- Planning (3%)	$81,000
- Design (7%)	$190,000
- Construction Engineering (1%)	$27,000
Legal Assistance (2%)	$54,000
Fiscal Services (2%)	$54,000
All Other Facilities Contingency (20%)	$543,000
Environmental & Archaeology Studies and Mitigation	$77,000
Land Acquisition and Surveying (7 acres)	$79,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$125,000
TOTAL COST OF PROJECT	**$3,944,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$278,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$27,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0

Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (637163 kW-hr @ 0.09 $/kW-hr)	$57,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$362,000**
Available Project Yield (acft/yr)	1,175
Annual Cost of Water ($ per acft), based on PF=0	$308
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$71
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.95
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.22
Note: One or more cost element has been calculated externally	
Plummer	*1/27/2025*

11.3.3 Brazos County

WUG: Texas A&M University

Strategy: Sparta Aquifer Development

Source: Sparta Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $6,185,000

Total Project Cost: $9,165,000

Total Annual Cost: $734,000

Available Project Yield: 951 acft/yr

Annual Cost of Water: $772 per acft/yr or $2.37 per 1,000 gal

This project will include eight 150 gpm wells drilled to 500 ft with 18,000 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Texas A&M - Brazos, Texas A&M, Sparta Aquifer Development***
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$6,185,000
TOTAL COST OF FACILITIES	**$6,185,000**
- Planning (3%)	$186,000
- Design (7%)	$433,000
- Construction Engineering (1%)	$62,000
Legal Assistance (2%)	$124,000
Fiscal Services (2%)	$124,000
All Other Facilities Contingency (20%)	$1,237,000
Environmental & Archaeology Studies and Mitigation	$304,000
Land Acquisition and Surveying (5 acres)	$221,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$289,000
TOTAL COST OF PROJECT	**$9,165,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$645,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$62,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (72701 kW-hr @ 0.09 $/kW-hr)	$27,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$734,000**
Available Project Yield (acft/yr)	951
Annual Cost of Water ($ per acft), based on PF=0	$772

Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$94
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.37
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.29
MP	*1/1/2025*

WUG: Brazos, Mining

Strategy: Yegua-Jackson Aquifer Development

Source: Yegua-Jackson Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $3,083,000

Total Project Cost: $4,530,000

Total Annual Cost: $350,000

Available Project Yield: 1,200 acft/yr

Annual Cost of Water: $292 per acft/yr or $0.89 per 1,000 gal

This project will include eight 100 gpm wells drilled to 400 ft with 4,000 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Brazos Mining - Yegua-Jackson Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$3,083,000
TOTAL COST OF FACILITIES	**$3,083,000**
- Planning (3%)	$92,000
- Design (7%)	$216,000
- Construction Engineering (1%)	$31,000
Legal Assistance (2%)	$62,000
Fiscal Services (2%)	$62,000

All Other Facilities Contingency (20%)	$617,000
Environmental & Archaeology Studies and Mitigation	$119,000
Land Acquisition and Surveying (6 acres)	$105,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$143,000
TOTAL COST OF PROJECT	**$4,530,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$319,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$31,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$350,000**
Available Project Yield (acft/yr)	1,200
Annual Cost of Water ($ per acft), based on PF=0	$292
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$26
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.89
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.08
MP	*1/1/2025*

WUG: Brazos, Mining

Strategy: Sparta Aquifer Development

Source: Sparta Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $980,000

Total Project Cost: $1,448,000

Total Annual Cost: $112,000

Available Project Yield: 300 acft/yr

Annual Cost of Water: $373 per acft/yr or $1.15 per 1,000 gal

This project will include two 120 gpm wells drilled to 400 ft with 2,000 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Brazos Mining - Sparta Aquifer Development***	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$980,000
TOTAL COST OF FACILITIES	**$980,000**
- Planning (3%)	$29,000
- Design (7%)	$69,000
- Construction Engineering (1%)	$10,000
Legal Assistance (2%)	$20,000
Fiscal Services (2%)	$20,000
All Other Facilities Contingency (20%)	$196,000
Environmental & Archaeology Studies and Mitigation	$43,000
Land Acquisition and Surveying (2 acres)	$35,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$46,000
TOTAL COST OF PROJECT	**$1,448,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$102,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$10,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0

Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$112,000**
Available Project Yield (acft/yr)	300
Annual Cost of Water ($ per acft), based on PF=0	$373
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$33
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.15
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.10
MP	*1/1/2025*

WUG: Brazos, County-Other

Strategy: Yegua-Jackson Aquifer Development

Source: Yegua-Jackson Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $912,000

Total Project Cost: $1,351,000

Total Annual Cost: $106,000

Available Project Yield: 125 acft/yr

Annual Cost of Water: $848 per acft/yr or $2.60 per 1,000 gal

This project will include two 100 gpm wells drilled to 400 ft with 2,000 ft of pipeline.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Brazos, County Other - Brazos, County Other, New Well(s) in the Yegua-Jackson

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$912,000
TOTAL COST OF FACILITIES	**$912,000**

- Planning (3%)	$27,000
- Design (7%)	$64,000
- Construction Engineering (1%)	$9,000
Legal Assistance (2%)	$18,000
Fiscal Services (2%)	$18,000
All Other Facilities Contingency (20%)	$182,000
Environmental & Archaeology Studies and Mitigation	$43,000
Land Acquisition and Surveying (2 acres)	$35,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$43,000
TOTAL COST OF PROJECT	**$1,351,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$95,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$9,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (25843 kW-hr @ 0.09 $/kW-hr)	$2,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$106,000**
Available Project Yield (acft/yr)	125
Annual Cost of Water ($ per acft), based on PF=0	$848
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$88
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.60
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.27
MP	*1/1/2025*

WUG: Wellborn SUD

Strategy: Yegua-Jackson Aquifer Development

Source: Yegua-Jackson Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $17,784,000

Total Project Cost: $26,367,000

Total Annual Cost: $2,129,000

Available Project Yield: 2,335 acft/yr

Annual Cost of Water: $912 per acft/yr or $2.80 per 1,000 gal

This project will include twenty 150 gpm wells drilled to 600 ft with 55,000 ft of pipeline.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Wellborn SUD - Brazos,Wellborn SUD, New Well(s) in the Yegua-Jackson

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$17,784,000
TOTAL COST OF FACILITIES	**$17,784,000**
- Planning (3%)	$534,000
- Design (7%)	$1,245,000
- Construction Engineering (1%)	$178,000
Legal Assistance (2%)	$356,000
Fiscal Services (2%)	$356,000
All Other Facilities Contingency (20%)	$3,557,000
Environmental & Archaeology Studies and Mitigation	$891,000
Land Acquisition and Surveying (35 acres)	$636,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$830,000
TOTAL COST OF PROJECT	**$26,367,000**
ANNUAL COST	

Debt Service (3.5 percent, 20 years)	$1,855,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$178,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (1070968 kW-hr @ 0.09 $/kW-hr)	$96,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$2,129,000**
Available Project Yield (acft/yr)	2,335
Annual Cost of Water ($ per acft), based on PF=0	$912
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$117
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.80
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.36
MP	*1/1/2025*

WUG: Wellborn SUD

Strategy: Carrizo-Wilcox Aquifer Development

Source: Carrizo-Wilcox Aquifer

Facilities: Well, collection pipes, treatment

Total Capital Cost: $24,450,000

Total Project Cost: $35,204,000

Total Annual Cost: $3,546,000

Available Project Yield: 6,500 acft/yr

Annual Cost of Water: $546 per acft/yr or $1.67 per 1,000 gal

This project will include twenty-four 200 gpm wells drilled to 1,080 ft with 27,000 ft of pipeline and disinfection treatment.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Wellborn SUD - Carrizo-Wilcox Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$24,056,000
Water Treatment Plant (5.5 MGD)	$394,000
TOTAL COST OF FACILITIES	**$24,450,000**
- Planning (3%)	$733,000
- Design (7%)	$1,711,000
- Construction Engineering (1%)	$244,000
Legal Assistance (2%)	$489,000
Fiscal Services (2%)	$489,000
All Other Facilities Contingency (20%)	$4,890,000
Environmental & Archaeology Studies and Mitigation	$599,000
Land Acquisition and Surveying (27 acres)	$490,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,109,000
TOTAL COST OF PROJECT	**$35,204,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,477,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$241,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$236,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (6582005 kW-hr @ 0.09 $/kW-hr)	$592,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$3,546,000**
Available Project Yield (acft/yr)	6,500
Annual Cost of Water ($ per acft), based on PF=0	$546
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$164
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.67
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.50

MP	*1/1/2025*

WUG: Wickson Creek SUD

Strategy: Sparta Aquifer Development

Source: Sparta Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $11,164,000

Total Project Cost: $16,135,000

Total Annual Cost: $1,398,000

Available Project Yield: 2,900 acft/yr

Annual Cost of Water: $482 per acft/yr or $1.48 per 1,000 gal

This project will include six 700 gpm wells drilled to 800 ft with 21,000 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Wickson Creek UCM - Brazos, Wickson Creek UCM, New Well(s) in the Sparta Aquifer***	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$11,164,000
TOTAL COST OF FACILITIES	**$11,164,000**
- Planning (3%)	$335,000
- Design (7%)	$782,000
- Construction Engineering (1%)	$112,000
Legal Assistance (2%)	$223,000
Fiscal Services (2%)	$223,000
All Other Facilities Contingency (20%)	$2,233,000
Environmental & Archaeology Studies and Mitigation	$327,000
Land Acquisition and Surveying (13 acres)	$228,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$508,000

TOTAL COST OF PROJECT	**$16,135,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,135,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$112,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (1681215 kW-hr @ 0.09 $/kW-hr)	$151,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,398,000**
Available Project Yield (acft/yr)	2,900
Annual Cost of Water ($ per acft), based on PF=0	$482
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$91
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.48
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.28
MP	*1/1/2025*

11.3.4 Burleson County

WUG: Burleson, Manufacturing

Strategy: Queen City Aquifer Development

Source: Queen City Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $566,000

Total Project Cost: $870,000

Total Annual Cost: $70,000

Available Project Yield: 50 acft/yr

Annual Cost of Water: $1,400 per acft/yr or $4.30 per 1,000 gal

This project will include two 50 gpm wells drilled to 800 ft with 2,000 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Burleson, Manufacturing - Burleson,Manufacturing, New Well(s) in the Queen City***	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$566,000
TOTAL COST OF FACILITIES	**$566,000**
- Planning (3%)	$17,000
- Design (7%)	$40,000
- Construction Engineering (1%)	$6,000
Legal Assistance (2%)	$11,000
Fiscal Services (2%)	$11,000
All Other Facilities Contingency (20%)	$113,000
Environmental & Archaeology Studies and Mitigation	$43,000
Land Acquisition and Surveying (2 acres)	$35,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$28,000
TOTAL COST OF PROJECT	**$870,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$61,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$6,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (27878 kW-hr @ 0.09 $/kW-hr)	$3,000
Purchase of Water (acft/yr @ $/acft)	$0

TOTAL ANNUAL COST	**$70,000**
Available Project Yield (acft/yr)	50
Annual Cost of Water ($ per acft), based on PF=0	$1,400
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$180
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$4.30
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.55
MP	*1/1/2025*

WUG: Burleson, Manufacturing

Strategy: Sparta Aquifer Development

Source: Sparta Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $245,000

Total Project Cost: $367,000

Total Annual Cost: $29,000

Available Project Yield: 25 acft/yr

Annual Cost of Water: $1,160 per acft/yr or $3.56 per 1,000 gal

This project will include one 25 gpm wells drilled to 1500 ft with 400 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Burleson County Manufacturing - Sparta Aquifer Development***	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$245,000
TOTAL COST OF FACILITIES	**$245,000**
- Planning (3%)	$7,000
- Design (7%)	$17,000
- Construction Engineering (1%)	$2,000

Legal Assistance (2%)	$5,000
Fiscal Services (2%)	$5,000
All Other Facilities Contingency (20%)	$49,000
Environmental & Archaeology Studies and Mitigation	$13,000
Land Acquisition and Surveying (1 acres)	$12,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$12,000
TOTAL COST OF PROJECT	**$367,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$26,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (6610 kW-hr @ 0.09 $/kW-hr)	$1,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$29,000**
Available Project Yield (acft/yr)	25
Annual Cost of Water ($ per acft), based on PF=0	$1,160
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$120
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.56
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.37
MP	*1/1/2025*

11.3.5 Comanche County

WUG: Comanche County Other

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer (Erath County)

Facilities: Well Field, collection pipes, transmission pipeline, and treatment

Total Capital Cost: $6,066,000

Total Project Cost: $8,981,000

Total Annual Cost: $766,000

Available Project Yield: 408 acft/yr

Annual Cost of Water: $1,877 per acft/yr or $5.76 per 1,000 gal

This project will include three 150 gpm wells drilled to 500 ft as well as 1,000 ft of collection pipeline and disinfection treatment per well, and approximately 5 miles of transmission pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Comanche County-Other - County-Other, Comanche	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$5,974,000
Water Treatment Plant (0.9 MGD)	$92,000
TOTAL COST OF FACILITIES	**$6,066,000**
- Planning (3%)	$182,000
- Design (7%)	$425,000
- Construction Engineering (1%)	$61,000
Legal Assistance (2%)	$121,000
Fiscal Services (2%)	$121,000
All Other Facilities Contingency (20%)	$1,213,000
Environmental & Archaeology Studies and Mitigation	$327,000
Land Acquisition and Surveying (28 acres)	$182,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$283,000
TOTAL COST OF PROJECT	**$8,981,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$632,000

Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$60,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$55,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (210868 kW-hr @ 0.09 $/kW-hr)	$19,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$766,000**
Available Project Yield (acft/yr)	408
Annual Cost of Water ($ per acft), based on PF=0	$1,877
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$328
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$5.76
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.01
Plummer	*1/27/2025*

WUG: Comanche County Mining

Strategy: Trinity Aquifer Development (Erath County)

Source: Trinity Aquifer

Facilities: Well Field, collection pipes, and transmission pipeline

Total Capital Cost: $4,816,000

Total Project Cost: $7,249,000

Total Annual Cost: $573,000

Available Project Yield: 241 acft/yr

Annual Cost of Water: $2,378 per acft/yr or $7.30 per 1,000 gal

This project will include three 150 gpm wells drilled to 500 ft as well as 1,000 ft of collection pipeline per well and approximately 5 miles of transmission pipeline.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Comanche County-Mining - Trinity Aquifer Development (Erath County)

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$4,816,000
TOTAL COST OF FACILITIES	**$4,816,000**
- Planning (3%)	$144,000
- Design (7%)	$337,000
- Construction Engineering (1%)	$48,000
Legal Assistance (2%)	$96,000
Fiscal Services (2%)	$96,000
All Other Facilities Contingency (20%)	$963,000
Environmental & Archaeology Studies and Mitigation	$335,000
Land Acquisition and Surveying (28 acres)	$185,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$229,000
TOTAL COST OF PROJECT	**$7,249,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$510,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$48,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (170617 kW-hr @ 0.09 $/kW-hr)	$15,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$573,000**
Available Project Yield (acft/yr)	241

Annual Cost of Water ($ per acft), based on PF=0	$2,378
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$261
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$7.30
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.80
Plummer	*1/27/2025*

11.3.6 Coryell County

WUG: Coryell County Other

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well Field, collection pipes, treatment

Total Capital Cost: $4,842,000

Total Project Cost: $6,858,000

Total Annual Cost: $598,000 (Maximum of Phased Costs)

Available Project Yield: 1,107 acft/yr

Annual Cost of Water: $540 per acft/yr or $1.66 per 1,000 gal (Maximum of Phased Costs)

This project will include five 200 gpm wells drilled to 1,000 ft as well as 1,000 ft of collection piping and disinfection treatment per well.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Coryell County Other - Trinity Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$4,796,000
Water Treatment Plant (0.3 MGD)	$46,000
TOTAL COST OF FACILITIES	**$4,842,000**
- Planning (3%)	$145,000

- Design (7%)	$339,000
- Construction Engineering (1%)	$48,000
Legal Assistance (2%)	$97,000
Fiscal Services (2%)	$97,000
All Other Facilities Contingency (20%)	$968,000
Environmental & Archaeology Studies and Mitigation	$40,000
Land Acquisition and Surveying (8 acres)	$66,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$216,000
TOTAL COST OF PROJECT	**$6,858,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$483,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$48,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$27,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (449870 kW-hr @ 0.09 $/kW-hr)	$40,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$598,000**
Available Project Yield (acft/yr)	1,107
Annual Cost of Water ($ per acft), based on PF=0	$540
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$104
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.66
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.32
Note: One or more cost element has been calculated externally	
Plummer	*1/27/2025*

WUG: Coryell County Mining

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well Field, collection pipes

Total Capital Cost: $3,745,000

Total Project Cost: $5,534,000

Total Annual Cost: $470,000

Available Project Yield: 1,270 acft/yr

Annual Cost of Water: $370 per acft/yr or $1.14 per 1,000 gal

This project will include five 200 gpm wells drilled to 1,000 ft as well as 2,000 ft of collection pipeline per well.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Coryell County Mining - Trinity Aquifer Development***	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$3,745,000
TOTAL COST OF FACILITIES	**$3,745,000**
- Planning (3%)	$112,000
- Design (7%)	$262,000
- Construction Engineering (1%)	$37,000
Legal Assistance (2%)	$75,000
Fiscal Services (2%)	$75,000
All Other Facilities Contingency (20%)	$749,000
Environmental & Archaeology Studies and Mitigation	$168,000
Land Acquisition and Surveying (14 acres)	$136,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$175,000
TOTAL COST OF PROJECT	**$5,534,000**
ANNUAL COST	

Debt Service (3.5 percent, 20 years)	$389,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$37,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (487261 kW-hr @ 0.09 $/kW-hr)	$44,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$470,000**
Available Project Yield (acft/yr)	1,270
Annual Cost of Water ($ per acft), based on PF=0	$370
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$64
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.14
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.20
Note: One or more cost element has been calculated externally	
Plummer	*1/27/2025*

11.3.7 Eastland County

WUG: Eastland, Mining

Strategy: Trinity Aquifer Development in Eastland County

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $400,000

Total Project Cost: $633,000

Total Annual Cost: $57,000

Available Project Yield: 167 acft/yr

Annual Cost of Water: $341 per acft/yr or $1.05 per 1,000 gal

This project will include four 40 gpm wells drilled to 120 ft with 1,400 ft of pipeline.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Eastland, Mining - Eastland, Mining, New Well(s) in the Trinity Aquifer

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$400,000
TOTAL COST OF FACILITIES	**$400,000**
- Planning (3%)	$12,000
- Design (7%)	$28,000
- Construction Engineering (1%)	$4,000
Legal Assistance (2%)	$8,000
Fiscal Services (2%)	$8,000
All Other Facilities Contingency (20%)	$80,000
Environmental & Archaeology Studies and Mitigation	$39,000
Land Acquisition and Surveying (3 acres)	$34,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$20,000
TOTAL COST OF PROJECT	**$633,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$45,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$4,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (89504 kW-hr @ 0.09 $/kW-hr)	$8,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$57,000**

Available Project Yield (acft/yr)	167
Annual Cost of Water ($ per acft), based on PF=0	$341
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$72
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.05
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.22
MP	*1/1/2025*

WUG: Eastland County Mining

Strategy: Trinity Aquifer Development in Erath County

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $5,945,000

Total Project Cost: $8,783,000

Total Annual Cost: $683,000

Available Project Yield: 92 acft/yr

Annual Cost of Water: $7,424 per acft/yr or $22.78 per 1,000 gal

This project will include five 150 gpm wells drilled to 500 ft with 1,400 ft of collection pipeline, and 5 miles of transmission pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Eastland County Mining - Trinity Aquifer Development (Erath Co)	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Transmission Pipeline (None)	$333,000
Well Fields (Wells, Pumps, and Piping)	$5,612,000
TOTAL COST OF FACILITIES	**$5,945,000**
- Planning (3%)	$178,000

- Design (7%)	$416,000
- Construction Engineering (1%)	$59,000
Legal Assistance (2%)	$119,000
Fiscal Services (2%)	$119,000
Pipeline Contingency (15%)	$50,000
All Other Facilities Contingency (20%)	$1,122,000
Environmental & Archaeology Studies and Mitigation	$319,000
Land Acquisition and Surveying (28 acres)	$179,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$277,000
TOTAL COST OF PROJECT	**$8,783,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$618,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$59,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (62617 kW-hr @ 0.09 $/kW-hr)	$6,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$683,000**
Available Project Yield (acft/yr)	92
Annual Cost of Water ($ per acft), based on PF=0	$7,424
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$707
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$22.78
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$2.17
Plummer	*1/27/2025*

11.3.8 Erath County

WUG: Stephenville

Strategy: Trinity Aquifer Well Field Development

Source: Trinity Aquifer

Facilities: Well Field, collection pipes, transmission pipe, roads, pads & electrical distribution , and treatment

Total Capital Cost: $4,978,000

Total Project Cost: $7,501,000

Total Annual Cost: $682,000

Available Project Yield: 405 acft/yr

Annual Cost of Water: $1,684 per acft/yr or $5.17 per 1,000 gal

This project will include constructing five new Trinity Aquifer wells to a depth of 565 ft, collection and transmission pipelines, disinfection treatment, well access roads, and electrical power distribution.

Cost Estimate Summary Water Supply Project Option September 2023 Prices City of Stephenville - Trinity Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Transmission Pipeline (None)	$18,000
Well Fields (Wells, Pumps, and Piping)	$2,814,000
Water Treatment Plant (1.7 MGD)	$150,000
Integration, Relocations, Backup Generator & Other	$1,996,000
TOTAL COST OF FACILITIES	**$4,978,000**
- Planning (3%)	$149,000
- Design (7%)	$348,000
- Construction Engineering (1%)	$50,000
Legal Assistance (2%)	$100,000
Fiscal Services (2%)	$100,000

Pipeline Contingency (15%)	$3,000
All Other Facilities Contingency (20%)	$992,000
Environmental & Archaeology Studies and Mitigation	$238,000
Land Acquisition and Surveying (21 acres)	$306,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$237,000
TOTAL COST OF PROJECT	**$7,501,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$528,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$48,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$90,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (178369 kW-hr @ 0.09 $/kW-hr)	$16,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$682,000**
Available Project Yield (acft/yr)	405
Annual Cost of Water ($ per acft), based on PF=0	$1,684
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$380
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$5.17
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.17
Note: One or more cost element has been calculated externally	
Plummer	*1/27/2025*

WUG: Erath County Other

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well Field, collection pipes, and treatment

Total Capital Cost: $1,690,000

Total Project Cost: $2,475,000

Total Annual Cost: $243,000 (Maximum of Phased Costs)

Available Project Yield: 347 acft/yr

Annual Cost of Water: $859 per acft/yr or $2.63 per 1,000 gal

This project will include two 150 gpm wells drilled to 500 ft as well as 1,000 ft of collection pipe and disinfection treatment.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Erath County-Other - Trinity Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Transmission Pipeline (None)	$67,000
Well Fields (Wells, Pumps, and Piping)	$1,551,000
Water Treatment Plant (0.6 MGD)	$72,000
TOTAL COST OF FACILITIES	**$1,690,000**
- Planning (3%)	$51,000
- Design (7%)	$118,000
- Construction Engineering (1%)	$17,000
Legal Assistance (2%)	$34,000
Fiscal Services (2%)	$34,000
Pipeline Contingency (15%)	$10,000
All Other Facilities Contingency (20%)	$325,000
Environmental & Archaeology Studies and Mitigation	$52,000
Land Acquisition and Surveying (5 acres)	$66,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$78,000
TOTAL COST OF PROJECT	**$2,475,000**
ANNUAL COST	

Debt Service (3.5 percent, 20 years)	$174,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$16,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$43,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (113487 kW-hr @ 0.09 $/kW-hr)	$10,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$243,000**
Available Project Yield (acft/yr)	283
Annual Cost of Water ($ per acft), based on PF=0	$859
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$244
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.63
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.75
Note: One or more cost element has been calculated externally	
Plummer	*1/27/2025*

11.3.9 Falls County

WUG: Falls, County-Other

Strategy: Brazos River Alluvium Aquifer Development

Source: Brazos River Alluvium Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $200,000

Total Project Cost: $323,000

Total Annual Cost: $29,000

Available Project Yield: 325 acft/yr

Annual Cost of Water: $89 per acft/yr or $0.27 per 1,000 gal

This project will include two 300 gpm wells drilled to 60 ft with 700 ft of pipeline.

Cost Estimate Summary *Water Supply Project Option* *September 2023 Prices* *Falls, County-Other - Falls, County-Other, Brazos River Alluvium*	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$200,000
TOTAL COST OF FACILITIES	**$200,000**
- Planning (3%)	$6,000
- Design (7%)	$14,000
- Construction Engineering (1%)	$2,000
Legal Assistance (2%)	$4,000
Fiscal Services (2%)	$4,000
All Other Facilities Contingency (20%)	$40,000
Environmental & Archaeology Studies and Mitigation	$22,000
Land Acquisition and Surveying (1 acres)	$20,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$11,000
TOTAL COST OF PROJECT	**$323,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$23,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (48223 kW-hr @ 0.09 $/kW-hr)	$4,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$29,000**

Available Project Yield (acft/yr)	325
Annual Cost of Water ($ per acft), based on PF=0	$89
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$18
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.27
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.06
MP	*1/1/2025*

11.3.10 Fisher County

WUG: Fisher County Mining

Strategy: Blaine Aquifer Development

Source: Blaine Aquifer

Facilities: Well Field, collection pipes

Total Capital Cost: $1,547,000

Total Project Cost: $2,272,000

Total Annual Cost: $198,000 (Maximum of Phased Costs)

Available Project Yield: 166 acft/yr

Annual Cost of Water: $1,193 per acft/yr (Maximum of Phased Costs)

This project will include two 76 gpm wells drilled to 55 ft,10,560 ft of transmission pipeline, and disinfection treatment.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Mining Fisher - Mining_Blaine_Fisher***	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,512,000
Water Treatment Plant (0.2 MGD)	$35,000
TOTAL COST OF FACILITIES	**$1,547,000**

- Planning (3%)	$46,000
- Design (7%)	$108,000
- Construction Engineering (1%)	$15,000
Legal Assistance (2%)	$31,000
Fiscal Services (2%)	$31,000
All Other Facilities Contingency (20%)	$309,000
Environmental & Archaeology Studies and Mitigation	$85,000
Land Acquisition and Surveying (11 acres)	$28,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$72,000
TOTAL COST OF PROJECT	**$2,272,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$160,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$15,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$21,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (27710 kW-hr @ 0.09 $/kW-hr)	$2,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$198,000**
Available Project Yield (acft/yr)	166
Annual Cost of Water ($ per acft), based on PF=0	$1,193
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$229
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.66
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.70
Plummer	*1/27/2025*

WUG: Fisher, County-Other

Strategy: Seymour Aquifer Development

Source: Seymour Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $139,000

Total Project Cost: $219,000

Total Annual Cost: $16,000

Available Project Yield: 25 acft/yr

Annual Cost of Water: $640 per acft/yr or $1.96 per 1,000 gal

This project will include two 50 gpm wells drilled to 65 ft with 700 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Fisher, County-Other - Fisher, County-Other, New Well(s) in the Seymour Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$139,000
TOTAL COST OF FACILITIES	**$139,000**
- Planning (3%)	$4,000
- Design (7%)	$10,000
- Construction Engineering (1%)	$1,000
Legal Assistance (2%)	$3,000
Fiscal Services (2%)	$3,000
All Other Facilities Contingency (20%)	$28,000
Environmental & Archaeology Studies and Mitigation	$14,000
Land Acquisition and Surveying (1 acres)	$10,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$7,000
TOTAL COST OF PROJECT	**$219,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$15,000
Reservoir Debt Service (3.5 percent, 40 years)	$0

Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (5350 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$16,000**
Available Project Yield (acft/yr)	25
Annual Cost of Water ($ per acft), based on PF=0	$640
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$40
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.96
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.12
MP	*1/1/2025*

WUG: The Bitter Creek WSC

Strategy: Blaine Aquifer Development

Source: Blaine Aquifer

Facilities: Well Field, collection pipes, treatment

Total Capital Cost: $305,000

Total Project Cost: $511,000

Total Annual Cost: $55,311 (Maximum of Phased Costs)

Available Project Yield: 50 acft/yr

Annual Cost of Water: $309 per acft/yr (Maximum of Phased Costs)

This project will include one 100 gpm wells drilled to 250 ft, 600 ft of pipeline, and water treatment.

11.3.11 Grimes County

WUG: Grimes Mining

Strategy: Gulf Coast Aquifer Development

Source: Gulf Coast Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $1,309,000

Total Project Cost: $1,934,000

Total Annual Cost: $155,000

Available Project Yield: 248 acft/yr

Annual Cost of Water: $625 per acft/yr or $1.92 per 1,000 gal

This project will include three 100 gpm wells drilled to 400 ft with 2,500 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Grimes, Mining - Gulf Coast Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,309,000
TOTAL COST OF FACILITIES	**$1,309,000**
- Planning (3%)	$39,000
- Design (7%)	$92,000
- Construction Engineering (1%)	$13,000
Legal Assistance (2%)	$26,000
Fiscal Services (2%)	$26,000
All Other Facilities Contingency (20%)	$262,000
Environmental & Archaeology Studies and Mitigation	$58,000
Land Acquisition and Surveying (3 acres)	$48,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$61,000
TOTAL COST OF PROJECT	**$1,934,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$136,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	

Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$13,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (70841 kW-hr @ 0.09 $/kW-hr)	$6,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$155,000**
Available Project Yield (acft/yr)	248
Annual Cost of Water ($ per acft), based on PF=0	$625
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$77
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.92
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.24
MP	*1/1/2025*

WUG: Grimes Irrigation

Strategy: Gulf Coast Aquifer Development

Source: Gulf Coast Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $1,309,000

Total Project Cost: $1,934,000

Total Annual Cost: $154,000

Available Project Yield: 181 acft/yr

Annual Cost of Water: $851 per acft/yr or $2.61 per 1,000 gal

This project will include three 100 gpm wells drilled to 400 ft with 2,500 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Grimes, Irrigation - Gulf Coast Aquifer Development***
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$1,309,000
TOTAL COST OF FACILITIES	**$1,309,000**
- Planning (3%)	$39,000
- Design (7%)	$92,000
- Construction Engineering (1%)	$13,000
Legal Assistance (2%)	$26,000
Fiscal Services (2%)	$26,000
All Other Facilities Contingency (20%)	$262,000
Environmental & Archaeology Studies and Mitigation	$58,000
Land Acquisition and Surveying (3 acres)	$48,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$61,000
TOTAL COST OF PROJECT	**$1,934,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$136,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$13,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (51702 kW-hr @ 0.09 $/kW-hr)	$5,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$154,000**
Available Project Yield (acft/yr)	181
Annual Cost of Water ($ per acft), based on PF=0	$851
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$99

Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.61
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.31
MP	*1/1/2025*

11.3.12 Hamilton County

WUG: Hamilton, Manufacturing

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $193,000

Total Project Cost: $293,000

Total Annual Cost: $26,000

Available Project Yield: 22 acft/yr

Annual Cost of Water: $1,182 per acft/yr or $3.63 per 1,000 gal

This project will include one 50 gpm well drilled to 500 ft with 600 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Hamilton, Manufacturing - Hamilton, Manufacturing, New Well(s) in the Trinity Aquifer	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$193,000
TOTAL COST OF FACILITIES	**$193,000**
- Planning (3%)	$6,000
- Design (7%)	$14,000
- Construction Engineering (1%)	$2,000
Legal Assistance (2%)	$4,000
Fiscal Services (2%)	$4,000
All Other Facilities Contingency (20%)	$39,000

Environmental & Archaeology Studies and Mitigation	$12,000
Land Acquisition and Surveying (1 acres)	$9,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$10,000
TOTAL COST OF PROJECT	**$293,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$21,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (33344 kW-hr @ 0.09 $/kW-hr)	$3,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$26,000**
Available Project Yield (acft/yr)	22
Annual Cost of Water ($ per acft), based on PF=0	$1,182
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$227
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.63
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.70
MP	*1/1/2025*

WUG: Hamilton, Irrigation

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $755,000

Total Project Cost: $1,135,000

Total Annual Cost: $126,000

Available Project Yield: 284 acft/yr

Annual Cost of Water: $444 per acft/yr or $1.36 per 1,000 gal

This project will include five 50 gpm wells drilled to 500 ft with 1,500 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Hamilton, Irrigation - Hamilton, Irrigation, New Well(s) in the Trinity Aquifer***	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$755,000
TOTAL COST OF FACILITIES	**$755,000**
- Planning (3%)	$23,000
- Design (7%)	$53,000
- Construction Engineering (1%)	$8,000
Legal Assistance (2%)	$15,000
Fiscal Services (2%)	$15,000
All Other Facilities Contingency (20%)	$151,000
Environmental & Archaeology Studies and Mitigation	$42,000
Land Acquisition and Surveying (3 acres)	$37,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$36,000
TOTAL COST OF PROJECT	**$1,135,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$80,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$8,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (426822 kW-hr @ 0.09 $/kW-hr)	$38,000

Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$126,000**
Available Project Yield (acft/yr)	284
Annual Cost of Water ($ per acft), based on PF=0	$444
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$162
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.36
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.50
MP	*1/1/2025*

11.3.13 Hill County

WUG: Brandon Irene WSC

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $1,375,000

Total Project Cost: $1,942,000

Total Annual Cost: $155,000

Available Project Yield: 30 acft/yr (2060)

Annual Cost of Water: $5,167 per acft/yr or $15.85 per 1,000 gal

This project will include one 100 gpm wells drilled to 2,600 ft with 600 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Brandon Irene WSC - Hill, Brandon Irene WSC, New Well(s) in the Trinity Aquifer***	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,375,000
TOTAL COST OF FACILITIES	**$1,375,000**

- Planning (3%)	$41,000
- Design (7%)	$96,000
- Construction Engineering (1%)	$14,000
Legal Assistance (2%)	$27,000
Fiscal Services (2%)	$27,000
All Other Facilities Contingency (20%)	$275,000
Environmental & Archaeology Studies and Mitigation	$14,000
Land Acquisition and Surveying (1 acres)	$11,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$62,000
TOTAL COST OF PROJECT	**$1,942,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$137,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$14,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (46335 kW-hr @ 0.09 $/kW-hr)	$4,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$155,000**
Available Project Yield (acft/yr)	30
Annual Cost of Water ($ per acft), based on PF=0	$5,167
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$600
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$15.85
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.84
MP	*1/1/2025*

11.3.14 Hood County

WUG: Acton MUD

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well Field, collection pipes, treatment

Total Capital Cost: $2,317,000

Total Project Cost: $3,385,000

Total Annual Cost: $304,000

Available Project Yield: 418 acft/yr

Annual Cost of Water: $727 per acft/yr or $2.23 per 1,000 gal

This project will include three 150 gpm wells drilled to 500 ft as well as 1 mile of transmission pipeline and disinfection treatment.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Acton MUD - Trinity for Acton MUD	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$2,265,000
Water Treatment Plant (0.4 MGD)	$52,000
TOTAL COST OF FACILITIES	**$2,317,000**
- Planning (3%)	$70,000
- Design (7%)	$162,000
- Construction Engineering (1%)	$23,000
Legal Assistance (2%)	$46,000
Fiscal Services (2%)	$46,000
All Other Facilities Contingency (20%)	$463,000
Environmental & Archaeology Studies and Mitigation	$44,000
Land Acquisition and Surveying (7 acres)	$107,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$107,000
TOTAL COST OF PROJECT	**$3,385,000**

ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$238,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$23,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$31,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (133702 kW-hr @ 0.09 $/kW-hr)	$12,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$304,000**
Available Project Yield (acft/yr)	418
Annual Cost of Water ($ per acft), based on PF=0	$727
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$158
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.23
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.48
Note: One or more cost element has been calculated externally	
Plummer	*1/27/2025*

WUG: Hood County-Other

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well Field, collection pipes

Total Capital Cost: $6,203,000

Total Project Cost: $9,303,000

Total Annual Cost: $949,000

Available Project Yield: 1,950 acft/yr

Annual Cost of Water: $487 per acft/yr or $1.49 per 1,000 gal

This project will include ten 150 gpm wells drilled to 500 ft as well as 1,000 ft of transmission pipeline per well.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Hood County-Other - Trinity for Hood County-Other	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$6,203,000
TOTAL COST OF FACILITIES	**$6,203,000**
- Planning (3%)	$186,000
- Design (7%)	$434,000
- Construction Engineering (1%)	$62,000
Legal Assistance (2%)	$124,000
Fiscal Services (2%)	$124,000
All Other Facilities Contingency (20%)	$1,241,000
Environmental & Archaeology Studies and Mitigation	$271,000
Land Acquisition and Surveying (15 acres)	$365,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$293,000
TOTAL COST OF PROJECT	**$9,303,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$655,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$62,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (2578807 kW-hr @ 0.09 $/kW-hr)	$232,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$949,000**

Available Project Yield (acft/yr)	1,950
Annual Cost of Water ($ per acft), based on PF=0	$487
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$151
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.49
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.46
Note: One or more cost element has been calculated externally	
Plummer	*1/27/2025*

WUG: Hood County Mining

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well Field, collection pipes

Total Capital Cost: $4,372,000

Total Project Cost: $6,465,000

Total Annual Cost: $571,000

Available Project Yield: 4,150 acft/yr

Annual Cost of Water: $138 per acft/yr or $0.42 per 1,000 gal

This project will include seven 500 gpm wells drilled to 400 ft as well as 1,000 ft of transmission pipeline per well.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Hood County Mining - Trinity for Hood County Mining	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$4,372,000
TOTAL COST OF FACILITIES	**$4,372,000**
- Planning (3%)	$131,000
- Design (7%)	$306,000
- Construction Engineering (1%)	$44,000

Legal Assistance (2%)	$87,000
Fiscal Services (2%)	$87,000
All Other Facilities Contingency (20%)	$874,000
Environmental & Archaeology Studies and Mitigation	$174,000
Land Acquisition and Surveying (12 acres)	$186,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$204,000
TOTAL COST OF PROJECT	**$6,465,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$455,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$44,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (799949 kW-hr @ 0.09 $/kW-hr)	$72,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$571,000**
Available Project Yield (acft/yr)	4,150
Annual Cost of Water ($ per acft), based on PF=0	$138
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$28
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.42
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.09
Note: One or more cost element has been calculated externally	
Plummer	*1/27/2025*

WUG: Lipan

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $323,000

Total Project Cost: $507,000

Total Annual Cost: $40,000

Available Project Yied: 50 acft/yr

Annual Cost of Water: $800 per acft/yr or $0.25 per 1,000 gal

This project will include one 85 gpm wells drilled to 350 ft with 1,250 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Lipan - Trinity Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$323,000
TOTAL COST OF FACILITIES	**$323,000**
- Planning (3%)	$10,000
- Design (7%)	$23,000
- Construction Engineering (1%)	$3,000
Legal Assistance (2%)	$6,000
Fiscal Services (2%)	$6,000
All Other Facilities Contingency (20%)	$65,000
Environmental & Archaeology Studies and Mitigation	$30,000
Land Acquisition and Surveying (1 acres)	$25,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$16,000
TOTAL COST OF PROJECT	**$507,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$36,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0

Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (9082 kW-hr @ 0.09 $/kW-hr)	$1,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$40,000**
Available Project Yield (acft/yr)	50
Annual Cost of Water ($ per acft), based on PF=0	$800
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$80
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.45
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.25
MP	*1/1/2025*

WUG: Tolar

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $1,042,000

Total Project Cost: $1,580,000

Total Annual Cost: $126,000

Available Project Yield: 125 acft/yr

Annual Cost of Water: $1,008 per acft/yr or $3.09 per 1,000 gal

This project will include two 85 gpm wells drilled to 450 ft with 3000 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Tolar - Trinity Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,042,000

TOTAL COST OF FACILITIES	**$1,042,000**
- Planning (3%)	$31,000
- Design (7%)	$73,000
- Construction Engineering (1%)	$10,000
Legal Assistance (2%)	$21,000
Fiscal Services (2%)	$21,000
All Other Facilities Contingency (20%)	$208,000
Environmental & Archaeology Studies and Mitigation	$68,000
Land Acquisition and Surveying (2 acres)	$56,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$50,000
TOTAL COST OF PROJECT	**$1,580,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$111,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$10,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (59288 kW-hr @ 0.09 $/kW-hr)	$5,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$126,000**
Available Project Yield (acft/yr)	125
Annual Cost of Water ($ per acft), based on PF=0	$1,008
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$120
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.09
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.37

MP	*1/1/2025*

11.3.15 Johnson County

Strategy: City of Godley

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $812,000

Total Project Cost: $1,231,000

Total Annual Cost: $95,000

Available Project Yield: 150 acft/yr

Annual Cost of Water: $633 per acft/yr or $1.94 per 1,000 gal

This project will include two 50 gpm wells drilled to 500 ft with 2,000 ft of pipeline.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Godley - Trinity Aquifer Development

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$812,000
TOTAL COST OF FACILITIES	**$812,000**
- Planning (3%)	$24,000
- Design (7%)	$57,000
- Construction Engineering (1%)	$8,000
Legal Assistance (2%)	$16,000
Fiscal Services (2%)	$16,000
All Other Facilities Contingency (20%)	$162,000
Environmental & Archaeology Studies and Mitigation	$52,000
Land Acquisition and Surveying (2 acres)	$45,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$39,000
TOTAL COST OF PROJECT	**$1,231,000**

ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$87,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$8,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$95,000**
Available Project Yield (acft/yr)	150
Annual Cost of Water ($ per acft), based on PF=0	$633
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$53
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.94
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.16
MP	*1/1/2025*

WUG: Johnson County SUD

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well Field, collection pipes, transmission

Total Capital Cost: $9,256,000

Total Project Cost: $13,414,940

Total Annual Cost: $1,205,000 (Maximum of Phased Costs)

Available Project Yield: 1,274 acft/yr (After Full Implementation)

Annual Cost of Water: $946 per acft/yr

This project will include eight 100 gpm wells drilled to 1,500 ft as well as 2,000 ft of transmission pipeline per well.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Johnson SUD - Trinity Aquifer Development

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$9,256,000
TOTAL COST OF FACILITIES	**$9,256,000**
- Planning (3%)	$278,000
- Design (7%)	$648,000
- Construction Engineering (1%)	$93,000
Legal Assistance (2%)	$185,000
Fiscal Services (2%)	$185,000
All Other Facilities Contingency (20%)	$1,851,000
Environmental & Archaeology Studies and Mitigation	$295,000
Land Acquisition and Surveying (13 acres)	$200,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$423,000
TOTAL COST OF PROJECT	**$13,414,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$944,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$93,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (1869304 kW-hr @ 0.09 $/kW-hr)	$168,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,205,000**

Available Project Yield (acft/yr)	1,274
Annual Cost of Water ($ per acft), based on PF=0	$946
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$205
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.90
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.63
Plummer	*1/1/2025*

WUG: Parker WSC

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $1,494,000

Total Project Cost: $2,249,000

Total Annual Cost: $183,000

Available Project Yield: 124 acft/yr

Annual Cost of Water: $1,476 per acft/yr or $4.53 per 1,000 gal

This project will include one 140 gpm wells drilled to 1170 ft with 5,280 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Parker WSC - Trinity Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,494,000
TOTAL COST OF FACILITIES	**$1,494,000**
- Planning (3%)	$45,000
- Design (7%)	$105,000
- Construction Engineering (1%)	$15,000
Legal Assistance (2%)	$30,000

Fiscal Services (2%)	$30,000
All Other Facilities Contingency (20%)	$299,000
Environmental & Archaeology Studies and Mitigation	$92,000
Land Acquisition and Surveying (3 acres)	$68,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$71,000
TOTAL COST OF PROJECT	**$2,249,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$158,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$15,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$10,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$183,000**
Available Project Yield (acft/yr)	124
Annual Cost of Water ($ per acft), based on PF=0	$1,476
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$202
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$4.53
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.62
MP	*1/1/2025*

WUG: Bethesda WSC

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $5,825,000

Total Project Cost: $8,481,000

Total Annual Cost: $861,000

Available Project Yield: 1,412 acft/yr

Annual Cost of Water: $610 per acft/yr or $1.87 per 1,000 gal

This project will include four 220 gpm wells drilled to 1500 ft with 10,000 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Bethesda WSC - Trinity Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$5,825,000
TOTAL COST OF FACILITIES	**$5,825,000**
- Planning (3%)	$175,000
- Design (7%)	$408,000
- Construction Engineering (1%)	$58,000
Legal Assistance (2%)	$116,000
Fiscal Services (2%)	$116,000
All Other Facilities Contingency (20%)	$1,165,000
Environmental & Archaeology Studies and Mitigation	$197,000
Land Acquisition and Surveying (7 acres)	$154,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$267,000
TOTAL COST OF PROJECT	**$8,481,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$597,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$58,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0

Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (2289777 kW-hr @ 0.09 $/kW-hr)	$206,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$861,000**
Available Project Yield (acft/yr)	1,412
Annual Cost of Water ($ per acft), based on PF=0	$610
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$187
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.87
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.57
MP	*1/1/2025*

WUG: Bethesda WSC

Strategy: Woodbine Aquifer Development

Source: Woodbine Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $4,773,000

Total Project Cost: $7,563,000

Total Annual Cost: $589,000

Available Project Yield: 369 acft/yr

Annual Cost of Water: $1,596 per acft/yr or $4.90 per 1,000 gal

This project will include sixteen 15 gpm wells drilled to 250 ft with 20,000 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Bethesda WSC - Woodbine Aquifer Development***
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$4,773,000
TOTAL COST OF FACILITIES	**$4,773,000**
- Planning (3%)	$143,000
- Design (7%)	$334,000
- Construction Engineering (1%)	$48,000
Legal Assistance (2%)	$95,000
Fiscal Services (2%)	$95,000
All Other Facilities Contingency (20%)	$955,000
Environmental & Archaeology Studies and Mitigation	$479,000
Land Acquisition and Surveying (17 acres)	$402,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$239,000
TOTAL COST OF PROJECT	**$7,563,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$532,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$48,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (104177 kW-hr @ 0.09 $/kW-hr)	$9,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$589,000**
Available Project Yield (acft/yr)	369
Annual Cost of Water ($ per acft), based on PF=0	$1,596
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$154
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$4.90

Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.47
MP	*1/1/2025*

WUG: Grandview

Strategy: Woodbine Aquifer Development

Source: Woodbine Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $1,241,000

Total Project Cost: $1,834,000

Total Annual Cost: $163,000

Available Project Yield: 125 acft/yr

Annual Cost of Water: $1,304 per acft/yr or $4.00 per 1,000 gal

This project will include one 80 gpm wells drilled to 1700 ft with 3,000 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Grandview - Woodbine Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,241,000
TOTAL COST OF FACILITIES	**$1,241,000**
- Planning (3%)	$37,000
- Design (7%)	$87,000
- Construction Engineering (1%)	$12,000
Legal Assistance (2%)	$25,000
Fiscal Services (2%)	$25,000
All Other Facilities Contingency (20%)	$248,000
Environmental & Archaeology Studies and Mitigation	$57,000

Land Acquisition and Surveying (2 acres)	$44,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$58,000
TOTAL COST OF PROJECT	**$1,834,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$129,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$12,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (246096 kW-hr @ 0.09 $/kW-hr)	$22,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$163,000**
Available Project Yield (acft/yr)	125
Annual Cost of Water ($ per acft), based on PF=0	$1,304
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$272
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$4.00
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.83
MP	*1/1/2025*

WUG: Johnson County SUD

Strategy: Woodbine Aquifer Development

Source: Woodbine Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $5,484,000

Total Project Cost: $8,391,000

Total Annual Cost: $673,000

Available Project Yield: 1037 acft/yr

Annual Cost of Water: $649 per acft/yr or $1.99 per 1,000 gal

This project will include sixteen 15 gpm wells drilled to 250 ft with 20,000 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Johnson County SUD - Woodbine Aquifer Development***	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$5,484,000
TOTAL COST OF FACILITIES	**$5,484,000**
- Planning (3%)	$165,000
- Design (7%)	$384,000
- Construction Engineering (1%)	$55,000
Legal Assistance (2%)	$110,000
Fiscal Services (2%)	$110,000
All Other Facilities Contingency (20%)	$1,097,000
Environmental & Archaeology Studies and Mitigation	$382,000
Land Acquisition and Surveying (14 acres)	$339,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$265,000
TOTAL COST OF PROJECT	**$8,391,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$590,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$55,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0

Advanced Water Treatment Facility	$0
Pumping Energy Costs (306197 kW-hr @ 0.09 $/kW-hr)	$28,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$673,000**
Available Project Yield (acft/yr)	1,037
Annual Cost of Water ($ per acft), based on PF=0	$649
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$80
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.99
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.25
MP	*1/1/2025*

11.3.16 Jones County

WUG: Jones County-Other

Strategy: Seymour Aquifer Development

Source: Seymour Aquifer

Facilities: Well Field, collection pipes, treatment

Total Capital Cost: $374,000

Total Project Cost: $570,000

Total Annual Cost: $49,000

Available Project Yield: 411 acft/yr

Annual Cost of Water: $119 per acft/yr or $0.37 per 1,000 gal (Maximum of Phased Costs)

This project will include four 100 gpm wells drilled to 70 ft as well as 1,400 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Jones, County-Other - Seymour Aquifer Development***	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$374,000

TOTAL COST OF FACILITIES	**$374,000**
- Planning (3%)	$11,000
- Design (7%)	$26,000
- Construction Engineering (1%)	$4,000
Legal Assistance (2%)	$7,000
Fiscal Services (2%)	$7,000
All Other Facilities Contingency (20%)	$75,000
Environmental & Archaeology Studies and Mitigation	$27,000
Land Acquisition and Surveying (3 acres)	$21,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$18,000
TOTAL COST OF PROJECT	**$570,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$40,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$4,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (53879 kW-hr @ 0.09 $/kW-hr)	$5,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$49,000**
Available Project Yield (acft/yr)	411
Annual Cost of Water ($ per acft), based on PF=0	$119
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$22
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.37
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.07
MP	*1/1/2025*

11.3.17 Kent County

WUG: Kent County-Other

Strategy: Seymour Aquifer Development

Source: Seymour Aquifer

Facilities: Well Field, collection pipes

Total Capital Cost: $169,000

Total Project Cost: $243,000

Total Annual Cost: $19,000

Available Project Yield: 20 acft/yr

Annual Cost of Water: $950 per acft/yr or $2.92 per 1,000 gal (Maximum of Phased Costs)

This project will include one 30 gpm wells drilled to 130 ft with 600 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Kent, County-Other - Seymour Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$169,000
TOTAL COST OF FACILITIES	**$169,000**
- Planning (3%)	$5,000
- Design (7%)	$12,000
- Construction Engineering (1%)	$2,000
Legal Assistance (2%)	$3,000
Fiscal Services (2%)	$3,000
All Other Facilities Contingency (20%)	$34,000
Environmental & Archaeology Studies and Mitigation	$5,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$8,000
TOTAL COST OF PROJECT	**$243,000**
ANNUAL COST	

Debt Service (3.5 percent, 20 years)	$17,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (2858 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$19,000**
Available Project Yield (acft/yr)	20
Annual Cost of Water ($ per acft), based on PF=0	$950
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$100
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.92
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.31
MP	*1/1/2025*

11.3.18 Knox County

WUG: Knox County Irrigation

Strategy: Blaine Aquifer Development

Source: Blaine Aquifer

Facilities: Well Field, collection pipes

Total Capital Cost: $672,000

Total Project Cost: $956,000

Total Annual Cost: $81,000

Available Project Yield: 383 acft/yr

Annual Cost of Water: $211 per acft/yr or $0.65 per 1,000 gal (Maximum of Phased Costs)

This project will include two 300 gpm wells drilled to 250 ft as well as 500 ft of transmission pipeline per well.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Knox County-Irrigation - Blaine Aquifer Development

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$672,000
TOTAL COST OF FACILITIES	**$672,000**
- Planning (3%)	$20,000
- Design (7%)	$47,000
- Construction Engineering (1%)	$7,000
Legal Assistance (2%)	$13,000
Fiscal Services (2%)	$13,000
All Other Facilities Contingency (20%)	$134,000
Environmental & Archaeology Studies and Mitigation	$12,000
Land Acquisition and Surveying (2 acres)	$7,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$31,000
TOTAL COST OF PROJECT	**$956,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$67,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$7,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (74287 kW-hr @ 0.09 $/kW-hr)	$7,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$81,000**

Available Project Yield (acft/yr)	383
Annual Cost of Water ($ per acft), based on PF=0	$211
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$37
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.65
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.11
Plummer	*1/27/2025*

11.3.19 Lampasas County

WUG: Lampasas

Strategy: Expand System Capacity

Source: Existing BRA Contract

Facilities: Transmission pipeline, pump station, and ground storage tank

Total Capital Cost: $2,574,000 (Lampasas Portion)

Total Project Cost: $3,803,000 (Lampasas Portion)

Total Annual Cost: $416,000 (Maximum of Phased Costs)

Available Project Yield: 1,500 acft/yr

Annual Cost of Water: $109 per acft/yr (Maximum of Phased Costs)

This project will include transmission pipeline improvements including valving, pump station improvements, tank rehabilitation, and new conveyance pipelines. Project costs would be shared with Kempner WSC.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Lampasas - 195 Pump Station Expansion (Lampasas Portion)

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Intake Pump Stations (3.4 MGD)	$1,231,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,273,000
Integration, Relocations, Backup Generator & Other	$70,000
TOTAL COST OF FACILITIES	**$2,574,000**

- Planning (3%)	$77,000
- Design (7%)	$180,000
- Construction Engineering (1%)	$26,000
Legal Assistance (2%)	$51,000
Fiscal Services (2%)	$51,000
All Other Facilities Contingency (20%)	$515,000
Environmental & Archaeology Studies and Mitigation	$46,000
Land Acquisition and Surveying (53 acres)	$50,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$233,000
TOTAL COST OF PROJECT	**$3,803,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$268,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$13,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$31,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (1154363 kW-hr @ 0.09 $/kW-hr)	$104,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$416,000**
Available Project Yield (acft/yr)	3,808
Annual Cost of Water ($ per acft), based on PF=1	$109
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$39
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.34
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.12
Note: One or more cost element has been calculated externally	
Plummer	*2/9/2025*

WUG: Lampasas County Irrigation

Strategy: Marble Falls Aquifer Development

Source: Marble Falls Aquifer

Facilities: Well Field, collection pipes, treatment

Total Capital Cost: $2,628,000

Total Project Cost: $3,772,000

Total Annual Cost: $313,000 (Maximum of Phased Costs)

Available Project Yield: 204 acft/yr

Annual Cost of Water: $1,534 per acft/yr (Maximum of Phased Costs)

This project will include one 1,000 gpm well drilled to 1,000 ft as well as 5,280 ft of transmission pipeline per well, and disinfection treatment.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Irrigation, Lampasas - Irrigation_MarbleFalls_Lampasas	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$2,591,000
Water Treatment Plant (0.2 MGD)	$37,000
TOTAL COST OF FACILITIES	**$2,628,000**
- Planning (3%)	$79,000
- Design (7%)	$184,000
- Construction Engineering (1%)	$26,000
Legal Assistance (2%)	$53,000
Fiscal Services (2%)	$53,000
All Other Facilities Contingency (20%)	$526,000
Environmental & Archaeology Studies and Mitigation	$65,000
Land Acquisition and Surveying (5 acres)	$39,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$119,000
TOTAL COST OF PROJECT	**$3,772,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$265,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$26,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0

Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$22,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (2541 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$313,000**
Available Project Yield (acft/yr)	204
Annual Cost of Water ($ per acft), based on PF=0	$1,534
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$235
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$4.71
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.72
Plummer	*1/27/2025*

WUG: Lampasas County Mining

Strategy: Ellenburger-San Saba Aquifer Development

Source: Ellenburger-San Saba Aquifer

Facilities: Well Field, collection pipes , treatment

Total Capital Cost: $2,626,000

Total Project Cost: $3,769,000

Total Annual Cost: $331,000 (Maximum of Phased Costs)

Available Project Yield: 133 acft/yr

Annual Cost of Water: $2,389 per acft/yr (Maximum of Phased Costs)

This project will include one 1,000 gpm well drilled to 1,000 ft as well as 5,280 ft of transmission pipeline, and disinfection treatment.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Mining, Lampasas - Mining_Ellenburger-San Saba_Lampasas***	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***

Well Fields (Wells, Pumps, and Piping)	$2,591,000
Water Treatment Plant (0.2 MGD)	$35,000
TOTAL COST OF FACILITIES	**$2,626,000**
- Planning (3%)	$79,000
- Design (7%)	$184,000
- Construction Engineering (1%)	$26,000
Legal Assistance (2%)	$53,000
Fiscal Services (2%)	$53,000
All Other Facilities Contingency (20%)	$525,000
Environmental & Archaeology Studies and Mitigation	$65,000
Land Acquisition and Surveying (5 acres)	$39,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$119,000
TOTAL COST OF PROJECT	**$3,769,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$265,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$26,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$21,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (216367 kW-hr @ 0.09 $/kW-hr)	$19,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$331,000**
Available Project Yield (acft/yr)	133
Annual Cost of Water ($ per acft), based on PF=0	$2,489
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$496
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$7.64
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.52

Plummer	*1/27/2025*

11.3.20 Lee County

WUG: Lee-County, Other

Strategy: Queen City Aquifer Development

Source: Queen City Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $912,000

Total Project Cost: $1,364,000

Total Annual Cost: $107,000

Available Project Yield: 99 acft/yr

Annual Cost of Water: $1,081 per acft/yr or $3.32 per 1,000 gal

This project will include two 100 gpm wells drilled to 400 ft with 2000 ft of pipeline.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Lee, County-Other - Queen City Aquifer Development

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$912,000
TOTAL COST OF FACILITIES	**$912,000**
- Planning (3%)	$27,000
- Design (7%)	$64,000
- Construction Engineering (1%)	$9,000
Legal Assistance (2%)	$18,000
Fiscal Services (2%)	$18,000
All Other Facilities Contingency (20%)	$182,000
Environmental & Archaeology Studies and Mitigation	$49,000
Land Acquisition and Surveying (2 acres)	$42,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$43,000

TOTAL COST OF PROJECT	**$1,364,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$96,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$9,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (26800 kW-hr @ 0.09 $/kW-hr)	$2,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$107,000**
Available Project Yield (acft/yr)	99
Annual Cost of Water ($ per acft), based on PF=0	$1,081
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$111
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.32
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.34
MP	*1/1/2025*

WUG: Lee-County, Other

Strategy: Sparta Aquifer Development

Source: Sparta Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $844,000

Total Project Cost: $1,271,000

Total Annual Cost: $97,000

Available Project Yield: 10 acft/yr

Annual Cost of Water: $9,700 per acft/yr or $29.76 per 1,000 gal

This project will include two 80 gpm wells drilled to 400 ft with 2000 ft of pipeline.

Cost Estimate Summary *Water Supply Project Option* *September 2023 Prices* *Lee, County-Other - Sparta Aquifer Development*	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$844,000
TOTAL COST OF FACILITIES	**$844,000**
- Planning (3%)	$25,000
- Design (7%)	$59,000
- Construction Engineering (1%)	$8,000
Legal Assistance (2%)	$17,000
Fiscal Services (2%)	$17,000
All Other Facilities Contingency (20%)	$169,000
Environmental & Archaeology Studies and Mitigation	$49,000
Land Acquisition and Surveying (2 acres)	$42,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$41,000
TOTAL COST OF PROJECT	**$1,271,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$89,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$8,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (2302 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$97,000**

Available Project Yield (acft/yr)	10
Annual Cost of Water ($ per acft), based on PF=0	$9,700
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$800
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$29.76
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$2.45
MP	*1/1/2025*

11.3.21 Limestone County

WUG: Bistone MWSD

Strategy: Carrizo-Wilcox Aquifer Development

Source: Carrizo-Wilcox Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $1,691,000

Total Project Cost: $2,403,000

Total Annual Cost: $234,000

Available Project Yield: 274 acft/yr

Annual Cost of Water: $854 per acft/yr or $2.62 per 1,000 gal

This project will include two 300 gpm wells drilled to 800 ft with 400 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Bistone Municipal WSD - Carrizo-Wilcox Aquifer Development***	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,620,000
TOTAL COST OF FACILITIES	**$1,691,000**
- Planning (3%)	$51,000

- Design (7%)	$118,000
- Construction Engineering (1%)	$17,000
Legal Assistance (2%)	$34,000
Fiscal Services (2%)	$34,000
All Other Facilities Contingency (20%)	$338,000
Environmental & Archaeology Studies and Mitigation	$22,000
Land Acquisition and Surveying (1 acres)	$22,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$76,000
TOTAL COST OF PROJECT	**$2,403,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$169,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$16,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$42,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (77972 kW-hr @ 0.09 $/kW-hr)	$7,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$234,000**
Available Project Yield (acft/yr)	274
Annual Cost of Water ($ per acft), based on PF=0	$854
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$237
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.62
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.73
MP	*1/1/2025*

11.3.22 McLennan County

WUG: Axtell WSC

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $2,454,000

Total Project Cost: $3,484,000

Total Annual Cost: $277,000

Available Project Yield: 100 acft/yr

Annual Cost of Water: $2,770 per acft/yr or $8.50 per 1,000 gal

This project will include one 250 gpm wells drilled to 3200 ft with 2500 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Axtell WSC - Trinity Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$2,454,000
TOTAL COST OF FACILITIES	**$2,454,000**
- Planning (3%)	$74,000
- Design (7%)	$172,000
- Construction Engineering (1%)	$25,000
Legal Assistance (2%)	$49,000
Fiscal Services (2%)	$49,000
All Other Facilities Contingency (20%)	$491,000
Environmental & Archaeology Studies and Mitigation	$36,000
Land Acquisition and Surveying (2 acres)	$24,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$110,000
TOTAL COST OF PROJECT	**$3,484,000**
ANNUAL COST	

Debt Service (3.5 percent, 20 years)	$245,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$25,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (76516 kW-hr @ 0.09 $/kW-hr)	$7,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$277,000**
Available Project Yield (acft/yr)	100
Annual Cost of Water ($ per acft), based on PF=0	$2,770
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$320
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$8.50
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.98
MP	*1/1/2025*

WUG: Chalk Bluff WSC

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $1,741,000

Total Project Cost: $2,471,000

Total Annual Cost: $232,000

Available Project Yield: 300 acft/yr

Annual Cost of Water: $733 per acft/yr or $2.37 per 1,000 gal

This project will include one 250 gpm wells drilled to 2200 ft with 1500 ft of pipeline.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Chalk Bluff WSC - Trinity Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,741,000
TOTAL COST OF FACILITIES	**$1,741,000**
- Planning (3%)	$52,000
- Design (7%)	$122,000
- Construction Engineering (1%)	$17,000
Legal Assistance (2%)	$35,000
Fiscal Services (2%)	$35,000
All Other Facilities Contingency (20%)	$348,000
Environmental & Archaeology Studies and Mitigation	$25,000
Land Acquisition and Surveying (1 acres)	$18,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$78,000
TOTAL COST OF PROJECT	**$2,471,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$174,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$17,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (451517 kW-hr @ 0.09 $/kW-hr)	$41,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$232,000**

Available Project Yield (acft/yr)	300
Annual Cost of Water ($ per acft), based on PF=0	$773
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$193
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.37
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.59
MP	*1/1/2025*

WUG: McLennan County-Other

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $740,000

Total Project Cost: $1,058,000

Total Annual Cost: $93,000

Available Project Yield: 150 acft/yr

Annual Cost of Water: $620 per acft/yr or $1.90 per 1,000 gal

This project will include one 100 gpm wells drilled to 1200 ft with 600 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Mclennan County Other - Trinity Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$740,000
TOTAL COST OF FACILITIES	**$740,000**
- Planning (3%)	$22,000
- Design (7%)	$52,000
- Construction Engineering (1%)	$7,000
Legal Assistance (2%)	$15,000
Fiscal Services (2%)	$15,000

All Other Facilities Contingency (20%)	$148,000
Environmental & Archaeology Studies and Mitigation	$14,000
Land Acquisition and Surveying (1 acres)	$11,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$34,000
TOTAL COST OF PROJECT	**$1,058,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$75,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$7,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (126138 kW-hr @ 0.09 $/kW-hr)	$11,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$93,000**
Available Project Yield (acft/yr)	150
Annual Cost of Water ($ per acft), based on PF=0	$620
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$120
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.90
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.37
MP	*1/1/2025*

WUG: Crawford

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $706,000

Total Project Cost: $1,018,000

Total Annual Cost: $90,000

Available Project Yield: 110 acft/yr

Annual Cost of Water: $818 per acft/yr or $2.51 per 1,000 gal

This project will include one 100 gpm wells drilled to 1000 ft with 1000 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Crawford - Trinity Aquifer Development***	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$706,000
TOTAL COST OF FACILITIES	**$706,000**
- Planning (3%)	$21,000
- Design (7%)	$49,000
- Construction Engineering (1%)	$7,000
Legal Assistance (2%)	$14,000
Fiscal Services (2%)	$14,000
All Other Facilities Contingency (20%)	$141,000
Environmental & Archaeology Studies and Mitigation	$19,000
Land Acquisition and Surveying (1 acres)	$14,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$33,000
TOTAL COST OF PROJECT	**$1,018,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$72,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$7,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0

Advanced Water Treatment Facility	$0
Pumping Energy Costs (127748 kW-hr @ 0.09 $/kW-hr)	$11,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$90,000**
Available Project Yield (acft/yr)	110
Annual Cost of Water ($ per acft), based on PF=0	$818
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$164
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.51
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.50
MP	*1/1/2025*

WUG: Levi WSC

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $1,528,000

Total Project Cost: $2,184,000

Total Annual Cost: $178,000

Available Project Yield: 30 acft/yr

Annual Cost of Water: $5,933 per acft/yr or $18.21 per 1,000 gal

This project will include one 100 gpm wells drilled to 2500 ft with 2000 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Levi WSC - Trinity Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,528,000

TOTAL COST OF FACILITIES	**$1,528,000**
- Planning (3%)	$46,000
- Design (7%)	$107,000
- Construction Engineering (1%)	$15,000
Legal Assistance (2%)	$31,000
Fiscal Services (2%)	$31,000
All Other Facilities Contingency (20%)	$306,000
Environmental & Archaeology Studies and Mitigation	$30,000
Land Acquisition and Surveying (1 acres)	$21,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$69,000
TOTAL COST OF PROJECT	**$2,184,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$154,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$15,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (99775 kW-hr @ 0.09 $/kW-hr)	$9,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$178,000**
Available Project Yield (acft/yr)	30
Annual Cost of Water ($ per acft), based on PF=0	$5,933
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$800
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$18.21
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$2.45

MP	*1/1/2025*

WUG: Spring Valley WSC

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $1,401,000

Total Project Cost: $2,006,000

Total Annual Cost: $176,000

Available Project Yield: 250 acft/yr

Annual Cost of Water: $704 per acft/yr or $2.16 per 1,000 gal

This project will include one 160 gpm wells drilled to 1500 ft with 2000 ft of pipeline.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Spring Valley WSC - Trinity Aquifer Development

Cost based on ENR CCI 13485.67 for September 2023 and

a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,401,000
TOTAL COST OF FACILITIES	**$1,401,000**
- Planning (3%)	$42,000
- Design (7%)	$98,000
- Construction Engineering (1%)	$14,000
Legal Assistance (2%)	$28,000
Fiscal Services (2%)	$28,000
All Other Facilities Contingency (20%)	$280,000
Environmental & Archaeology Studies and Mitigation	$30,000
Land Acquisition and Surveying (1 acres)	$21,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$64,000

TOTAL COST OF PROJECT	**$2,006,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$141,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$14,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (232448 kW-hr @ 0.09 $/kW-hr)	$21,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$176,000**
Available Project Yield (acft/yr)	250
Annual Cost of Water ($ per acft), based on PF=0	$704
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$140
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.16
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.43
MP	*1/1/2025*

WUG: Woodway

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $1,649,000

Total Project Cost: $2,351,000

Total Annual Cost: $211,000

Available Project Yield: 200 acft/yr

Annual Cost of Water: $1,055 per acft/yr or $3.24 per 1,000 gal

This project will include one 200 gpm wells drilled to 1800 ft with 2000 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Woodway - Trinity Aquifer Development***	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,649,000
TOTAL COST OF FACILITIES	**$1,649,000**
- Planning (3%)	$49,000
- Design (7%)	$115,000
- Construction Engineering (1%)	$16,000
Legal Assistance (2%)	$33,000
Fiscal Services (2%)	$33,000
All Other Facilities Contingency (20%)	$330,000
Environmental & Archaeology Studies and Mitigation	$30,000
Land Acquisition and Surveying (1 acres)	$21,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$75,000
TOTAL COST OF PROJECT	**$2,351,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$166,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$16,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (321581 kW-hr @ 0.09 $/kW-hr)	$29,000

Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$211,000**
Available Project Yield (acft/yr)	200
Annual Cost of Water ($ per acft), based on PF=0	$1,055
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$225
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.24
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.69
MP	*1/1/2025*

WUG: East Crawford WSC

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $1,533,000

Total Project Cost: $2,256,000

Total Annual Cost: $197,000

Available Project Yield: 113 acft/yr

Annual Cost of Water: $1,743 per acft/yr or $5.35 per 1,000 gal

This project will include one 140 gpm wells drilled to 1170 ft with 5,280 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices East Crawford WSC - Trinity Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,494,000
TOTAL COST OF FACILITIES	**$1,533,000**

- Planning (3%)	$46,000
- Design (7%)	$107,000
- Construction Engineering (1%)	$15,000
Legal Assistance (2%)	$31,000
Fiscal Services (2%)	$31,000
All Other Facilities Contingency (20%)	$306,000
Environmental & Archaeology Studies and Mitigation	$71,000
Land Acquisition and Surveying (3 acres)	$45,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$71,000
TOTAL COST OF PROJECT	**$2,256,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$159,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$15,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$23,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$197,000**
Available Project Yield (acft/yr)	113
Annual Cost of Water ($ per acft), based on PF=0	$1,743
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$336
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$5.35
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.03
MP	*1/1/2025*

11.3.23 Milam County

WUG: Rockdale

Strategy: Carrizo-Wilcox Aquifer Development

Source: Carrizo-Wilcox Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $4,594,000

Total Project Cost: $7,720,000

Total Annual Cost: $655,000

Available Project Yield: 433 acft/yr

Annual Cost of Water: $1,513 per acft/yr or $4.64 per 1,000 gal

This project will include one 1800 gpm well drilled to 1225 ft with 5,280 ft of pipeline.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Rockdale - Carrizo Wilcox Aquifer Development

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Intake Pump Stations (0 MGD)	$1,096,000
Well Fields (Wells, Pumps, and Piping)	$3,418,000
Water Treatment Plant (0.7 MGD)	$78,000
Integration, Relocations, Backup Generator & Other	$2,000
TOTAL COST OF FACILITIES	**$4,594,000**
- Planning (3%)	$138,000
- Design (7%)	$322,000
- Construction Engineering (1%)	$46,000
Legal Assistance (2%)	$92,000
Fiscal Services (2%)	$92,000
All Other Facilities Contingency (20%)	$919,000
Environmental & Archaeology Studies and Mitigation	$520,000

Land Acquisition and Surveying (35 acres)	$754,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$243,000
TOTAL COST OF PROJECT	**$7,720,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$543,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$34,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$27,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$47,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (40834 kW-hr @ 0.09 $/kW-hr)	$4,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$655,000**
Available Project Yield (acft/yr)	433
Annual Cost of Water ($ per acft), based on PF=2	$1,513
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$259
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$4.64
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$0.79
MP	*1/1/2025*

WUG: Southwest Milam WSC

Strategy: Carrizo Wilcox Aquifer Development

Source: Carrizo Wilcox Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $2,640,000

Total Project Cost: $3,852,000

Total Annual Cost: $358,000

Available Project Yield: 834 acft/yr

Annual Cost of Water: $429 per acft/yr or $1.32 per 1,000 gal

This project will include one 1000 gpm wells drilled to 1000 ft with 5,000 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Southwest Milam WSC - Carrizo-Wilcox Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$2,538,000
Water Treatment Plant (1 MGD)	$102,000
TOTAL COST OF FACILITIES	**$2,640,000**
- Planning (3%)	$79,000
- Design (7%)	$185,000
- Construction Engineering (1%)	$26,000
Legal Assistance (2%)	$53,000
Fiscal Services (2%)	$53,000
All Other Facilities Contingency (20%)	$528,000
Environmental & Archaeology Studies and Mitigation	$94,000
Land Acquisition and Surveying (3 acres)	$72,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$122,000
TOTAL COST OF PROJECT	**$3,852,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$271,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$25,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$61,000

Advanced Water Treatment Facility	$0
Pumping Energy Costs (6354 kW-hr @ 0.09 $/kW-hr)	$1,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$358,000**
Available Project Yield (acft/yr)	834
Annual Cost of Water ($ per acft), based on PF=0	$429
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$104
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.32
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.32
MP	*1/1/2025*

WUG: Milam Mining

Strategy: Queen City Aquifer Development

Source: Queen City Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $4,699,000

Total Project Cost: $7,336,000

Total Annual Cost: $576,000

Available Project Yield: 800 acft/yr

Annual Cost of Water: $720 per acft/yr or $2.21 per 1,000 gal

This project will include twenty 50 gpm wells drilled to 150 ft with 14,000 ft of pipeline.

Cost Estimate Summary *Water Supply Project Option* *September 2023 Prices* *Milam, Mining - Queen City Aquifer Development*	
Cost based on ENR CCI 13485.67 for September 2023 and *a PPI of 278.502 for September 2023*	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$4,699,000

TOTAL COST OF FACILITIES	**$4,699,000**
- Planning (3%)	$141,000
- Design (7%)	$329,000
- Construction Engineering (1%)	$47,000
Legal Assistance (2%)	$94,000
Fiscal Services (2%)	$94,000
All Other Facilities Contingency (20%)	$940,000
Environmental & Archaeology Studies and Mitigation	$404,000
Land Acquisition and Surveying (16 acres)	$357,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$231,000
TOTAL COST OF PROJECT	**$7,336,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$516,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$47,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (146818 kW-hr @ 0.09 $/kW-hr)	$13,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$576,000**
Available Project Yield (acft/yr)	800
Annual Cost of Water ($ per acft), based on PF=0	$720
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$75
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.21
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.23

MP	1/1/2025

WUG: Thorndale

Strategy: Carrizo-Wilcox Aquifer Development

Source: Carrizo-Wilcox Aquifer

Facilities: Well Field, collection pipes, transmission pipeline, treatment

Total Capital Cost: $9,414,000

Total Project Cost: $13,774,000

Total Annual Cost: $1,083,000

Available Project Yield: 200 acft/yr

Annual Cost of Water: $570 per acft/yr

This project will include two 100 gpm well drilled to 550 ft as well as 500 ft of transmission pipeline per well, 45000 feet of transmission pipeline, and disinfection treatment.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Thorndale - Carrizo Wilco Hooper Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (0 MGD)	$752,000
Transmission Pipeline (8 in. dia., 8.5 miles)	$7,421,000
Well Fields (Wells, Pumps, and Piping)	$1,240,000
Integration, Relocations, Backup Generator & Other	$1,000
TOTAL COST OF FACILITIES	**$9,414,000**
- Planning (3%)	$282,000
- Design (7%)	$659,000
- Construction Engineering (1%)	$94,000
Legal Assistance (2%)	$188,000
Fiscal Services (2%)	$188,000
Pipeline Contingency (15%)	$1,113,000
All Other Facilities Contingency (20%)	$399,000

Environmental & Archaeology Studies and Mitigation	$404,000
Land Acquisition and Surveying (28 acres)	$599,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$434,000
TOTAL COST OF PROJECT	**$13,774,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$969,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$87,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$19,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (90081 kW-hr @ 0.09 $/kW-hr)	$8,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,083,000**
Available Project Yield (acft/yr)	200
Annual Cost of Water ($ per acft), based on PF=2	$5,415
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$570
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$16.62
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$1.75
MP	*1/1/2025*

11.3.24 Nolan County

WUG: The Bitter Creek WSC

Strategy: Blaine Aquifer Development (Fisher County)

Source: Blaine Aquifer

Facilities: Well Field, collection pipe, conveyance, treatment

Total Capital Cost: $1,744,000

Total Project Cost: $2,488,000

Total Annual Cost: $205,000

Available Project Yield: 50 acft/yr

Annual Cost of Water: $4,100 per acft/yr or $12.58 per 1,000 gal (Maximum of Phased Costs)

This project will include two 500 gpm wells drilled to 75 ft, 1,000 ft of collection pipeline, 1.9 miles of transmission pipeline and pump station, and disinfection treatment.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Bitter Creek WSC - Bitter Creek WSC_Blaine_Fisher	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (0 MGD)	$218,000
Transmission Pipeline (6 in. dia., 1.9 miles)	$1,302,000
Well Fields (Wells, Pumps, and Piping)	$209,000
Water Treatment Plant (0.1 MGD)	$15,000
TOTAL COST OF FACILITIES	**$1,744,000**
- Planning (3%)	$52,000
- Design (7%)	$122,000
- Construction Engineering (1%)	$17,000
Legal Assistance (2%)	$35,000
Fiscal Services (2%)	$35,000
Pipeline Contingency (15%)	$195,000
All Other Facilities Contingency (20%)	$88,000
Environmental & Archaeology Studies and Mitigation	$79,000
Land Acquisition and Surveying (16 acres)	$42,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$79,000
TOTAL COST OF PROJECT	**$2,488,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$175,000

Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$15,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$5,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$9,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (8197 kW-hr @ 0.09 $/kW-hr)	$1,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$205,000**
Available Project Yield (acft/yr)	50
Annual Cost of Water ($ per acft), based on PF=2	$4,100
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$600
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$12.58
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$1.84
Plummer	*1/27/2025*

WUG: City of Roscoe

Strategy: Colorado Aquifer Development

Source: Colorado Aquifer

Facilities: Well Field, collection pipes, conveyance, treatment

Total Capital Cost: $8,362,000

Total Project Cost: $11,866,000

Total Annual Cost: $945,000

Available Project Yield: 89 acft/yr

Annual Cost of Water: $10,618 per acft/yr or $32.58 per 1,000 gal (Maximum of Phased Costs)

This project will include two 100 gpm wells drilled to 200 ft, 10,000 ft of collection pipeline, 8.5 miles of transmission pipeline and pump station, and disinfection treatment.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Nolan County-Roscoe - Colorado Aquifer Development

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (0 MGD)	$609,000
Transmission Pipeline (6 in. dia., 8.5 miles)	$5,858,000
Well Fields (Wells, Pumps, and Piping)	$1,870,000
Water Treatment Plant (0.1 MGD)	$25,000
TOTAL COST OF FACILITIES	**$8,362,000**
- Planning (3%)	$251,000
- Design (7%)	$585,000
- Construction Engineering (1%)	$84,000
Legal Assistance (2%)	$167,000
Fiscal Services (2%)	$167,000
Pipeline Contingency (15%)	$879,000
All Other Facilities Contingency (20%)	$501,000
Environmental & Archaeology Studies and Mitigation	$349,000
Land Acquisition and Surveying (57 acres)	$147,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$374,000
TOTAL COST OF PROJECT	**$11,866,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$835,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$77,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$15,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$15,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (36770 kW-hr @ 0.09 $/kW-hr)	$3,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$945,000**

Available Project Yield (acft/yr)	89
Annual Cost of Water ($ per acft), based on PF=2	$10,618
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$1,236
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$32.58
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$3.79
Plummer	*1/27/2025*

WUG: Nolan County Manufacturing

Strategy: Colorado Aquifer Development

Source: Colorado Aquifer

Facilities: Well Field, collection pipes, conveyance, treatment

Total Capital Cost: $2,330,000

Total Project Cost: $3,349,000

Total Annual Cost: $289,000

Available Project Yield: 133 acft/yr

Annual Cost of Water: $2,173 per acft/yr or $6.67 per 1,000 gal (Maximum of Phased Costs)

This project will include three 80 gpm wells drilled to 300 ft, 2,000 ft of collection pipe per well, 2,000 ft of transmission pipeline and pump station, and disinfection treatment.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Nolan County-Manufacturing - Colorado Aquifer Development

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Intake Pump Stations (0 MGD)	$462,000
Transmission Pipeline (6 in. dia., 0.4 miles)	$260,000
Well Fields (Wells, Pumps, and Piping)	$1,576,000
Water Treatment Plant (0.1 MGD)	$32,000
TOTAL COST OF FACILITIES	**$2,330,000**

- Planning (3%)	$70,000
- Design (7%)	$163,000
- Construction Engineering (1%)	$23,000
Legal Assistance (2%)	$47,000
Fiscal Services (2%)	$47,000
Pipeline Contingency (15%)	$39,000
All Other Facilities Contingency (20%)	$414,000
Environmental & Archaeology Studies and Mitigation	$74,000
Land Acquisition and Surveying (14 acres)	$36,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$106,000
TOTAL COST OF PROJECT	**$3,349,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$236,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$18,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$12,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$19,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (49362 kW-hr @ 0.09 $/kW-hr)	$4,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$289,000**
Available Project Yield (acft/yr)	133
Annual Cost of Water ($ per acft), based on PF=2	$2,173
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$398
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$6.67
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$1.22
Plummer	*1/27/2025*

WUG: Nolan County Mining

Strategy: Colorado Aquifer Development

Source: Colorado Aquifer

Facilities: Well Field, transmission pipeline, treatment

Total Capital Cost: $536,000

Total Project Cost: $789,000

Total Annual Cost: $71,000

Available Project Yield: 10 acft/yr

Annual Cost of Water: $7,100 per acft/yr or $21.79 per 1,000 gal (Maximum of Phased Costs)

This project will include one 20 gpm well drilled to 300 ft as well as 2,000 ft of transmission pipeline and pump station, and disinfection treatment.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Nolan County-Mining - Colorado Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (0 MGD)	$101,000
Transmission Pipeline (6 in. dia., 0.2 miles)	$130,000
Well Fields (Wells, Pumps, and Piping)	$290,000
Water Treatment Plant (0.1 MGD)	$15,000
TOTAL COST OF FACILITIES	**$536,000**
- Planning (3%)	$16,000
- Design (7%)	$38,000
- Construction Engineering (1%)	$5,000
Legal Assistance (2%)	$11,000
Fiscal Services (2%)	$11,000
Pipeline Contingency (15%)	$20,000
All Other Facilities Contingency (20%)	$81,000
Environmental & Archaeology Studies and Mitigation	$27,000
Land Acquisition and Surveying (7 acres)	$19,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$25,000

TOTAL COST OF PROJECT	**$789,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$55,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$4,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$3,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$9,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (3918 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$71,000**
Available Project Yield (acft/yr)	10
Annual Cost of Water ($ per acft), based on PF=2	$7,100
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$1,600
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$21.79
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$4.91
Plummer	*1/27/2025*

11.3.25 Palo Pinto County

WUG: City of Gordon

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well Field, collection pipes, disinfection, and pipeline

Total Capital Cost: $1,246,000

Total Project Cost: $1,946,000

Total Annual Cost: $177,000

Available Project Yield: 124 acft/yr

Annual Cost of Water: $1,427 per acft/yr or $4.38 per 1,000 gal

This project will include one 180 gpm well drilled to 420 ft, 5,280 ft of transmission pipeline, and disinfection.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Gordon - Gordon_Trinity_Erath***	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,203,000
Water Treatment Plant (0.3 MGD)	$43,000
TOTAL COST OF FACILITIES	**$1,246,000**
- Planning (3%)	$37,000
- Design (7%)	$87,000
- Construction Engineering (1%)	$12,000
Legal Assistance (2%)	$25,000
Fiscal Services (2%)	$25,000
All Other Facilities Contingency (20%)	$249,000
Environmental & Archaeology Studies and Mitigation	$112,000
Land Acquisition and Surveying (5 acres)	$91,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$62,000
TOTAL COST OF PROJECT	**$1,946,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$137,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$12,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$26,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (20774 kW-hr @ 0.09 $/kW-hr)	$2,000

Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$177,000**
Available Project Yield (acft/yr)	124
Annual Cost of Water ($ per acft), based on PF=0	$1,427
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$323
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$4.38
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.99
Note: One or more cost element has been calculated externally	
Plummer	*1/27/2025*

WUG: City of Strawn

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well Field, collection pipes, disinfection, and pipeline from Strawn to Erath County

Total Capital Cost: $5,371,000

Total Project Cost: $7,732,000

Total Annual Cost: $631,000

Available Project Yield: 29 acft/yr

Annual Cost of Water: $21,759 per acft/yr or $66.76 per 1,000 gal

This project will include one 180 gpm well drilled to 420 ft, 5,280 ft of transmission pipeline per well, disinfection, and 6 miles of pipeline to transfer water from Erath County to City of Strawn.

Cost Estimate Summary Water Supply Project Option September 2023 Prices City of Strawn - Strawn_Trinity_Erath	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (0 MGD)	$244,000
Transmission Pipeline (6 in. dia., 6 miles)	$4,482,000
Well Fields (Wells, Pumps, and Piping)	$597,000

Water Treatment Plant (0.3 MGD)	$48,000
TOTAL COST OF FACILITIES	**$5,371,000**
- Planning (3%)	$161,000
- Design (7%)	$376,000
- Construction Engineering (1%)	$54,000
Legal Assistance (2%)	$107,000
Fiscal Services (2%)	$107,000
Pipeline Contingency (15%)	$672,000
All Other Facilities Contingency (20%)	$178,000
Environmental & Archaeology Studies and Mitigation	$227,000
Land Acquisition and Surveying (36 acres)	$235,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$244,000
TOTAL COST OF PROJECT	**$7,732,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$544,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$51,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$6,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$29,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (9368 kW-hr @ 0.09 $/kW-hr)	$1,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$631,000**
Available Project Yield (acft/yr)	29
Annual Cost of Water ($ per acft), based on PF=2	$21,759
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$3,000
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$66.76
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$9.21

Note: One or more cost element has been calculated externally
Plummer 1/27/2025

WUG: Palo Pinto Mining

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well Field, collection pipes, disinfection and pipeline from Palo Pinto Mining to Erath County

Total Capital Cost: $9,792,000

Total Project Cost: $14,768,000

Total Annual Cost: $1,215,000

Available Project Yield: 649 acft/yr

Annual Cost of Water: $1,872 per acft/yr or $5.74 per 1,000 gal

This project will include four 180 gpm wells drilled to 420 ft, as well as 21,120 ft of collection pipeline, disinfection, pump station, and 3.5 miles of transmission pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Mining Palo Pinto - Mining Palo Pinto_Trinity_Erath	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (0 MGD)	$874,000
Transmission Pipeline (10 in. dia., 3.5 miles)	$3,509,000
Well Fields (Wells, Pumps, and Piping)	$5,312,000
Water Treatment Plant (0.8 MGD)	$86,000
Integration, Relocations, Backup Generator & Other	$11,000
TOTAL COST OF FACILITIES	**$9,792,000**
- Planning (3%)	$294,000
- Design (7%)	$685,000
- Construction Engineering (1%)	$98,000
Legal Assistance (2%)	$196,000
Fiscal Services (2%)	$196,000

Pipeline Contingency (15%)	$526,000
All Other Facilities Contingency (20%)	$1,256,000
Environmental & Archaeology Studies and Mitigation	$595,000
Land Acquisition and Surveying (44 acres)	$665,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$465,000
TOTAL COST OF PROJECT	**$14,768,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,038,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$88,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$22,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$51,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (177700 kW-hr @ 0.09 $/kW-hr)	$16,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,215,000**
Available Project Yield (acft/yr)	649
Annual Cost of Water ($ per acft), based on PF=1	$1,872
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$273
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$5.74
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.84
Plummer	*1/27/2025*

WUG: Palo Pinto Irrigation

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well Field, collection pipes, disinfection and pipeline

Total Capital Cost: $25,344,000

Total Project Cost: $39,990,000

Total Annual Cost: $3,379,000

Available Project Yield: 1,911 acft/yr

Annual Cost of Water: $2,230 per acft/yr or $5.86 per 1,000 gal

This project will include ten 180 gpm wells drilled to 420 ft as well as 52,800 ft of transmission pipeline, and disinfection.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Irrigation Palo Pinto - Irrigation Palo Pinto_Trinity_Erath	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (0 MGD)	$2,605,000
Transmission Pump Station(s) & Storage Tank(s)	$7,683,000
Well Fields (Wells, Pumps, and Piping)	$14,820,000
Water Treatment Plant (2 MGD)	$167,000
Integration, Relocations, Backup Generator & Other	$69,000
TOTAL COST OF FACILITIES	**$25,344,000**
- Planning (3%)	$760,000
- Design (7%)	$1,774,000
- Construction Engineering (1%)	$253,000
Legal Assistance (2%)	$507,000
Fiscal Services (2%)	$507,000
All Other Facilities Contingency (20%)	$5,069,000
Environmental & Archaeology Studies and Mitigation	$1,925,000
Land Acquisition and Surveying (166 acres)	$2,594,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,257,000
TOTAL COST OF PROJECT	**$39,990,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,809,000
Reservoir Debt Service (3.5 percent, 40 years)	$0

Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$174,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$194,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$100,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (1128612 kW-hr @ 0.09 $/kW-hr)	$102,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$3,379,000**
Available Project Yield (acft/yr)	1,768
Annual Cost of Water ($ per acft), based on PF=2	$1,911
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$322
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$5.86
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$0.99
Note: One or more cost element has been calculated externally	
Plummer	*1/27/2025*

11.3.26 Robertson County

WUG: Robertson County WSC

Strategy: Carrizo Wilcox Aquifer Development

Source: Carrizo Wilcox Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $3,784,000

Total Project Cost: $5,477,000

Total Annual Cost: $682,000

Available Project Yield: 550 acft/yr

Annual Cost of Water: $1,142 per acft/yr or $3.50 per 1,000 gal

This project will include four 150 gpm wells drilled to 1080 ft with 5,000 ft of pipeline.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Robertson County WSC - Carrizo-Wilcox Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$3,682,000
Water Treatment Plant (1 MGD)	$102,000
TOTAL COST OF FACILITIES	**$3,784,000**
- Planning (3%)	$114,000
- Design (7%)	$265,000
- Construction Engineering (1%)	$38,000
Legal Assistance (2%)	$76,000
Fiscal Services (2%)	$76,000
All Other Facilities Contingency (20%)	$757,000
Environmental & Archaeology Studies and Mitigation	$107,000
Land Acquisition and Surveying (5 acres)	$87,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$173,000
TOTAL COST OF PROJECT	**$5,477,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$385,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$37,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$61,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (1612774 kW-hr @ 0.09 $/kW-hr)	$145,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$628,000**

Available Project Yield (acft/yr)	550
Annual Cost of Water ($ per acft), based on PF=0	$1,142
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$442
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.50
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.36
MP	*1/1/2025*

WUG: Robertson County Other

Strategy: Carrizo Wilcox Aquifer Development

Source: Carrizo Wilcox Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $712,000

Total Project Cost: $1,055,000

Total Annual Cost: $84,000

Available Project Yield: 75 acft/yr

Annual Cost of Water: $1,120 per acft/yr or $3.04 per 1,000 gal

This project will include one 100 gpm wells drilled to 700 ft with 2,000 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Robertson County,Other - Carrizo-Wilcox Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$712,000
TOTAL COST OF FACILITIES	**$712,000**
- Planning (3%)	$21,000
- Design (7%)	$50,000
- Construction Engineering (1%)	$7,000
Legal Assistance (2%)	$14,000
Fiscal Services (2%)	$14,000
All Other Facilities Contingency (20%)	$142,000
Environmental & Archaeology Studies and Mitigation	$35,000

Land Acquisition and Surveying (1 acres)	$26,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$34,000
TOTAL COST OF PROJECT	**$1,055,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$74,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$7,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (31571 kW-hr @ 0.09 $/kW-hr)	$3,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$84,000**
Available Project Yield (acft/yr)	75
Annual Cost of Water ($ per acft), based on PF=0	$1,120
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$133
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.44
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.41
MP	*1/1/2025*

11.3.27 Stephens County

WUG: Stephens County Irrigation

Strategy: Other Aquifer Development

Source: Other Aquifer

Facilities: Well Field and collection pipes

Total Capital Cost: $188,000

Total Project Cost: $277,000

Total Annual Cost: $22,000

Available Project Yield: 30 acft/yr

Annual Cost of Water: $733 per acft/yr or $2.25 per 1,000 gal (Maximum of Phased Costs)

This project will include two 25 gpm wells drilled to 200 ft as well as 600 ft of transmission pipeline.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Stephens County Irrigation - Other Aquifer Development

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$188,000
TOTAL COST OF FACILITIES	**$188,000**
- Planning (3%)	$6,000
- Design (7%)	$13,000
- Construction Engineering (1%)	$2,000
Legal Assistance (2%)	$4,000
Fiscal Services (2%)	$4,000
All Other Facilities Contingency (20%)	$38,000
Environmental & Archaeology Studies and Mitigation	$8,000
Land Acquisition and Surveying (2 acres)	$5,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$9,000
TOTAL COST OF PROJECT	**$277,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$19,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (8790 kW-hr @ 0.09 $/kW-hr)	$1,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$22,000**

Available Project Yield (acft/yr)	30
Annual Cost of Water ($ per acft), based on PF=0	$733
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$100
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.25
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.31
Plummer	*1/27/2025*

11.3.28 Stonewall County

WUG: Stonewall County Mining

Strategy: Blaine Aquifer Development

Source: Blaine Aquifer

Facilities: Well Field and collection pipes

Total Capital Cost: $970,000

Total Project Cost: $1,394,000

Total Annual Cost: $139,000

Available Project Yield: 372 acft/yr

Annual Cost of Water: $374 per acft/yr or $1.15 per 1,000 gal (Maximum of Phased Costs)

This project will include six 50 gpm wells drilled to 250 ft as well as 500 ft of transmission pipeline per well.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Stonewall County Mining - Blaine for Stonewall County Mining

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$970,000
TOTAL COST OF FACILITIES	**$970,000**
- Planning (3%)	$29,000

- Design (7%)	$68,000
- Construction Engineering (1%)	$10,000
Legal Assistance (2%)	$19,000
Fiscal Services (2%)	$19,000
All Other Facilities Contingency (20%)	$194,000
Environmental & Archaeology Studies and Mitigation	$30,000
Land Acquisition and Surveying (6 acres)	$11,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$44,000
TOTAL COST OF PROJECT	**$1,394,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$98,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$10,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (349924 kW-hr @ 0.09 $/kW-hr)	$31,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$139,000**
Available Project Yield (acft/yr)	372
Annual Cost of Water ($ per acft), based on PF=0	$374
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$110
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.15
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.34
Plummer	*1/27/2025*

11.3.29 Throckmorton County

WUG: Throckmorton County Mining

Strategy: Cross Timbers Aquifer Development

Source: Cross Timbers Aquifer

Facilities: Well Field, collection pipes

Total Capital Cost: $320,000

Total Project Cost: $510,000

Total Annual Cost: $40,000

Available Project Yield: 84 acft/yr

Annual Cost of Water: $476 per acft/yr or $1.46 per 1,000 gal

This project will include four 25 gpm wells drilled to 200 ft as well as 200 ft of transmission pipeline per well.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Throckmorton County-Mining - Cross Timbers Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$320,000
TOTAL COST OF FACILITIES	**$320,000**
- Planning (3%)	$10,000
- Design (7%)	$22,000
- Construction Engineering (1%)	$3,000
Legal Assistance (2%)	$6,000
Fiscal Services (2%)	$6,000
All Other Facilities Contingency (20%)	$64,000
Environmental & Archaeology Studies and Mitigation	$29,000
Land Acquisition and Surveying (3 acres)	$33,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$17,000
TOTAL COST OF PROJECT	**$510,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$36,000

Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (10425 kW-hr @ 0.09 $/kW-hr)	$1,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$40,000**
Available Project Yield (acft/yr)	84
Annual Cost of Water ($ per acft), based on PF=0	$476
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$48
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.46
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.15
Note: One or more cost element has been calculated externally	
Plummer	*1/27/2025*

WUG: Throckmorton County Irrigation

Strategy: Cross Timbers Aquifer Development

Source: Cross Timbers

Facilities: Well Field, collection pipes

Total Capital Cost: $398,000

Total Project Cost: $565,000

Total Annual Cost: $46,000

Available Project Yield: 152 acft/yr

Annual Cost of Water: $303 per acft/yr or $0.93 per 1,000 gal

This project will include three 94 gpm wells drilled to 200 ft as well as 200 ft of transmission pipeline per well.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Throckmorton County-Irrigation - Cross Timbers Aquifer Development

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$398,000
TOTAL COST OF FACILITIES	**$398,000**
- Planning (3%)	$12,000
- Design (7%)	$28,000
- Construction Engineering (1%)	$4,000
Legal Assistance (2%)	$8,000
Fiscal Services (2%)	$8,000
All Other Facilities Contingency (20%)	$80,000
Environmental & Archaeology Studies and Mitigation	$3,000
Land Acquisition and Surveying (2 acres)	$6,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$18,000
TOTAL COST OF PROJECT	**$565,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$40,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$4,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (18902 kW-hr @ 0.09 $/kW-hr)	$2,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$46,000**
Available Project Yield (acft/yr)	152
Annual Cost of Water ($ per acft), based on PF=0	$303
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$39

Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.93
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.12
Plummer	*1/27/2025*

11.3.30 Washington County

WUG: Washington Brenham

Strategy: Gulf Coast Aquifer Development

Source: Gulf Coast Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $4,985,000

Total Project Cost: $7,484,000

Total Annual Cost: $624,000

Available Project Yield: 250 acft/yr

Annual Cost of Water: $2,496 per acft/yr or $7.66 per 1,000 gal

This project will include three 154 gpm wells drilled to 820 ft with 21,120 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Brenham - Gulf Coast Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$4,914,000
Water Treatment Plant (0.6 MGD)	$71,000
TOTAL COST OF FACILITIES	**$4,985,000**
- Planning (3%)	$150,000
- Design (7%)	$349,000
- Construction Engineering (1%)	$50,000
Legal Assistance (2%)	$100,000

Fiscal Services (2%)	$100,000
All Other Facilities Contingency (20%)	$997,000
Environmental & Archaeology Studies and Mitigation	$309,000
Land Acquisition and Surveying (11 acres)	$208,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$236,000
TOTAL COST OF PROJECT	**$7,484,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$526,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$49,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$42,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (477509 kW-hr @ 0.09 $/kW-hr)	$7,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$624,000**
Available Project Yield (acft/yr)	250
Annual Cost of Water ($ per acft), based on PF=0	$2,496
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$392
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$7.66
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.20
MP	*1/1/2025*

WUG: Washington Mining

Strategy: Gulf Coast Aquifer Development

Source: Gulf Coast Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $2,476,000

Total Project Cost: $3,554,000

Total Annual Cost: $314,000

Available Project Yield: 1,245 acft/yr

Annual Cost of Water: $252 per acft/yr or $0.77 per 1,000 gal

This project will include four 250 gpm wells drilled to 500 ft with 1,400 ft of pipeline.

Cost Estimate Summary *Water Supply Project Option* *September 2023 Prices* *Washington Mining - Gulf Coast Aquifer Development*	
Cost based on ENR CCI 13485.67 for September 2023 and *a PPI of 278.502 for September 2023*	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,901,000
TOTAL COST OF FACILITIES	**$1,901,000**
- Planning (3%)	$57,000
- Design (7%)	$133,000
- Construction Engineering (1%)	$19,000
Legal Assistance (2%)	$38,000
Fiscal Services (2%)	$38,000
All Other Facilities Contingency (20%)	$380,000
Environmental & Archaeology Studies and Mitigation	$42,000
Land Acquisition and Surveying (3 acres)	$38,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$87,000
TOTAL COST OF PROJECT	**$2,733,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$192,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$19,000

Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (430048 kW-hr @ 0.09 $/kW-hr)	$21,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$232,000**
Available Project Yield (acft/yr)	650
Annual Cost of Water ($ per acft), based on PF=0	$357
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$62
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.10
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.19
MP	*1/1/2025*

WUG: Central Washington WSC

Strategy: Gulf Coast Aquifer Development

Source: Gulf Coast Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $729,000

Total Project Cost: $1,080,000

Total Annual Cost: $86,000

Available Project Yield: 80 acft/yr

Annual Cost of Water: $1,075 per acft/yr or $3.30 per 1,000 gal

This project will include one 150 gpm wells drilled to 500 ft with 2,000 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Washington-Central Washington WSC - Gulf Coast Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***

Well Fields (Wells, Pumps, and Piping)	$729,000
TOTAL COST OF FACILITIES	**$729,000**
- Planning (3%)	$22,000
- Design (7%)	$51,000
- Construction Engineering (1%)	$7,000
Legal Assistance (2%)	$15,000
Fiscal Services (2%)	$15,000
All Other Facilities Contingency (20%)	$146,000
Environmental & Archaeology Studies and Mitigation	$35,000
Land Acquisition and Surveying (1 acres)	$26,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$34,000
TOTAL COST OF PROJECT	**$1,080,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$76,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$7,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (28836 kW-hr @ 0.09 $/kW-hr)	$3,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$86,000**
Available Project Yield (acft/yr)	80
Annual Cost of Water ($ per acft), based on PF=0	$1,075
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$125
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.30
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.38

MP	*1/1/2025*

WUG: Washington Manufacturing

Strategy: Gulf Coast Aquifer Development

Source: Gulf Coast Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $1,715,000

Total Project Cost: $2,499,000

Total Annual Cost: $202,000

Available Project Yield: 300 acft/yr

Annual Cost of Water: $673 per acft/yr or $2.07 per 1,000 gal

This project will include three 150 gpm wells drilled to 500 ft with 2,500 ft of pipeline.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Washington Manufacturing - Gulf Coast Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,715,000
TOTAL COST OF FACILITIES	**$1,715,000**
- Planning (3%)	$51,000
- Design (7%)	$120,000
- Construction Engineering (1%)	$17,000
Legal Assistance (2%)	$34,000
Fiscal Services (2%)	$34,000
All Other Facilities Contingency (20%)	$343,000
Environmental & Archaeology Studies and Mitigation	$58,000
Land Acquisition and Surveying (3 acres)	$48,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$79,000

TOTAL COST OF PROJECT	**$2,499,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$176,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$17,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (105364 kW-hr @ 0.09 $/kW-hr)	$9,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$202,000**
Available Project Yield (acft/yr)	300
Annual Cost of Water ($ per acft), based on PF=0	$673
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$87
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.07
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.27
MP	*1/1/2025*

11.3.31 Williamson County

WUG: City of Bartlett

Strategy: Trinity Aquifer Development (Bell County)

Source: Trinity Aquifer

Facilities: Well Field, collection pipes, transmission and treatment

Total Capital Cost: $1,900,000

Total Project Cost: $2,724,000

Total Annual Cost: $248,000

Available Project Yield: 275 acft/yr (After Full Implementation)

Annual Cost of Water: $902 per acft/yr or $2.77 per 1,000 gal (Maximum of Phased Costs)

This project will include two 300 gpm wells drilled to 800 ft as well as 1,000 ft of transmission pipeline per well and disinfection treatment.

Cost Estimate Summary Water Supply Project Option September 2023 Prices City of Bartlett - Trinity Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,837,000
Water Treatment Plant (0.5 MGD)	$63,000
TOTAL COST OF FACILITIES	**$1,900,000**
- Planning (3%)	$57,000
- Design (7%)	$133,000
- Construction Engineering (1%)	$19,000
Legal Assistance (2%)	$38,000
Fiscal Services (2%)	$38,000
All Other Facilities Contingency (20%)	$380,000
Environmental & Archaeology Studies and Mitigation	$41,000
Land Acquisition and Surveying (2 acres)	$32,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$86,000
TOTAL COST OF PROJECT	**$2,724,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$192,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$18,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$38,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$248,000**

Available Project Yield (acft/yr)	275
Annual Cost of Water ($ per acft), based on PF=0	$902
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$204
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.77
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.62
JMP	*1/30/2025*

WUG: Williamson County Other

Strategy: Trinity Aquifer Development

Source: Trinity Aquifer

Facilities: Well, collection pipes

Total Capital Cost: $477,000

Total Project Cost: $703,000

Total Annual Cost: $54,000

Available Project Yield: 5 acft/yr

Annual Cost of Water: $10,800 per acft/yr or $33.14 per 1,000 gal

This project will include one 100 gpm wells drilled to 600 ft with 600 ft of pipeline.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Williamson County-Other - Trinity Aquifer Development***	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$477,000
TOTAL COST OF FACILITIES	**$477,000**
- Planning (3%)	$14,000
- Design (7%)	$33,000
- Construction Engineering (1%)	$5,000
Legal Assistance (2%)	$10,000
Fiscal Services (2%)	$10,000
All Other Facilities Contingency (20%)	$95,000

Environmental & Archaeology Studies and Mitigation	$19,000
Land Acquisition and Surveying (1 acres)	$17,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$23,000
TOTAL COST OF PROJECT	**$703,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$49,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$5,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (3885 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$54,000**
Available Project Yield (acft/yr)	5
Annual Cost of Water ($ per acft), based on PF=0	$10,800
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$1,000
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$33.14
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$3.07
MP	*1/1/2025*

11.3.32 Young County

WUG: Young County-Other

Strategy: Cross Timbers Aquifer Development

Source: Cross Timbers Aquifer

Facilities: Well Field, collection pipes, conveyance, and treatment

Total Capital Cost: $3,899,000

Total Project Cost: $5,679,000

Total Annual Cost: $470,000

Available Project Yield: 150 acft/yr

Annual Cost of Water: $1,091 per acft/yr or $3.35 per 1,000 gal

This project will include ten 20 gpm wells drilled to 200 ft, 1,000 ft of collection pipeline per well, 2,000 ft of transmission pipeline, pump station, and disinfection treatment.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Young County-County-Other - Cross Timbers Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (0 MGD)	$523,000
Transmission Pipeline (6 in. dia., 0.4 miles)	$260,000
Well Fields (Wells, Pumps, and Piping)	$3,082,000
Water Treatment Plant (0.1 MGD)	$34,000
TOTAL COST OF FACILITIES	**$3,899,000**
- Planning (3%)	$117,000
- Design (7%)	$273,000
- Construction Engineering (1%)	$39,000
Legal Assistance (2%)	$78,000
Fiscal Services (2%)	$78,000
Pipeline Contingency (15%)	$39,000
All Other Facilities Contingency (20%)	$728,000
Environmental & Archaeology Studies and Mitigation	$163,000
Land Acquisition and Surveying (25 acres)	$86,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$179,000
TOTAL COST OF PROJECT	**$5,679,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$400,000
Reservoir Debt Service (3.5 percent, 40 years)	$0

Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$33,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$13,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$20,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (47913 kW-hr @ 0.09 $/kW-hr)	$4,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$470,000**
Available Project Yield (acft/yr)	150
Annual Cost of Water ($ per acft), based on PF=2	$3,133
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$467
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$9.61
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$1.43
Plummer	*1/27/2025*

WUG: Young County Manufacturing

Strategy: Cross Timbers Aquifer Development

Source: Cross Timbers Aquifer

Facilities: Well Field, collection pipes, conveyance, and treatment

Total Capital Cost: $628,000

Total Project Cost: $932,000

Total Annual Cost: $83,000

Available Project Yield: 10 acft/yr

Annual Cost of Water: $8,300 per acft/yr or $25.47 per 1,000 gal

This project will include one 20 gpm well drilled to 200 ft, 2,000 ft of transmission pipeline and pump station, and disinfection treatment.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Young County-Manufacturing - Cross Timbers Aquifer Development***
Cost based on ENR CCI 13485.67 for September 2023 and

a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (0 MGD)	$101,000
Transmission Pipeline (6 in. dia., 0.4 miles)	$260,000
Well Fields (Wells, Pumps, and Piping)	$252,000
Water Treatment Plant (0.1 MGD)	$15,000
TOTAL COST OF FACILITIES	**$628,000**
- Planning (3%)	$19,000
- Design (7%)	$44,000
- Construction Engineering (1%)	$6,000
Legal Assistance (2%)	$13,000
Fiscal Services (2%)	$13,000
Pipeline Contingency (15%)	$39,000
All Other Facilities Contingency (20%)	$74,000
Environmental & Archaeology Studies and Mitigation	$37,000
Land Acquisition and Surveying (8 acres)	$29,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$30,000
TOTAL COST OF PROJECT	**$932,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$66,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$5,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$3,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$9,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (1748 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$83,000**

Available Project Yield (acft/yr)	10
Annual Cost of Water ($ per acft), based on PF=2	$8,300
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$1,700
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$25.47
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$5.22
Plummer	*1/27/2025*

WUG: Young County Irrigation

Strategy: Cross Timbers Aquifer Development

Source: Cross Timbers Aquifer

Facilities: Well Field, collection pipes

Total Capital Cost: $531,000

Total Project Cost: $755,000

Total Annual Cost: $63,000

Available Project Yield: 403 acft/yr

Annual Cost of Water: $156 per acft/yr or $0.48 per 1,000 gal

This project will include four 94 gpm wells drilled to 200 ft as well as 200 ft of transmission pipeline per well.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Young County-Irrigation - Cross Timbers Aquifer Development	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$531,000
TOTAL COST OF FACILITIES	**$531,000**
- Planning (3%)	$16,000
- Design (7%)	$37,000
- Construction Engineering (1%)	$5,000

Legal Assistance (2%)	$11,000
Fiscal Services (2%)	$11,000
All Other Facilities Contingency (20%)	$106,000
Environmental & Archaeology Studies and Mitigation	$5,000
Land Acquisition and Surveying (3 acres)	$9,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$24,000
TOTAL COST OF PROJECT	**$755,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$53,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$5,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (50116 kW-hr @ 0.09 $/kW-hr)	$5,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$63,000**
Available Project Yield (acft/yr)	403
Annual Cost of Water ($ per acft), based on PF=0	$156
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$25
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.48
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.08
Plummer	*1/27/2025*

11.4 Miscellaneous Purchases, Interconnects & Reallocations

11.4.1 Bell County

WUG: 439 WSC

Strategy: Purchase Raw Water Supply from Fort Cavazos

Source: Fort Cavazos (Lake Belton)

Facilities: None; purchasing raw in place in Lake Belton

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $62,600

Available Project Yield: 626 acft/yr

Annual Cost of Water: $100 per acft/yr or $0.31 per 1,000 gal

This project will include contracting with Fort Cavazos to purchase portions of Fort Cavazos's raw water supply in Lake Belton not currently required to meet projected demands. Water purchased under this strategy will be diverted, treated, and delivered to 439 WSC by Bell County WCID No. 1 using existing infrastructure. Cost of raw water is assumed and is estimated based on an approximately 33 percent markup to typical raw water wholesale cost from the Brazos River Authority.

Cost Estimate Summary Water Supply Project Option September 2023 Prices 439 WSC - Purchase Raw Water Supply from Fort Cavazos	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0

Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (626 acft/yr @ 100 $/acft)	$63,000
TOTAL ANNUAL COST	**$63,000**
Available Project Yield (acft/yr)	626
Annual Cost of Water ($ per acft), based on PF=0	$101
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$101
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.31
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.31
JMP	*2/9/2025*

WUG: 439 WSC

Strategy: Purchase Diversion, Treatment, and Delivery Capacity from Bell County WCID No. 1

Source: 439 WSC (Lake Belton)

Facilities: None; existing infrastructure assumed sufficient.

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $1,161,000

Available Project Yield: 1,161 acft/yr

Annual Cost of Water: $1,000 per acft/yr or $3.07 per 1,000 gal

This strategy includes contracting with the Bell County WCID No. 1 to increase allocated capacity to divert, treat, and deliver raw water from Lake Belton to 439 WSC by Bell County WCID No.1. Cost of water estimated based on unit cost of water associated with expansion of Bell County WCID No. 1 treatment facilities.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

439 WSC - Purchase Diversion Treatment and Delivery Capacity from Bell County WCID1

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**

ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (248 acft/yr @ 1000 $/acft)	$248,000
TOTAL ANNUAL COST	**$248,000**
Available Project Yield (acft/yr)	248
Annual Cost of Water ($ per acft), based on PF=0	$1,000
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$1,000
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.07
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$3.07
JMP	*2/9/2025*

WUG: Elm Creek WSC

Strategy: Reallocation of Supply from Moffat WSC

Source: Moffat WSC

Facilities: None; existing infrastructure assumed sufficient.

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $1,161,000

Available Project Yield: 154 acft/yr

Annual Cost of Water: $978 per acft/yr or $3.00 per 1,000 gal

This strategy involves reallocation/purchasing a portion of Moffat WSC's surplus supply from Bluebonnet WSC. Reimbursement/purchase cost of water assumed equal to Moffat WSC current contract with Bluebonnet WSC.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Elm Creek WSC - Reallocation of Supply from Moffat WSC	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (154 acft/yr @ 978 $/acft)	$151,000
TOTAL ANNUAL COST	**$151,000**
Available Project Yield (acft/yr)	154
Annual Cost of Water ($ per acft), based on PF=0	$981
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$981
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.01
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$3.01
JMP	*2/9/2025*

WUG: Harker Heights

Strategy: Purchase Raw Water Supply from Fort Hood

Source: Fort Hood (Lake Belton)

Facilities: None; purchasing raw in place in Lake Belton

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $48,700

Available Project Yield: 487 acft/yr

Annual Cost of Water: $100 per acft/yr or $0.31 per 1,000 gal

This project will include contracting with Fort Hood to purchase portions of Fort Hood's projected surplus of raw water supply in Lake Belton. Water purchased under this strategy will be diverted, treated, and delivered to Harker Heights by Bell County WCID No. 1 using existing infrastructure. Cost of raw water is assumed and is estimated based on an approximately 33 percent markup to typical raw water wholesale cost from the Brazos River Authority.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Harker Heights - Purchase Raw Water Supply from Fort Cavazos***	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (487 acft/yr @ 100 $/acft)	$49,000
TOTAL ANNUAL COST	**$49,000**
Available Project Yield (acft/yr)	487
Annual Cost of Water ($ per acft), based on PF=0	$101
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$101
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.31
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.31
JMP	*2/9/2025*

WUG: Harker Heights

Strategy: Purchase Diversion, Treatment, and Delivery Capacity from Bell County WCID No. 1

Source: Harker Heights (Lake Belton)

Facilities: None; existing infrastructure assumed sufficient.

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $1,232,000

Available Project Yield: 1,232 acft/yr

Annual Cost of Water: $1,000 per acft/yr or $3.07 per 1,000 gal

This strategy includes contracting with the Bell County WCID No. 1 to increase allocated capacity to divert, treat, and deliver raw water from Lake Belton to Harker Heights by Bell County WCID No.1. Cost of water estimated based on unit cost of water associated with expansion of Bell County WCID No. 1 treatment facilities.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Harker Heights - Purchase from Bell County WCID 1

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (185 acft/yr @ 1000 $/acft)	$185,000
TOTAL ANNUAL COST	**$185,000**

Available Project Yield (acft/yr)	185
Annual Cost of Water ($ per acft), based on PF=0	$1,000
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$1,000
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.07
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$3.07
JMP	*2/9/2025*

WUG: Bell County-Manufacturing

Strategy: Purchase Reuse Supplies from Bell County WCID No. 1 (North)

Source: Bell County WCID No. 1

Facilities: None; existing infrastructure assumed sufficient.

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $139,612

Available Project Yield: 152 acft/yr

Annual Cost of Water: $919 per acft/yr or $2.82 per 1,000 gal

This strategy includes purchasing existing reuse supplies; unit cost of reuse water based on Bell County WCID No. 1's cost to develop reuse supply.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Bell County Manufacturing - Purchase Reuse from Bell County WCID 1

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0

Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (152 acft/yr @ 1590 $/acft)	$242,000
TOTAL ANNUAL COST	**$242,000**
Available Project Yield (acft/yr)	152
Annual Cost of Water ($ per acft), based on PF=0	$1,592
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$1,592
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$4.89
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$4.89
JMP	*2/9/2025*

11.4.2 Callahan County

WUG: City of Baird

Strategy: Purchase Additional Supply from Abilene

Source: City of Abilene

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $476,684 (Maximum of Phased Costs)

Available Project Yield: 206 acft/yr

Annual Cost of Water: $2,314 per acft/yr

This project will include a contract increase of up to 206 acft/yr for additional water utilizing existing infrastructure from Abilene to the City of Baird.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Baird - Purchase additional supply from Abilene***	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***

Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (206 acft/yr @ 2314 $/acft)	$477,000
TOTAL ANNUAL COST	**$477,000**
Available Project Yield (acft/yr)	206
Annual Cost of Water ($ per acft), based on PF=0	$2,316
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$2,316
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$7.11
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$7.11
JMP	*2/9/2025*

WUG: City of Clyde

Strategy: Purchase Additional Supply from Abilene

Source: City of Abilene

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $363,000 (Maximum of Phased Costs)

Available Project Yield: 100 acft/yr

Annual Cost of Water: $2,314 per acft/yr

This project will include a contract increase of up to 100 acft/yr for additional water utilizing existing infrastructure from Abilene to the City of Clyde.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Clyde - Purchase additional supply from Abilene***	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (100 acft/yr @ 2314 $/acft)	$231,000
TOTAL ANNUAL COST	**$231,000**
Available Project Yield (acft/yr)	100
Annual Cost of Water ($ per acft), based on PF=0	$2,310
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$2,310
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$7.09
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$7.09
JMP	*2/9/2025*

11.4.3 Coryell County

WUG: Multi-County WSC

Strategy: Purchase Additional Treated Water Supply from the City of Hamilton

Source: City of Hamilton

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: maximum of $354,000

Available Project Yield: 174 acft/yr

Annual Cost of Water: $2,037 per acft/yr or $6.25 per 1,000 gal (City of Hamilton Wholesale Costs)

This project will include a contract increase of up to 174 additional acft/yr utilizing existing infrastructure from the City of Hamilton to Multi-County WSC.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
Multi-County WSC - Purchase additional supply from Hamilton

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (174 acft/yr @ 2037 $/acft)	$354,000
TOTAL ANNUAL COST	**$354,000**
Available Project Yield (acft/yr)	174
Annual Cost of Water ($ per acft), based on PF=0	$2,034
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$2,034
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$6.24
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$6.24

JMP *2/9/2025*

WUG: Flat WSC

Strategy: Purchase Additional Treated Water Supply from the City of Gatesville

Source: City of Gatesville

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: maximum of $28,798

Available Project Yield: 75 acft/yr

Annual Cost of Water: $1,466 per acft/yr or $4.50 per 1,000 gal (City of Gatesville Wholesale Cost)

This project will include a contract increase of up to 75 additional acft/yr utilizing existing infrastructure from the City of Gatesville to Flat WSC.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Flat WSC - Purchase additional supply from Gatesville

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (75 acft/yr @ 1466 $/acft)	$110,000
TOTAL ANNUAL COST	**$110,000**

Available Project Yield (acft/yr)	75
Annual Cost of Water ($ per acft), based on PF=0	$1,467
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$1,467
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$4.50
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$4.50
JMP	*2/9/2025*

WUG: City of Copperas Cove

Strategy: Purchase Raw Water Supply from Fort Hood

Source: Fort Hood (Lake Belton)

Facilities: None; purchasing raw in place in Lake Belton

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: maximum of $156,000

Available Project Yield: 1,285 acft/yr

Annual Cost of Water: $121 per acft/yr

This project will include contracting with Fort Hood to purchase Fort Hood's raw water supply from Lake Belton. Water purchased under this strategy will be diverted, treated, and delivered to Copperas Cove by Bell County WCID No. 1 using existing infrastructure. Cost of raw water is assumed and is estimated based on an approximately 33 percent markup to typical raw water wholesale cost from the Brazos River Authority.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Copperas Cover - Purchase Raw Water Supply from Fort Cavazos

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0

Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (1285 acft/yr @ 121 $/acft)	$155,000
TOTAL ANNUAL COST	**$155,000**
Available Project Yield (acft/yr)	1,285
Annual Cost of Water ($ per acft), based on PF=0	$121
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$121
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.37
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.37
JMP	*2/9/2025*

WUG: City of Gatesville

Strategy: Purchase Additional Raw Water Supply from the Brazos River Authority

Source: Coryell County OCR

Facilities: None; existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: maximum of $115,000

Available Project Yield: 1,158 acft/yr

Annual Cost of Water: $99.50/acft

This strategy includes increasing existing raw water purchase contracts with the Brazos River Authority; water supplied under this increase will be sourced from the new Coryell County OCR.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Gatesville - Purchase additional supply from BRA***
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***

Item	*Estimated Costs for Facilities*
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (1158 acft/yr @ 99.5 $/acft)	$115,000
TOTAL ANNUAL COST	**$115,000**
Available Project Yield (acft/yr)	1,158
Annual Cost of Water ($ per acft), based on PF=0	$99
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$99
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.30
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.30
JMP	*2/9/2025*

11.4.4 Eastland County

WUG: Staff WSC

Strategy: Purchase Additional Supply from Ranger

Source: City of Ranger

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: maximum of $84,734

Available Project Yield: 26 acft/yr

Annual Cost of Water: $3,259 per acft/yr or $10.00 per 1,000 gal (City of Ranger Water Rate)

This project will include a contract increase of up to 26 additional acft/yr utilizing existing infrastructure from the City of Ranger to Staff WSC.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Staff WSC - Purchase additional supply from Ranger***	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (26 acft/yr @ 3259 $/acft)	$85,000
TOTAL ANNUAL COST	**$85,000**
Available Project Yield (acft/yr)	26
Annual Cost of Water ($ per acft), based on PF=0	$3,269
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$3,269
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$10.03
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$10.03
JMP	*2/9/2025*

11.4.5 Erath County

WUG: Erath County-Manufacturing

Strategy: Purchase Additional Supply from the City of Stephenville

Source: City of Stephenville

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $22,000 (Maximum of Phased Costs)

Available Project Yield: 17 acft/yr

Annual Cost of Water: $1,271 per acft/yr or $3.90 per 1,000 gal

This project will include a contract increase of up to 17 additional acft/yr utilizing existing infrastructure from the City of Stephenville to Erath County-Manufacturing. Annual cost of water is estimated based on City of Stephenville's retail service rate structure.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
Erath Co Manufacturing - Purchase additional supply from Stephenville

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (17 acft/yr @ 1271 $/acft)	$22,000
TOTAL ANNUAL COST	**$22,000**
Available Project Yield (acft/yr)	17
Annual Cost of Water ($ per acft), based on PF=0	$1,294

Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$1,294
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.97
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$3.97
JMP	*2/9/2025*

11.4.6 Fisher County

WUG: City of Rotan

Strategy: Additional Purchase from the City of Snyder

Source: The City of Snyder

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $101,000

Available Project Yield: 88 acft/yr

Annual Cost of Water: $1,143 per acft/yr or $3.51 per 1,000 gal (City of Snyder Wholesale Costs)

This project will include an increase of up to 88 additional acft/yr utilizing existing infrastructure from the City of Snyder to the City of Rotan. This additional supply is already under contract from City of Snyder to City of Rotan.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Rotan - Purchase additional supply from Snyder	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0

Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (88 acft/yr @ 1143 $/acft)	$101,000
TOTAL ANNUAL COST	**$101,000**
Available Project Yield (acft/yr)	88
Annual Cost of Water ($ per acft), based on PF=0	$1,148
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$1,148
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.52
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$3.52
JMP	*2/9/2025*

11.4.7 Hill County

WUG: Chatt WSC

Strategy: Purchase Additional Supply from Files Valley WSC

Source: Files Valley WSC via Aquilla Water Supply

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $7,820

Available Project Yield: 12 acft/yr

Annual Cost of Water: $652 per acft/yr or $2.00 per 1,000 gal (White Bluff base rates)

This project will include a voluntary sale of 12 acft/yr from Files Valley WSC utilizing existing infrastructure from Aquilla Water Supply to Chatt WSC.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Chatt WSC - Purchase additional supply from Files Valley WSC***	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***

Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (12 acft/yr @ 652 $/acft)	$8,000
TOTAL ANNUAL COST	**$8,000**
Available Project Yield (acft/yr)	12
Annual Cost of Water ($ per acft), based on PF=0	$667
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$667
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.05
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$2.05
JMP	*2/9/2025*

WUG: Post Oak SUD

Strategy: Purchase Additional Supply from Corsicana

Source: Corsicana

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $539,00

Available Project Yield: 208 acft/yr

Annual Cost of Water: $2,591 per acft/yr

This project will include additional sale of 208 acft/yr utilizing existing infrastructure from Corsicana to Post Oak SUD.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Post Oak SUD - Purchase additional supply from Corsicana***	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (208 acft/yr @ 2591 $/acft)	$539,000
TOTAL ANNUAL COST	**$539,000**
Available Project Yield (acft/yr)	208
Annual Cost of Water ($ per acft), based on PF=0	$2,591
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$2,591
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$7.95
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$7.95
JMP	*2/9/2025*

WUG: Hill County-Other

Strategy: Purchase Additional Supply from Brandon-Irene WSC

Source: Brandon-Irene WSC

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $114,000

Available Project Yield: 70 acft/yr

Annual Cost of Water: $1,629 per acft/yr or $5.00 per 1,000 gal (based on Brandon-Irene tier 1 rates)

This project will include additional sale of up to 70 acft/yr utilizing existing infrastructure from Brandon-Irene WSC to Hood County-Other.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
Hill County-Other - Purchase additional supply from Brandon-Irene WSC

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (70 acft/yr @ 1629 $/acft)	$114,000
TOTAL ANNUAL COST	**$114,000**
Available Project Yield (acft/yr)	70
Annual Cost of Water ($ per acft), based on PF=0	$1,629
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$1,629
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$5.00
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$5.00
JMP	*2/9/2025*

11.4.8 Jones County

WUG: Jones County Other

Strategy: Purchase Additional Supplies from City of Abilene

Source: City of Abilene

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $280,000

Available Project Yield: 121 acft/yr

Annual Cost of Water: $2,314 per acft/yr

Cost Estimate Summary Water Supply Project Option September 2023 Prices Jones County-Other - Purchase additional supply from Abilene	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (121 acft/yr @ 2314 $/acft)	$280,000
TOTAL ANNUAL COST	**$280,000**

Available Project Yield (acft/yr)	121
Annual Cost of Water ($ per acft), based on PF=0	$2,314
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$2,314
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$7.10
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$7.10
JMP	*2/9/2025*

11.4.9 Johnson County

WUG: Bethesda WSC

Strategy: Additional Purchase from the City of Fort Worth

Source: The City of Fort Worth

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $1,532,000

Available Project Yield: 2,886 acft/yr

Annual Cost of Water: $531 per acft/yr

This project will include a contract increase of up to 2,886 additional acft/yr utilizing existing infrastructure from the City of Fort Worth to Bethesda WSC.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Bethesda WSC - Purchase additional supply from Fort Worth	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	

Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (2886 acft/yr @ 531 $/acft)	$1,532,000
TOTAL ANNUAL COST	**$1,532,000**
Available Project Yield (acft/yr)	2,886
Annual Cost of Water ($ per acft), based on PF=0	$531
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$531
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.63
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.63
JMP	*2/9/2025*

WUG: Johnson County – Steam-Electric

Strategy: Additional Purchase from reuse water from City of Cleburne

Source: City of Cleburne

Facilities: Pump station, transmission pipeline, storage tanks, and water treatment plant

Total Capital Cost: Existing Infrastructure

Total Project Cost: Existing Infrastructure

Total Annual Cost: $244,000

Available Project Yield: 571 acft/yr

Annual Cost of Water: $427 per acft/yr

This project will include a contract increase of up to 571 additional acft/yr utilizing new infrastructure from Cleburne to Johnson County – Steam Electric.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Johnson County Steam Electric - Purchase reuse from Cleburne

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*

Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (571 acft/yr @ 427 $/acft)	$244,000
TOTAL ANNUAL COST	**$244,000**
Available Project Yield (acft/yr)	571
Annual Cost of Water ($ per acft), based on PF=0	$427
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$427
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.31
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.31
JMP	*2/9/2025*

11.4.10 Limestone County

WUG: City of Mexia

Strategy: Purchase Additional Supply from Bistone Municipal Water Supply District

Source: Bistone Municipal Water Supply District

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $131,00

Available Project Yield: 363 acft/yr

Annual Cost of Water: $360 per acft/yr or $1.10 per 1,000 gal

This project will include a contract increase of up to 363 acft/yr of additional groundwater supply utilizing existing infrastructure from the Bistone Municipal Water Supply District to the City of Mexia, with some sales to the City of Wortham in Region C. Cost of water estimated based on Bistone Municipal Water Supply District's cost of developing additional supplies. Alternative Project due to MAG limitation.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
Mexia - Purchase supply from Bistone MWD

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (363 acft/yr @ 360 $/acft)	$131,000
TOTAL ANNUAL COST	**$131,000**
Available Project Yield (acft/yr)	363
Annual Cost of Water ($ per acft), based on PF=0	$361
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$361
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.11
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.11
JMP	*2/9/2025*

11.4.11 Lampasas County

WUG: Lampasas County Manufacturing

Strategy: Increase treated water contract from City of Lampasas

Source: City of Lampasas

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $24,000

Available Project Yield: 16 acft/yr

Annual Cost of Water: $1,499 per acft/yr or $4.60 per 1,000 gallons (City of Lampasas Water Rate)

This project will include a treated water contract increase of up to 16 additional acft/yr utilizing existing infrastructure from the City of Lampasas to Lampasas Manufacturing.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Lampasas Co Manufacturing - Purchase supply from Lampasas

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (16 acft/yr @ 1499 $/acft)	$24,000
TOTAL ANNUAL COST	**$24,000**

Available Project Yield (acft/yr)	16
Annual Cost of Water ($ per acft), based on PF=0	$1,500
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$1,500
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$4.60
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$4.60
JMP	*2/9/2025*

11.4.12 McLennan County

WUG: Axtell WSC

Strategy: Purchase water from City of Waco

Source: City of Waco

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $340,392

Available Project Yield: 104 acft/yr

Annual Cost of Water: $3,273 per acft/yr

This project will include a treated water contract increase for additional 104 acft/yr utilizing existing infrastructure from City of Waco to the City of Bellmead.

Cost Estimate Summary Water Supply Project Option September 2023 Prices Axtell WSC - Purchase supply from Waco	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0

Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (104 acft/yr @ 3273 $/acft)	$340,000
TOTAL ANNUAL COST	**$340,000**
Available Project Yield (acft/yr)	104
Annual Cost of Water ($ per acft), based on PF=0	$3,269
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$3,269
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$10.03
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$10.03
JMP	*2/9/2025*

WUG: East Crawford WSC

Strategy: Purchase water from City of Waco

Source: City of Waco

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $369,849

Available Project Yield: 113 acft/yr

Annual Cost of Water: $3,273 per acft/yr

This project will include a treated water contract increase for additional 113 acft/yr utilizing existing infrastructure from City of Waco to the East Crawford WSC.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***East Crawford - Purchase supply from Waco***	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***

Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (113 acft/yr @ 3273 $/acft)	$370,000
TOTAL ANNUAL COST	**$370,000**
Available Project Yield (acft/yr)	113
Annual Cost of Water ($ per acft), based on PF=0	$3,274
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$3,274
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$10.05
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$10.05
JMP	*2/9/2025*

WUG: EOL WSC

Strategy: Purchase water from City of Waco

Source: City of Waco

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $451,674

Available Project Yield: 138 acft/yr

Annual Cost of Water: $3,273 per acft/yr

This project will include a treated water contract increase for additional 138 acft/yr utilizing existing infrastructure from City of Waco to the EOL WSC.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***EOL WSC - Purchase supply from Waco***	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (138 acft/yr @ 3273 $/acft)	$452,000
TOTAL ANNUAL COST	**$452,000**
Available Project Yield (acft/yr)	138
Annual Cost of Water ($ per acft), based on PF=0	$3,275
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$3,275
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$10.05
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$10.05
JMP	*2/9/2025*

WUG: City of Hewitt

Strategy: Purchase water from City of Waco

Source: City of Waco

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $1,668,444

Available Project Yield: 771 acft/yr

Annual Cost of Water: $2,164 per acft/yr

This project will include additional 771 acft/yr utilizing existing infrastructure from City of Waco to the City of Hewitt.

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Hewitt - Purchase supply from Waco***	
Cost based on ENR CCI 13485.67 for September 2023 and ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (771 acft/yr @ 2164 $/acft)	$1,668,000
TOTAL ANNUAL COST	**$1,668,000**
Available Project Yield (acft/yr)	771
Annual Cost of Water ($ per acft), based on PF=0	$2,163
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$2,163
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$6.64
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$6.64

JMP	*2/9/2025*

WUG: Leroy Tours Gerald WSC

Strategy: Purchase water from Brazos River Authority

Source: BRA System Operations Supplies

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $386,656

Available Project Yield: 86 acft/yr

Annual Cost of Water: $4,496 per acft/yr

This project will include additional 86 acft/yr utilizing infrastructure developed by FHLM WSC.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Leroy Tours Gerald WSC - Purchase supply from BRA

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (86 acft/yr @ 4496 $/acft)	$387,000
TOTAL ANNUAL COST	**$387,000**

Available Project Yield (acft/yr)	86
Annual Cost of Water ($ per acft), based on PF=0	$4,500
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$4,500
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$13.81
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$13.81
JMP	*2/9/2025*

WUG: Leroy Tours Gerald WSC

Strategy: Alternative Purchase water from City of Waco

Source: City of Waco

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $281,478

Available Project Yield: 86 acft/yr

Annual Cost of Water: $3,273 per acft/yr

This project will include additional 86 acft/yr utilizing existing infrastructure from City of Waco to the Leroy Tours Gerald WSC.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Leroy Tours Gerald WSC - Purchase supply from Waco

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0

Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (86 acft/yr @ 3273 $/acft)	$281,000
TOTAL ANNUAL COST	**$281,000**
Available Project Yield (acft/yr)	86
Annual Cost of Water ($ per acft), based on PF=0	$3,267
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$3,267
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$10.03
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$10.03
JMP	*2/9/2025*

WUG: City of Mart

Strategy: Purchase water from City of Waco

Source: City of Waco

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $528,016

Available Project Yield: 244 acft/yr

Annual Cost of Water: $2,164 per acft/yr

This project will include additional 244 acft/yr utilizing existing infrastructure from City of Waco to the City of Mart.

Cost Estimate Summary Water Supply Project Option September 2023 Prices City of Mart - Purchase supply from Waco	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**

ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (244 acft/yr @ 2164 $/acft)	$528,000
TOTAL ANNUAL COST	**$528,000**
Available Project Yield (acft/yr)	244
Annual Cost of Water ($ per acft), based on PF=0	$2,164
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$2,164
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$6.64
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$6.64
JMP	*2/9/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Mart - Interconnect from Waco to Mart

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Intake Pump Stations (0.2 MGD)	$751,000
Transmission Pipeline (8 in. dia., 15.3 miles)	$14,410,000
Storage Tanks (Other Than at Booster Pump Stations)	$632,000
Integration, Relocations, Backup Generator & Other	$6,000
TOTAL COST OF FACILITIES	**$15,799,000**
- Planning (3%)	$474,000
- Design (7%)	$1,106,000

- Construction Engineering (1%)	$158,000
Legal Assistance (2%)	$316,000
Fiscal Services (2%)	$316,000
Pipeline Contingency (15%)	$2,161,000
All Other Facilities Contingency (20%)	$278,000
Environmental & Archaeology Studies and Mitigation	$509,000
Land Acquisition and Surveying (81 acres)	$658,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$708,000
TOTAL COST OF PROJECT	**$22,483,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,582,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$150,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$19,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (93726 kW-hr @ 0.09 $/kW-hr)	$8,000
Purchase of Water (250 acft/yr @ 979.02 $/acft)	$245,000
TOTAL ANNUAL COST	**$2,004,000**
Available Project Yield (acft/yr)	250
Annual Cost of Water ($ per acft), based on PF=1	$8,016
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$1,688
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$24.60
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$5.18
JMP	*2/20/2025*

11.4.13 Nolan County

WUG: City of Sweetwater

Strategy: Purchase water from City of Abilene

Source: City of Abilene

Facilities: Pump Station, storage tank, transmission pipeline

Total Capital Cost: $63,196,000

Total Project Cost: $90,373,000

Total Annual Cost: $11,729,000

Available Project Yield: 1,839 acft/yr

Annual Cost of Water: $6,378 per acf (includes cost to purchase water from Abilene at $2,314 per acft/yr)

This project will include an interconnection between the City of Abilene and the City of Sweetwater including 40 miles of 12 inch diameter transmission pipeline, a pump station and storage tank. Water will be purchased from the City of Abilene at an estimated wholesale rate of $2,314/acft.

Cost Estimate Summary September 2023 Prices	
City of Sweetwater – Sweetwater Nolan	
Item	***Estimated Costs for Facilities***
Primary Pump Station (1.7 MGD)	$7,116,000
Transmission Pipeline (12 in dia., 40 miles)	$45,446,000
Transmission Pump Station(s) & Storage Tank(s)	$8,752,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,681,000
TOTAL COST OF FACILITIES	**$63,196,000**
- Planning (3%)	$1,896,000
- Design (7%)	$4,424,000
- Construction Engineering (1%)	$632,000
Legal Assistance (2%)	$1,264,000
Fiscal Services (2%)	$1,264,000
Pipeline Contingency (15%)	$6,817,000
All Other Facilities Contingency (20%)	$3,550,000
Environmental & Archaeology Studies and Mitigation	$1,252,000
Land Acquisition and Surveying (216 acres)	$562,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$5,516,000
TOTAL COST OF PROJECT	**$90,373,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$6,359,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$508,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$310,000
Pumping Energy Costs (3,303,353 kW-hr @ 0.09 $/kW-hr)	$264,000

Purchase of Water (1,839 acft/yr @ 2,314 $/acft)	$4,255,000
TOTAL ANNUAL COST	**$11,729,000**
Available Project Yield (acft/yr)	1,839
Annual Cost of Water ($ per acft), based on PF=1	$6,378
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$2,920
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$19.57
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$8.96

WUG: City of Roscoe

Strategy: Additional Purchase from the City of Sweetwater

Source: City of Sweetwater

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $263,500

Available Project Yield: 107 acft/yr

Annual Cost of Water: $2,463 per acft/yr

This project will include a contract increase of up to 107 additional acft/yr utilizing existing infrastructure from the City of Sweetwater to City of Roscoe.

WUG: Nolan County Mining

Strategy: Additional Purchase from the City of Sweetwater

Source: The City of Sweetwater

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $458,100

Available Project Yield: 186 acft/yr

Annual Cost of Water: $1,031 per acft/yr

This project will include a contract increase of up to 186 additional acft/yr utilizing existing infrastructure from the City of Sweetwater to Nolan County Mining.

11.4.14 Palo Pinto County

WUG: Palo Pinto County Other

Strategy: Purchase Additional Supply from the City of Mineral Wells

Source: City of Mineral Wells

Facilities: Wholesale rate included only. Not enough information to cost delivery.

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $1,187,000

Available Project Yield: 190 acft/yr

Annual Cost of Water: $6,247 per acft/yr

This project will include a contract for the purchase of water up to 190 acft/yr. Infrastructure such as pipelines, pump stations, and storage tanks will be needed once the location(s) of use are determined.

WUG: Palo Pinto County Manufacturing

Strategy: Purchase Additional Supply from the City of Mineral Wells

Source: City of Mineral Wells

Facilities: Wholesale rate included only. Not enough information to cost delivery.

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $144,000

Available Project Yield: 23 acft/yr

Annual Cost of Water: $6,247 per acft/yr

This project will include a contract for the purchase of water up to 23 acft/yr. Infrastructure such as pipelines, pump stations, and storage tanks will be needed once the location(s) of use are determined.

11.4.15 Taylor County

WUG: Potosi WSC

Strategy: Additional Purchase from the City of Abilene

Source: The City of Abilene

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $3,892,100

Available Project Yield: 1,682 acft/yr

Annual Cost of Water: $2,314 acft/yr

This project will include a contract increase of up to additional 1,682 acft/yr utilizing existing infrastructure from the City of Abilene to Potosi WSC.

WUG: S U N WSC

Strategy: Additional Purchase from the City of Abilene

Source: The City of Abilene

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $286,900

Available Project Yield: 124 acft/yr

Annual Cost of Water: $2,314 acft/yr

This project will include a contract increase of up to additional 124 acft/yr utilizing existing infrastructure from the City of Abilene to S U N WSC.

WUG: Steamboat Mountain WSC

Strategy: Additional Purchase from the City of Abilene

Source: The City of Abilene

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $4,514,600

Available Project Yield: 1,951 acft/yr

Annual Cost of Water: $2,314 acft/yr

This project will include a contract increase of up to additional 1,951 acft/yr utilizing existing infrastructure from the City of Abilene to Steamboat Mountain WSC.

WUG: View Caps WSC

Strategy: Additional Purchase from the City of Abilene

Source: The City of Abilene

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $520,700

Available Project Yield: 225 acft/yr

Annual Cost of Water: $2,314 acft/yr

This project will include a contract increase of up to additional 225 acft/yr utilizing existing infrastructure from the City of Abilene to View Caps WSC.

WUG: Taylor County-Other

Strategy: Additional Purchase from the City of Abilene

Source: The City of Abilene

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $445,900

Available Project Yield: 197 acft/yr

Annual Cost of Water: $2,314 acft/yr

This project will include a contract increase of up to additional 197 acft/yr utilizing existing infrastructure from the City of Abilene to Taylor County-Other.

WUG: Taylor County Manufacturing

Strategy: Additional Purchase from the City of Abilene

Source: The City of Abilene

Facilities: Wholesale rate included only. Not enough information to cost delivery.

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $2,001,600

Available Project Yield: 865 acft/yr

Annual Cost of Water: $2,314 acft/yr

This project will include a contract increase of up to additional 865 acft/yr utilizing existing infrastructure from the City of Abilene to Taylor County Manufacturing.

WUG: Taylor County Mining

Strategy: Purchase of water from Abilene

Source: The City of Abilene

Facilities: Wholesale rate included only. Not enough information to cost delivery.

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $476,700

Available Project Yield: 206 acft/yr

Annual Cost of Water: $2,314 acft/yr

This project will include a contract for the purchase of water up to 206 acft/yr. Infrastructure such as pipelines, pump stations, and storage tanks will be needed once the location(s) of use are determined.

WUG: Taylor County Irrigation

Strategy: Purchase of water from Abilene

Source: The City of Abilene

Facilities: Wholesale rate included only. Not enough information to cost delivery.

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $2,665,700

Available Project Yield: 1,152 acft/yr

Annual Cost of Water: $2,314 acft/yr

This project will include a contract for the purchase of water up to 1,152 acft/yr. Infrastructure such as pipelines, pump stations, and storage tanks will be needed once the location(s) of use are determined.

11.4.16 Williamson County

WUG: City of Bartlett

Strategy: Purchase Supply from Jarrell-Schwertner WSC

Source: Jarrell-Schwertner WSC

Facilities: assumed delivery through existing infrastructure

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $672,375

Available Project Yield: 275 acft/yr

Annual Cost of Water: $2,445 per acft/yr or $7.50 per 1,000 gal

Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***City of Bartlett - Purchase supply from Jarrell-Schwertner WSC*** ***Cost based on ENR CCI 13485.67 for September 2023 and*** ***a PPI of 278.502 for September 2023***	
Item	***Estimated Costs for Facilities***

Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (275 acft/yr @ 2445 $/acft)	$672,000
TOTAL ANNUAL COST	**$672,000**
Available Project Yield (acft/yr)	275
Annual Cost of Water ($ per acft), based on PF=0	$2,444
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$2,444
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$7.50
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$7.50
JMP	*2/9/2025*

WUG: Brushy Creek MUD

Strategy: Purchase Supply from BRA

Source: BRA

Facilities: assumed delivery through existing infrastructure

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $456,000

Available Project Yield: 500 acft/yr

Annual Cost of Water: $912 per acft/yr or $2.80 per 1,000 gal

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Brushy Creek MUD - Purchase supply from BRA

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (500 acft/yr @ 912 $/acft)	$456,000
TOTAL ANNUAL COST	**$456,000**
Available Project Yield (acft/yr)	500
Annual Cost of Water ($ per acft), based on PF=0	$912
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$912
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.80
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$2.80
JMP	*2/9/2025*

WUG: City of Florence

Strategy: Purchase Supply from City of Georgetown

Source: City of Georgetown

Facilities: assumed delivery through existing infrastructure

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: maximum of $144,000

Available Project Yield: 184 acft/yr

Annual Cost of Water: maximum of $782 per acft/yr or $2.40 per 1,000 gal

Cost Estimate Summary Water Supply Project Option September 2023 Prices City of Florence - Purchase supply from Georgetown	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (184 acft/yr @ 782 $/acft)	$144,000
TOTAL ANNUAL COST	**$144,000**
Available Project Yield (acft/yr)	184
Annual Cost of Water ($ per acft), based on PF=0	$783
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$783
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.40
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$2.40
JMP	*2/9/2025*

WUG: City of Leander

Strategy: Contract Amendment with LCRA or Redistribution of Supplies through the BCRUA Project

Source: LCRA

Facilities: assumed delivery through existing infrastructure

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: maximum of $3,411,000

Available Project Yield: 4,041 acft/yr

Annual Cost of Water: $844 per acft/yr or $2.59 per 1,000 gal

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
City of Leander - Purchase supply from LCRA

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (4041 acft/yr @ 844 $/acft)	$3,411,000
TOTAL ANNUAL COST	**$3,411,000**
Available Project Yield (acft/yr)	4,041
Annual Cost of Water ($ per acft), based on PF=0	$844
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$844

Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.59
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$2.59
JMP	*2/9/2025*

WUG: Williamson County-Other

Strategy: Purchase Supply from Round Rock

Source: City of Round Rock

Facilities: assumed delivery through existing infrastructure

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: maximum of $8,406,000

Available Project Yield: 9,217 acft/yr

Annual Cost of Water: $912 per acft/yr or $2.80 per 1,000 gal

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Williamson County-Other - Purchase BCRUA supply from Round Rock

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$0
TOTAL COST OF PROJECT	**$0**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$0
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0

Purchase of Water (9217 acft/yr @ 912 $/acft)	$8,406,000
TOTAL ANNUAL COST	**$8,406,000**
Available Project Yield (acft/yr)	9,217
Annual Cost of Water ($ per acft), based on PF=0	$912
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$912
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.80
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$2.80
JMP	*2/9/2025*

11.4.17 Young County

WUG: Fort Belknap WSC

Strategy: Purchase Additional Water from the City of Graham

Source: City of Graham

Facilities: None, existing infrastructure assumed sufficient

Total Capital Cost: N/A

Total Project Cost: N/A

Total Annual Cost: $214,000

Available Project Yield: 95 acft/yr

Annual Cost of Water: $2,248 per acft/yr or $6.90 per 1,000 gal (City of Graham Wholesale Costs)

WUG: City of Graham

Strategy: Treated Water Purchase and Conveyance

Source: City of Throckmorton

Facilities: Pump station, transmission pipeline, storage tanks

Total Capital Cost: $46,201,000

Total Project Cost: $67,141,000

Total Annual Cost: $8,500,000

Available Project Yield: 1,202 acft/yr

Annual Cost of Water: $7,072 per acft/yr (Maximum of Phased Costs)

This project will include approximately thirty-seven miles of 10 inch transmission pipeline and associated pump station to convey treated surface water from the City of Throckmorton (New Throckmorton Reservoir) to the City of Graham. Project cost includes cost of purchasing water from the City of Throckmorton.

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Graham - Interconnect to Throckmorton

Item	***Estimated Costs for Facilities***
Intake Pump Stations (1.41 MGD)	$1,459,000
Transmission Pipeline (10 in. dia., 37 miles)	$36,988,000
Transmission Pump Station(s) & Storage Tank(s)	$7,619,000
Integration, Relocations, Backup Generator & Other	$135,000
TOTAL COST OF FACILITIES	**$46,201,000**
- Planning (3%)	$1,386,000
- Design (7%)	$3,234,000
- Construction Engineering (1%)	$462,000
Legal Assistance (2%)	$924,000
Fiscal Services (2%)	$924,000
Pipeline Contingency (15%)	$5,548,000
All Other Facilities Contingency (20%)	$1,843,000
Environmental & Archaeology Studies and Mitigation	$1,228,000
Land Acquisition and Surveying (199 acres)	$1,293,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$4,098,000
TOTAL COST OF PROJECT	**$67,141,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$4,724,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$405,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$142,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0

Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (2,220,136 kW-hr @ 0.09 $/kW-hr)	$200,000
Purchase of Water (1,202 acft/yr @ 2,520 $/acft)	$3,029,000
TOTAL ANNUAL COST	**$8,500,000**
Available Project Yield (acft/yr)	1,202
Annual Cost of Water ($ per acft), based on PF=1	$7,072
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$3,141
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$21.70
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$9.64

11.5 Miscellaneous WTP Upgrades and Facilities Expansions

There are a total of 15 water user groups and or wholesale water providers that will require a water treatment plant expansion, treated water reallocation or a new water treatment plant to meet potable water demand during the planning period. New or expanded treatment plants are sized for peaking capacity. However the yield of these projects is assumed to be 50% of the expansion or plant size to be consistent with the methodology for the surface water constraints. Table 11.5-1 summarizes water treatment plant strategies. This table includes only the water treatment plant strategies that are not included in any of the other Volume II water management strategy evaluations.

Table 11.5-1 Miscellaneous Strategies: Water Treatment Plant Strategies for WUGs/WWPs

WUG/WWP	Strategy	Project Yield (acft/yr)	Capital Cost	Total Project Cost	Annual Cost	Unit Cost	
						$/acft	$/kgal
Abilene	Expand WTP by 23.2	25,760	$53,637,000	$78,266,000	$9,236,000	$359	$1.110
Acton MUD and Johnson County SUD	Increase WTP Capacity (SWATS) by 10.8 MGD	6,031	$30,318,000	$42,421,000	$5,107,000	$847	$2.60
Bell County WCID No. 1	Water Treatment Plant Expansion (Lake Belton) 3 mgd x2	1,680	$12,255,000	$17,107,000	$2,237,000	$1,332	$4.09
Central Texas WSC	Water System Expansion	7,281	$65,105,000	$85,082,000	$9,517,000	$1,307	$4.01
City of Belton	Water Treatment Plant Expansion	1,167	$10,125,000	$14,148,000	$1,902,000	$1,630	$5.00

City of Gatesville	Water Treatment Plant Expansion	1,355	$7,996,000	$11,507,000	$1,443,000	$1,073	$3.29
City of Lampasas	New Water Treatment Plant	3,360	$37,227,000	$53,624,000	$6,425,000	$1,912	$5.87
City of Mineral Wells	Water Treatment Plant Expansion (8 MGD)	8,968	$41,400,000	$57,707,000	$5,796,000	$646	$1.98
City of Temple	Water Treatment Plant Expansion	4,704	$15,093,000	$21,081,000	$2,685,000	$571	$1.75
Falls County-Other (Moore WSC)	Upgrade Treatment for Arsenic	53	$200,000	$279,000	$100,000	$1,887	$5.79
Granbury North Water Treatment Plant	New Water Treatment Plant	2,800	$42,705,000	$59,504,000	$8,994,000	$3,212	$9.86
Kempner WSC	New WTP (1.8 MGD)	2,015	$9,416,000	$13,550,000	$1,682,000	$835	$2.56
McLennan County-Other (FHLM WSC)	Upgrade Treatment for Arsenic	917	$3,466,000	$4,832,000	$2,046,000	$2,231	$6.85
Prairie Hill WSC	Upgrade Treatment for Arsenic	268	$1,103,000	$1,538,000	$312,000	$1,164	$3.57
Robinson	Expand WTP by 4 MGD	4,481	$14,620,000	$20,410,000	$2,610,000	$582	$1.79

11.5.1 WTP Cost Summaries

11.5.1.1 Abilene

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

City of Abilene – WTP Expansion

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Water Treatment Plant (23.2 MGD)	$53,637,000
TOTAL COST OF FACILITIES	**$53,637,000**

- Planning (3%)	$1,609,000
- Design (7%)	$3,755,000
- Construction Engineering (1%)	$536,000
Legal Assistance (2%)	$1,073,000
Fiscal Services (2%)	$1,073,000
All Other Facilities Contingency (20%)	$10,727,000
Environmental & Archaeology Studies and Mitigation	$27,000
Land Acquisition and Surveying (12 acres)	$1,051,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$4,778,000
TOTAL COST OF PROJECT	**$78,266,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$5,430,000
Reservoir Debt Service (3.5 percent, 40 years)	$51,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$3,755,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$9,236,000**
Available Project Yield (acft/yr)	25,760
Annual Cost of Water ($ per acft), based on PF=0	$359
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$146
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.10
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.45
CJM	*1/16/2025*

11.5.1.2 Acton MUD, Granbury, and Johnson County SUD SWATS WTP Expansion

Item	*Estimated Costs for Facilities*
Water Treatment Plant (10.8 MGD)	$30,318,000
TOTAL COST OF FACILITIES	**$30,318,000**
Engineering:	
- Planning (3%)	$910,000
- Design (7%)	$2,122,000
- Construction Engineering (1%)	$303,000
Legal Assistance (2%)	$606,000
Fiscal Services (2%)	$606,000
All Other Facilities Contingency (20%)	$6,064,000
Environmental & Archaeology Studies and Mitigation	$74,000
Land Acquisition and Surveying (5 acres)	$82,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,336,000
TOTAL COST OF PROJECT	**$42,421,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,985,000
Operation and Maintenance	
Water Treatment Plant	$2,122,000
TOTAL ANNUAL COST	**$5,107,000**
Available Project Yield (acft/yr)	6,031
Annual Cost of Water ($ per acft), based on PF=0	$847
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$352
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.60
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.08
CB	*1/27/2025*

11.5.1.3 Bell County WCID No. 1 (Lake Belton)

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Bell County WCID #1 - Bell County WCID #1 WTP Expansion (Lake Belton)

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

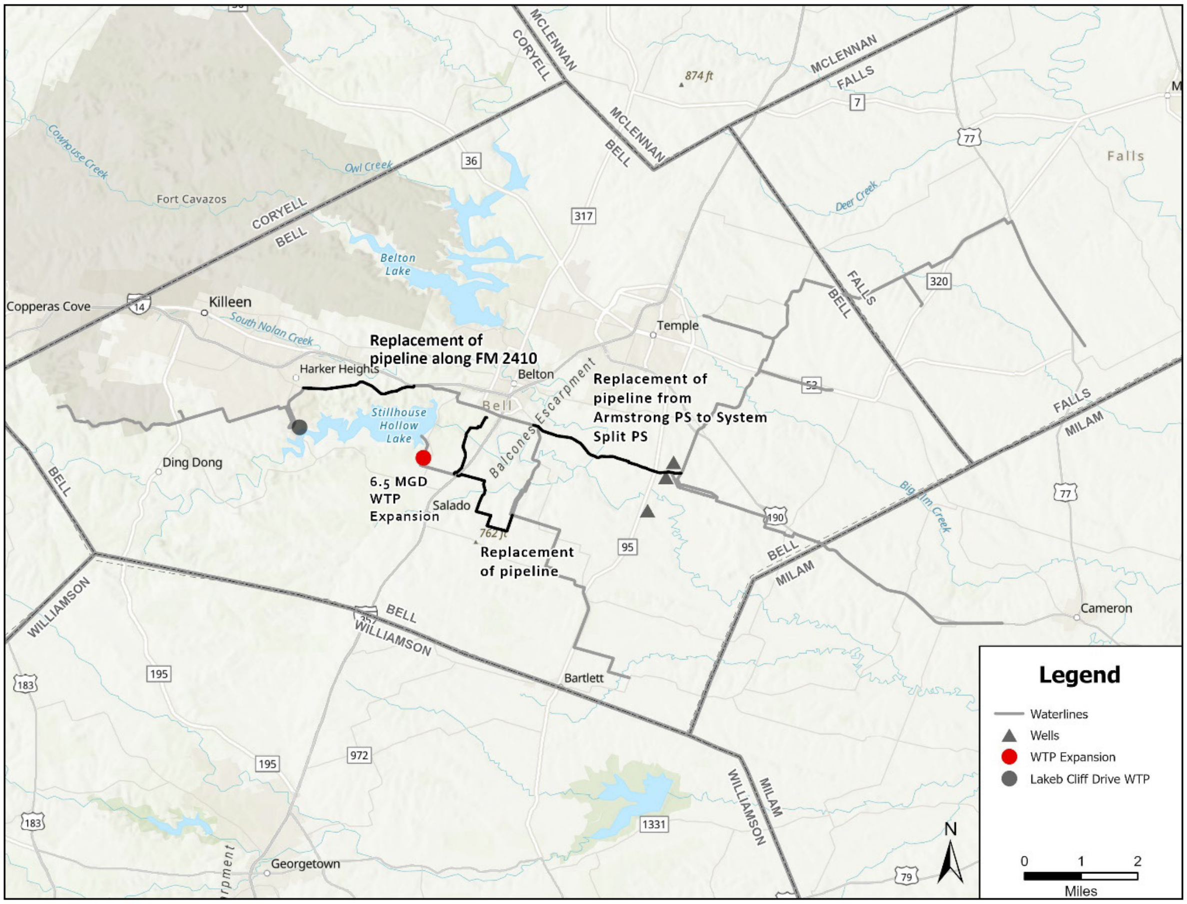
Item	***Estimated Costs for Facilities***
Water Treatment Plant (3 MGD)	$12,255,000
TOTAL COST OF FACILITIES	**$12,255,000**
- Planning (3%)	$368,000
- Design (7%)	$858,000
- Construction Engineering (1%)	$123,000
Legal Assistance (2%)	$245,000
Fiscal Services (2%)	$245,000
All Other Facilities Contingency (20%)	$2,451,000
Environmental & Archaeology Studies and Mitigation	$11,000
Land Acquisition and Surveying (2 acres)	$12,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$539,000
TOTAL COST OF PROJECT	**$17,107,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,204,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$1,033,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$2,237,000**
Available Project Yield (acft/yr)	1,680

Annual Cost of Water ($ per acft), based on PF=0	$1,332
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$615
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$4.09
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.89
JMP	*2/5/2025*

11.5.1.4 Central Texas WSC Water System Expansion

This water management strategy consists of multiple project elements with online dates between 2030 and 2040. Project elements include:

- Two - 6.5 MGD expansions and upgrade of the Doc Curb WTP including an upgrade of the existing intake structure, additional water storage, expansion of existing pump station, and addition of new pump station.
- Upgrade of the Shanklin Lane High Service Pump Station.
- Replacement of existing transmission pipeline along FM2410.
- Replacement of existing transmission pipelines from Armstrong Pump Station to System Split Pump Station and from Shanklin Lane Pump Station to Armstrong Pump Station.



Cost Estimate Summary Water Supply Project Option September 2023 Prices Central Texas WSC - Doc Curb WTP Expansion	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (18 MGD)	$2,520,000
Storage Tanks (Other Than at Booster Pump Stations)	$4,551,000
Two Water Treatment Plants (6.5 MGD and 6.5 MGD)	$34,693,000
Integration, Relocations, Backup Generator & Other	$2,876,000
TOTAL COST OF FACILITIES	**$44,640,000**
- Planning (3%)	$1,339,000
- Design (7%)	$3,125,000

- Construction Engineering (1%)	$446,000
Legal Assistance (2%)	$893,000
Fiscal Services (2%)	$893,000
All Other Facilities Contingency (11%)	$4,814,000
Environmental & Archaeology Studies and Mitigation	$57,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,824,000
TOTAL COST OF PROJECT	**$58,031,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$4,076,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$74,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$63,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$3,050,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (1579677 kW-hr @ 0.09 $/kW-hr)	$142,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$7,405,000**
Available Project Yield (acft/yr)	3,641
Annual Cost of Water ($ per acft), based on PF=2	$2,034
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$914
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$6.24
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$2.81
Note: One or more cost element has been calculated externally	
JMP	*2/17/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Central Texas WSC - Pump Station Expansion

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***

Intake Pump Stations (2 MGD)	$285,000
Integration, Relocations, Backup Generator & Other	$159,000
TOTAL COST OF FACILITIES	**$444,000**
- Planning (3%)	$13,000
- Design (7%)	$31,000
- Construction Engineering (1%)	$4,000
Legal Assistance (2%)	$9,000
Fiscal Services (2%)	$9,000
All Other Facilities Contingency (20%)	$89,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$20,000
TOTAL COST OF PROJECT	**$619,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$44,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$7,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$53,000**
Available Project Yield (acft/yr)	2,258
Annual Cost of Water ($ per acft), based on PF=0	$23
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$4
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.07
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.01
Note: One or more cost element has been calculated externally	
JMP	*2/17/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Central Texas WSC - FM2410 Pipeline Replacement

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Transmission Pipeline (20 in. dia., 0 miles)	$3,111,000
TOTAL COST OF FACILITIES	**$3,111,000**
- Planning (3%)	$93,000
- Design (7%)	$218,000
- Construction Engineering (1%)	$31,000
Legal Assistance (2%)	$62,000
Fiscal Services (2%)	$62,000
Pipeline Contingency (13%)	$393,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$130,000
TOTAL COST OF PROJECT	**$4,100,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$288,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$31,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$319,000**
Available Project Yield (acft/yr)	3,641
Annual Cost of Water ($ per acft), based on PF=0	$88
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$9
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$0.27
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.03

Note: One or more cost element has been calculated externally	
JMP	*2/17/2025*

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Central Texas WSC - Transmission Pipeline Upgrade

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Transmission Pipeline (18 in. dia., 0 miles)	$16,910,000
TOTAL COST OF FACILITIES	**$16,910,000**
- Planning (3%)	$507,000
- Design (7%)	$1,184,000
- Construction Engineering (1%)	$169,000
Legal Assistance (2%)	$338,000
Fiscal Services (2%)	$338,000
Pipeline Contingency (13%)	$2,181,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$703,000
TOTAL COST OF PROJECT	**$22,330,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,571,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$169,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,740,000**
Available Project Yield (acft/yr)	3,641

Annual Cost of Water ($ per acft), based on PF=0	$478
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$46
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.47
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.14
Note: One or more cost element has been calculated externally	
JMP	*2/17/2025*

11.5.1.5 City of Belton WTP Expansion

Item	*Estimated Costs for Facilities*
Water Treatment Plant (2.1 MGD)	$10,125,000
TOTAL COST OF FACILITIES	**$10,125,000**
Engineering:	
- Planning (3%)	$304,000
- Design (7%)	$709,000
- Construction Engineering (1%)	$101,000
Legal Assistance (2%)	$203,000
Fiscal Services (2%)	$203,000
All Other Facilities Contingency (20%)	$2,025,000
Environmental & Archaeology Studies and Mitigation	$12,000
Land Acquisition and Surveying (1 acres)	$20,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$446,000
TOTAL COST OF PROJECT	**$14,148,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$995,000
Operation and Maintenance	
Water Treatment Plant	$907,000
TOTAL ANNUAL COST	**$1,902,000**
Available Project Yield (acft/yr)	1,167
Annual Cost of Water ($ per acft), based on PF=0	$1,630

Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$777
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$5.00
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$2.38
Note: One or more cost element has been calculated externally	
CB	*1/27/2025*

11.5.1.6 City of Gatesville

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Gatesville - Expand WTP (1.2 MGD)

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Water Treatment Plant (1.2 MGD)	$7,996,000
TOTAL COST OF FACILITIES	**$7,996,000**
- Planning (3%)	$240,000
- Design (7%)	$560,000
- Construction Engineering (1%)	$80,000
Legal Assistance (2%)	$160,000
Fiscal Services (2%)	$160,000
All Other Facilities Contingency (20%)	$1,599,000
Environmental & Archaeology Studies and Mitigation	$4,000
Land Acquisition and Surveying (1 acres)	$5,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$703,000
TOTAL COST OF PROJECT	**$11,507,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$810,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0

Water Treatment Plant	$633,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,443,000**
Available Project Yield (acft/yr)	1,345
Annual Cost of Water ($ per acft), based on PF=0	$1,073
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$471
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.29
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.44
Plummer	*1/27/2025*

11.5.1.7 City of Lampasas New WTP

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices
Lampasas - New WTP

Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Intake Pump Stations (3.2 MGD)	$5,650,000
Transmission Pipeline (14 in. dia., 0.3 miles)	$329,000
Water Treatment Plant (1 MGD and 2 MGD Expansion)	$31,220,000
Integration, Relocations, Backup Generator & Other	$28,000
TOTAL COST OF FACILITIES	**$37,227,000**
- Planning (3%)	$1,117,000
- Design (7%)	$2,606,000
- Construction Engineering (1%)	$372,000
Legal Assistance (2%)	$745,000
Fiscal Services (2%)	$745,000
Pipeline Contingency (15%)	$49,000
All Other Facilities Contingency (20%)	$7,380,000
Environmental & Archaeology Studies and Mitigation	$51,000
Land Acquisition and Surveying (8 acres)	$59,000

Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$3,273,000
TOTAL COST OF PROJECT	**$53,624,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,773,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$4,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$141,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$2,466,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (455636 kW-hr @ 0.09 $/kW-hr)	$41,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$6,425,000**
Available Project Yield (acft/yr)	3,360
Annual Cost of Water ($ per acft), based on PF=1	$1,912
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$789
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$5.87
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.42
Plummer	*2/9/2025*

11.5.1.8 City of Mineral Wells WTP Expansion

The Hilltop WTP is being evaluated for the ability to expand treatment capacity to be able to treat future supplies from the Turkey Peak Reservoir Project currently being implemented by the Palo Pinto County Municipal Water District No. 1. Additional capacity and other improvements are needed to address issues with the pre-treatment system which impacts operations reliability, treatment performance, and regulatory compliance. Additional improvements have been identified to renew and replace infrastructure that will enhance the capacity, performance, and reliability of the Hilltop WTP. The figure and table below provide an overview of the Hilltop WTP and the estimated costs for an 8 MGD WTP expansion and upgrade. The capital cost was provided by the City from the Capital Improvement Program (CIP). The total project cost was estimated using the UCM.

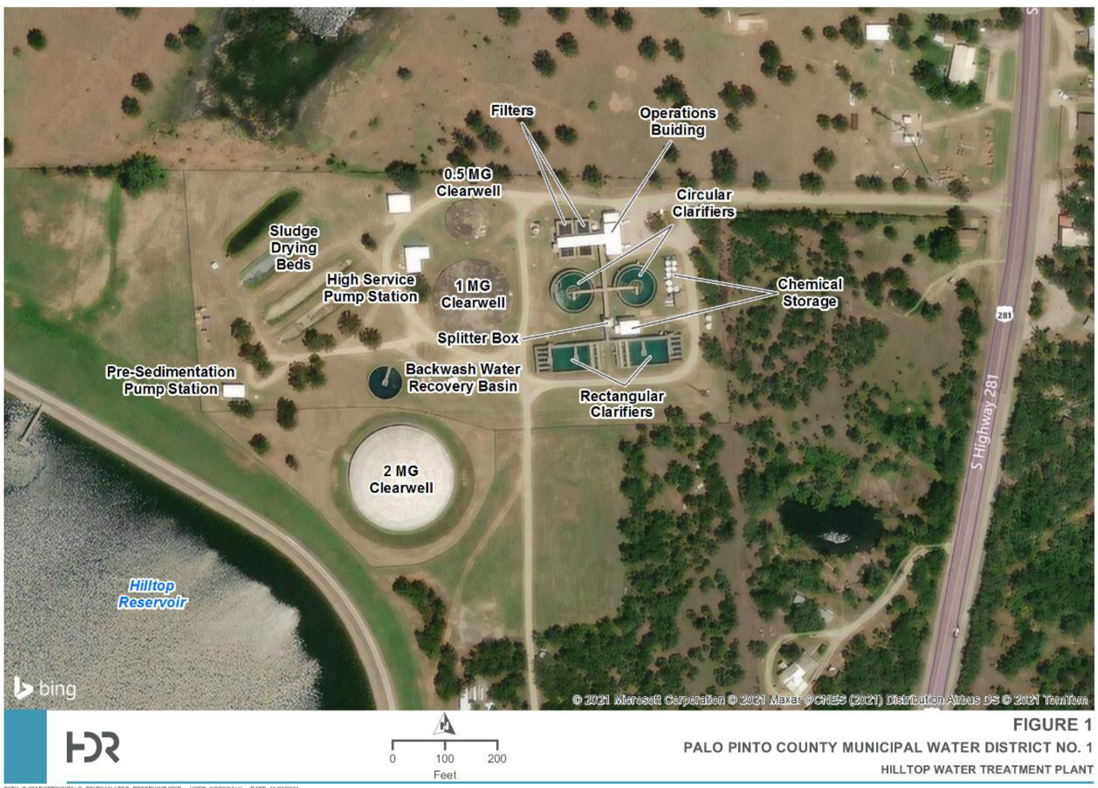


Figure 11.1 Mineral Wells Hilltop Water Treatment Plant Overview

Cost Estimate Summary *Water Supply Project Option* *September 2023 Prices* *City of Mineral Wells - Miscellaneous Strategies: WTP Facilities Expansions*	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Item	***Estimated Costs for Facilities***
Water Treatment Plant Expansion (8 MGD) and Upgrades	$41,400,000
TOTAL COST OF FACILITIES	**$41,400,000**
- Planning (3%)	$1,242,000
- Design (7%)	$2,898,000
- Construction Engineering (1%)	$414,000
Legal Assistance (2%)	$828,000
Fiscal Services (2%)	$828,000
All Other Facilities Contingency (20%)	$8,280,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,817,000
TOTAL COST OF PROJECT	**$57,707,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$4,060,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$1,736,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$5,796,000**
Available Project Yield (acft/yr)	8,968
Annual Cost of Water ($ per acft), based on PF=1	$646
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$194
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.98

Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.59
Note: One or more cost element has been calculated externally	
CEB	*2/3/2025*

11.5.1.9 City of Temple WTP Expansion

Item	***Estimated Costs for Facilities***
Water Treatment Plant (4.2 MGD)	$15,093,000
TOTAL COST OF FACILITIES	**$15,093,000**
Engineering:	
- Planning (3%)	$453,000
- Design (7%)	$1,057,000
- Construction Engineering (1%)	$151,000
Legal Assistance (2%)	$302,000
Fiscal Services (2%)	$302,000
All Other Facilities Contingency (20%)	$3,019,000
Environmental & Archaeology Studies and Mitigation	$12,000
Land Acquisition and Surveying (2 acres)	$28,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$664,000
TOTAL COST OF PROJECT	**$21,081,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,483,000
Operation and Maintenance	
Water Treatment Plant	$1,202,000
TOTAL ANNUAL COST	**$2,685,000**
Available Project Yield (acft/yr)	4,704
Annual Cost of Water ($ per acft), based on PF=0	$571
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$256
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.75
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.78
Note: One or more cost element has been calculated externally	
CB	*1/27/2025*

11.5.1.10 Falls County-Other (Moore WSC)

Item	Estimated Costs for Facilities
Cost Estimate Summary ***Water Supply Project Option*** ***September 2023 Prices*** ***Falls County-Other - Upgrade for Arsenic Treatment***	
Cost based on ENR CCI 13485.67 for September 2023 and a PPI of 278.502 for September 2023	
Water Treatment Plant (0.1 MGD)	$200,000
TOTAL COST OF FACILITIES	**$200,000**
- Planning (3%)	$6,000
- Design (7%)	$14,000
- Construction Engineering (1%)	$2,000
Legal Assistance (2%)	$4,000
Fiscal Services (2%)	$4,000
All Other Facilities Contingency (20%)	$40,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$9,000
TOTAL COST OF PROJECT	**$279,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$20,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$80,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$100,000**
Available Project Yield (acft/yr)	53
Annual Cost of Water ($ per acft), based on PF=0	$1,887
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$1,509
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$5.79
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$4.63

Note: One or more cost element has been calculated externally	
JMP	*2/3/2025*

11.5.1.11 Granbury North Water Treatment Plant

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

City of Granbury - North Water Treatment Plant

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Intake Pump Stations (5 MGD)	$6,501,000
Transmission Pipeline (18 in. dia., 0.3 miles)	$571,000
Advanced Water Treatment Facility (4.075 MGD)	$35,614,000
Integration, Relocations, Backup Generator & Other	$19,000
TOTAL COST OF FACILITIES	**$42,705,000**
- Planning (3%)	$1,281,000
- Design (7%)	$2,989,000
- Construction Engineering (1%)	$427,000
Legal Assistance (2%)	$854,000
Fiscal Services (2%)	$854,000
Pipeline Contingency (15%)	$86,000
All Other Facilities Contingency (20%)	$8,427,000
Environmental & Archaeology Studies and Mitigation	$8,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$1,873,000
TOTAL COST OF PROJECT	**$59,504,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$4,185,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$6,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$163,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0

Advanced Water Treatment Facility	$4,612,000
Pumping Energy Costs (311751 kW-hr @ 0.09 $/kW-hr)	$28,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$8,994,000**
Available Project Yield (acft/yr)	2,800
Annual Cost of Water ($ per acft), based on PF=2	$3,212
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$1,718
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$9.86
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$5.27
CJM	*1/14/2025*

11.5.1.12 Kempner WSC

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Kempner WSC - Kempner WSC WTP Expansion

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Water Treatment Plant (1.8 MGD)	$9,416,000
TOTAL COST OF FACILITIES	**$9,416,000**
- Planning (3%)	$282,000
- Design (7%)	$659,000
- Construction Engineering (1%)	$94,000
Legal Assistance (2%)	$188,000
Fiscal Services (2%)	$188,000
All Other Facilities Contingency (20%)	$1,883,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$6,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	$828,000
TOTAL COST OF PROJECT	**$13,550,000**
ANNUAL COST	

Debt Service (3.5 percent, 20 years)	$954,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$728,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$1,682,000**
Available Project Yield (acft/yr)	2,015
Annual Cost of Water ($ per acft), based on PF=0	$835
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$361
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$2.56
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$1.11
CJM	*1/16/2025*

11.5.1.13 McLennan County-Other (FHLM WSC)

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

McLennan County-Other - Individual Treatment Plants for Arsenic

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	***Estimated Costs for Facilities***
Water Treatment Plant (0.8 MGD)	$3,466,000
TOTAL COST OF FACILITIES	**$3,466,000**
- Planning (3%)	$104,000
- Design (7%)	$243,000
- Construction Engineering (1%)	$35,000
Legal Assistance (2%)	$69,000
Fiscal Services (2%)	$69,000
All Other Facilities Contingency (20%)	$693,000

Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$153,000
TOTAL COST OF PROJECT	**$4,832,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$340,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$1,706,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$2,046,000**
Available Project Yield (acft/yr)	917
Annual Cost of Water ($ per acft), based on PF=0	$2,231
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$1,860
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$6.85
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$5.71
Note: One or more cost element has been calculated externally	
JMP	*2/5/2025*

11.5.1.14 Prairie Hill WSC

Cost Estimate Summary
Water Supply Project Option
September 2023 Prices

Prairie Hill WSC - Upgrade for Arsenic Treatment

Cost based on ENR CCI 13485.67 for September 2023 and
a PPI of 278.502 for September 2023

Item	*Estimated Costs for Facilities*
Water Treatment Plant (0.2 MGD)	$1,103,000
TOTAL COST OF FACILITIES	**$1,103,000**
- Planning (3%)	$33,000
- Design (7%)	$77,000
- Construction Engineering (1%)	$11,000

Legal Assistance (2%)	$22,000
Fiscal Services (2%)	$22,000
All Other Facilities Contingency (20%)	$221,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$49,000
TOTAL COST OF PROJECT	**$1,538,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$108,000
Reservoir Debt Service (3.5 percent, 40 years)	$0
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$0
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$204,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$312,000**
Available Project Yield (acft/yr)	268
Annual Cost of Water ($ per acft), based on PF=0	$1,164
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$761
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$3.57
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$2.34
Note: One or more cost element has been calculated externally	
JMP	*2/5/2025*

11.5.1.15 Robinson WTP Expansion

Item	*Estimated Costs for Facilities*
Water Treatment Plant (4 MGD)	$14,620,000
TOTAL COST OF FACILITIES	**$14,620,000**
Engineering:	
- Planning (3%)	$439,000
- Design (7%)	$1,023,000

- Construction Engineering (1%)	$146,000
Legal Assistance (2%)	$292,000
Fiscal Services (2%)	$292,000
All Other Facilities Contingency (20%)	$2,924,000
Environmental & Archaeology Studies and Mitigation	$15,000
Land Acquisition and Surveying (2 acres)	$16,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	$643,000
TOTAL COST OF PROJECT	**$20,410,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,436,000
Operation and Maintenance	
Water Treatment Plant	$1,174,000
TOTAL ANNUAL COST	**$2,610,000**
Available Project Yield (acft/yr)	4,481
Annual Cost of Water ($ per acft), based on PF=0	$582
Annual Cost of Water After Debt Service ($ per acft), based on PF=0	$262
Annual Cost of Water ($ per 1,000 gallons), based on PF=0	$1.79
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=0	$0.80
CB	*1/27/2025*

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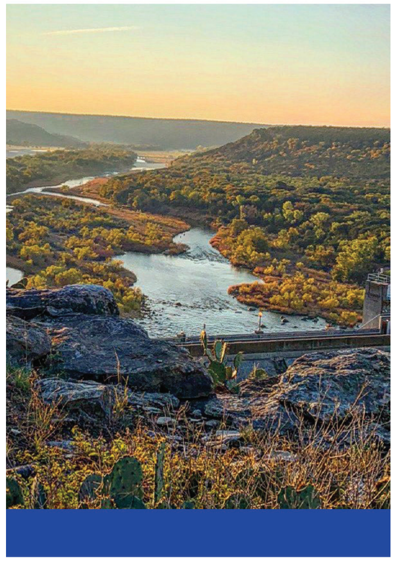

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