5 Groundwater Supplies and Projects

5.1 City of Bryan Groundwater Strategies

5.1.1 Description of Option

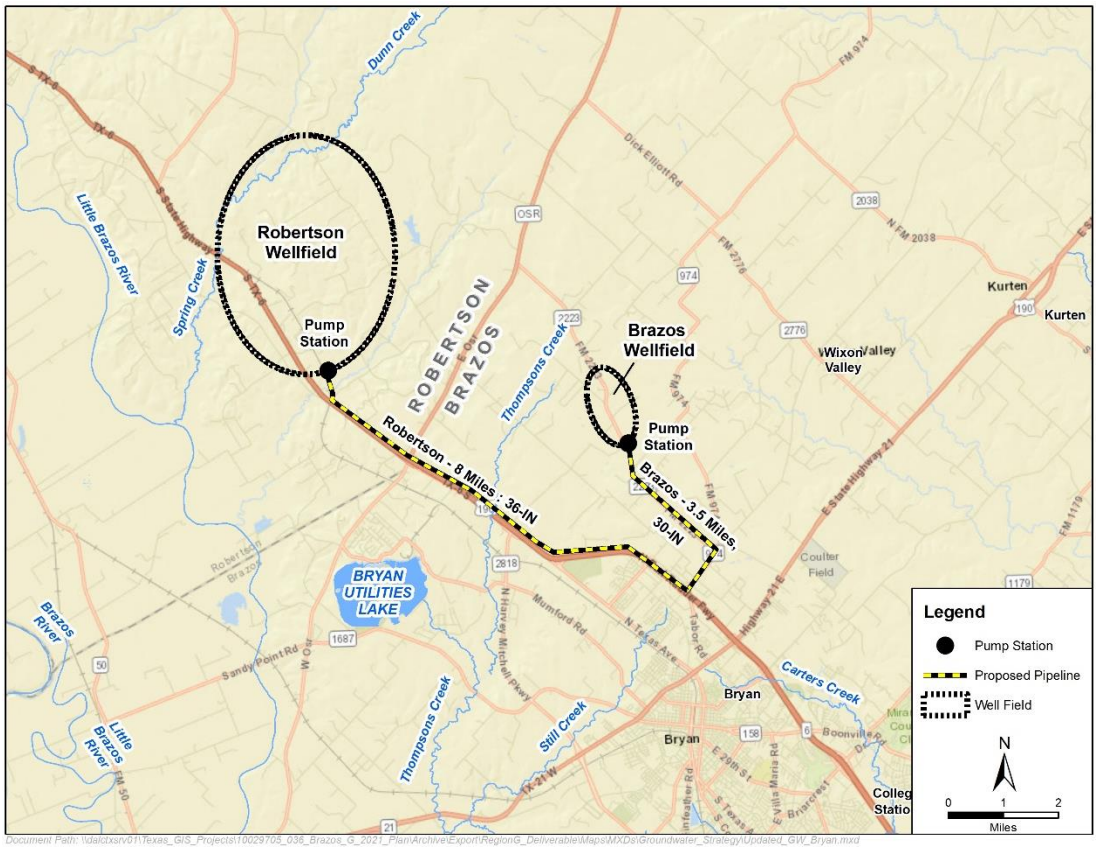
The City of Bryan (Bryan) currently supplies all of its customers with water from the Sparta and Simsboro (Carrizo-Wilcox) Aquifers in Brazos County. In 2070, Bryan has been allocated 19,398 acft/yr from the Carrizo-Wilcox Aquifer through this regional planning process. Bryan is projected to grow significantly over the planning period and the needs can no longer be met solely by groundwater within Brazos County. Estimated water needs for Bryan ranges from a surplus of about 215 acft/yr in 2020 to a shortage of about 17,161 acft/yr in in 2070. A review of the MAG for the Carrizo-Wilcox in Brazos County after existing supplies are accounted for shows availability from 7,501 acft.yr in 2020 increasing to about 19,893 acft/yr in 2070, accounting for the MAG Peak Factors adopted by Brazos G and approved by the Brazos Valley Groundwater Conservation District. A review of the MAG for the Carrizo-Wilcox in Robertson County after existing supplies are accounted for shows groundwater availability to increase from about 10,483 acft/yr in 2020 to about 12,175 acft/yr in 2070, with little availability in the Sparta Aquifer.

To meet the future needs in the Bryan, two well fields are proposed, one in Robertson County and an expansion of the Bryan's current 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. The Robertson and Brazos well field expansions are expected to meet Bryan's needs through 2070. Figure 5.1-1 illustrates the proposed regional groundwater system for 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. According to hydrogeologic information of the area, the Simsboro wells are capable of producing 2,000 gpm and are 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 99,940 in 2020 and 114,024 acft/yr in 2070, respectively, accounting for the MAG Peak Factor in Brazos County. Three wells will be drilled with one as a standby well.

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 six Simsboro Aquifer wells, and the Brazos County existing well field will add five Simsboro wells to the existing number.

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*).

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

[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.

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. 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 3 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. In 2050, a local well field in Brazos County is proposed to supplement the Bryan's supply with 3 additional Simsboro wells. A transmission line and pump station from this well field will supply this water to existing raw water pipelines at the same point as the Robertson well field. The raw water from both well fields will be treated for disinfection and cooling within the Bryan before distribution. When completed, this combined regional project will have a maximum capacity of 17,474 acft/yr for the City of Bryan. 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 $523 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 $471 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. Major 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

Item	Estimated Costs for Facilities
Primary Pump Station (17.8 MGD)	$5,365,000
Transmission Pipeline (36 in dia.,8.2 miles)	$15,128,000
Well Fields (Wells, Pumps, and Piping)	$15,184,000
Water Treatment Plant (17.8 MGD)	$1,009,000
TOTAL COST OF FACILITIES	**$36,686,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$12,084,000
Environmental & Archaeology Studies and Mitigation	$338,000
Land Acquisition and Surveying (132 acres)	$800,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$1,373,000
TOTAL COST OF PROJECT	**$51,281,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,608,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$303,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$134,000
Water Treatment Plant	$605,000
Pumping Energy Costs (7085455 kW-hr @ 0.08 $/kW-hr)	$567,000
TOTAL ANNUAL COST	**$5,217,000**
Available Project Yield (acft/yr)	9,973
Annual Cost of Water ($ per acft), based on PF=2	$523
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$161
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$1.61
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$0.50

Table 5.1-2. Cost Estimate Summary for Brazos County Well Field for Bryan

Item	Estimated Costs for Facilities
Primary Pump Station (13.4 MGD)	$2,285,000
Transmission Pipeline (30 in dia., 3.5 miles)	$5,328,000
Well Fields (Wells, Pumps, and Piping)	$16,405,000
Water Treatment Plant (13.4 MGD)	$760,000
TOTAL COST OF FACILITIES	**$24,778,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$8,406,000
Environmental & Archaeology Studies and Mitigation	$208,000
Land Acquisition and Surveying (74 acres)	$396,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$930,000
TOTAL COST OF PROJECT	**$34,718,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,443,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$217,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$57,000
Water Treatment Plant	$456,000
Pumping Energy Costs (4532762 kW-hr @ 0.08 $/kW-hr)	$363,000
TOTAL ANNUAL COST	**$3,536,000**
Available Project Yield (acft/yr)	7,501
Annual Cost of Water ($ per acft), based on PF=2	$471
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$146
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$1.45
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$0.45

Table 5.1-3. Comparison of Bryan Regional Groundwater Option to Plan Development Criteria

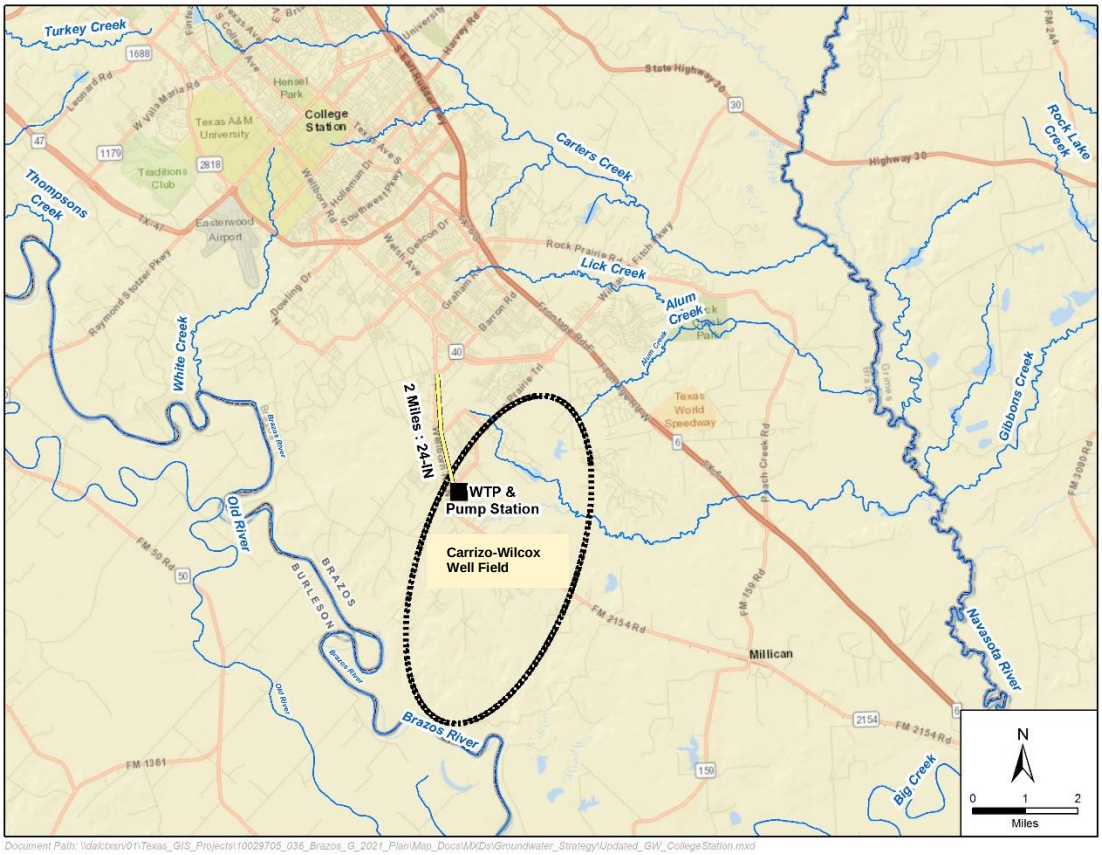
Impact Category	*Comment(s)*
A. Water Supply	
1. Quantity	1. Meets Demands
2. Reliability	2. High
3. Cost	3. Low to Moderate
B. Environmental factors	
1. Environmental Water Needs	1. None
2. Habitat	2. None
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	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
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

5.2 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. In 2070, College Station has been allocated 16,264 acft of Carrizo-Wilcox Aquifer and 606 to 745 acft from the Sparta Aquifer through this regional planning process. College Station is projected to more than double in population over the planning period and the needs can no longer be met with existing wells. Estimated water needs for College Station range from about 3,492 acft/yr in 2030 to 13,360 acft/yr in 2070. A review of the MAG for the Carrizo-Wilcox shows remaining availability ranging from 7,501 to 19,893 acft/yr from 2020 to 2070, but some of this availability will be utilized by other WUGs. The MAG peak factor increased the total availability of water in the Carrizo-Wilcox. The proposed project for College Station contains an ultimate build out of four 2,746 gpm Carrizo-Wilcox wells south of College Station. Figure 5.2-1 illustrates the proposed groundwater strategy for College Station.

Figure 5.2-1. Location of College Station Well Field and Facilities



5.2.2 Available Yield

The Carrizo-Wilcox in Brazos County has modeled available groundwater supply which could be used by College Station. According to hydrogeologic information in the area, the Carrizo-Wilcox wells are capable of producing 2,746 gpm and are about 2,700 ft deep. The TWDB has determined that the Modeled Available Groundwater (MAG) for the Carrizo-Wilcox Aquifer in Brazos County is 57,167 acft/yr in 2070, but with the MAG peak factor the availability increases to 65,742 acft/yr. After allowance for existing groundwater supplies, the MAG constrained availability ranges between 6,962 acft/yr in 2020 to 19,354 acft/yr in 2070. To meet the 2070 needs for College Station, 9,796 acft/yr of this supply would be developed.

5.2.3 Environmental Issues

The Local Groundwater Strategy for College Station Project involves the development of a new well field in Brazos County utilizing water from the Carrizo-Wilcox Aquifer, a well collection pipeline, pump stations, a water treatment plant and a transmission pipeline. The well field will include a total of 4 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. Outside the maintained right-of-way, land use would not be anticipated to change due to

[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.

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 Viewer[3] 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

[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.

sandy loams in openings in post oak woodlands. No USFWS designated critical habitat areas occur near the project area. 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 envisioned Carrizo-Wilcox groundwater project 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. When completed, the new well field will have a maximum capacity of 9,796 acft/yr for College Station. The major facilities required for this strategy are:

- Carrizo-Wilcox wells
- Well field collection pipeline(s)
- Transmission pipeline/pump stations
- Storage tanks for cooling
- Water Treatment Plant for disinfection and cooling.

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 that ranges from to $513 per acft/yr in 2020 to $198 per acft/yr after debt service.

5.2.5 Implementation Issues

Implementation of the Local Groundwater Plan for College Station with a Carrizo-Wilcox option could involve limited conflicts with other planned water supply projects. The development of groundwater in the Carrizo-Wilcox Aquifers in the Brazos G Water Planning Region must address several issues. Major issues include:

- Acquisition of water rights from landowners,
- Exposure to groundwater conservation district rules that may reduce groundwater production if 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 5.2-2, and the option meets each criterion.

Table 5.2-1. Cost Estimate Summary for Carrizo-Wilcox Well Field for College Station

Item	Estimated Costs for Facilities
Primary Pump Station (17.5 MGD)	$4,023,000
Transmission Pipeline (36 in dia., 2.2 miles)	$5,194,000
Well Fields (Wells, Pumps, and Piping)	$16,517,000
Storage Tanks (Other Than at Booster Pump Stations)	$4,445,000
Water Treatment Plant (17.5 MGD)	$992,000
TOTAL COST OF FACILITIES	**$31,171,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$10,650,000
Enviromental & Archaeology Studies and Mitigation	$271,000
Land Acquisition and Surveying (71 acres)	$646,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$1,176,000
TOTAL COST OF PROJECT	**$43,914,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,090,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$262,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$101,000
Water Treatment Plant	$595,000
Pumping Energy Costs (12252430 kW-hr @ 0.08 $/kW-hr)	$980,000
TOTAL ANNUAL COST	**$5,028,000**
Available Project Yield (acft/yr)	**9,796**
Annual Cost of Water ($ per acft), based on PF=2	**$513**
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	**$198**
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	**$1.57**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	**$0.61**

Table 5.2-2. Comparison of College Station Local Groundwater Option to Plan Development Criteria

Impact Category	*Comment(s)*
A. Water Supply	
1. Quantity	1. Meets Demands
2. Reliability	2. High
3. Cost	3. Low to 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
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

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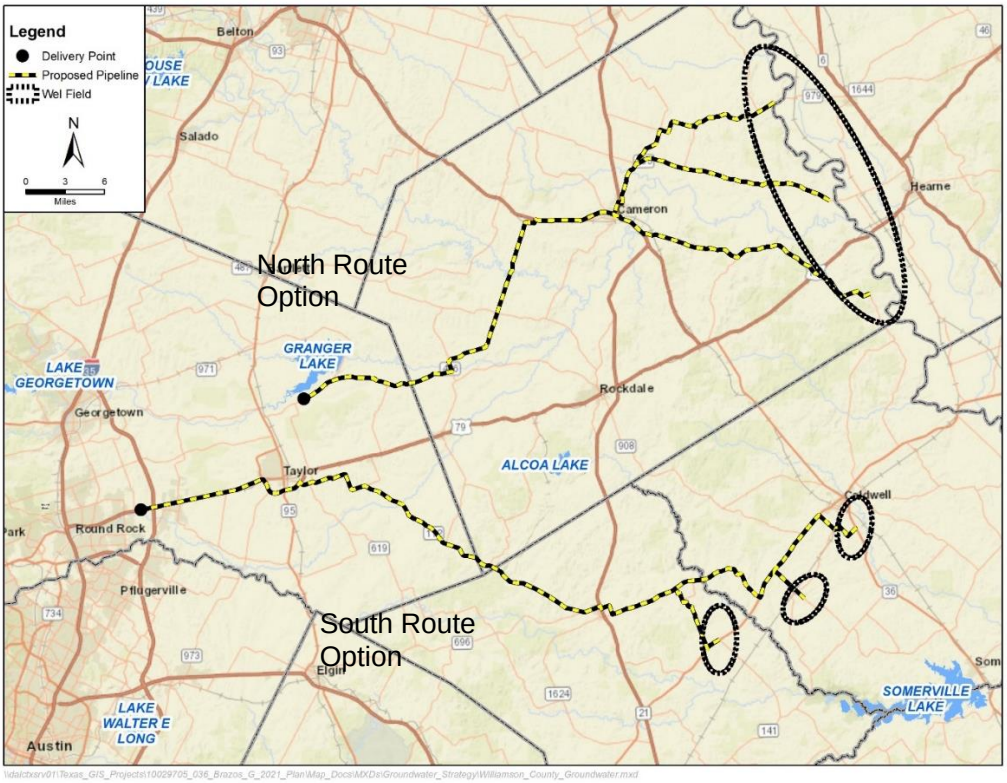
5.3 Williamson County Groundwater Strategies

5.3.1 Description of Option

Williamson County currently meets approximately 13 percent of municipal demands with groundwater and 87 percent with surface water. The TWDB has projected the county's population to grow significantly over the planning period and the future shortages cannot be met with local groundwater. By 2070, Williamson County has approximately 162,000 acft/yr of unmet needs and limited groundwater supplies. To meet some of the future needs in Williamson County, three well fields are proposed in Milam, Burleson and Lee Counties. At build-out, the Burleson County well field project includes nine Sparta Aquifer wells and 23 250 gpm Yegua Jackson wells. The Lee County well field at buildout includes nine 1,000 gpm Carrizo-Wilcox Aquifer wells, and two 500 gpm Sparta Aquifer wells to supplement the supply. . The Milam County Well field will have wells ranging from 400-1,000 gpm for over 80 wells in the Brazos River Alluvium Aquifer. Conversations with local groundwater conservation districts indicated that availability from the Brazos River Alluvium Aquifer likely is overstated. Raw water pipelines from the multiple well fields will drop off at two locations: one south and one north. The south drop off location is near the I-30 corridor which is assumed there will be infrastructure eventually to take the supply and deliver it to the areas with needs. The north drop off is near the BRA East Williamson County Water Treatment Plant near Lake Granger. After treatment, pump stations and pipelines will deliver the water through a regional system to meet needs. Figure 5.3-1 illustrates the proposed Regional Groundwater System for Williamson County.

Figure 5.3-1. Location of Regional Williamson County Well Fields and Facilities



5.3.2 Available Yield

There is groundwater available within the MAG in Burleson, Lee, and Milam Counties. Burleson County has availability in the Sparta Aquifer ranging from 750 acft/yr to 5,239 acft/yr in 2070 and from the Yegua Jackson Aquifer from 7,500 to 9,300 acft/yr. Lee County has availability in the Carrizo-Wilcox Aquifer ranging from 6,476 acft/yr to 4,279 acft/yr from 2020 to 2070 and Sparta Aquifer from 1,211 acft/yr from 2020 to 1,222 acft/yr from 2070. Milam County has availability in the Brazos River Alluvium Aquifer from 43,157 acft/yr to 41,951 acft/yr, although this volume may be overstated. According to hydrogeologic maps of the area, the Carrizo-Wilcox Aquifer wells are capable of producing 1,500 gpm and are 1,500 ft deep.

5.3.3 Environmental Issues

The Regional Groundwater for Williamson County Project involves the development of three new well fields, one each in Milam, and Burleson counties, and two in Lee County, associated well collection pipelines and pumps, two new drop-off stations (one north and one south), and a shared distribution pipeline system. The Burleson County well field will include 20 Sparta wells, the Lee County well field will include three Carrizo wells and five Sparta wells. The Milam County well field will include over 80 wells in the Brazos River Alluvium Aquifer. 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.). Oak, elm, cottonwood (*Populus* sp.) and

[1] Gould, F.W., "The Grasses of Texas," Texas A&M University Press, College Station, Texas, 1975.

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 Brushy, 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 three 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 within the three 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 Milam, Burleson and Lee County groundwater projects will be developed in phases as necessary to meet growing needs. At build-out, the Burleson County well field project includes nineSparta Aquifer wells and 23, 250 gpm Yegua Jackson wells. The Lee County well field at buildout includes nine 1,000 gpm Carrizo-Wilcox Aquifer wells, and two 500 gpm Sparta Aquifer wells to supplement the supply. The Milam County Well field will have wells ranging from 400-1,000 gpm for over 80 wells in the Brazos River Alluvium Aquifer. Other facilities include well field collection pipelines, a transmission line and pump stations 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 2020 needs. The shared water treatment plant will provide disinfection and cooling before the water enters the shared distribution system. When completed, the Milam County well field will have a maximum capacity of 41,300 acft/yr and the Burleson and Lee county well field will have a maximum capacity of 10,622 acft/yr. These capacities utilize nearly all of the remaining groundwater availability under the MAG accounting for projected local demands. The combined capacity in 2070 for the strategy is 51,922 acft/yr,for WUGs throughout Williamson County. The major facilities required for this strategy are:

- Wells
- Well field collection pipeline(s)
- Transmission Pipeline/Pump Stations
- Shared Water Treatment Plant/Pump Stations
- Shared Distribution system for multiple WUG’s

The approximate locations of these facilities are displayed in Figure 5.3-1. For the Burleson County component of this Regional Groundwater Strategy, approximately 80 percent of the supply will be coming from the Brazos Alluvium Aquifer wells and 20 percent from the Carrizo-Wilcox and Sparta Aquifers. 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 Burleson and Lee county well field excluding the shared pipeline and associated pump stations will have a unit cost that ranges from $739 per acft/yr to $1,670 per acft/yr (Table 5.3-1).

For the Milam County component 100 percent of the supply will be coming from the Brazos River Alluvium Aquifer. Power costs were estimated by calculating the horsepower

needed to operate the wells and to pump the water 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 Milam County well field excluding the shared pipeline and associated pump stations will have a unit cost that ranges from $536 per acft/yr to $1,507 per acft/yr (Table 5.3-2).

5.3.5 Implementation Issues

Implementation of the Regional Groundwater Strategy for Williamson County utilizing Carrizo-Wilcox Aquifer supplies in Burleson and Lee Counties involve potential conflicts with other planned water supply projects. MAG estimates for the Brazos River Alluvium Aquifer likely are overstated and may not be considered a reliable supply.

The development of groundwater must address several issues. Major issues include:

- Competition with others in the area for groundwater.
- Acquisition of water rights from land owners,
- Exposure to groundwater conservation district rules that may reduce groundwater production if 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,

This water supply option has been compared to the plan development criteria, as shown in Table 5.3-3, and the option meets each criterion.

Table 5.3-1. Cost Estimate Summary for Burleson and Lee County Well Fields (South Option)

Item	*Estimated Costs for Facilities*
Primary Pump Station (21.8 MGD)	$32,347,000
Transmission Pipeline (36 in dia., 878,918 ft and 48 in.)	$226,777,000
Well Fields (Wells, Pumps, and Piping)	$35,573,000
Water Treatment Plant (9.5 MGD)	$539,000
TOTAL COST OF FACILITIES	$295,236,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$91,994,000
Environmental & Archaeology Studies and Mitigation	$4,699,000
Land Acquisition and Surveying (2104 acres)	$11,979,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$11,108,000
TOTAL COST OF PROJECT	$415,016,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$29,201,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,624,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$809,000
Water Treatment Plant	$324,000
Pumping Energy Costs (100,520,163 kW-hr @ 0.08 $/kW-hr)	$8,042,000
TOTAL ANNUAL COST	$41,000,000
Available Project Yield (acft/yr)	23,250
Annual Cost of Water ($ per acft), based on PF=1	$1,763
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$507
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$5.41
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.56
Available Project Yield (acft/yr)	23,250
Annual Cost of Water ($ per acft), based on PF=1	$1,763
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$507

Table 5.3-2. Cost Estimate Summary for Milam County Well Field (North Option)

Item	*Estimated Costs for Facilities*
Primary Pump Station (38.8 MGD)	$36,466,000
Transmission Pipeline (48 in dia., 159 miles)	$377,499,000
Well Fields (Wells, Pumps, and Piping)	$4,304,000
TOTAL COST OF FACILITIES	**$418,269,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$127,519,000
Environmental & Archaeology Studies and Mitigation	$4,221,000
Land Acquisition and Surveying (1022 acres)	$4,583,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$15,252,000
TOTAL COST OF PROJECT	**$569,844,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$40,095,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,818,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$912,000
Pumping Energy Costs (217,730,069 kW-hr @ 0.08 $/kW-hr)	$17,418,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$62,243,000**
Available Project Yield (acft/yr)	41,300
Annual Cost of Water ($ per acft), based on PF=1	$1,507
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$536
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$4.62
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.65

Table 5.3-3. Comparison of Williamson County Option 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	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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