Feasibility Study: Regional Industrial Wastewater Treatment & Reuse Facility

Prepared for:

Gulf Coast Waste Disposal Authority

Prepared by:

PARSONS

October 2016

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2200 West Loop South
Houston, TX 77027

October 2016

Partial funding for the development of this report was provided by the Texas Water Development Board

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ACRONYMS AND ABBREVIATIONS

BOD_5	Biological oxygen demand (five day)
COD	Chemical oxygen demand
CWA	Coastal Water Authority
DO	Dissolved oxygen
ETJ	Extraterritorial jurisdiction
ft^3/MG	Cubic feet per million gallons
FS	Feasibility Study
GCA	Gulf Coast Waste Disposal Authority
HDPE	High-density polyethylene
HGAC	Houston-Galveston Area Council
IWWTP	Industrial wastewater treatment plant
IWWTR	Industrial wastewater treatment and reuse
MBR	Membrane bioreactor
MF	Microfiltration
mg/L	Milligram per liter
MGD	Million gallons per day
MPN	Most probable number
msl	Mean sea level
NPS	Nonpoint source
NTU	Nephelometric turbidity unit
OSSF	On-site sewage facility
PER	Preliminary Engineering Report
PVC	Polyvinyl chloride
RAS	Return activated sludge
RO	Reverse osmosis
ROW	Right-of-way
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TDS	Total dissolved solids
TLAP	Texas Land Application Permit
TOC	Total organic carbon
TPDES	Texas Pollutant Discharge Elimination System
TSS	Total suspended solids
TWDB	Texas Water Development Board
UBO	Ultimate build out
UF	Ultrafiltration
UV	Ultraviolet
WWTP	Wastewater treatment plant

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Executive Summary

Background

In June 2015, the Gulf Coast Waste Disposal Authority (GCA) received a Regional Facility Planning grant from the Texas Water Development Board (TWDB) (Contract No. 1548321871) to evaluate the feasibility of building a regional industrial wastewater treatment and water reuse (IWWTR) facility in the Mont Belvieu, Texas, area. In September 2015, GCA and the five participating members initiated this study to evaluate the financial, environmental and regulatory perspectives and findings associated with building a new IWWTR facility. The five participating members are the City of Mont Belvieu, ExxonMobil Chemicals Company, Targa Downstream LLC, Enterprise Products Operating LLC, and ONEOK Hydrocarbon L.P.. If the proposed IWWTR facility identified herein is deemed financially and environmentally practicable, additional technical analysis and design engineering will be required prior to its implementation.

Regional Conditions

The project area addressed in this Feasibility Study (FS) is a 10-mile-diameter area surrounding Mont Belvieu. The outcome of this project can influence and benefit the future direction of all land use categories in Mont Belvieu. While no specific site for the new proposed IWWTR plant was selected during this FS, various criteria were identified and recommended for investigating potential parcels of land on which a new proposed IWWTR facility might be sited.

This FS focuses on evaluating whether a regional approach to the growing wastewater treatment capacity needs and water use demands associated with the facilities of the participating members is viable. Population growth is the primary indicator of future municipal wastewater treatment capacity needs and water use demands. Population projections demonstrate that considerable industrial, commercial and residential growth is anticipated in the Mont Belvieu area. This growth will require expansion of the existing wastewater treatment and water supply infrastructure. In addition to the participating members supporting this project, other industrial and municipal facilities in and around Mont Belvieu expect to grow to a size that could generate higher water demand in the future. All of these conditions suggest that a broader look at industrial and municipal wastewater collection and treatment throughout the area is necessary.

Existing Facilities and Requirements

Data were acquired from each of the participating members to evaluate the quantity and quality of wastewater influent that would be delivered to the new proposed IWWTR facility and to define the demand and quality of reuse water being sought. Each participating member provided both daily average and daily maximum flow volumes and extrapolated these values for the entire planning horizon including 2025, 2050 and ultimate build out (UBO) in 2075.

Mont Belvieu's Cotton Bayou Wastewater Treatment Plant is reaching the end of its initial design capacity, which limits its ability to handle increases in wastewater flow from projected growth. Therefore, Mont Belvieu is interested in sending a portion of its existing and future raw wastewater to the proposed IWWTR facility. All four of the industrial participating members are interested in sending wastewater influent to the proposed IWWTR facility. Three are interested in sending a portion of their stormwater to the facility.

Table ES-1 summarizes the cumulative existing and projected wastewater volumes for all five participating members.

Table ES-1 Wastewater Quantities Discharged to Proposed IWWTR Facility (MGD)

Dischargers Providing Wastewater Influent	2016 Estimated Influent Flow		Future Flow Estimate (Including Stormwater)		
	Dry Weather Flow	Maximum Average Daily Flow	2025	2050	UBO 2075
5	5.6	17.9	19.2	23.7	29.0

MGD – million gallons per day

Table ES-2 compares the estimated demand for reuse water from the industrial participating members to the estimated total wastewater influent volumes summarized in Table ES-2. The potential for water reuse is high. Process cooling water and wash-down water represent a significant portion of water use for each of the industrial participating members. As a result, both types of water use contribute to the wastewater volume for these facilities. Based on the wastewater treatment volume data provided by the participating members under dry weather conditions, demand for reuse water by the participating members exceeds wastewater supply. Conversely, under the maximum daily flow conditions for wastewater treatment volumes, wastewater supply exceeds reuse water demands. The industrial participating members stated that they preferred that the quality of reuse water to be delivered to their sites be similar to that of the surface water currently provided by the Coastal Water Authority (CWA).

Table ES-2 Potential for Water Reuse Demand

Dischargers Providing Wastewater Influent	Reuse Water Purchasers	Wastewater Quantities Discharged to Proposed IWWTR Facility (MGD)					Requested Reuse Water Quantity (MGD)		
		2016 Estimated Influent Flow		Future Flow Estimate (Including Stormwater)					
		Dry Weather Flow	Maximum Average Daily Flow	2025	2050	UBO 2075	2025	2050	UBO 2075
5	4	5.6	17.9	19.2	23.7	29.0	11.6	13.8	18.0

The basis of design approach for the infrastructure necessary to meet these wastewater collection and reuse water distribution needs are driven by the location of the sites requesting the service and the ultimate location of the proposed IWWTR plant. In addition to these proximity relationships, a wide array of surface and subsurface natural and manmade features (e.g., salt dome, railroad crossing, subsurface utilities, roadways, topography, and surface water) were evaluated as part of the basis of design approach for wastewater collection and reuse water distribution infrastructure.

Basis of Design

The flow range that will guide the basis of design will be from the dry weather estimate of 5.6 MGD to the wet weather estimate of 19.23 MGD for the planning year 2025. In order to operate the main process units at a consistent flow rate, the wastewater flow will be equalized using an equalization tank, which will provide a manageable and continuous flow for the wastewater treatment process units. The unit processes selected for this wastewater treatment plant are primarily driven by the need to remove the biological oxygen demand (BOD_5), total organic carbon (TOC), and total suspended solids (TSS) from the wastewater flows delivered. The treated effluent from the IWWTR plant will be discharged to Cedar Bayou Tidal. In addition, the wastewater influent will contain a component of municipal wastewater that will necessitate the inclusion of pathogen removal. The proposed IWWTR plant will include a treatment unit to remove pathogens before effluent is discharged to Cedar Bayou Tidal or provided as reuse water back to the industrial participating members.

In general, the treatment steps for the proposed IWWTR plant are described below.

- Preliminary treatment – This step consists of grit, debris and fine particle removal before the influent enters to the biological treatment step. The major treatment units are a bar screen, a grit chamber and a fine screen.
- Flow equalization – This step will follow preliminary treatment. It involves equalization of flow from the preliminary treatment and the on-site stormwater basin.
- Biological treatment – This step consists of removal of BOD_5, TSS, TOC and nutrients. Various process units (e.g., conventional activated sludge process, membrane bioreactor, sequencing batch reactor) are capable of providing necessary treatment for these parameters.
- Tertiary Treatment/disinfection – This step consists of removing pathogens from the wastewater prior to its discharge to Cedar Bayou Tidal and reuse treatment to meet Texas Administrative Code 309 requirements.

In addition, the proposed IWWTR plant site will have a stormwater storage unit for on-site stormwater. When necessary, collected stormwater can be discharged to the flow equalization tank to further normalize flow.

For the basis of design, the initial sizing of the water reuse process units is based on the treatment and delivery of 5 MGD of non-potable reuse water. While the wastewater treatment plant will be designed to handle peak influent flows, it is more practical to design the water reuse treatment system to respond to average influent flows. The plant will be configured to accommodate future expansion as a function of wastewater influent flow rates.

Three distinct pipelines categories will be required for the proposed IWWTR plant as part of the overall system to provide service to the participating members:

1. Wastewater conveyance lines,
2. An outfall pipeline to discharge treated wastewater effluent to Cedar Bayou Tidal, and
3. Reuse water distribution lines.

Wastewater will be collected from each participating member before combining the influent into a single trunk line for delivery to the proposed IWWTR plant. The basis of design for the collection and distribution system is influenced by many different existing natural and anthropogenic constraints throughout the study area. Wastewater collection and reuse distribution lines will follow the same routing in most instances to and from the proposed

IWWTR plant. The proposed IWWTR plant will also require a Texas Pollutant Discharge Elimination System permit to discharge treated effluent to Cedar Bayou Tidal. For the proposed IWWTR plant, it is expected that sludge will be transported to an existing off-site GCA facility. Figure ES-1 on the following page provides a conceptual layout of the facility within a parcel that is approximately 40 acres.

Cost Estimate

A cost estimate was prepared consistent with a Class 4 estimate as defined by the Association for the Advancement of Cost Engineering International criteria. Expected accuracy for Class 4 estimates typically ranges from -30% to +50%, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Subsequent phases of this project will focus on evaluating alternatives to optimize treatment, collection and distribution technologies with the goal to improve the accuracy of the cost estimate and to reduce overall construction, operation and maintenance costs. The final costs of the project will depend on actual labor, material costs, competitive market conditions, implementation schedule, and other variable factors. Table ES-3 summarizes the cost estimate that combines all of the costs for providing the entire regional IWWTR plant and the wastewater collection and reuse water distribution systems.

Table ES-3 Class 4 Cost Estimate for Regional IWWTR System

Item No.	Item Description	Estimated Cost
	Wastewater Treatment Cost	
A	**Wastewater Collection & Treatment Cost**	**$ 60,600,000.00**
B	**Water Reuse Treatment & Distribution System Cost**	**$ 21,300,000.00**
	Total Estimated Cost	**$ 81,900,000.00**
	Estimated Capital Cost:	
	AACE Recommended Range For A Class 4 Cost Estimate:	
	Low [-15% to -30%] - Use -15%	$ 69,600,000.00
	High [20% to 50%] - Use 30%	$ 106,500,000.00
	Average Cost:	**$ 88,100,000.00**
C	**Estimated Annual Operation and Maintenance Cost**	**$ 5,000,000.00**

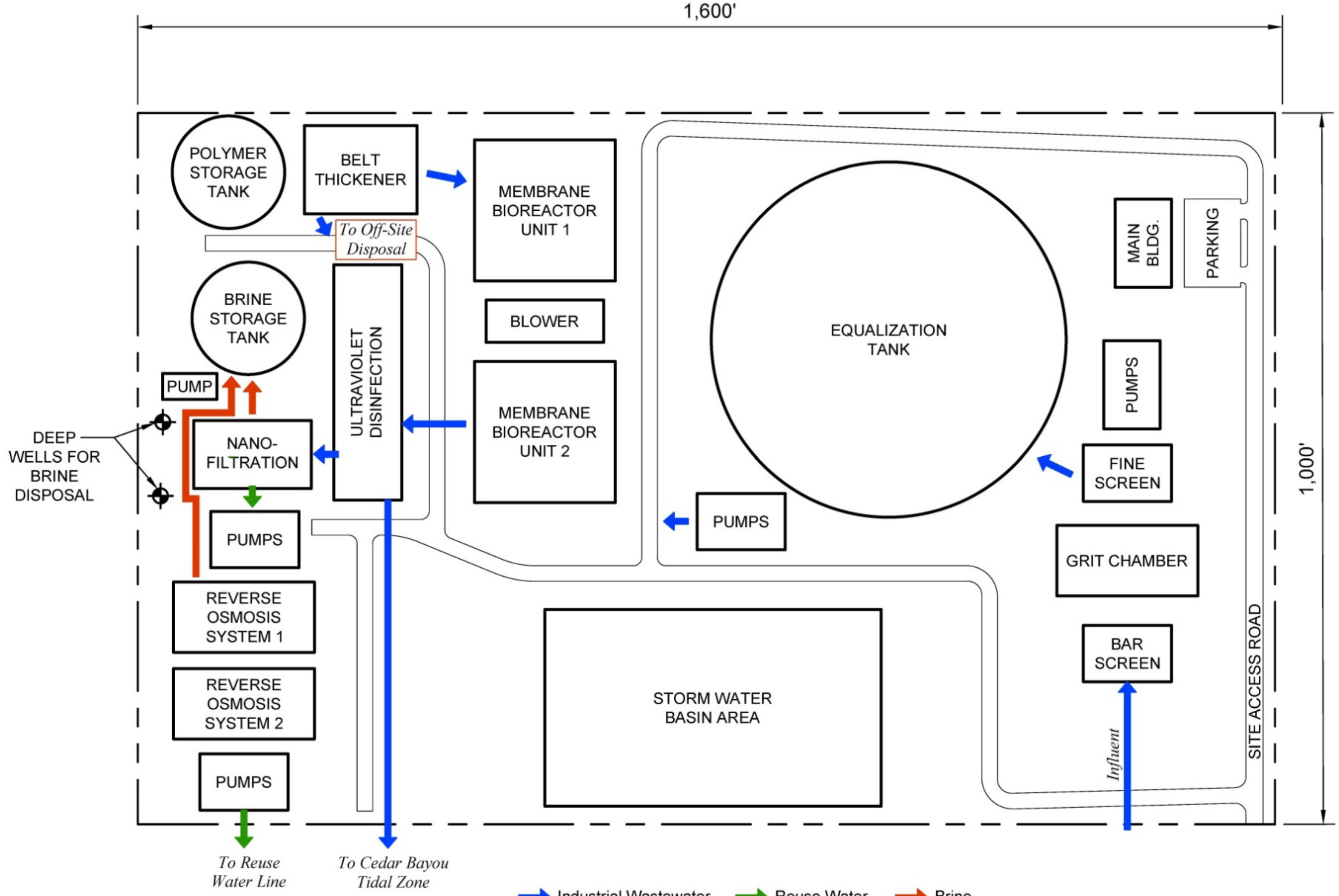

Figure ES-1 Conceptual Layout of IWWTR Plant

Next Steps

This feasibility study demonstrates local interest for regional approaches to wastewater and water supply management. The report also identifies several characteristics of the Mont Belvieu area that suggest infrastructure needs required by future projected growth trends in commercial, industrial, and residential development can be partially addressed through a regional approach to wastewater treatment and water reuse. If GCA and the participating members commit to move forward with the proposed IWWTR plant summarized herein, development agreements will be prepared to initiate the additional steps necessary to execute a front-end engineering design process and schedule. This additional planning and engineering are the necessary next steps to guide implementation and construction of the regional IWWTR plant and the necessary wastewater collection and water reuse distribution systems.

GCA has investigated various options to fund the proposed regional IWWTR facility in the Mont Belvieu area. Some of the known parameters for this project are:

- Partners in this project would include the City of Mont Belvieu and various industrial partners.
- GCA will own and operate the facility.
- The cost estimate for the project is $70 to $106 million.

The estimated timeline for the completion of the construction is three years and three months from the start of the planning and design phase.

SECTION 1
INTRODUCTION

In June 2015, Gulf Coast Waste Disposal Authority (GCA) received a Regional Facility Planning grant from the Texas Water Development Board (TWDB) (contract No. 1548321871) to evaluate the feasibility of building a regional industrial wastewater treatment and water reuse (IWWTR) facility in the Mont Belvieu, Texas area. In addition to GCA, the City of Mont Belvieu (Mont Belvieu) and four local industrial companies signed on as participating members and contributed financial resources to provide the local matching funds required by the TWDB grant. In September 2015, GCA and the five participating members initiated this study to evaluate the financial, environmental and regulatory perspectives and findings associated with building a new IWWTR facility.

This feasibility study (FS) is a mid to high-level planning study that meets the discussion categories and formatting recommendations provided by the TWDB to GCA in the project contract. If the proposed IWWTR facility identified herein is deemed financially and environmentally practicable, additional technical analysis and design engineering will be required prior to its implementation.

1.1 Project Background

The following background information summarizes a variety of factors that influenced GCA to undertake this study. The project study area lies within Region H of the State Water Plan. Population in Region H is projected to grow from 7.3 million in 2020 to approximately 11.7 in 2070 (TWDB 2016), which translates to a growth rate of 60 percent. Chambers County population is projected to increase from 42,162 in 2020 to 88,999 in 2070 (TWDB 2016). This equals a projected annual average growth rate of 2.2 percent per year for this 50-year planning horizon. More specifically, the area surrounding Mont Belvieu is experiencing significant economic expansion and growth, particularly industrial and commercial development. Abundant supplies of natural gas liquids are being derived from new North American sources such as fracking shale and other tight formations, and deep-water discoveries in the Gulf of Mexico. These supplies, coupled with the existing pipeline infrastructure, provide a nexus for Mont Belvieu to continue attracting expansions of existing natural gas and petrochemical facilities and new facilities. Figure 1-1 displays multiple facilities that operate and maintain their own industrial wastewater treatment plants (IWWTP) within a 10-mile diameter around Mont Belvieu. Most of these industries have capital expansion projects in various planning, design, or construction stages. As each facility implements these capital projects, additional investment is required at each IWWTP to accommodate the wastewater generated from the expansions and new processes. Many of these facilities will also be faced with having to manage increases in effluent discharge volumes to area receiving streams under more stringent effluent regulations.

With trends showing industrial, commercial, and residential growth in the Mont Belvieu area, water use demand will also increase over the next 50 years. Mont Belvieu's Cotton Bayou Wastewater Treatment Plant (WWTP) (see Figure 1-1), is reaching the end of its initial design capacity and as such will not be able to handle increases in wastewater flow from projected growth. All of these conditions suggest that a broader look at industrial and municipal wastewater collection and treatment throughout the area is necessary.

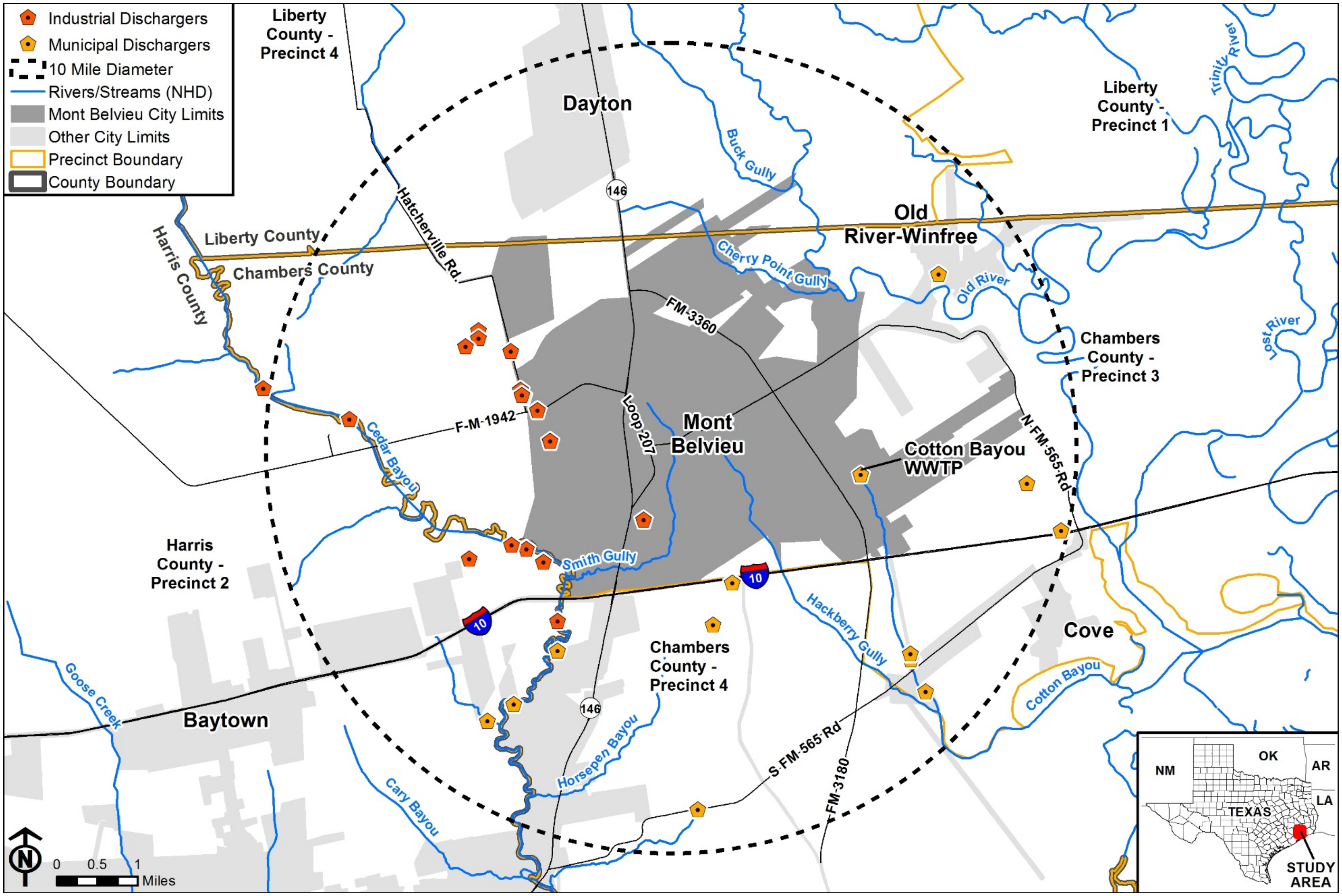

Figure 1-1 Existing Industrial and Municipal WWTPs in Study Area

Region H planning area faces a two-fold increase in water needs from 2020 to 2070 (TWDB 2016). More specifically, based on the TWDB's 2017 State Water Plan for Region H, municipal water use demand is expected to increase from 1.25 million acre-feet/year in 2020 to 1.89 million acre-feet/year in 2070 (TWDB 2016). Manufacturing, which also constitutes a large share of the region's water demand, is projected to increase from 753,307 acre-feet/year in 2020 to 910,294 acre-feet/year in 2070 (TWDB 2016). Already in 2020, municipal and manufacturing water demands in Region H face potential shortages of approximately 142,000 and 88,000 acre-feet/year, respectively (TWDB 2016).

In response to these regional wastewater management issues, part of GCA's mission is to identify and promote regional solutions to industrial and municipal wastewater treatment needs. In addition, both the TWDB and the Texas Commission on Environmental Quality (TCEQ) support regional solutions to wastewater collection, treatment and reuse. TWDB offers grants to political subdivisions of the State of Texas for studies and analyses to:

- Evaluate and determine the most feasible alternatives to meet regional wastewater treatment needs;
- Estimate the costs associated with implementing feasible regional alternatives; and
- Identify institutional arrangements to provide regional wastewater services (TWDB 2015b).

These complementary factors led GCA to secure funding and initiate this FS to evaluate whether a regional facility can demonstrate the following.

- Industrial customers can benefit from foregoing the capital and operating expense of unnecessary pretreatment systems and regulatory permitting requirements.
- Additional future industrial and municipal wastewater collection and treatment capacity can be provided.
- Partnerships can enable environmentally sound solutions.
- Wastewater reuse is a viable source of water for industry to meet increasing water demands in Region H.

1.2 Project Purpose

The purpose of this project is to evaluate the feasibility of constructing a regional IWWTR facility in the Mont Belvieu area. If this FS demonstrates that the regional IWWTR facility is economically practical and economically feasible, the participating industrial members would strongly consider delivering their influent for regional treatment and obtaining non-potable reuse water for their manufacturing operations, starting as early as 2019. By transferring the wastewater generated from multiple industrial or municipal operations to a centralized location for treatment, the industrial partners can place more focus on their core operations.

The consolidation and rerouting of industrial process waste streams to a regional IWWTR facility also minimizes the burden on the regulatory agencies because only one discharge permit and one monthly discharge monitoring report is required. The proposed IWWTR facility would also be responsible for any air emissions and permitting for the treatment facility. Further, the elimination of treated wastewater discharge points can have a corollary benefit on receiving water quality in the area.

1.3 Project Participants

The City of Mont Belvieu's (Mont Belvieu) need for future wastewater collection and treatment capacity makes it a key project participant. GCA collaborated with the City to identify local existing industrial companies that might be interested in the concept of a regional IWWTR facility. From the resulting inventory, four companies expressed an interest in supporting and participating in the FS project: ExxonMobil Chemicals Company, Targa Downstream LLC, Enterprise Products Operating LLC, and ONEOK Hydrocarbon L.P. All four companies have treatment facilities within the Mont Belvieu city limits. Other companies may participate in the future. Figure 1-2 displays the organization chart of the project team that participated in the preparation of this FS.

Figure 1-2 Project Participants

1.4 Feasibility Study Process Overview

This FS report includes a number of technical evaluations and coordination steps to identify and evaluate wastewater collection, treatment and reuse alternatives for the participating members. Throughout the study, GCA conducted meetings and conference calls with the project team members to present progress and to receive input and feedback on the various activities. GCA also held three public meetings in Mont Belvieu to summarize project progress. Table 1-1 summarizes the public meetings conducted as part of this project.

Table 1-1 Public Meetings

Meeting Date & Location	Objective	Number of Attendees
Public Meeting #1 November 10, 2015; City of Mont Belvieu	Summary of Project Participants, Objectives and Timeline	14
Public Meeting #2 August 9, 2016; City of Mont Belvieu	Review and discussion of Draft FS Report	14
Public Meeting #3 November 9, 2016; City of Mont Belvieu	Presentation of Final Findings from FS	TBD

The organizations that attended the public meetings are listed in Appendix A. Formal meeting announcements that were published are also provided in Appendix A. Figure 1-3 provides a schematic diagram of the process used to complete this study. As part of the FS report development and review process the TWDB provided a formal set of comments (see Appendix C) after reviewing the draft FS report. All of the recommendations TWDB provided in their comments were incorporated into this final report.

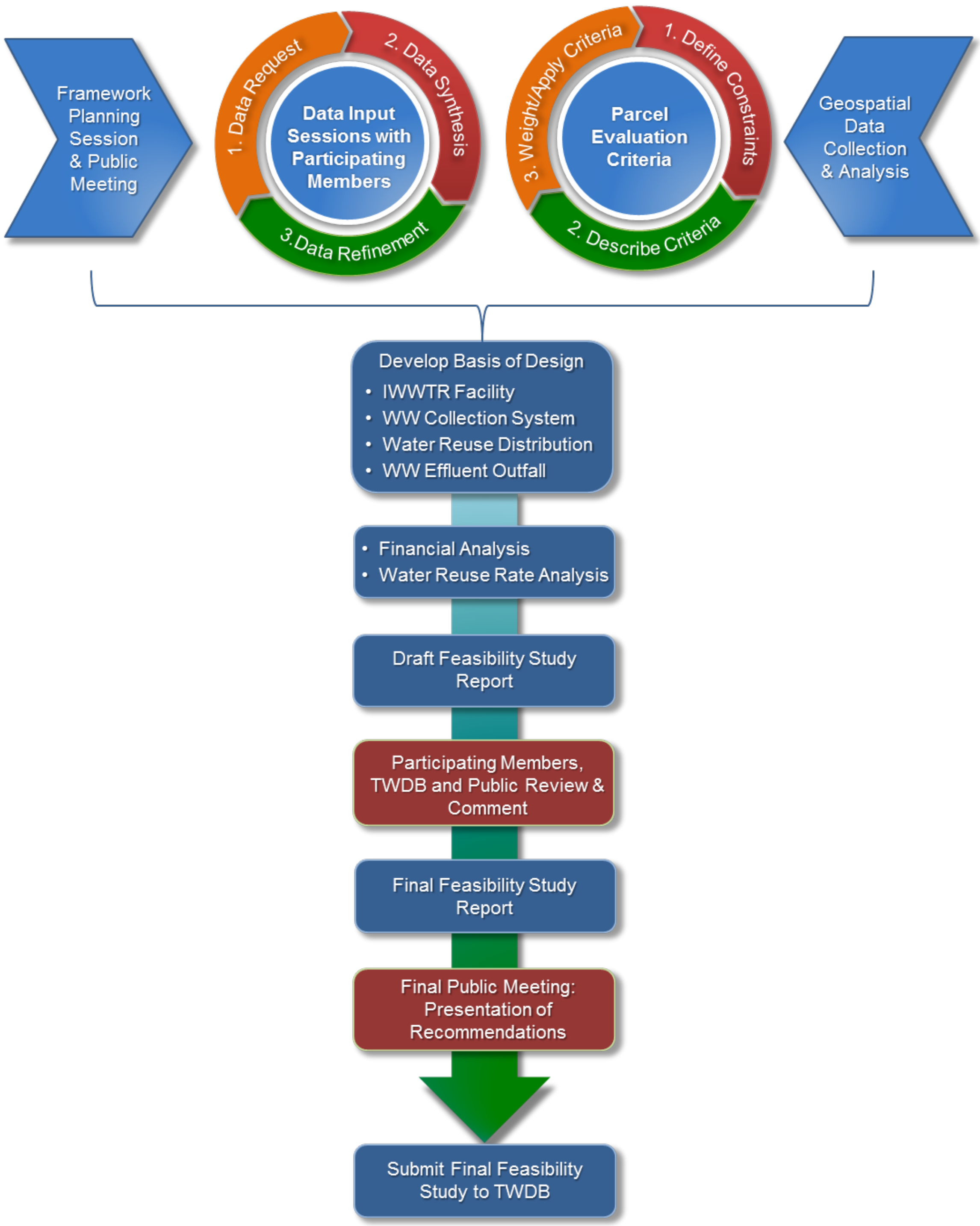

Figure 1-3 Feasibility Study Development Process

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SECTION 2
REGIONAL CONDITIONS

2.1 Project Study Area

The project area addressed in this FS is located around Mont Belvieu. In cooperation with the City of Mont Belvieu, GCA began by establishing a 10-mile-diameter area surrounding the city as the initial study area boundary. The initial study boundary was selected to define a viable area to query potential customers regarding their interest in participating in the FS for a regional IWWTR facility. The facility parcels of the four participating members and Mont Belvieu’s Cotton Bayou WWTP are located north of Interstate Highway 10 (I-10).

The study area covers portions of Harris County (Precinct 2), Chambers County (Precincts 3 and 4) and Liberty County (Precincts 1 and 4). The entire city limits of Mont Belvieu and portions of the Dayton, Baytown, Old River-Winfree, and Cove municipalities fall within the study area. The relevant special service districts within the study area include:

- Baytown Area Water Authority
- Chambers-Liberty County Navigation District
- Coastal Water Authority
- Harris County Flood Control District
- Cedar Bayou Park Utility District
- Chambers County MUD 1
- Harris County MUD 459

Figure 2-1 depicts the project study area, these various political jurisdictions, service districts and parcel locations of the participating members.

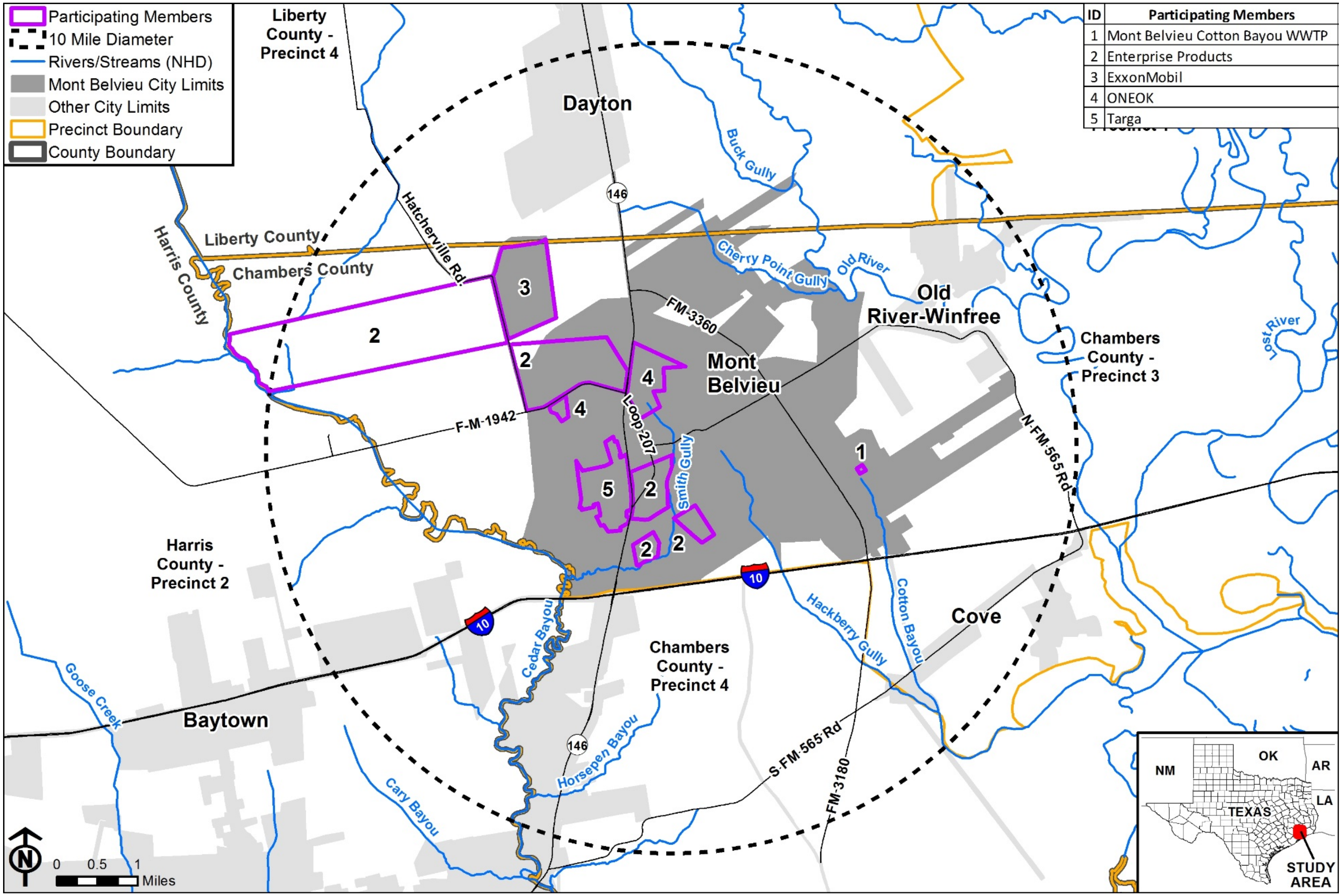

Figure 2-1 Project Study Area

2.2 Existing and Projected Land Uses

The study area has a mixture of land uses, including commercial, industrial, residential, institutional and open space. More than three-quarters of the land within the city is classified as vacant and undeveloped (Mont Belvieu 2010). Agricultural land is included in the vacant land category. Figure 2-2 depicts the distribution of the approximate percentages of Mont Belvieu's existing land uses (Mont Belvieu 2010).

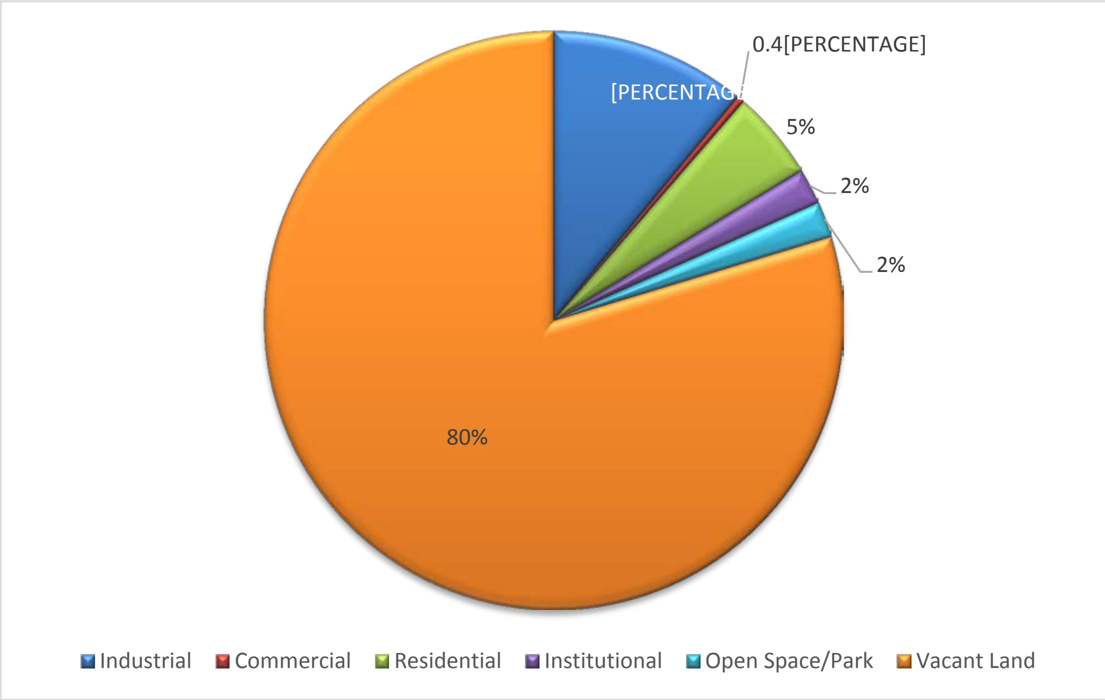

Figure 2-2 Distribution of Land Uses – Mont Belvieu

For planning purposes, Mont Belvieu has divided the city into the following four distinct districts largely influenced by geographic and land use characteristics: New Town, the Hill, West Side Industrial and the I-10 Corridor (Mont Belvieu 2010). The land uses for these four geographical districts identified in Mont Belvieu's 2010 Comprehensive Plan are summarized below.

- New Town area is primarily residential, institutional and recreational with open space and undeveloped lands predominating. It is expected to remain non-industrial. The existing Cotton Bayou WWTP is located in the New Town area.
- The Hill District is primarily distinguished by its distinctive geology/topography, formed by the immense salt dome lying beneath the ground surface. The area is primarily industrial; over 90% of occupied land in this area is used for industrial purposes. A regional transportation corridor (State Highway 146) runs through this area (Mont Belvieu 2010). Several participating members of this FS have their current operations in the Hill District area.

- The West Side Industrial area is primarily industrial and currently contains various industries and vacant/undeveloped lands. Several participating members of this FS have current operations in the West Side Industrial area.
- The I-10 Corridor is primarily vacant and undeveloped. The area is the main entry and exit point for traffic servicing the industrial areas.

Figure 2-3 displays the zoning map, which Mont Belvieu updated in 2015 (Mont Belvieu 2015). Figure 2-3 also depicts the general boundaries of the four geographic districts described above. As comprehensive planning instruments, the zoning map and four districts indicate that a proposed new IWWTR facility would best be suited for placement in the Westside Industrial or 1-10 Corridor zones. Another land use characteristic that requires mention is the proposed alignment and construction of the eastern portion of Grand Parkway (S.H. 99) shown in Figure 2-3 (Mont Belvieu 2010). The outcome of this project can influence and benefit the future direction of all land use categories in Mont Belvieu.

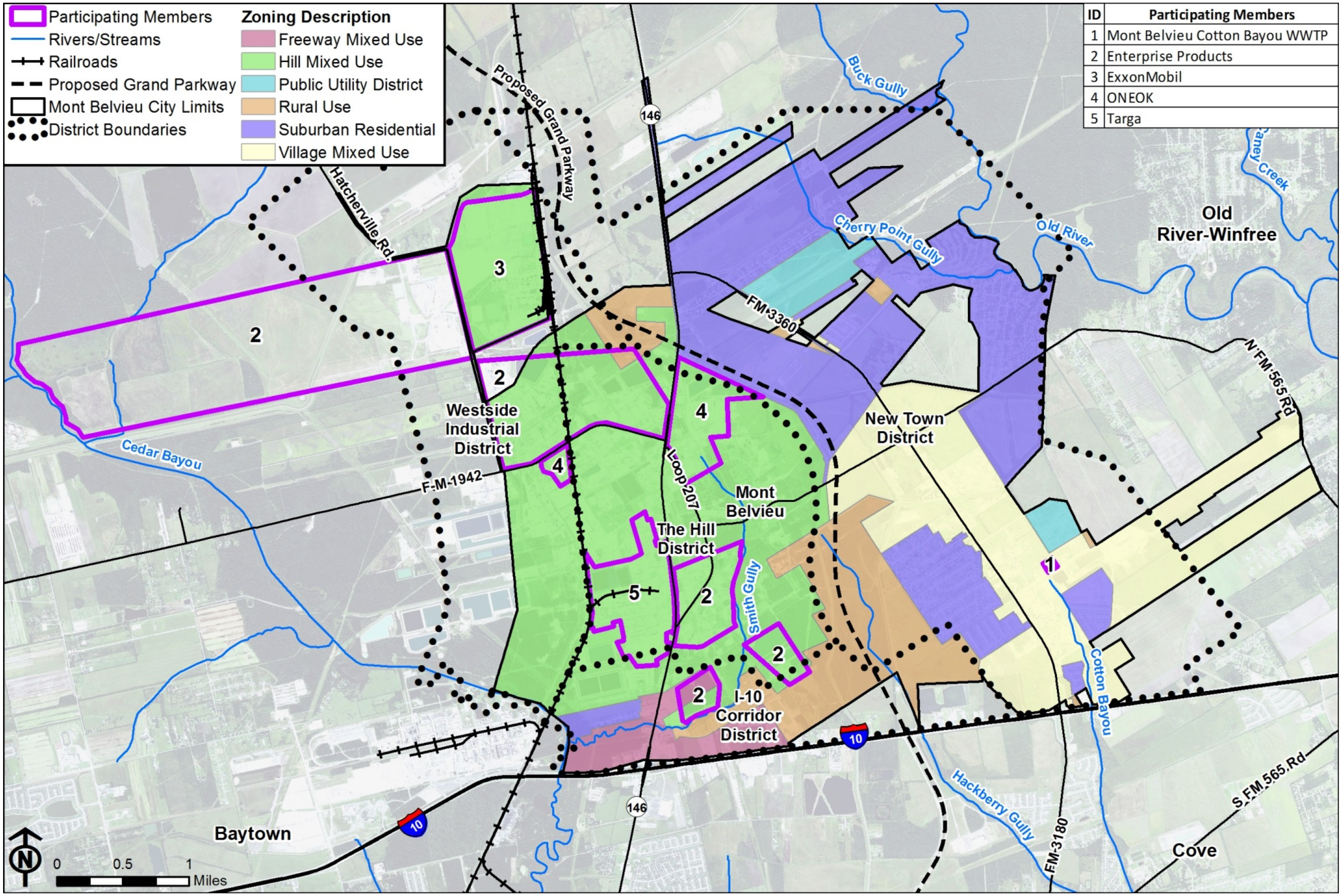

Figure 2-3 Zoning Classification – Mont Belvieu

2.3 Topography and Soils

The topography of the study area is generally flat with the exception of the salt dome formation, which is located in the Hill District. The Mont Belvieu Cotton Bayou WWTP is at approximately 34 feet mean sea level (msl), the highest point of the salt dome is at 77 feet msl, and the tidal boundary of Cedar Bayou is at approximately 6 feet msl. In addition, the natural topography divides Mont Belvieu almost in half with a ridge running in a north-south direction. Figure 2-4 depicts the salt dome and the topographic divide of the study area. This ridge location is relevant because it influences engineering approaches to existing and future wastewater collection and water distribution systems. Municipal wastewater collected from the west side of the ridge is currently pumped to a gravity system on the east side of the ridge that then benefits from gravity flow to the Cotton Bayou WWTP on the east side of Mont Belvieu.

The soil map for Chambers County indicates that, of the 560,000 acres in the county, approximately 68% is land area and 32% is water (United States Department of Agriculture [USDA] 1976). According to the general soil map completed by the USDA Soil Conservation Service, the soil throughout the service area includes two types - Anahuac-Morey-Frost and Beaumont-Morey-Lake Charles association (USDA 1976). Anahuac-Morey-Frost soil is considered poorly drained, loamy soil with very slow permeability and high water capacity. Beaumont-Morey-Lake Charles soil is acidic to neutral, clayey and loamy soil and is characterized as having poor drainage, slow rates of permeability, and high available water capacity. Runoff and internal drainage are also very slow. For hydrogeological purposes, the soil is classified in Soil Conservation Service Group D. Soil composition characteristics indicate that drainage of rainfall runoff is a problem throughout the study area.

2.4 Hydrology and Water Quality

The study area is located in a humid subtropical climate zone, characterized by mild winters and warm summers. Rainfall is typically abundant and evenly distributed throughout the year. The heaviest rains usually occur during the hurricane season, which extends from about June through October.

Salt domes are common geologic features within the Gulf Coast aquifer along the upper Texas Coast. The Barber Hill Salt dome lies below a significant percentage of the Mont Belvieu city limits. The core of a salt dome forms a vertically elongate, cylindrical stock, consisting of 90 to 99 percent crystalline rock salt (halite). Cap rock composed of sulfate and carbonate minerals commonly overlies the crest of the salt stock and drapes down the uppermost flanks. Salt stock and cap rock are enclosed in sediments and sedimentary rocks of the Gulf Coast aquifer and deeper saline-water intervals. Salt-dome crests are generally one to three miles in diameter and buried at depths that range from land surface (essentially zero feet) to greater than 10,000 feet. The Barber Hill salt dome has history of intense development, including oil production, salt-cavern storage and cap rock brine disposal (TWDB 2006).

At Barbers Hill salt dome, which penetrates Evangeline and Chicot freshwater sands in Chambers County, head measurements and pumping tests were conducted in the cap rock aquifer, which is saturated with dense brine (Hamlin and others, 1988). Controlled brine injection tests at Barbers Hill salt dome indicated that the cap rock is a single integrated aquifer with leaky vertical and lateral boundaries. Because of the arched shape of the cap rock, the vertical boundary corresponds to vertical and lateral contacts with freshwater sands, and the lateral boundary is the lower edge down the dome flanks that is in contact with deeper saline-water sands. At Barbers Hill salt dome, Hamlin and others (1988) used closely spaced well logs to map individual sand bodies and groundwater salinities near the dome. These analyses revealed a complicated pattern of vertical and lateral salinity variation indicating that high-salinity groundwater plumes extends away from the salt dome (TWDB 2006).

Figure 2-4 displays the hydrologic network and surface water flood zones throughout the study area. As discussed earlier, the ridge running north/south through Mont Belvieu forces the area east of the ridge to drain toward the Old River and Cotton Bayou watersheds and the area west of the ridge to drain to the Cedar Bayou watershed. Groundwater, surface water captured in reservoirs, and run-of-river sources comprise the majority of the water supply to the study area. Mont Belvieu operates three groundwater wells for public water supply.

The Smith Gully sub-watershed drains to Cedar Bayou Tidal. Buck Gully, Hackberry Gully, Cotton Bayou, and Cherry Point Gully sub-watersheds drain to Old River in the Trinity River Basin.

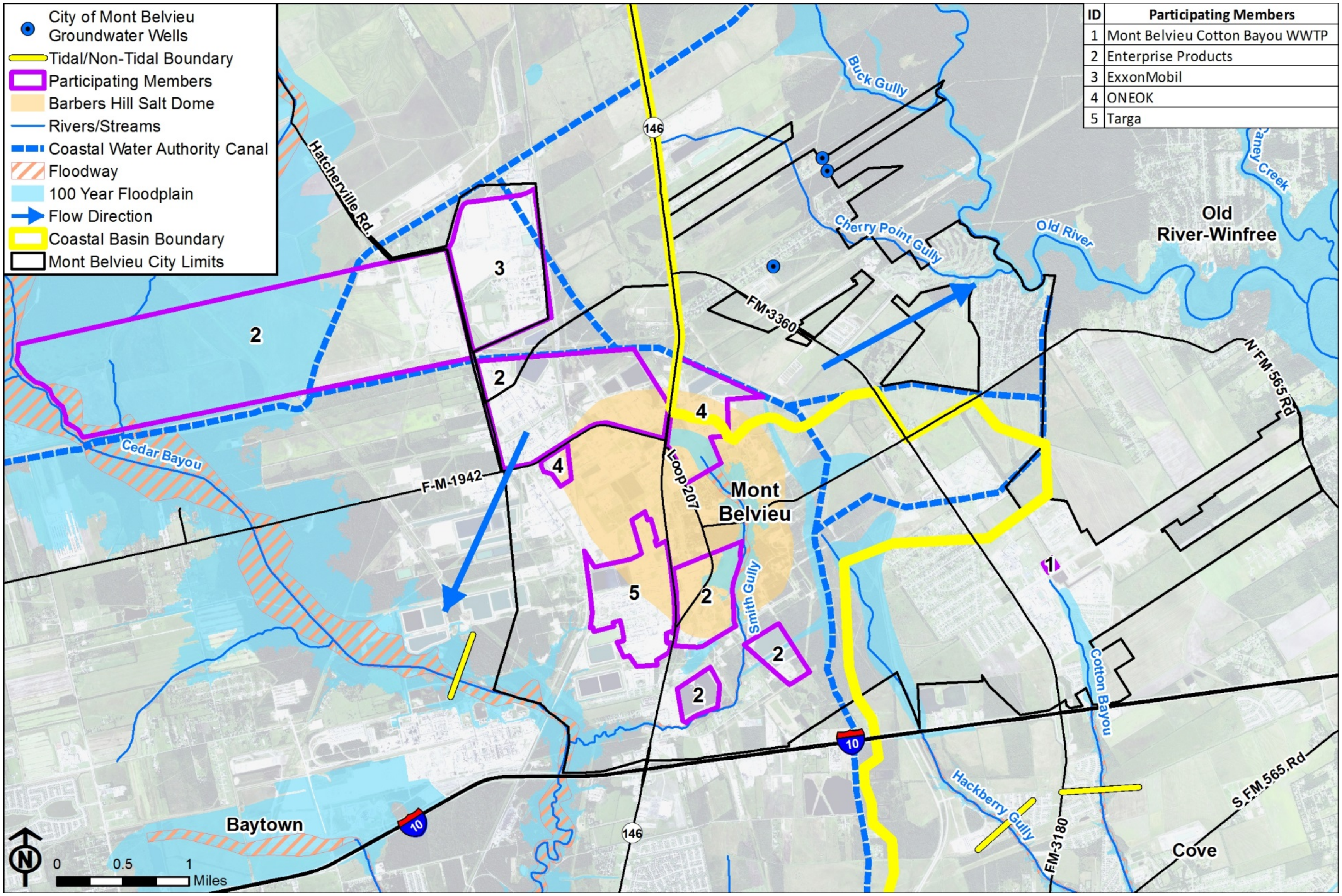

Figure 2-4 Surface Water Hydrologic Network and Flood Zones

In the TCEQ 2014 Integrated Report, nonpoint source (NPS) pollution in the Cedar Bayou Tidal Segment (SEGID 0901) is specifically identified as a contributor to water quality impairments associated with high levels of bacteria and concerns associated with low dissolved oxygen (DO) and chlorophyll-*a* levels (TCEQ 2014). A fish consumption advisory associated with the Galveston Bay system caused by elevated levels of PCBs and dioxins is also a concern in Cedar Bayou Tidal (TCEQ 2014). NPS pollution is specifically identified as a contributor to water quality concerns associated with low DO levels in Cedar Bayou above Tidal (Segment 902) (TCEQ 2014). These water quality characterizations for Cedar Bayou in the TCEQ 2014 Integrated Report are based on data collected between December 1, 2005, and November 30, 2012 (TCEQ 2015). Based on the TCEQ 2014 Integrated Report, the pollution sources that contribute to water quality impairments and concerns in Cotton Bayou (Segment 0801C) and Old River (Segment 0801B) (TCEQ 2014) are unknown.

The Cedar Bayou Watershed Protection Plan 2015 summarizes pollution sources that influence the water quality of Cedar Bayou and its tributaries. Based on this summary, NPS pollution in the service area is considered low from non-urban land uses and moderate from urban land use categories (Houston-Galveston Area Council [HGAC] 2015). These same characterizations of NPS pollution apply to the portion of the service area that drains to the Old River or Cotton Bayou watersheds.

The Coastal Water Authority (CWA), a conservation and reclamation district within Harris, Chambers and Liberty Counties, conveys surface water to several industries within the service area via their Main Canal and a Cedar Point Lateral from a sedimentation basin of the Trinity River. The CWA Main Canal connects this basin with Lynchburg Reservoir located southwest of the study area. Some of the CWA conveyance canals are displayed in Figure 2-4. A map of the entire CWA conveyance system map is located at

https://www.coastalwaterauthority.org/files/operations/maps/Map_Conveyance_System_July06.pdf

2.5 Residential & Industrial Utility Infrastructure

Driven by the large number of industrial facilities in the Mont Belvieu area, above-ground and subsurface utility infrastructure is dense. The public and private systems throughout the study area rely on pipelines for distribution or collection of various commodities including, but not limited to treated water, wastewater, telecommunications, oil, gasoline, ethane, butane, propane, propylene and natural gas.

More than 1,380 wells for oil and gas production are located throughout the study area. Approximately 1,200 of these wells are located in and immediately surrounding the Barber Hill salt dome (Texas Railroad Commission 2015). Figure 2-5 displays data derived from the Texas Railroad Commission showing the extensive number of commodity pipelines that service industries in the study area. Figure 2-5 displays Mont Belvieu's existing sanitary sewer collection system, which is described in more detail Section 3.2.

Within the Mont Belvieu city limits, there is one residential development on the north side of the city with 29 existing residences that rely on on-site sewage facilities (OSSF) for wastewater treatment. An additional 13 residential lots could be built out in this subdivision that would also rely on an OSSF for wastewater treatment. All residences in this subdivision are likely candidates for future conversion from OSSFs to Mont Belvieu's municipal wastewater collection system.

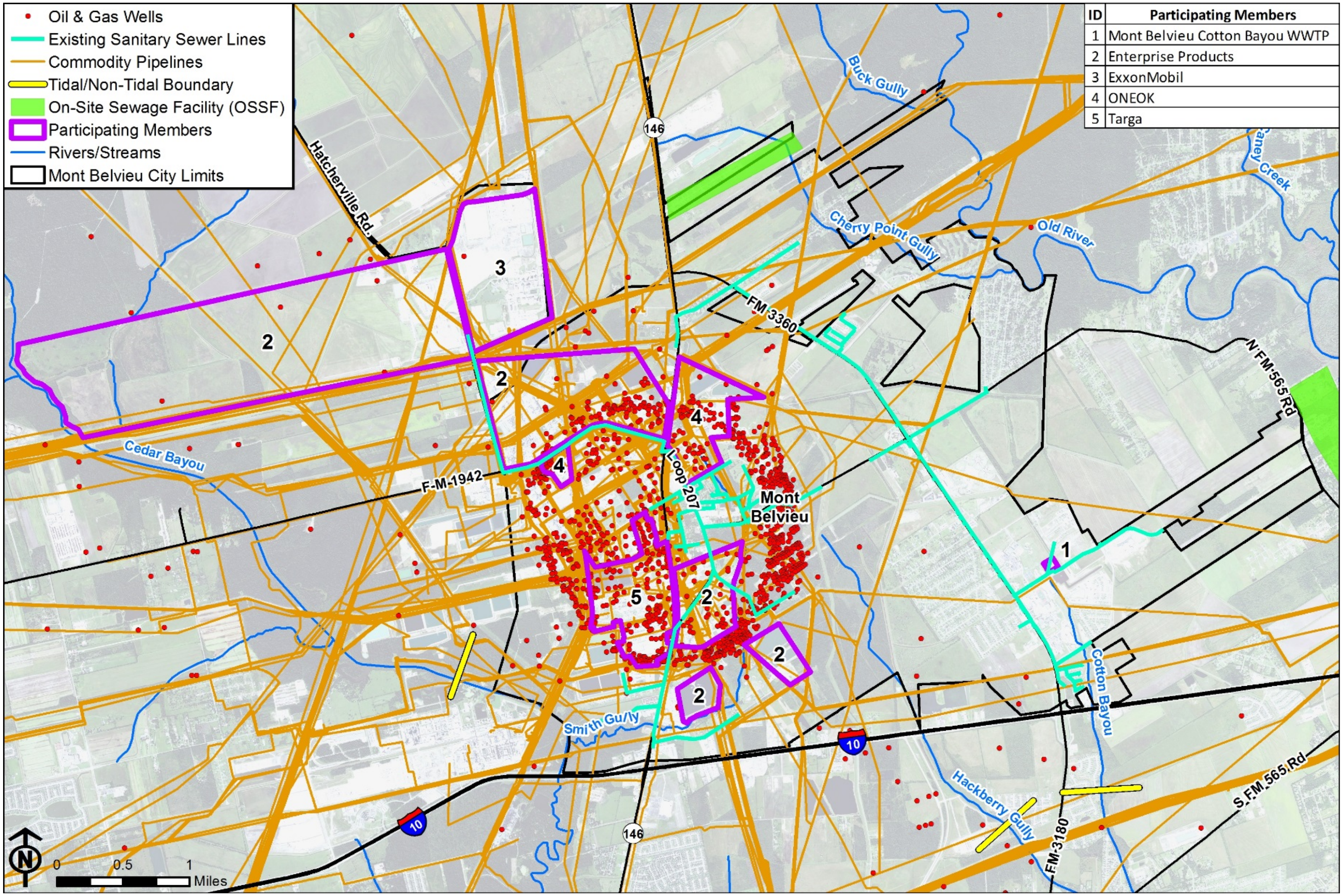

Figure 2-5 Partial Inventory of Utility Infrastructure

2.6 Recent Feasibility Studies for Regional Industrial WWTP and Reuse Facility

To date, neither GCA nor the participating members have conducted an evaluation of the feasibility of a regional IWWTR facility in the study area. In 2013, Mont Belvieu funded and completed a Preliminary Engineering Report (PER), for expanding the City's Cotton Bayou WWTP. This document can be accessed at

http://tx-montbelvieu.civicplus.com/DocumentCenter/View/547

As per the information presented in the 2013 PER (Klotz 2013), if the population in Mont Belvieu grows as predicted, the permitted capacity of the plant will be reached by 2024. However, the exact timing of moving forward with the engineering of a new WWTP for Mont Belvieu is dependent on residential/commercial growth rates.

Mont Belvieu and TWDB have completed various other studies that provide information relevant to the development of this FS. However, the feasibility of a regional IWWTR facility in the study area was not evaluated in any of the studies. The following is a list of the applicable studies either used in the technical analysis for this FS or discussed during the progress meetings:

- Mont Belvieu 2010 Comprehensive Plan – A public document that provided developmental goals, objectives, policies and criteria for Mont Belvieu physical growth. The report can be accessed at

  http://static1.squarespace.com/static/557efecce4b0a5d8f4bdd393/t/5591b1d5e4b03acd3ae89acc/1435611605723/Comprehensive_plan.pdf

- City of Mont Belvieu Fiscal Year 2014-2025 Capital Improvements Program: This plan provides information on prioritized water facility and other infrastructure needs for Mont Belvieu. It can be accessed at

  http://www.montbelvieu.net/DocumentCenter/View/511

2.7 Linkages to other Regional Initiatives or Plans

The idea of building a regional IWWTR plant in the Mont Belvieu area does align with and advance the goals and objectives of four key regional planning initiatives, as described below.

- TWDB 2016 Region H Plan: Provides comprehensive information for the overall water planning of the greater Houston area for the 2020-2070 period. Region H faces growth in municipal and manufacturing water demand over the next 50 years. Water reuse, one of many water management strategies recommended in the Region H plan, could be advanced by this proposed regional IWWTR plant. The 2016 Region H Plan can be accessed at

  http://www.twdb.texas.gov/waterplanning/rwp/plans/2016/H/Region_H_2016_RWP.pdf[twdb.texas.gov]

- The Galveston Bay Plan (Texas Natural Resources Conservation Commission [TNRCC] 1995): Provides a comprehensive management plan to enhance governance of the Bay at the ecosystem level. It can be accessed at

  http://www.gbep.state.tx.us/about-the-galveston-bay-plan/.
- Since the completion of the Galveston Bay Plan, GCA has partnered with the Galveston Bay National Estuary Program (TCEQ) to identify opportunities for advancing regionalization of wastewater treatment in the Galveston Bay Watershed. This regional IWWTR plant does align with the action items of the Galveston Bay Plan, which aim to promote improvements in managing contributions of point source pollutants from industrial and municipal facilities. Specifically under the Action Plan for Point Sources of Pollution, Action PS-3 promotes the idea of finding opportunities to consolidate wastewater treatment systems into larger regional systems which are more efficient to operate and monitor the performance of (TNRCC 1995).
- The *Our Great Region 2040 Plan* (HGAC 2016): Summarizes the goals, objectives and input from hundreds of organizations and thousands of people from across the area on how to make the Houston/Galveston region one of the greatest places to live, work, and succeed by 2040. It can be accessed from: http://www.h-gac.com/community/our-great-region-2040/default.aspx The regional IWWTR plant addressed in this FS can advance the following goals of the *Our Great Region 2040 Plan*:
  - Our region enjoys clean and plentiful water, air, soil and food resources to sustain healthy future generations.
  - Our region coordinates infrastructure, housing, and transportation investments, creating areas of opportunity and enhancing existing neighborhoods.
  - Our region is resilient and adaptive to economic downturns and environmental or natural disasters.
- The Cedar Bayou Watershed Plan (HGAC 2015): The purpose of the Cedar Bayou Watershed Protection Plan is to identify priority water quality issues, investigate their causes and sources, and recommend a comprehensive set of voluntary measures for addressing them based on sound science and local decision-making. The approach that will be used to design a regional IWWTR plant will adhere to the goals and requirements set forth in the Cedar Bayou Watershed Plan to protect the long-term water quality and aquatic habitats of Cedar Bayou. The Cedar Bayou Watershed Plan (2015) can be accessed at

  http://www.h-gac.com/community/water/watershed_protection/default.aspx

2.8 Land Evaluation Process

No specific site has been selected for the new proposed IWWTR plant. As part of this FS, however, various criteria were identified and recommended for investigating potential parcels of land throughout the study area for siting a new proposed IWWTR facility. The following initial criteria are recommended to identify possible parcels in the study area:

1. Land area required for new proposed IWWTR facility (approximately 40 acres of land is needed);
2. Land zoned as Freeway Mixed Use or Hill Mixed Use; and

3. Land parcels within the city limits or extraterritorial jurisdiction (ETJ) of Mont Belvieu.

There are a variety of additional environmental and anthropogenic factors that should be evaluated as opportunities and constraints through an iterative process to select a preferred parcel location for constructing a new IWWTR facility. These are summarized below.

Environmental Factors

- Topography

  Slope direction should be considered throughout the study area since it influences gravity flow and pumping associated with wastewater collection and water distribution.
- Minimize construction of WWTP facilities in the 100-year floodplain

  This is a key objective stipulated by TCEQ as part of Texas Administrative Code Title 30, §217.35, which provides general design criteria for wastewater treatment facilities.
- Avoidance of Barbers Hill salt dome
- Proximity of tidal receiving waters to the new proposed IWWTR facility

  While water reuse will be maximized at the proposed facility, conditions may occur that require excess treated effluent that cannot be stored or treated for reuse to be discharged.

Anthropogenic Factors

- Parcel size necessitated for new proposed IWWTR facility and future buildout
- Proximity of new proposed IWWTR facility to each parcel of participating members
- High priority assigned to parcels west of S.H. 146 (zoned Freeway Mixed Use or Hill Mixed Use)
- Location of existing subsurface and surface commodity pipelines and other utilities or drainage features
- Availability of easements
- Existing infrastructure (surface and subsurface) may hinder the development potential of certain land parcels
- Identifiable potential right-of-ways for collection and distribution lines that minimize impact to residential land owners
- Access to existing roadway

While land cost was not included in the list of criteria, it will be included in the financial analysis of the new proposed IWWTR facility. An estimated cost of a 40-acre parcel will be included in the cost summary analysis, which will factor in as another criterion for determining the financial feasibility of building a new facility.

Table 2-1 provides a <u>hypothetical example</u> of a qualitative evaluation of the various environmental and anthropogenic factors that could be considered to select a preferred site for a new proposed IWWTR facility. The color codes in Table 2-1 are defined as: green – favorable, yellow – moderately unfavorable, and red – unfavorable. Another option would be to develop weighting factors for each of the criteria and use a quantitative approach to select a preferred site. In the example matrix below the qualitative evaluation suggests that Site A would be the preferred location for the new proposed IWWTR facility. A more detailed evaluation using geographic information system data and other information to find a preferred site will be conducted during the next phase of the project if the proposed plant is determined to be economically practical and feasible.

Table 2-1 Example of Site Evaluation Matrix

Hypothetical IWWTR Plant Site	A	B	C	D	E	Notes
Environmental Factors						
Topography						A favorable rating is given to a site if wastewater collection and water distribution can be accomplished using only gravity lines.
Avoidance of salt dome						
Avoidance of the 100-year flood plain						
Proximity of tidal receiving waters to locate treated wastewater outfall						Unfavorable rating is based on distance from plant site to Cedar Bayou Tidal.
Anthropogenic Factors						
Parcel size						
High priority to sites west of S.H. 146 (i.e., zoned Freeway Mixed Use or Hill Mixed Use)						
Avoidance of existing subsurface and surface commodity pipelines/utilities						
Potential rights of way for collection and distribution lines that minimize impact to residential land owners						
Proximity to each parcel of participating members						
Roadway access						In order to receive a favorable rating, the site must have frontage along an existing road.
Availability of easements						
Land parcels within city limits or ETJ of Mont Belvieu						

2.9 Regional Population and Water Use Demands

This FS focuses on evaluating whether a regional approach to growing wastewater treatment capacity needs and water use demands associated with the facilities of the participating members is viable. Population growth is the primary indicator of future municipal wastewater treatment capacity needs and water use demands. Table 2-2 provides baseline indicators demonstrating that a regional approach in the Mont Belvieu area can be a beneficial strategy to address the impacts projected population growth can have on future wastewater management and water supply needs. For comparison, Table 2-3 displays population projections recently developed by Kendig Keast Collaborative, a consulting firm hired by Mont Belvieu to update the city's comprehensive plan. These numbers are significantly different from the TWDB population projections showing an annual growth rate between 2020 and 2030 of 12.9 percent compared to the TWDB projections, which suggest an annual growth rate of only 2.8 percent for that decade. The Mont Belvieu population projections are provided to demonstrate that considerable industrial, commercial and residential growth is anticipated in the Mont Belvieu area, which equates to the need to expand the existing wastewater treatment and water supply infrastructure as well as other types of infrastructure. Based on the results of the analysis of modeled available groundwater sources in the *2016 Regional Water Plan* for Region H, Chambers County has limited groundwater availability to meet growing demands (TWDB 2015a).

Table 2-2 Population Projections

Region	2020	2030	2040	2050	2060	2070
Region H	7,325,314	8,207,700	9,024,533	9,867,512	10,766,073	11,743,278
Chambers County	42,162	50,543	59,210	68,541	78,519	88,999
Mont Belvieu	5,013	6,410	7,855	9,411	11,075	12,822

Source: TWDB – Water for Texas 2017 State Water Plan

Table 2-3 Mont Belvieu Population Projections

	2020	2025	2030	2035
Mont Belvieu	9,356	14,306	21,393	30,115

Source: City of Mont Belvieu and Kendig Keast Collaborative, July 26, 2016

Table 2-4 summarizes the projected water needs for Chambers County based on the Region H Plan (2015a).

Table 2-4 Projected Water Needs for Chambers County (acre-feet)

Category	2020	2030	2040	2050	2060	2070
Irrigation	3,760	3,760	3,760	3,760	3,760	3,780
Livestock	0	0	0	0	47	86
Manufacturing	0	157	315	456	638	835
Mining	112	112	112	112	112	112
Municipal	40	107	409	1,158	1,967	2,819
Steam Electric Power	0	0	0	0	0	0
Total	**3,912**	**4,136**	**4,596**	**5,486**	**6,524**	**7,632**

Source: TWDB – *2016 Regional Water Plan*, Region H: Table 4-1

As the facilities of the participating members and other industrial facilities in the area continue to grow, expanding the availability of water reuse is one water management strategy that can help address the Region H estimate of the increase in Annual Unmet Water Needs summarized in Table 2-5. All of the metrics presented in this subsection suggest that other water management strategies such as water reuse can be a practical option for meeting the growing long-term water demands in Chambers County.

Table 2-5 Region H Annual Unmet Water Needs for Select Water Use Groups (acre-feet)

Water User Group	2020	2030	2040	2050	2060	2070
Irrigation	56,480	56,000	57,970	59,520	61,080	62,560
Municipal	30,310	29,950	25,960	36,560	54,120	70,430
Manufacturing	3,150	4,510	3,370	8,200	3,910	3,950

Source: TWDB – Water for Texas - 2017 State Water Plan, Chapter 7.

SECTION 3
WASTEWATER TREATMENT FACILITIES AND REQUIREMENTS

This section provides general information pertaining to the participating members' industrial operations, the quality and quantity of their respective wastewater effluent, and their stormwater management approach. This information was used to summarize the quantity and quality of industrial wastewater delivered to the new proposed IWWTR facility and the volume and quality of the non-potable reuse water that will be delivered back to the industrial participating members. Based on discussions with Mont Belvieu, the city is not seeking reuse water from the new proposed IWWTR facility.

3.1 Industrial Operation and Treatment Facilities of Participating Members

The industrial participating members have established various operations around the salt dome in the Mont Belvieu area. Their facilities include a plastics plant, a propane dehydrogenation and natural gas liquids fractionation plant, a chemical manufacturing facility, and two natural gas liquid plants. Each of the four industrial participating members currently operates its own IWWTP at its facility(s). Each industrial participating members also has a TPDES or National Pollutant Discharge Elimination System permit for industrial stormwater. Three of the industrial participating members discharge to Cedar Bayou above Tidal, and two discharge to Cedar Bayou Tidal. The various types of wastewater and stormwater generated at the facilities of the industrial participating members include:

- Treated process wastewater, treated process area stormwater, and utility wastewaters
- Utility wastewaters and demineralizer neutralization tank effluent
- Stormwater
- Treated process area stormwater, interior and exterior washdown water, neutralized utility wastewater, hydrostatic test water and truck wash water
- Cooling tower blowdown and back flush water
- Treated domestic wastewater and utility wastewaters
- Non-process area stormwater, post first-flush stormwater, and allowable non-stormwater
- Utility wastewaters
- Reverse osmosis reject water
- Fire testing water, and safety water
- Treated industrial wastewater, including filter backwash, cooling tower blowdown and equipment washdown
- Hydrostatic test and fire hydrant water

All four industrial participating members are interested in sending wastewater influent to the proposed IWWTR facility. Three of them are interested in sending a portion of their stormwater to the proposed IWWTR facility.

3.2 City of Mont Belvieu Wastewater Infrastructure and OSSFs

Mont Belvieu's sanitary sewer system contains more than 80,000 linear feet of gravity sanitary sewer lines varying in diameter from 6 inches to 42 inches. There are also approximately 14,400 linear feet of sanitary force main and 11 wastewater lift stations. These serve approximately 823 wastewater connections (Mont Belvieu 2010). The terminus of the wastewater collection system is the Cotton Bayou WWTP located in the southeast corner of the Mont Belvieu just east of Eagle Drive. The Cotton Bayou WWTP is permitted by TCEQ to discharge an average flow of 1.5 million gallons per day (MGD) and a peak flow of 4.5 MGD to an unnamed ditch that flows to Cotton Bayou (TPDES Permit WQ0014807000). The treatment plant is equipped with an oxidation ditch, clarifiers, ultraviolet (UV) disinfection, solids treatment and dewatering, and solids disposal at a local sanitary landfill (Mont Belvieu 2010).

The PER (Klotz 2013) states that the Cotton Bayou WWTP, originally constructed in 1981, underwent various upgrades in 1997 and 2010. Currently the plant operates at approximately 40 percent of its permitted capacity. As discussed in the 2013 PER, if population in Mont Belvieu grows as predicted, the permitted capacity of the plant will be reached by 2024.

The Mont Belvieu Capital Improvement Program 2014-2025 includes an estimated $25.2 million in proposed improvements to the city’s wastewater collection and treatment system (City of Mont Belvieu 2016). The construction of a new regional IWWTR facility could delay the need for a major expansion of the Cotton Bayou WWTP. The sewer collection system associated with the new regional IWWTR facility would alter the costs and design approach for sewer line rehabilitation projects slated for SH 146, Hatcherville Road, and possibly FM 1942. This FS will provide city leaders and residents with preliminary information to consider future financial and engineering options for managing long-term wastewater collection and treatment demands.

While various residential subdivisions around the study area are serviced by individual on-site sewage systems (OSSFs) for wastewater treatment, only the Kings Point Boulevard subdivision falls within the Mont Belvieu city limit. Located on the north side of the city, the Kings Point Boulevard subdivision has 29 existing residences in the Kings Point Boulevard subdivision that rely on OSSFs for wastewater treatment. Mont Belvieu is interested in removing these OSSFs and placing these homes on the city’s sanitary sewer system at some time in the future. The wastewater flow generated from these residences could be part of the municipal flow sent to the proposed IWWTR facility.

3.3 Summary of Wastewater Volumes and Influent Loading Rates for Proposed IWWTR Plant

Data were acquired from each of the participating members to evaluate the quantity and quality of the wastewater influent that would be delivered to the new proposed IWWTR facility. Each participating member provided both daily average and daily maximum flow volumes and extrapolated these values for the entire planning horizon including 2025, 2050 and ultimate build out (UBO) in 2075. Some of the industrial participating members’ maximum average daily flow and future flow estimate volumes included a portion of their stormwater. Mont Belvieu estimated the amount of raw municipal wastewater (existing and future flows) that would be diverted from the existing sanitary sewer collection system to the new proposed IWWTR facility. Table 3-1 summarizes the cumulative existing and projected wastewater volumes for all five participating members.

Table 3-1 Wastewater Quantities Discharged to Proposed IWWTR Facility (MGD)

Dischargers Providing Wastewater Influent	2016 Estimated Influent Flow		Future Flow Estimate (Including Stormwater)		
	Dry Weather Flow	Max. Avg. Daily Flow	2025	2050	UBO 2075
5	5.6	17.9	19.2	23.7	29.0

The influent quality of the wastewater from each participating member was evaluated for the following parameters:

- Total suspended solids (TSS)
- Total dissolved solids (TDS)
- Total organic carbon (TOC)
- Chemical oxygen demand (COD)
- Five-day biochemical oxygen demand (BOD_5)
- Total nitrate-nitrogen
- Total phosphorus
- pH (minimum, maximum, average)
- Calcium
- Hardness
- Magnesium
- Fluoride

The analysis and summary of the data provided by the participating members were condensed to focus on the four key parameters (TSS, TDS, TOC and BOD_5) that most influence the wastewater treatment processes in the proposed plant. Nutrient loading of the existing and projected wastewater influent from the participating members is insignificant. Table 3-2 summarizes influent quality concentrations of key parameters and total nitrogen typical of the wastewater that would be delivered to the new proposed IWWTR facility.

Table 3-2 Existing and Projected Loading for Select Parameters of Wastewater Influent from Participating Members (pounds/day)

Parameter	Dry Weather Condition	Wet Weather Condition	Year 2025	Year 2050	Year 2075
TSS	3,850	11,870	11,070	13,320	17,490
TDS	125,940	326,590	345,860	424,850	545,870
TOC	2,570	9,910	12,040	15,710	18,330
BOD_5	1,680	4,130	4,190	6,860	8,610
Total N	370	800	1080	1320	1720

3.4 Proposed IWWTR Plant Effluent Discharge Requirements

Design criteria for the basis of design of the new proposed IWWTR plant will be driven by TCEQ permit requirements for industrial WWTP discharges. The level of treatment required of any wastewater plant is governed in large part by the method of effluent disposal. Typical methods for disposal of treated wastewater effluent in Texas include: 1) disposal of treated effluent wastewater by spray or subsurface drip irrigation in accordance with the TCEQ's Texas Land Application Permit (TLAP) requirements defined in Chapter 309, and 2) discharge of the treated effluent wastewater to a surface water under a TPDES permit. Considering that the total treatment volume for the new proposed IWWTR plant is 19.2 MGD, a significant land area would be required for land application. This method is therefore not considered practical for this project. A TPDES permit to discharge treated effluent will be required for the new proposed IWWTR plant.

A TPDES permit authorizes the discharge of treated effluent to a receiving water body. Permit limits for WWTPs are developed by the TCEQ based on the requirements to protect the designated use of the receiving water body. The recommended wastewater outfall for the proposed IWWTR plant will be within Cedar Bayou Tidal (Segment 901), as shown in Figure 3-1 in Section 3.7. Since Cedar Bayou Tidal is a water quality limited segment, conventional treatment may not be sufficient to meet instream water quality standards. A portion of the wastewater influent that will be treated at the new proposed IWWTR plant is domestic sewage. Therefore, disinfection of the industrial wastewater treatment must also be provided to protect public health and aquatic life. For discharges into salt water (Cedar Bayou Tidal), *Enterococci* is the indicator bacteria that will dictate the disinfection requirement incorporated into effluent limits for the proposed IWWTR plant (TCEQ 2009). Construction of the proposed IWWTR plant would result in a reduction in the number of outfalls discharging to Cedar Bayou above Tidal and Cedar Bayou Tidal.

3.5 Summary of Water Reuse Volumes

As part of this FS, data were acquired from each of the participating members to evaluate water reuse as a viable water management strategy. The participating members provided water supply needs and water quality requirements for reuse water. Mont Belvieu was the only participating member that is not interested in receiving reuse water. The potential for water reuse is high among all four other participating members because a significant portion of their water use is process cooling water and wash-down water, both of which contribute to the wastewater volume for these facilities. These types of water use do not require potable water, so treated wastewater effluent could help reduce their demand for surface water or groundwater.

Table 3-3 compares the estimated demand for reuse water from the industrial participating members to the estimated total wastewater influent volumes summarized in Table 3-1. Table 3-3 summarizes the estimated demand for reuse water from the industrial participating members. Future flow estimates for 2025 and 2050 were compared against the dry weather and maximum daily flow conditions. Under dry weather conditions for wastewater treatment volumes, demand for reuse water by the participating members exceeds wastewater supply. Under the maximum daily flow condition for wastewater treatment volumes, reuse water supply exceeds demand. These conditions represent both opportunities and constraints for long-term management of the water reuse supply.

Table 3-3 Potential for Water Reuse Demand

Dischargers Providing Wastewater Influent	Reuse Water Purchasers	Wastewater Quantities Discharged to Proposed IWWTR Facility (MGD)					Requested Reuse Water Quantity (MGD)		
		2016 Estimated Influent Flow		Future Flow Estimate (Including Stormwater)					
		Dry Weather Flow	Maximum Average Daily Flow	2025	2050	UBO 2075	2025	2050	UBO 2075
5	4	5.6	17.9	19.2	23.7	29.0	11.6	13.8	18.0

3.6 Reuse Water Quality Requirements

Wastewater reuse quality and system design requirements for municipal effluent reuse are regulated by TCEQ under 30 TAC[1] §210. However, 30 TAC 210, subpart E, specifically excludes industrial water reuse including the types of industrial influent from the sources that will be delivered to the proposed IWWTR facility. It is assumed that the reuse water provisions in the permit for the proposed IWWTR facility will be developed on a case-specific basis through collaboration with TCEQ. At this time, it is assumed that the reuse quality criteria that will be required will be based on the water quality needs of the industrial users.

The industrial participating members stated that they preferred the quality of the reuse water to be delivered to their sites be similar to that of the surface water currently provided by Coastal Water Authority (CWA). More specifically, they requested reuse water containing less than 3 Nephelometric turbidity units (NTU) and less than 100 milligrams per liter (mg/L) TSS. The CWA is a Conservation and Reclamation District established by the Texas Legislature in 1967. CWA provides raw water supply to three of the four industrial participating members from its network of water supply canals throughout Chambers, Liberty and Harris counties. Ambient surface water quality data are not readily available online from CWA. Ambient water quality data were compiled from TCEQ for Luce Bayou (Segment 1002B) for a general comparison of the quality of the raw water that the three industrial participating members currently receive from CWA. TCEQ provided data from 1984 through 2015 for TDS, chlorides, sulfate and hardness. These are summarized in Table 3-4. The data sets obtained from TCEQ from two different water quality monitoring stations on Luce Bayou are provided in Appendix C.

Table 3-4 Ambient Water Quality for Select Parameters in Luce Bayou (mg/L)

Parameter	Average Concentration
TDS	110[a]
Sulfate	10
Chloride	20
Total Hardness	54

Source: TCEQ Water Quality Monitoring & Assessment Team, June 2016.
a = Converted from specific conductivity measurements

[1] TAC – Texas Administrative Code

3.7 Collection and Distribution System Options

As discussed above, some of the participating members have multiple facilities within the study area that are interested in delivering wastewater influent and stormwater and receiving reuse water. However, not all facilities for participating members will need reuse water. Table 3-5 quantifies these interests. This quantification will guide the basis of design approach for developing the wastewater collection and reuse water distribution systems.

Table 3-5 Wastewater and Reuse Water Services Sought by Participating Members

Participating Member	Number of Sites	Sites Providing Wastewater (Type)	Sites Needing Reuse Water
City of Mont Belvieu	1	1 (untreated municipal sewage)	0
ExxonMobil	1	1 (influent and stormwater)	1
Enterprise Products LLC	5	3 (influent and stormwater)	3
Targa Resources	1	1 (influent)	1
OneOK	2	2 (influent and stormwater)	1

The basis of design approach for the infrastructure necessary to meet these wastewater collection and reuse water distribution needs is driven by the location of the sites requesting the service and ultimate location of the proposed IWWTR plant. The industrial participating members recommended preferred points at each of their sites for their wastewater and/or reuse water connections. Figure 3-1 on the following page identifies the recommended access points for wastewater collection and delivery of reuse water service to each site. In addition to these proximity relationships, a wide array of surface and subsurface natural and manmade features (e.g., salt dome, railroad crossing, subsurface utilities, roadways, topography, and surface water) were evaluated as part of the basis of design approach for the wastewater collection and reuse water distribution infrastructure.

The integration of all of these characteristics influence the hydraulic requirements necessary to provide wastewater collection and reuse water distribution to and from the proposed location of the IWWTR plant. The natural and anthropogenic characteristics of the study area warrant the use of a combination of gravity lines and lift stations/force mains for the proposed wastewater collection and reuse water distribution lines.

3.8 Potential for Future Integration of Other WWTP Facilities

In addition to the participating members supporting this project, other industrial and municipal facilities in and around Mont Belvieu expect to grow to a size that could generate higher water demand in the area. Two other industrial facilities are interested in the proposed regional IWWTR plant, but they prefer to wait for completion of this FS report before engaging in any further discussions with GCA. Any additional industrial or municipal WWTP that may be interested in connecting to the new proposed IWWTR facility may have different organic and wastewater influent quality requirements than those outlined above for the participating members. The basis of design for the new proposed IWWTR facility summarized in the following chapters would need to be re-evaluated and re-engineered to accommodate any additional flow or loading from other industrial facilities or WWTPs.

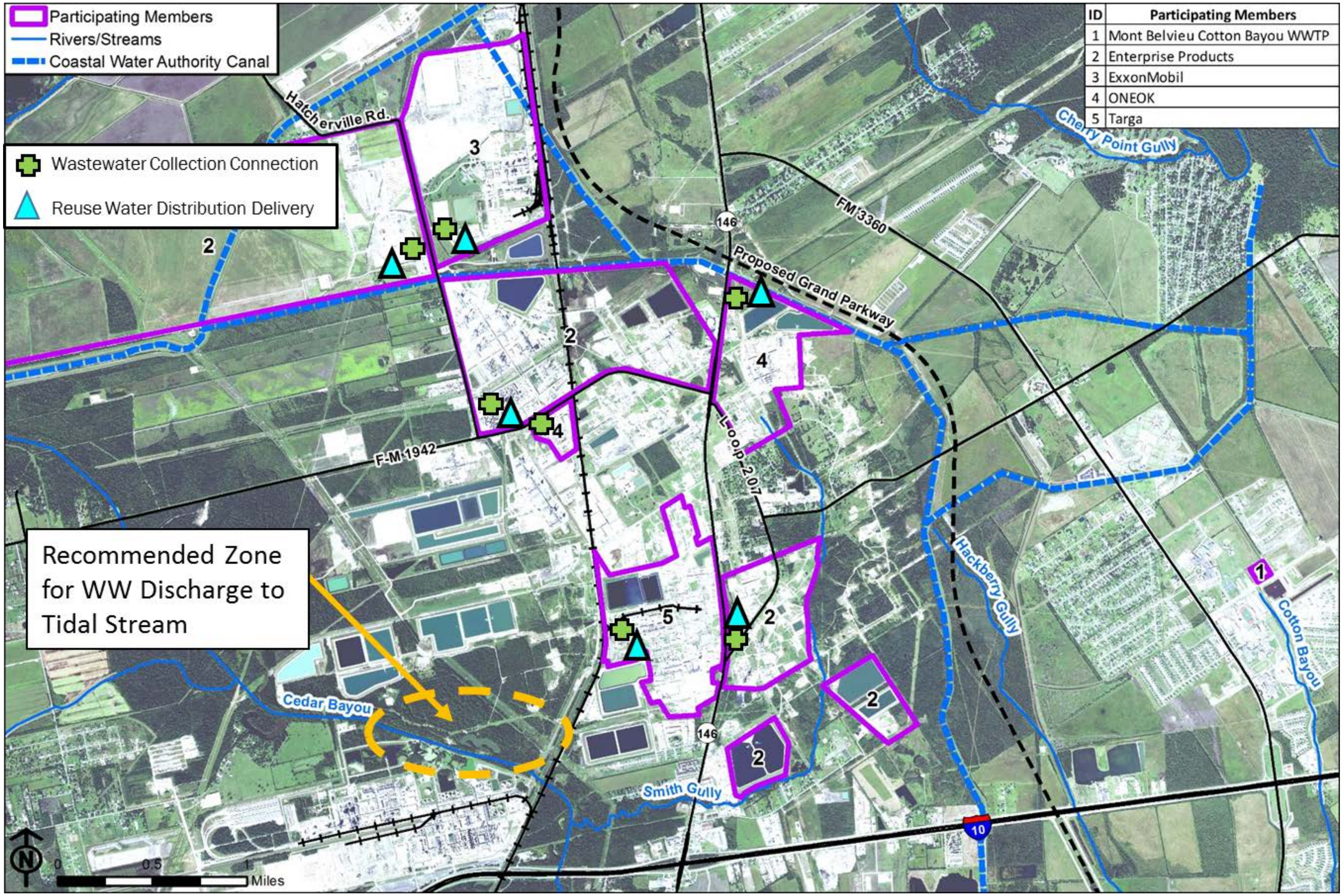

Figure 3-1 Wastewater Collection and Reuse Water Service Points

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SECTION 4
BASIS OF DESIGN

This section provides an evaluation and recommendations for design of the proposed IWWTR plant, associated site improvements, and the wastewater conveyance and reuse water distribution systems. A supporting planning level cost estimate (Class 4) is also provided for each of the major components discussed.

4.1 Basis of Design for Wastewater Treatment System

The projected wastewater volume and loading rates for years 2025, 2050 and UBO are discussed in Section 3.3. The consensus reached during discussions with participating members was to use the wastewater influent flow projection for the year 2025 as the basis of design for wastewater treatment. As such, the flow range that will guide the basis of design will be from the dry weather estimate of 5.6 MGD to the wet weather estimate of 19.23 MGD for the planning year 2025.

Based on the information received from the various participating members and considering that the future integration of other potential companies is unknown at this time, the feasibility of the proposed IWWTR plant using either the 2050 or UBO flow condition as the basis of design is not practical at this time. Table 4-1 provides the wastewater treatment quantities that dictate the basis of design for the proposed IWWTR plant.

Table 4-1 Wastewater Influent Quantity for Basis of Design (MGD)

Dischargers Providing Wastewater Influent	Current Dry Weather Flow	Current Maximum Average Daily Flow	Estimated Wastewater Flow to IWWTR Plant 2025 (including Stormwater Flow)
5	5.6	17.9	19.23

Table 4-2 provides the loading rates associated with the key parameters and their estimated concentrations in the 2025 influent that drive the basis of design for wastewater treatment in the proposed IWWTR plant.

Table 4-2 Wastewater Influent Quality (2025) for Basis of Design

Parameter	Loading rate (pounds/day)	Concentration (mg/L)
TSS	11,070	69
TDS	345,860	2,156
TOC	12,040	75
BOD_5	4,190	34
Total N	1,080	6.73

The wastewater flow will be equalized using an equalization tank so that the wastewater treatment process units can be operated at a consistent flow rate. The unit processes selected for this wastewater treatment plant are primarily driven by the need to remove the BOD_5, TOC, and TSS from the wastewater flows delivered. Nutrient removal is considered unnecessary because nutrient loading to the proposed IWWTR plant is considered de minimus. The treated effluent from the IWWTR plant will be discharged to Cedar Bayou Tidal. Since the wastewater influent will also contain a component of municipal wastewater, it will require pathogen removal to meet the effluent limitation defined in Table 1 of 30 TAC chapter 309. The proposed IWWTR plant will include a treatment unit to remove pathogens before effluent is discharged to Cedar Bayou Tidal or provided as reuse water back to the industrial participating members.

4.2 Basis of Design for Water Reuse Treatment System

As discussed in Section 3.5, demand for reuse water by the participating members exceeds wastewater supply under dry weather conditions for wastewater treatment volumes. Conversely, under the maximum daily flow conditions for wastewater treatment volumes, wastewater supply exceeds reuse water demands. These conditions represent both opportunities and constraints for long-term management of the water reuse supply. For the basis of design, the initial sizing of the water reuse process units is based on the treatment and delivery of 5 MGD of non-potable reuse water. While the wastewater treatment plant will be designed to handle peak influent flows, it is more practical to design the water reuse treatment system to respond to average influent flows. The plant will be configured to accommodate future expansion required by increased wastewater influent flow rates and customer demand.

As discussed in Section 3.6, the basis of design for the water reuse treatment system is primarily driven by the participating members' interest in obtaining water that is similar in quality to their current source of raw water received from CWA (i.e., achieving an average TDS concentration of less than 110 mg/L). Based on the information provided by participating members, the hardness of wastewater influent may range in concentrations from 200 mg/L to 400 mg/L. This concentration range is approximately four to 10 times higher than the average hardness concentration of CWA water quality (see Table 3-4). Therefore, an important driver in the water reuse treatment process will be controlling TDS and hardness concentrations to provide reuse water of acceptable quality.

4.3 Basis of Design for Wastewater Collection and Water Distribution System

Three distinct types of system IWWTR pipelines will be required to provide service to the participating members (see Figure 4-1):

1. wastewater conveyance lines;
2. an outfall pipeline to discharge treated wastewater effluent to Cedar Bayou Tidal; and
3. reuse water distribution lines.

Wastewater will be collected from each participating member before combining the influent into a single trunk line for delivery to the proposed IWWTR plant. In most instances, wastewater collection and reuse distribution lines will follow the same routing to and from the proposed IWWTR plant. The proposed IWWTR plant will also require a TPDES permit to discharge treated effluent to Cedar Bayou Tidal.

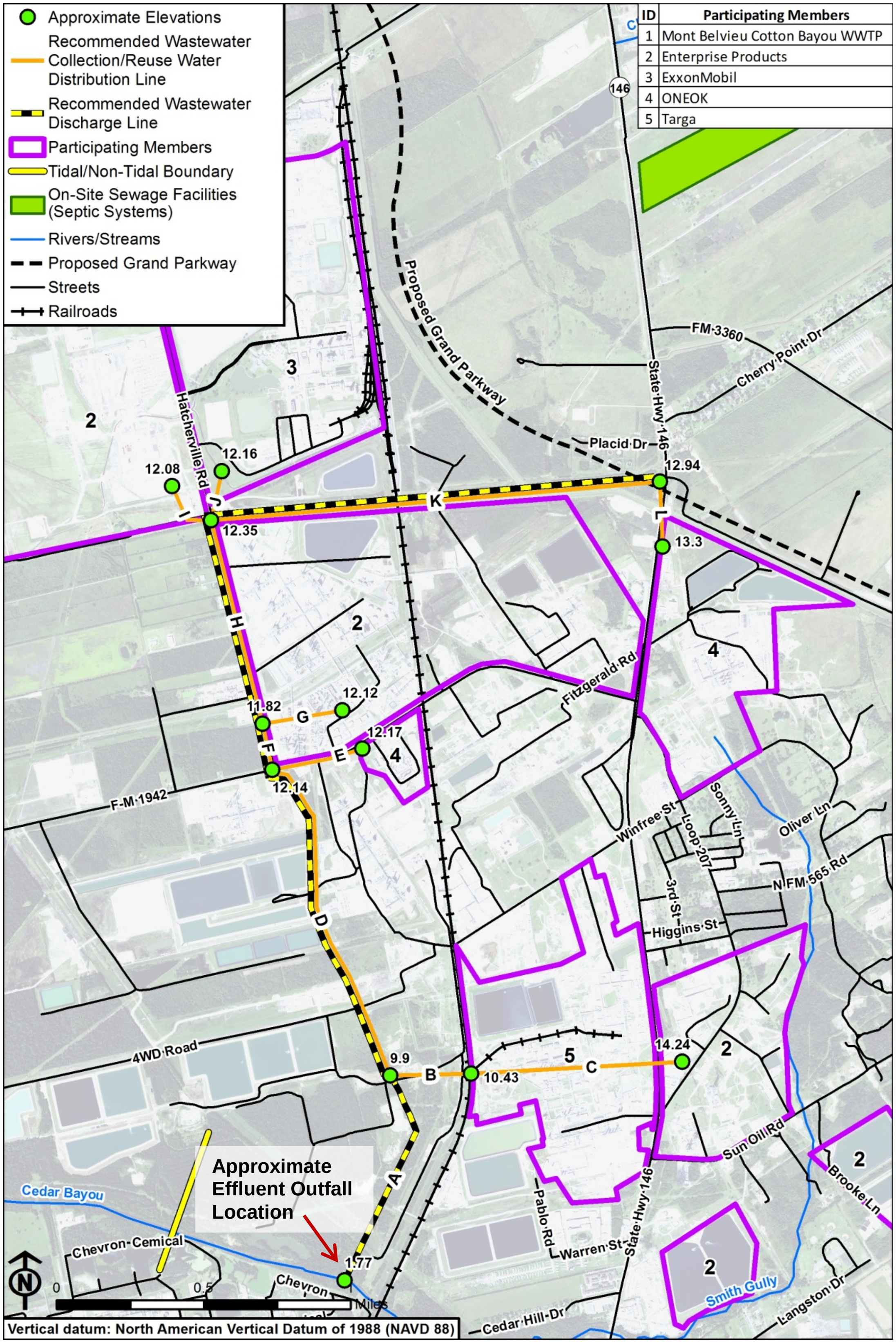

Figure 4-1 Conceptual Routing of Conveyance, Distribution and Effluent Discharge Lines

The basis of design for the collection and distribution system is influenced by many existing natural and anthropogenic constraints throughout the study area. As discussed in Section 2.5, the existing above-ground and subsurface utility infrastructure in the study area is extensive due to the number of pipelines associated with distribution or collection of various commodities. These commodities include but are not limited to treated water, wastewater, telecommunications, oil, gasoline, ethane, butane, propane, propylene and natural gas. Consequently, limited right-of-way (ROW) is available within the study area. Roadways, railroads, topography and hydrology are other key physical constraints that were closely considered as part of the basis of design. In addition, the City of Mont Belvieu is interested in sending as much of the wastewater it collects west of State Hwy 146 to the proposed IWWTR plant. The city's existing wastewater collection system east of State Hwy 146 will continue to deliver wastewater to the Cotton Bayou WWTP.

Based on all of these constraints, options were investigated for a conceptual routing of lines for wastewater conveyance, reuse water distribution, and discharge of treated wastewater to Cedar Bayou Tidal. Driven by the factors discussed above, a force main with a lift station is recommended to convey wastewater to the proposed IWWTR plant. Wastewater influent from each participating member will need to be pumped to the force main. Additional evaluation will be necessary to identify the best locations for connecting the Mont Belvieu sanitary sewer system to the proposed force main or to the proposed IWWTR plant. Reuse water will be pumped from the proposed IWWTR plant to the reuse water distribution line.

Figure 4-1 displays the conceptual pipeline routing for the three main pipelines and includes approximate surface elevations for reference purposes only. Based on the locations of the participating member's sites, ROW corridors along State Highway 146 and Hatcherville Road are recommended as the most viable corridors for installation of the main collection and distribution pipelines. Based on the preliminary evaluation of the existing municipal sewer collection system (Figure 2.5) and discussions with Mont Belvieu, the availability of ROW for installation of main pipelines is more feasible along Hatcherville Road than State Highway 146. The pipeline route for the wastewater outfall will follow an unnamed creek that begins just south of the intersection of FM 1942 and Hatcherville Road to its terminus with Cedar Bayou Tidal. This same route will be used to reach the two southernmost participating member sites.

As shown in Figure 4-1, it is expected that access points from each of the participating members will tie in with the wastewater conveyance system and reuse water distribution line. Based on preliminary calculations, the total estimated length of each pipeline is:

- tie-in lines to force main from industrial partners – 0.65 miles
- wastewater conveyance system – 5.2 miles
- reuse water distribution system – 5.2 miles
- wastewater effluent outfall pipeline – 4.2 miles

Based on the anticipated wastewater volume from the participating members and the necessary reuse water distribution system, the estimated sizes of the tie-ins and main pipelines are:

- wastewater tie-in line from each participating member sites - 18-inch-diameter polyvinyl chloride (PVC)
- wastewater conveyance – 32-inch-diameter high density polyethylene (HDPE)

- reuse water line – 20-inch-diameter HDPE
- wastewater effluent outfall line – 24-inch-diameter PVC
- lift/pump stations – one lift station for the wastewater conveyance and one pump station for the reuse water line

The detailed design of the collection system will adhere to the design criteria defined in TCEQ's rules under Chapter 217.51 to 217.71 (Design Criteria for Domestic Wastewater Systems).

4.4 Proposed Industrial Wastewater Treatment Train

A number of process units will be required to treat the wastewater influent to meet the effluent criteria outlined in Section 4.1. The typical process units include preliminary treatment (screening and grit removal), equalization of flow for the downstream process units, biological treatment, and disinfection. Each step was peer reviewed to select an appropriate process unit that can meet the desired effluent criteria. In general, the treatment steps for the proposed IWWTR plant are described below.

- Preliminary treatment – This step consists of grit, debris and fine particle removal before the influent enters to the biological treatment step. The major treatment units are a bar screen, a grit chamber and a fine screen.
- Flow equalization – This step will follow preliminary treatment. It involves equalization of flow from the preliminary treatment and the on-site stormwater basin.
- Biological treatment – This step consists of removal of BOD_5, TSS, TOC and nutrients. Various process units (e.g., conventional activated sludge process, membrane bioreactor, sequencing batch reactor) are capable of providing necessary treatment for these parameters.
- Tertiary Treatment/disinfection – This step consists of removing pathogens from the wastewater prior to its discharge to Cedar Bayou Tidal and reuse treatment to meet TAC 309 requirements.

In addition, the proposed IWWTR plant site will have a stormwater storage unit for on-site stormwater. When necessary, stormwater can be discharged to the flow equalization tank to further normalize flow. The parcel size needed to construct the proposed IWWTR plant is estimated to be 40 acres. Figure 4-2 is a schematic layout of the main treatment processes recommended for the proposed IWWTR Plant.

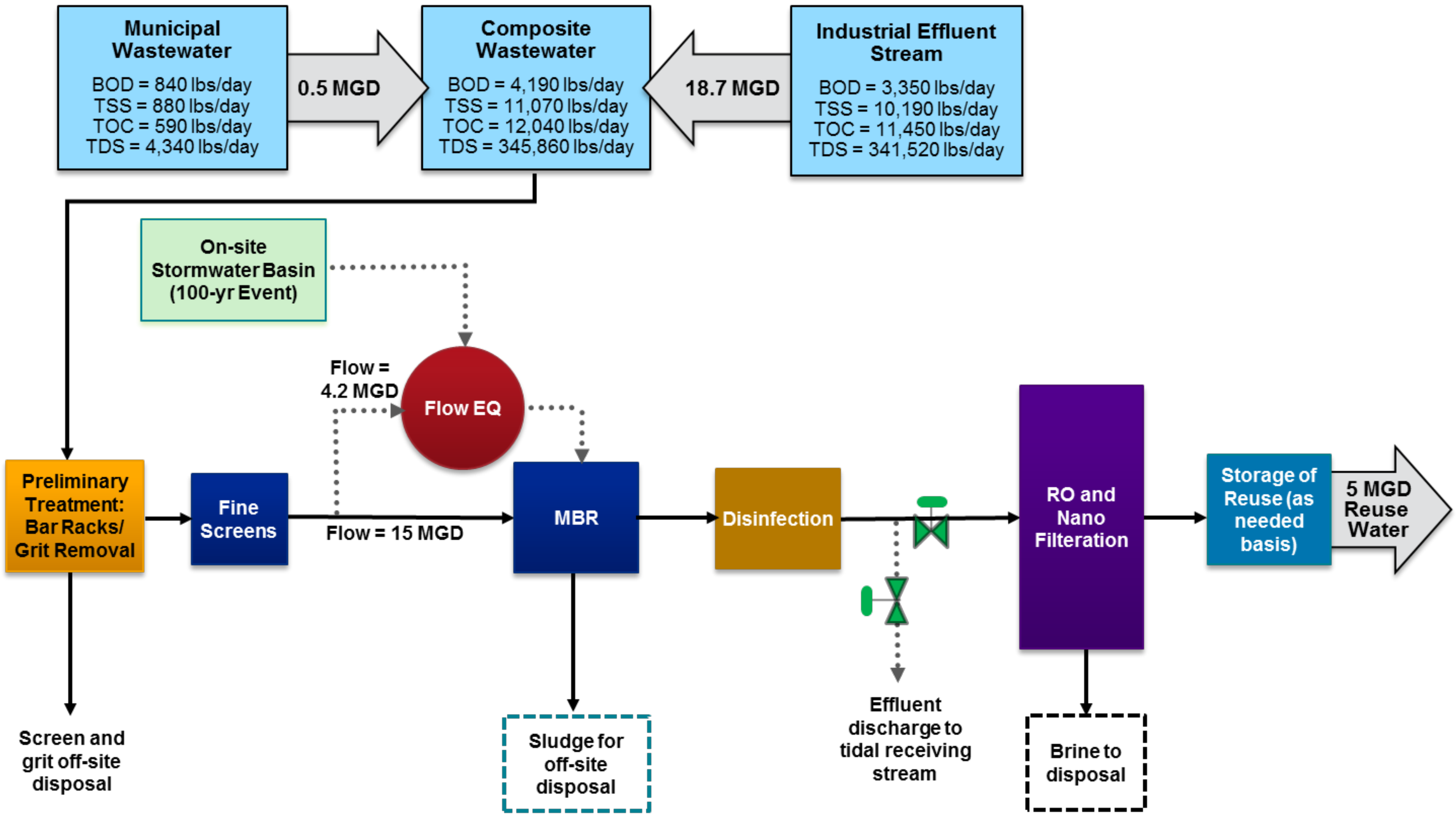

Figure 4-2 IWWTR Plant Treatment Block Diagram

4.4.1 Preliminary Treatment

The wastewater influent from the industrial participating members and Mont Belvieu will be delivered to the proposed IWWTR plant where it will be subject to preliminary treatment. The first step in preliminary treatment will be removal of large to small objects using a bar rack screen. Two types of bar screens can remove the large objects: multi-rake screen and perforated plate. Of these two screens, the multi-rake has a greater screening capacity and is recommended for the proposed IWWTR plant. The multi-rake screens are equipped with upper and lower sprockets or guides that carry the drive chain. Multiple rakes are attached to the chain to permit quick cleaning of the bars and to reduce the amount of screen blinding.

The bar screen is designed to handle a 19.2 MGD flow with 3/16-inch openings. Based on the design flow rate and hydraulic capacity, it is estimated that two bar screen units will be needed to handle the large to small objects.

Design guidelines for the amount of screenings to be anticipated from separate and combined sewer systems are published by the Water Environment Federation in its Manual of Practice No. 8 (MOP 8). For the bar style configuration, average volumes range from 0.5 cubic feet per million gallons (ft^3/MG) for coarse screens (nominal 2½-inch openings) to approximately 14.0 ft^3/MG for fine screens (nominal ¼-inch openings). For design purposes, 14 ft^3/MG is assumed, and the screened materials will be disposed of as a solid waste at an approved landfill site.

Following the bar screen, the wastewater influent will be pass through a grit chamber to remove grit (e.g., sand, gravel, cinder or other heavy solid material) and grease to protect downstream biological process units. The removal of grit reduces unnecessary abrasion and wear of mechanical equipment and prevents grit deposition in downstream process units. A vortex grit basin is recommended to remove grit and grease from the wastewater influent.

It is estimated that approximately 5 ft^3/MG of grit will be removed using a vortex system. The preliminary analysis indicates that two vortex grit systems will be required for the 19.2-MGD flow. The grit system will also include a grit washer and a grit pump. The grit will be transported off-site for disposal. Since the grit chamber will remove solids, it is anticipated that the TSS loading rate will be reduced by approximately 5% in the vortex grit system.

Following the grit and grease removal, the wastewater influent will be discharged to a fine screen to keep the non-biodegradable materials out of the biological process units. A rotary drum fine screen is proposed. This screen can remove the fine particles and further improve the efficiency of the downstream process equipment. Based on the anticipated 19.2-MGD flow, it is anticipated that approximately 1 to 2 acres of land will be required to stage the bar screen, grit chamber and fine screen.

4.4.2 Flow Equalization

In order to operate the main process units at a consistent flow rate, wastewater influent flow during wet weather flow conditions will be diverted to an equalization tank. As shown on the block diagram, the biological and UV disinfection units are designed to handle 15 MGD of wastewater flow. The remaining flow balance of 4.2 MGD will be diverted to an equalization tank. If necessary, the anticipated on-site stormwater flow of 3.3 MGD could also be diverted to this equalization tank. For the basis of design, it is assumed that the equalization tank will be a 10-foot-high circular tank. Approximately 2 to 4 acres of land will be required for the flow equalization unit, associated piping and pumps.

4.4.3 Biological Treatment

Membrane bioreactors (MBRs) use many aspects of activated sludge biological systems, but include ultrafiltration (UF) or microfiltration (MF) membranes, replacing conventional gravity clarifiers and return activated sludge (RAS) systems in conventional activated sludge biological treatment systems. The membranes are typically immersed directly in bioreactor tanks, and the biological system can be operated at much higher suspended solids concentrations. This provides greater treatment capacity per unit volume. Submerged membrane assemblies are typically made up of bundles of hollow-fiber or flat sheets of microporous membranes. Clean effluent (permeate) is drawn through the membrane assemblies by means of a vacuum applied by a pumping system to the effluent side of the membrane. MBR technology can provide essentially complete removal of suspended solids that can meet TAC 309 effluent limitations and producing effluent suitable for reuse.

The following design parameters for the MBR will be incorporated into the IWWTR plant:

- design flow – 15 MGD
- approximate land size to facilitate plant operation and maintenance – 2 to 4 acres
- design sludge retention time – at least 10 days, but not more than 25 days

4.4.4 Tertiary Treatment - Disinfection

After the wastewater is treated for the typical parameters (TSS, BOD_5, and nutrients), the final step is to disinfect the wastewater to meet TCEQ's TAC 309 effluent requirements prior to discharging it to Cedar Bayou Tidal.

The traditional disinfection method uses chlorine. However, UV light is a more environmentally friendly alternative. UV light disinfects the water by killing or mutating at the DNA level the bacteria, viruses and other microorganisms that are exposed to the UV light. Once the DNA is mutated, the organisms cannot reproduce, thereby minimizing the health risk. The only purpose of the UV irradiation process is pathogen inactivation. This process is currently targeted with achieving 6-log removal for all three relevant pathogen classes (virus, *Giardia*, and *Cryptosporidium*). The controlling organism for UV inactivation is pathogens, which requires the highest dose per log removal credit awarded.

The design parameters for the UV system are as follows:

- peak hour design flow – 14.0 MGD
- UV transmission at 50% (minimum)
- maximum average particle size - 30 microns
- disinfection limit: 23 MPN/100 mL[2] *Enterococcus*

[2] MPN/100 mL – most probable number per 100 milliliters

4.4.5 Solids Management

Wastewater solids produced by biological processes during sewage treatment are removed from the wastewater stream by physical unit processes. These solids include screenings, grit, scum, and sludge isolated by various process units. For the proposed IWWTR plant, grit and grease will be transported to an existing off-site landfill facility directly from the preliminary treatment units.

The sludge generated from the biological treatment will be thickened using a belt thickener. Using a belt thickener, solids will be concentrated as free water drains through a porous belt. Chemical conditioning using a polymer will be performed. The polymer addition will maximize the solids capture and help bind the solids together. For the proposed IWWTR plant, it is expected that sludge will be transported to an existing off-site GCA facility.

4.5 Class 4 Cost Estimate for Industrial Wastewater Collection and Treatment Systems

A Class 4 level cost estimate was prepared for the wastewater collection system and wastewater treatment components of the proposed plant. The estimated costs are consistent with a Class 4 estimate as defined by the Association for the Advancement of Cost Engineering International criteria, which is considered a Planning Level or Design Technical Feasibility Estimate. Class 4 estimates are used to prepare planning level costs or to evaluate alternatives in design conditions and form the base work for the Class 3 Project Budget or Funding Estimate. Expected accuracy for Class 4 estimates typically ranges from -30% to +50%, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. As more project specifics are refined during the project delivery cycle, the accuracy range will narrow to increased confidence in the total projected costs. Subsequent phases of this project will focus on evaluating alternatives to optimize the treatment, collection and distribution technologies with the goal to improving the accuracy of the cost estimate and reducing overall construction, operation and maintenance costs. The final costs of the project will depend on actual labor, material costs, competitive market conditions, implementation schedule and other variable factors.

Table 4-3 summarizes the cost estimate for the following subcategories: wastewater conveyance system, preliminary treatment, flow equalization, biological treatment, an UV disinfection, sludge management, an outfall line to the Cedar Bayou Tidal zone, and site improvements. Table 4-3 also includes estimated costs for other non-capital items, project and construction management, testing and inspection during construction, land costs, and contingencies.

Table 4-3 Class 4 Cost Estimate for Wastewater Collection & Treatment

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost (Material, Equipment, Labor)	Estimated Cost
	Wastewater Treatment Cost				
A	**Site Improvement**				
1	Mobilization/Demobilization	1	LS	$ 50,000.00	$50,000
2	Land Surveying	1	LS	$ 15,000.00	$15,000
3	General Building	10,000	SF	$ 75.00	$750,000
4	Site Civil Work (roadway, landscaping, etc.)	1	LS	$ 382,000.00	$382,000
5	Instrument and Electrical Building	5,000	SF	$ 75.00	$375,000
	Subtotal - Site Improvements				***$1,572,000***
B	**WW Conveyance System and Outfall Line**				
6	6-inch I.D. PVC tie-in line (0-6' excavation) OSSF to IWWTR	0	LF	$ 72.50	$0
7	18-inch I.D. PVC tie-in line (0-6' excavation) Industrial Dischargers	3,450	LF	$ 127.50	$439,875
8	32-inch OD HDPE Wastewater Conveyance Pipe (0-6' excavation)	27,580	LF	$ 210.50	$5,805,590
9	24-inch I.D. PVC Outfall Pipe (0-6' excavation)	22,113	LF	$ 145.00	$3,206,385
10	ROW Land Acquistion (3-foot each side)	4	Acre	$ 5,000.00	$20,000
11	Lift station, including pumps and fittings	1	Each	$ 500,000.00	$500,000
12	Lift station Electrical	1	LS	$ 50,000.00	$50,000
	Subtotal - WW Conveyance and Outfall Line				***$10,021,850***
C	**Headworks and Flow Equalization**				
13	Bar Screen with Compactors	2	Each	$ 270,000.00	$540,000
14	Bar Screen Pump Station (including electrical)	2	Each	$ 200,000.00	$400,000
15	Pump Station Building	2500	SF	$ 75.00	$187,500
16	Vortex Grit System with Grit Washer	2	Each	$ 240,000.00	$480,000
17	Grit Chamber Building	5000	SF	$ 75.00	$375,000
18	Fine Screen	1	Each	$ 840,000.00	$840,000
19	Equalization Tank (8 MG Each without roof)	1	Each	$ 3,800,000.00	$3,800,000
20	Equalization Tank Pump Station	2	Each	$ 100,000.00	$200,000
21	Pump station building	5000	SF	$ 75.00	$375,000
22	20-inch OD HDPE Pipe	3,000	Each	$ 151.50	$454,500
23	Excavation for Stormwater Basin (on-site)	27066	CY	$ 20.00	$541,320
24	Stormwater Basin Installation	27066	CY	$ 50.00	$1,353,300
25	Stormwater Pump Station (including electrical)	1	Each	$ 50,000.00	$50,000
26	Stormwater Conveyance Pipe to Equalization Tank (18-inch ID RCP)	200	LF	$ 84.00	$16,800
	Subtotal - Headworks and Flow Equalization				***$9,613,420***
D	**Biological Treatment and UV Disinfection**				
27	20-inch OD HDPE Pipes from Equalization tank to MBR Area	400	LF	$ 151.50	$60,600
28	Membrane Bioreactor (MBR) Units	1	LS	$ 12,500,000.00	$12,500,000
29	MBR Associated Equipment	1	LS	$ 100,000.00	$100,000
30	MBR Blowers	2	Each	$ 330,000.00	$660,000
31	Electrical Installation	1	LS	$ 100,000.00	$100,000
32	20-inch OD HDPE Pipe	400	LF	$ 151.50	$60,600
33	UV System	1	Each	$ 480,000.00	$480,000
34	Blower Building	5000	LF	$ 75.00	$375,000
	Subtotal - Biological Treatment and UV Disinfection				***$14,336,200***
E	**Sludge Management**				
35	Sludge Pumps	2	EACH	$ 50,000.00	$100,000
36	Sludge Pump Building	2000	SF	$ 70.00	$140,000
37	Belt Thickner	1	Each	$ 400,000.00	$400,000
38	Polymer Tank	1	Each	$ 250,000.00	$250,000
	Subtotal - Sludge Management				***$890,000***
39	***Subtotal Capital Cost - Wastewater Collection & Treatment***				$36,433,470
40	**Wastewater Collection & Treatment Capital Cost**				**$36,400,000**
41	Project and Construction Management (10.0%)				$3,640,000
42	Payment and Performance Bond (1.0%)				$360,000
43	General Liability, Pollution Liability and Professional Liability Insurances (2.0%)				$730,000
44	Builder Risk (2.25%)				$820,000
45	Testing and Inspection (5.0%)				$1,820,000
46	**Total Construction Hard Cost**				**$43,770,000**
	Soft Costs:				
47	Engineering (15.0%)				$6,565,500
48	Geotechnical Investigation				$40,000
49		30	Acre	Purchase Land	$1,500,000
52	Contingency for Construction Hard Cost (20.0%)				$8,754,000
53	**Total Estimated Cost**				**$60,600,000**

4.6 Water Reuse Treatment System

A reverse osmosis (RO) system is recommended for the proposed IWWTR plant to meet the TDS concentration desired for reuse water. RO is a useful separation method because it permits the passage of water and rejects the passage of most ions and molecules other than water. RO is used to purify water and remove salts and other impurities in order to improve the color, taste or properties of the fluid.

Since some of the fluid passes through the membrane, the rest continues downstream, sweeping the rejected species away from the membrane. As discussed in 4.2, the wastewater entering upstream of the water reuse treatment system may contain hardness concentrations approximately four to 10 times the CWA water quality. A nanofiltration unit located upstream of the RO units will be used to reduce TDS and hardness concentrations.

The following design parameters for the reuse water treatment system:

- design flow rate – 5.6 MGD
- approximate land size requirement – 2 to 4 acres
- final TDS concentration – less than 110 mg/L
- final hardness – less than 54 mg/L

The RO and nanofiltration process units will produce a reject stream of brine or concentrate that can present complications for disposal. Prior to disposal of brine, the rejected streams from nanofiltration and RO will be mixed in a tank. While the reject stream is still mostly water (98 to 99.5% by weight), it is unfit for most uses and cannot be discharged to a receiving water body. It represents a significant fraction of the original water source (10 to 35%). Careful consideration must therefore be given to disposal of this volume of high salinity water.

4.7 Disposal of Brine

The most common options for brine concentrate disposal are deep well injection, evaporation ponds and direct surface water disposal. Direct surface water disposal is not practical given the distance between Mont Belvieu and the Gulf of Mexico or another saline water body. Evaporation ponds are not practical given the large amount of land area needed for the ponds and the cost of property. As discussed in subsection 2.4, saline groundwater conditions are prevalent throughout the study area. Therefore, given the surrounding hydrogeology, deep well injection is a viable option for brine disposal. It is assumed that RO will produce approximately 1 MGD of concentrated brine that will require disposal through deep well injection. It is expected that TDS concentrations will be more than 10,000 mg/L in the brine stream. Based on the information reviewed in the 2006 TWDB Report 365, the depth for the saline sand in the project study area (excluding salt dome area) can range from 2,000 feet to 3,000 feet below the Burkeville aquitard. The final depth of the brine disposal wells will be dependent on the selection of the IWWTR parcel and the presence of the Burkeville aquitard and saline sand. For the basis of design and cost estimate, two 6-inch-diameter injection wells are anticipated to be installed up to a depth of 3,000 feet in accordance with TCEQ regulations.

4.8 Class 4 Cost Estimate for Water Reuse Treatment and Distribution System

A Class 4 level cost estimate was prepared for the water reuse treatment system and the necessary reuse water distribution system. Table 4-4 summarizes the cost estimate for the following subcategories: RO treatment system, a nanofiltration system, reuse water distribution lines, and the brine disposal system. Table 4-4 also includes estimated costs for other non-capital items, project and construction management, testing and inspection during construction, land costs, and contingencies. The costs provided in Table 4-4 represent the estimated costs associated with constructing the reuse water distribution line and the RO treatment components at the same time the IWWTP and wastewater collection system are built.

While the reuse water distribution line and the RO treatment components could be constructed at some date (e.g., five years) after the IWWTP and wastewater collection system are built, this approach would result in additional costs. The total estimated cost for building this portion of the system five years later would increase to $23,430,000 compared to line item number 24 in Table 4-4.

Table 4-4 Class 4 Cost Estimate for Water Reuse Treatment and Distribution System

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost (Material, Equipment, Labor)	Estimated Cost
A	**Site Improvement for RO and Water Reuse Distribution**				
1	Mobilization/Demobilization	1	LS	$ 50,000.00	$50,000
2	Land Surveying	1	LS	$ 10,000.00	$10,000
3	Site Civil Work (roadway, landscaping, etc.)	1	LS	$ 380,000.00	$380,000
	Subtotal - Site Improvements				***$440,000***
B	**RO and Distribution System**				
4	Reverse Osmosis	1	Each	$ 3,125,000.00	$3,125,000
5	Install Deep Well Injection (6 inch diameter)	6000	LF	$ 250.00	$1,500,000
6	8-inch OD HDPE pipe to Deep Well	600	LF	$ 110.00	$66,000
7	Electrical Installation	1	LS	$ 156,250.00	$156,250
8	20-inch OD. HDPE Reuse Water Distribution Pipe (0-6' excavation)	27,580	LF	$ 146.50	$4,040,470
9	18-inch I.D. PVC tie-in line (0-6' excavation) Industrial Dischargers	3,450	LF	$ 127.50	$439,875
10	ROW Land Acquistion	2	Acre	$ 5,000.00	$10,000
11	Nanofilteration for Hardness Removal (as needed)	1	Each	$ 3,000,000.00	$3,000,000
	Subtotal RO & Distirbution System				***$12,337,595***
12	***Subtotal Capital Cost - Water Reuse System***				***$12,777,595***
13	**Water Reuse Treatment & Distribution System Capital Cost**				**$12,780,000**
14	Project and Construction Management (10.0%)				$1,280,000
15	Payment and Performance Bond (1.0%)				$130,000
16	General Liability, Pollution Liability and Professional Liability Insurances (2.0%)				$260,000
17	Builder Risk (2.25%)				$290,000
18	Testing and Inspection (5.0%)				$640,000
19	**Total Construction Hard Cost**				**$15,380,000**
	Soft Costs:				
20	Engineering (15.0%)				$2,307,000
21	Geotechnical Investigation				$20,000
22		10	Acre	Purchase Land	$500,000
23	Contingency for Construction Hard Cost (20.0%)				$3,076,000
24	**Total Estimated Cost**				**$21,300,000**

4.9 Site Improvements

A typical set of site improvements will be needed no matter where the preferred site is located for the proposed IWWTR plant. It is anticipated that excavation will be required to accommodate adequate base rock in the proposed paved areas. Road access may need to be acquired depending on the exact location of the proposed plant parcel. Asphalt concrete paving suitable to truck traffic is recommended throughout the proposed IWWTR facility. Basic utilities (water, electric, natural gas, and telecommunications) will need to be delivered to the site. Sufficient land area for future plant expansion should also be accommodated at the preferred site.

The site improvements associated with the proposed IWWTR plant will require a stormwater management system. A preliminary hydraulic analysis was performed to estimate the required size of a stormwater basin for a 40-acre site using the 24-hour, 100-year flood event as the design criteria. The hydraulic analysis used the Rational Method outlined in the Drainage Criteria Manual for Chambers County (Chambers County 2005). Based on this analysis, approximately 3 acres of the 40-acre site will be required to handle the stormwater at the proposed IWWTR plant. Stormwater will be stored in a basin and will be periodically released to an equalization tank where it can be mixed with the industrial and municipal wastewater for treatment. Figure 4-3 provides a conceptual layout of the facility within a parcel that is approximately 40 acres. Figure 4-4 displays a Process Flow Diagram of the proposed IWWTR plant and a materials balance summary of the main wastewater treatment components.

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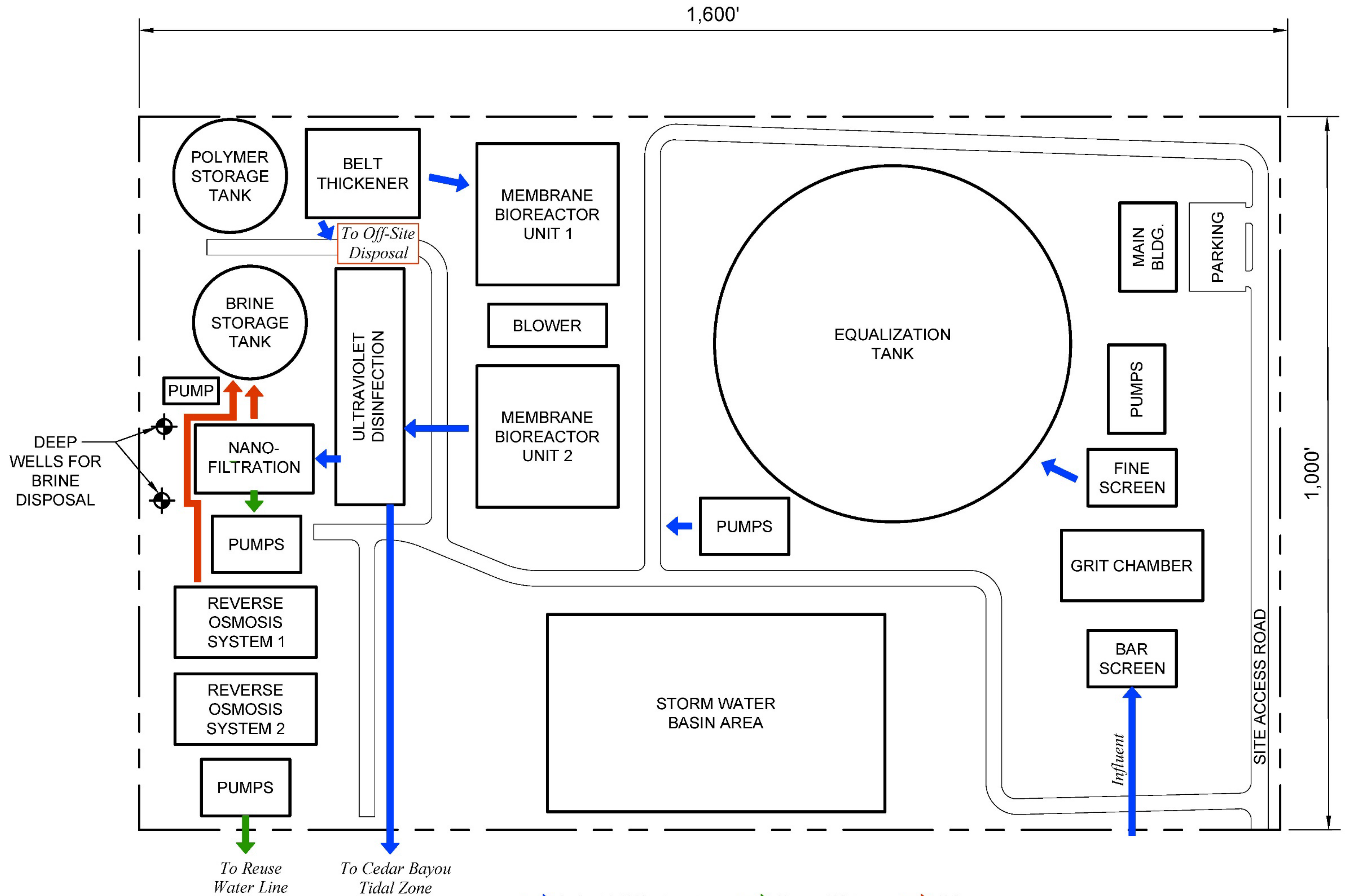
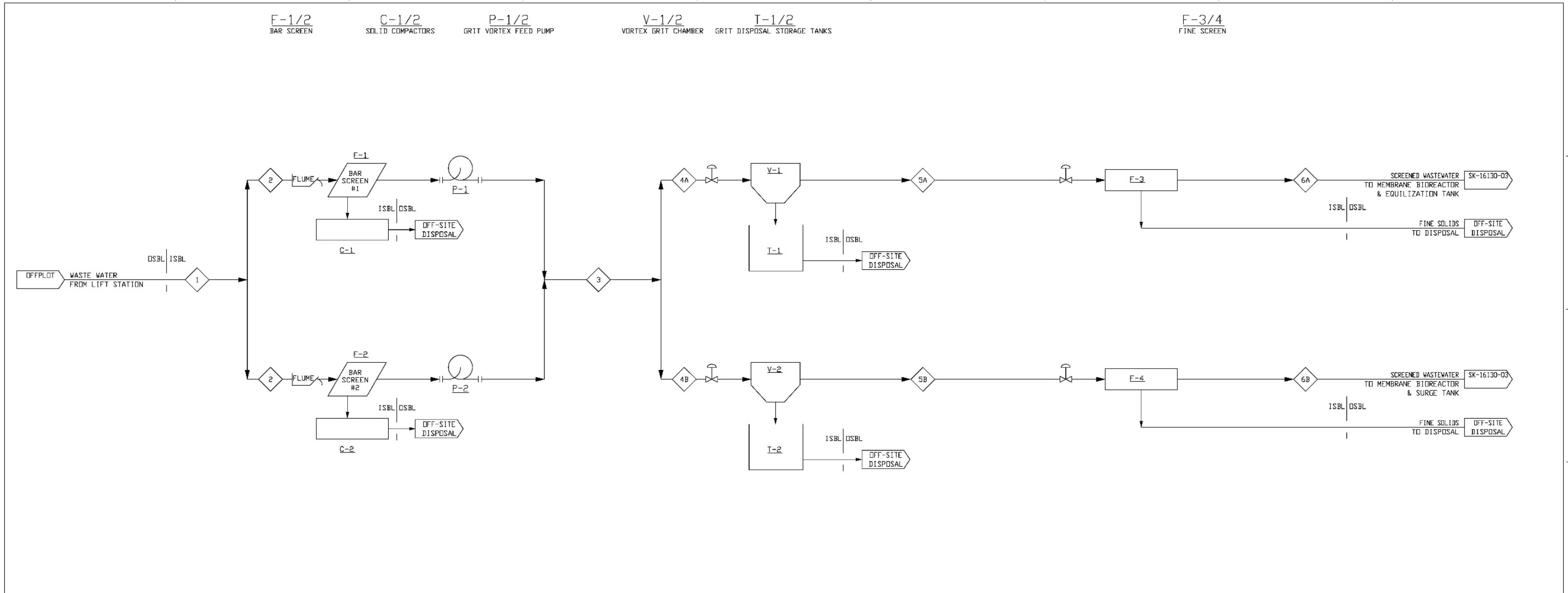
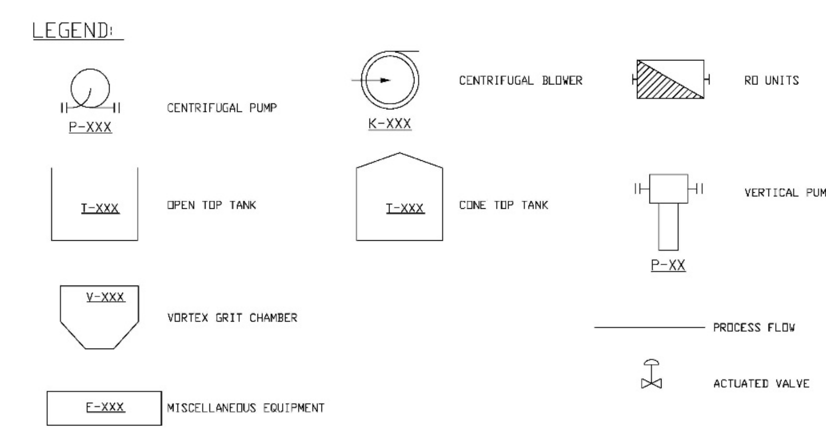


Figure 4-3 Conceptual Layout of IWWTR Plant





Stream Number	1	2	3	4A	4B	5A	5B	6A	6B
Description	Influent WW	Flow to Bar Screen Train	Total Flow to Grit Chamber	Flow to Grit Chamber Train	Flow to Grit Chamber Train	Total Flow to Fine Screen	Flow To Fine Screen Train	Total Water from Fine Screen to MBR/Equalization Tank	Total Water from Fine Screen to MBR/Equalization Tank
MAX. Design Flow (MGD)	19.2	9.6	19.2	9.6	9.6	9.6	9.6	9.6	9.6
AVG. Dry Weather Flow (MGD)	5.6	2.8	5.6	5.6	0	5.6	0	5.6	0
BOD5 (mg/L)	34	33.8	34	34	34	32	32	32	32
BOD5 Loading (lbs/d)	5420	2710	5420	2710	2710	2570	2570	2570	2570
TSS (mg/L)	69	69	69	69	69	55	55	52	50
TSS Loading (lbs/d)	11070	5535	11050	5525	5525	4420	4420	4199	4199
TDS (mg/L)	2156	2156	2156	2156	2156	2156	2156	2156	2156
TDS Loading (lbs/d)	345860	172930	345270	172635	172635	172640	172640	172640	172640
TOC (mg/L)	75	75	75	75	75	75	75	75	75
TOC Loading (lbs/d)	12040	6020	12020	6010	6010	6010	6010	6010	6010
TN (mg/L)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
TN Loading (lbs/d)	1080	540	1080	540	540	540	540	540	540
Total P (mg/L)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total P Loading (lbs/d)	250	125	240	120	120	120	120	120	120
pH (Std Unit)	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8

REFERENCE DRAWINGS: TITLE SHEET & DRAWING INDEX - PROCESS — SK-16130-01

PARSONS
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Houston TX. 77027
Phone: 713-871-7000

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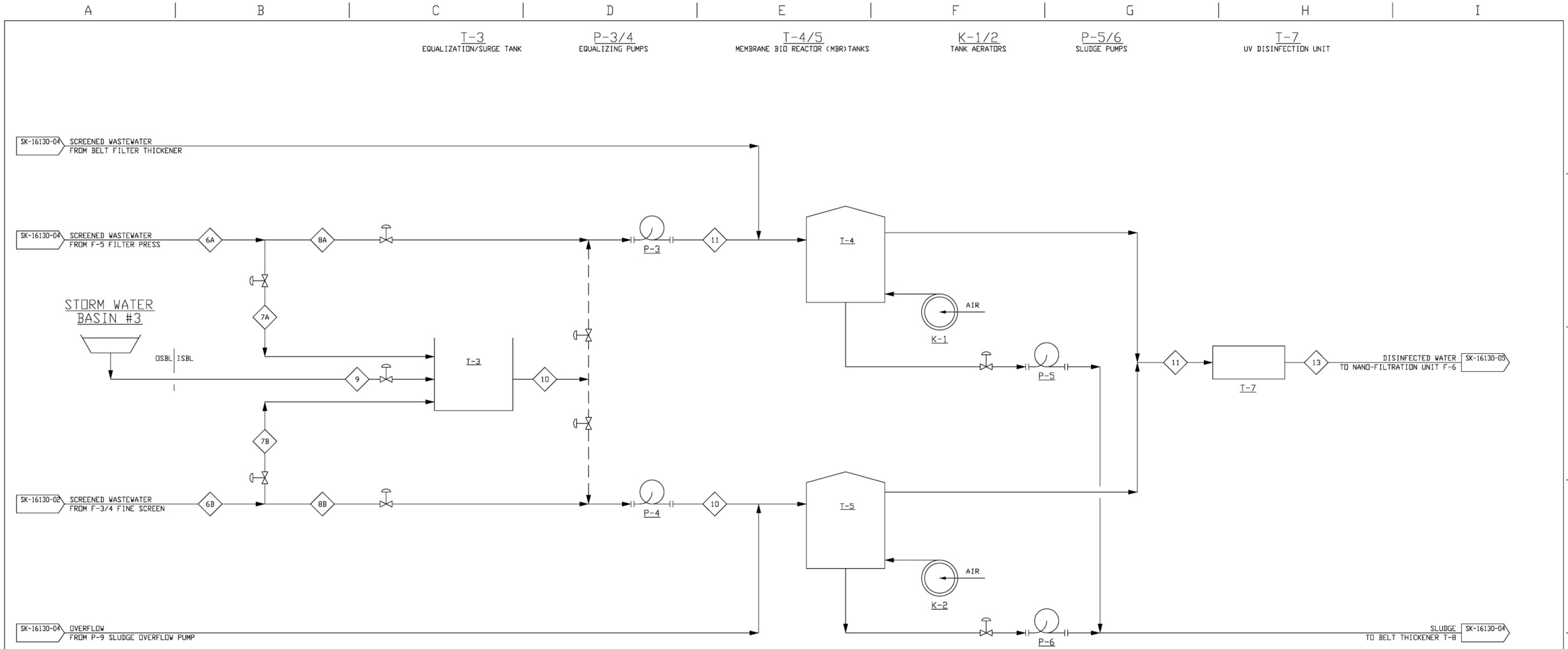
PROCESS FLOW DIAGRAM - WASTEWATER TREATMENT
WASTE WATER TREATMENT AND REUSE FACILITY
MONT BELVIEU, TEXAS
MONT BELVIEU, T. XXS/ R. XXE, SECTION XX
DATE 06/14/16 DR. AMC CH. BCT ENGR. PARSONS SCALE NONE
SK-16130-02 SHEET 1 OF 1 REV C

Figure 4-4 Treatment Train and Materials Balance for Proposed IWWTR Plant



Stream Number	6A	6B	7A	7B	8A	8B	9	10	11	12	13
Description	Total Water from Fine Screen to MBR/Equalization Tank	Total Water from Fine Screen to MBR/Equalization Tank	Total Flow to Equalization Tank (Wet Weather Condition)	Total Flow to Equalization Tank (Wet Weather Condition)	Flow Through MBR Train	Flow Through MBR Train	Total Water from Stormwater Basin to Equalization Tank	Flow Through Equalization Tank (Wet Weather Condition)	Total Flow to UV Disinfection	Treated Effluent to Cedar Bayou Tidal Segment	Total Flow to NanoFilteration
MAX. Design Flow (MGD)	9.6	9.6	2.1	2.1	7.5	7.5	3.3	7.5	14	1	13
AVG. Dry Weather Flow (MGD)	5.6	0	0	0	5.6	0	0	0	5.6	0	5.6
BOD5 (mg/L)	32	32	32	32	32	32	0	32	1	1	1
BOD5 Loading (lbs/d)	2570	2570	560	560	560	560		2010	120	10	110
TSS (mg/L)	52	50	50	50	50	50	100	70	1	1	1
TSS Loading (lbs/d)	4199	4199	870	870	3130	3130	2750	4490	120	10	110
TDS (mg/L)	2156	2156	2156	2156	2156	2156	0	2156	2156	2156	2156
TDS Loading (lbs/d)	172640	172640	37760	37760	134860	134860		134860	251760	17980	233750
TOC (mg/L)	75	75	75	75	75	75	0	75	1	1	1
TOC Loading (lbs/d)	6010	6010	1310	1310	4690	4690		4690	120	10	110
TN (mg/L)	6.7	6.7	6.7	6.7	6.7	6.7	0	6.7	0.5	0.5	0.5
TN Loading (lbs/d)	540	540	120	120	420	420		420	60	4	54
Total P (mg/L)	1.5	1.5	1.5	1.5	1.5	1.5	0	1.5	0.2	0.2	0.2
Total P Loading (lbs/d)	120	120	30	30	100	100		100	20	2	22
pH (Std Unit)	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8

REFERENCE DRAWINGS
TITLE SHEET & DRAWING INDEX - PROCESS SK-16130-01

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C RE-ISSUED FOR REVIEW (PER CLIENT COMMENTS) 07/29/16 SM JS MV

PROCESS FLOW DIAGRAM - WASTEWATER TREATMENT
WASTE WATER TREATMENT AND REUSE FACILITY
MONT BELVIEU, TEXAS
MONT BELVIEU, T. XXS/ R. XXE, SECTION XX
DATE 06/14/16 DR. AMC CH. BCT
SCALE NONE
SK-16130-03 SHEET 1 OF 1 REV C

Figure 4-4 Treatment Train and Materials Balance for Proposed IWWTR Plant (*continued*)

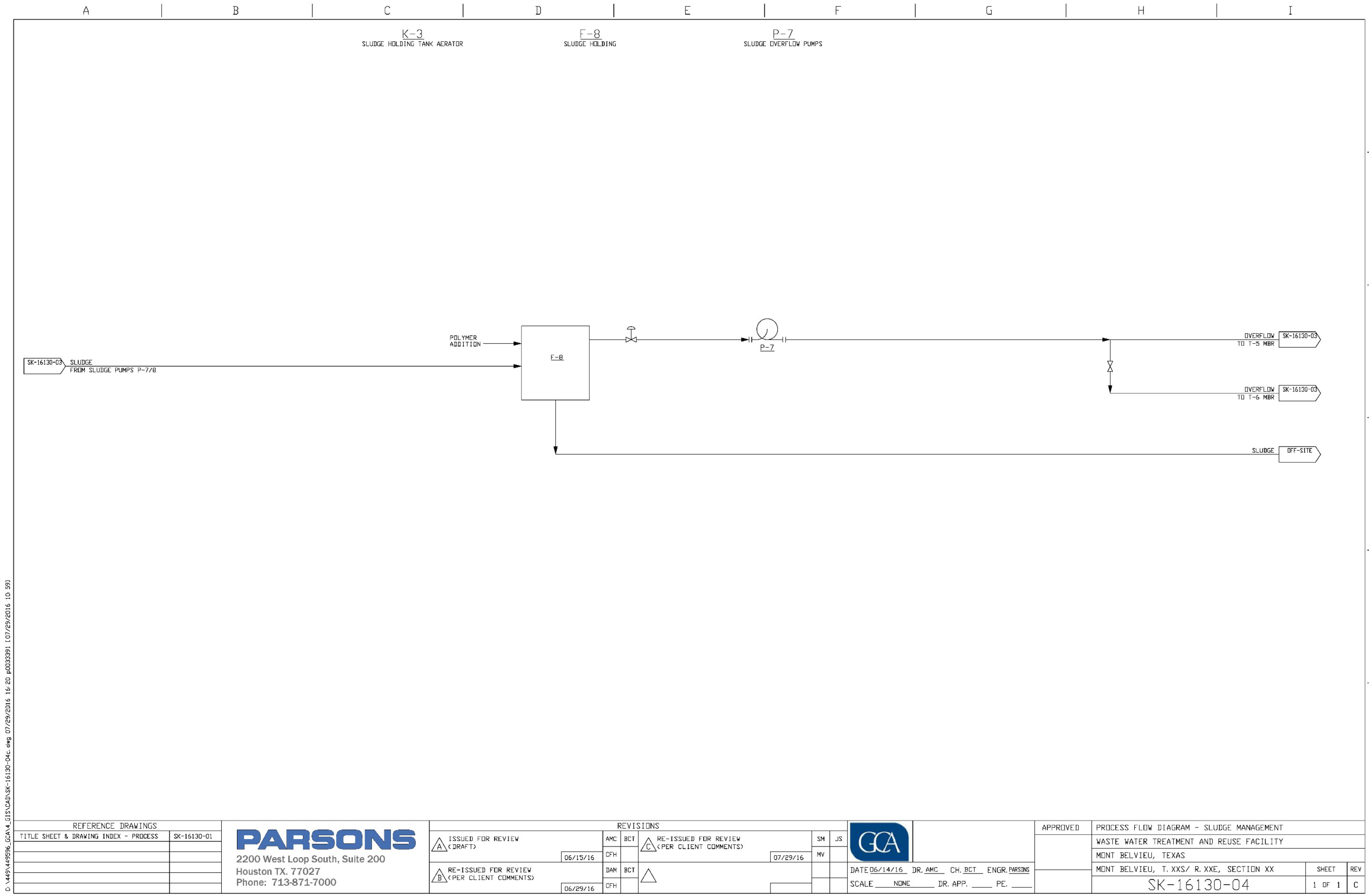
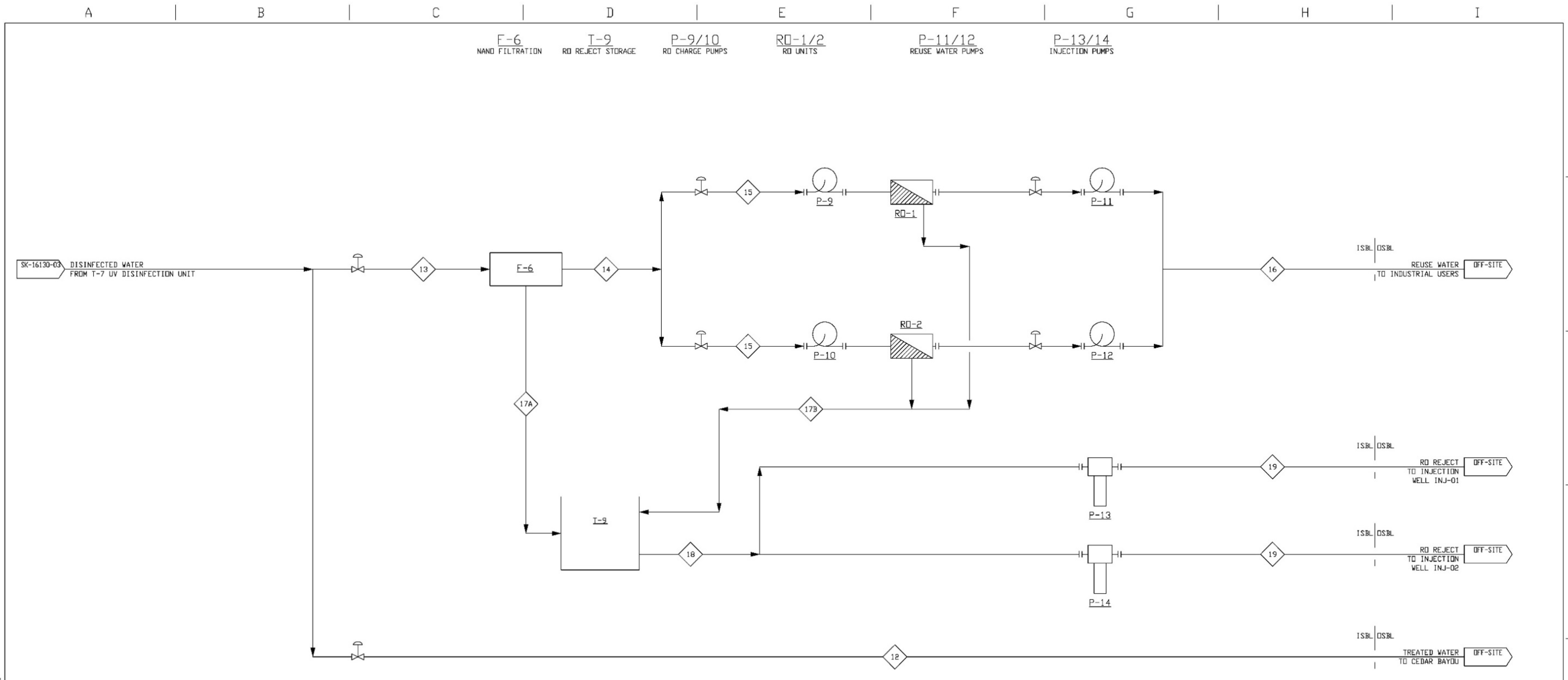


Figure 4-4 Treatment Train and Materials Balance for Proposed IWWTR Plant (*continued*)



Stream Number	12	13	14	15	16	17A	17B	18
Description	Treated Effluent to Cedar Bayou Tidal Segment	Total Flow to NanoFilteration	Total Flow To RO System	Flow Through RO System Train	Reuse Water to Industrial Usage	Nano-Filtration Waste to T-9	RO Reject to T-9	Total Brine Disposal to Deep Well
MAX. Design Flow (MGD)	1	13	12.35	6.175	11.8	0.65	0.65	1.3
AVG. Dry Weather Flow (MGD)	0.1	5.6	5.32	2.66	5	0.28	0.32	0.6
BOD5 (mg/L)	1	1	1	1	1	1	1	1
BOD5 Loading (lbs/d)	10	110	100	50	100	0	0	10
TSS (mg/L)	1	1	1	1	1	1	1	1
TSS Loading (lbs/d)	10	110	100	50	100	0	0	10
TDS (mg/L)	2156	2156	2156	2156	100	22373	22373	22373
TDS Loading (lbs/d)	17980	233750	222070	111035	9841	60643	30321	242570
TOC (mg/L)	1	1	1	1	1	1	1	1
TOC Loading (lbs/d)	10	110	100	50	98	2.5	1.25	10
TN (mg/L)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
TN Loading (lbs/d)	4	54	51	25.5	49	1.25	0.625	5
Total P (mg/L)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total P Loading (lbs/d)	2	22	21	10.5	20	0.5	0.25	2
pH (Std Unit)	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8

REFERENCE DRAWINGS
TITLE SHEET & DRAWING INDEX - PROCESS SK-16130-01

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GCA
DATE 06/14/16 DR. AMC CH. BCT ENGR. PARSONS
SCALE NONE DR. APP. PE.

APPROVED
PROCESS FLOW DIAGRAM - REUSE TREATMENT
WASTE WATER TREATMENT AND REUSE FACILITY
MONT BELVIEU, TEXAS
MONT BELVIEU, T. XXS/ R. XXE, SECTION XX
SK-16130-05 SHEET 1 OF 1 REV B

Figure 4-4 Treatment Train and Materials Balance for Proposed IWWTR Plant (*continued*)

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4.10 Comprehensive Cost Summary of Regional IWWTR System

Table 4-5 summarizes the cost estimate that combines all of the costs for providing the regional IWWTR plant and the wastewater collection and reuse water distribution systems. The range recommended by the criteria set forth for a Class 4 estimate as defined by the Association for the Advancement of Cost Engineering International criteria is also provided in Table 4-5. The low end estimated cost is based on minus 15 percent, and the high end cost is based on plus 30 percent. As a Class 4 cost estimate, GCA and the participating members recognize that there are opportunities ahead to optimize the basis of design components and the cost estimate provided in this report. Subsequent phases of this project will focus on evaluating alternatives to optimize treatment, collection and distribution technologies with the goal to improve the accuracy of the cost estimate and to reduce overall construction, operations and maintenance costs.

Table 4-5 Class 4 Cost Estimate for Regional IWWTR System

Item No.	Item Description	Estimated Cost
	Wastewater Treatment Cost	
A	**Wastewater Collection & Treatment Cost**	**$ 60,600,000.00**
B	**Water Reuse Treatment & Distribution System Cost**	**$ 21,300,000.00**
	Total Estimated Cost	**$ 81,900,000.00**
	Estimated Capital Cost:	
	AACE Recommended Range For A Class 4 Cost Estimate:	
	Low [-15% to -30%] - Use -15%	$ 69,600,000.00
	High [20% to 50%] - Use 30%	$ 106,500,000.00
	Average Cost:	**$ 88,100,000.00**
C	**Estimated Annual Operation and Maintenance Cost**	**$ 5,000,000.00**

4.11 Possible Funding Options for Wastewater Treatment & Water Reuse Infrastructure

GCA has investigated various options to fund the proposed regional IWWTR facility in the Mont Belvieu area. Some of the known parameters for this project are:

- Partners in this project would include the City of Mont Belvieu and various industrial partners.
- GCA will own and operate the facility.
- The cost estimate for the project is $70 to $106 million.
- The estimated timeline for the completion of the construction is three years and three months from the start of the planning and design phase.

Option 1: GCA could issue nontaxable private activity bonds for the construction of the facility. The security for the bonds would be a contract with the participants in the project who would guaranty the revenue stream for the repayment of the bonds. This process takes approximately three months to complete the various steps needed for a bond issue and contract(s) with the participants.

Option 2: The participants in the project could capitalize the project and pay for the construction based on a predetermined pro rata share of the costs. They could either fund the project upfront with the funds being held in escrow by GCA or fund it on a pay-as-you-go basis.

Option 3: The TWDB administers the TWDB Fund and the Clean Water State Revolving Fund that could provide funding through low interest loans for projects such as this facility. The payments would come from the participants in the project based on a predetermined pro rata share. The security for the loans would be a contract with the participants in the project who would guaranty the revenue stream for the repayment of the loans. In addition to the private funding options described above, there are other financial assistance programs available in Texas that have provided funding for wastewater and water infrastructure projects around the state.

4.12 Next Steps

The goal of this project, guided by GCA's mission and the TWDB's support of regional facility planning, has been successfully accomplished through the completion of this feasibility study report. This feasibility study demonstrates local interest for regional approaches to wastewater and water supply management. The report also identifies that the Mont Belvieu area has several characteristics, which suggest that infrastructure needs required by future projected growth trends in commercial, industrial, and residential development can be partially addressed through a regional approach to wastewater treatment and water reuse.

If GCA and the participating members commit to move forward with the proposed IWWTR plant summarized herein, development agreements will be prepared to initiate the additional steps necessary to execute a front-end engineering design process and schedule. This additional planning and engineering are the necessary next steps to guide design and construction of the regional IWWTR plant and the necessary wastewater collection and water reuse distribution systems. As part of the planning and engineering design phase, water conservation and drought contingency strategies will be investigated and incorporated into the project design where appropriate. Figure 4-5 displays a preliminary implementation schedule for the tasks necessary to move the project from design through construction if commitments are secured to build the new regional plant.

Figure 4-5 Preliminary Project Schedule for Design/Construction of Regional IWWTR Facility

Acitivity Name	Duration (days)	Year 1												Year 2												Year 3												Year 4											
		A	B	C	D	E	F	G	H	I	J	K	L	A	B	C	D	E	F	G	H	I	J	K	L	A	B	C	D	E	F	G	H	I	J	K	L	A	B	C	D	E	F	G	H	I	J	K	L
Planning and Conceptual Design	150																																																
Property and ROW Acquisition	180																																																
Front End Engineering and Design (FEED)	240																																																
Permits	360																																																
Secure Funding	150																																																
Detailed Design	300																																																
Bidding and Procurement	270																																																
Construction and Commissioning	360																																																

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SECTION 5
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Appendix A
Attendees at Public Meetings

Organizations present at Public Meeting #1: November 15, 2015

- Town of Cove, TX
- Houston Galveston Area Council of Governments
- Gulf Coast Waste Disposal Authority
- ExxonMobil
- Enterprise Products
- Chambers County
- City of Mont Belvieu
- City of Baytown
- Parsons

Organizations present at Public Meeting #2: August 9, 2016

- City of Mont Belvieu
- Chevron Phillips Chemical Company
- Dayton Community Development Corporation
- GCA
- Enterprise Products
- Texas Water Development Board
- Interested Citizen
- Parsons

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Notice of Public Meeting

Gulf Coast Waste Disposal Authority (GCA) has initiated a study to determine the feasibility of a regional industrial wastewater treatment facility with a water reuse component for a 15,360 acre planning area around Mont Belvieu, Texas (see attached map for study area). This area has significant projected industrial growth. The goal of the study is to determine if implementation of a strong regional industrial wastewater treatment/water reuse system could provide efficient and cost effective services for the study area. The study will identify potential municipal and industrial participants, the benefits, a preferred alternative (facility location, collection and distribution system) and the financial feasibility of the regional facility.

Over the course of the study three public meetings will be held to gather information from industry and community members. We invite you to attend our first meeting at the location and time below:

When: **Tuesday, November 10, 2015 from 1:30 – 3:00 PM**

Where: **City of Mont Belvieu**
City Council Chambers
2nd Floor, City Hall
11607 Eagle Drive
Mont Belvieu, TX 77580

If you are unable to attend please feel free to send a representative from your organization. If you have questions, please contact Lori Traweek, Manager of Operations for GCA at 281.226.1130 or by email: ltraweek@gcwda.com.

Notice of Public Meeting

Gulf Coast Waste Disposal Authority (GCA) initiated a study last fall to determine the feasibility of a regional industrial wastewater treatment facility with a water reuse component for a 15,360 acre planning area around Mont Belvieu, Texas (see attached map for study area). This area has significant projected industrial growth. The goal of the study is to determine if implementation of a strong regional industrial wastewater treatment/water reuse system could provide efficient and cost effective services for the study area. The study has since identified potential municipal and industrial participants, the benefits, a preferred alternative (facility footprint, collection and distribution system) and the estimated cost of the components of the regional facility.

Over the course of the study three public meetings will be held to gather information from industry and community members. We held our first one on November 10, 2015 and are inviting you to attend our second meeting at the location and time below:

When: **Tuesday, August 9, 2016 from 10:00 – 11:30 AM**

Where: **City of Mont Belvieu**
City Council Chambers
2nd Floor, City Hall
11607 Eagle Drive
Mont Belvieu, TX 77580

The draft final report for the study can be accessed for review via GCA's website at www.gcwda.com under the Publications tab – Grant reports.

If you are unable to attend please feel free to send a representative from your organization. If you have questions, please contact Lori Traweek, Assistant General Manager for GCA, at 281.226.1130 or by email: ltraweek@gcwda.com.

Notice of Public Meeting

Gulf Coast Waste Disposal Authority (GCA) initiated a study last fall to determine the feasibility of a regional industrial wastewater treatment facility with a water reuse component for a 15,360 acre planning area around Mont Belvieu, Texas (see attached map for study area). This area has significant projected industrial growth. The goal of the study is to determine if implementation of a strong regional industrial wastewater treatment/water reuse system could provide efficient and cost effective services for the study area. The study has since identified potential municipal and industrial participants, the benefits, a preferred alternative (facility footprint, collection and distribution system) and the estimated cost of the components of the regional facility.

Two public meetings have already been held to gather information from industry and community members. Our final public meeting to review the final grant report will be held on November 9, 2016. We invite you to attend at the location and time below:

When: **Wednesday, November 9, 2016 from 1:30 PM – 3 PM**

Where: **City of Mont Belvieu**
City Council Chambers
2nd Floor, City Hall
11607 Eagle Drive
Mont Belvieu, TX 77580

The final report for the study can be accessed for review via GCA's website at www.gcwda.com under the Publications tab – Grant reports.

If you are unable to attend please feel free to send a representative from your organization. If you have questions, please contact Lori Traweek, Assistant General Manager for GCA, at 281.226.1130 or by email: ltraweek@gcwda.com.

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Appendix B
TCEQ Ambient Surface Water Quality – Luce Bayou

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Station ID	End date	Station Description	Latitude	Longitude	Segment ID	County	Parameter (MG/L)	Value	Parameter (MG/L)3	Value2	Parameter (MG/L)2	Value3
13610	2/2/1984	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	23	SULFATE	20
13610	3/26/1984	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	13	SULFATE	8.5
13610	3/29/1984	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	12	SULFATE	13
13610	8/22/1984	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	12	SULFATE	15
13610	2/12/1985	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	5.8	SULFATE	8
13610	6/21/1985	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	12	SULFATE	18
13610	8/28/1985	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	18	SULFATE	7.4
13610	11/27/1985	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	13	SULFATE	11
13610	1/27/1986	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	65	SULFATE	12
13610	3/3/1986	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	12	SULFATE	13
13610	5/22/1986	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	47	SULFATE	13
13610	8/19/1986	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	40	SULFATE	12
11187	10/7/1986	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	16	SULFATE	5
11187	10/9/1986	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	18	SULFATE	4
11187	10/14/1986	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	9	SULFATE	10
11187	10/21/1986	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	11	SULFATE	4
11187	10/28/1986	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	15	SULFATE	6
11187	11/6/1986	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	14	SULFATE	4
11187	11/13/1986	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	28	SULFATE	4
11187	11/18/1986	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	28	SULFATE	4
11187	11/20/1986	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	28	SULFATE	5
11187	11/25/1986	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	6	SULFATE	6
11187	12/4/1986	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	10	SULFATE	10
11187	12/11/1986	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	61	SULFATE	4
11187	12/16/1986	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	10	SULFATE	10
11187	12/18/1986	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	11	SULFATE	9
11187	1/8/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	17	SULFATE	6
11187	1/13/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	19	SULFATE	5
13610	1/16/1987	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	15	SULFATE	13
11187	1/20/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	10	SULFATE	3
11187	1/22/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	7	SULFATE	6
11187	1/27/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	13	SULFATE	5
13610	1/29/1987	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	23	SULFATE	15
11187	2/10/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	37	SULFATE	8
11187	2/12/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	36	SULFATE	3
11187	2/17/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	41	SULFATE	4
11187	2/19/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	55	SULFATE	5
11187	2/24/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	20	SULFATE	2
13610	2/25/1987	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	19	SULFATE	13
11187	3/10/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	12	SULFATE	3
11187	3/17/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	26	SULFATE	11
11187	3/19/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	22	SULFATE	9
11187	3/24/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	29	SULFATE	6
11187	3/31/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	29	SULFATE	5
11187	4/9/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	34	SULFATE	12
11187	4/14/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	29	SULFATE	6
11187	4/16/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	31	SULFATE	1
11187	4/23/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	33	SULFATE	2
11187	4/28/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	29	SULFATE	4
11187	5/7/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	38	SULFATE	1
11187	5/12/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	37	SULFATE	17

Station ID	End date	Station Description	Latitude	Longitude	Segment ID	County	Parameter (MG/L)	Value	Parameter (MG/L)3	Value2	Parameter (MG/L)2	Value3
11187	5/14/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	34	SULFATE	26
11187	5/19/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	47	SULFATE	10
11187	5/26/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	45	SULFATE	2
11187	6/4/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	33	SULFATE	7
11187	6/9/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	31	SULFATE	14
13610	6/9/1987	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	3.5	SULFATE	6
13610	6/15/1987	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	3.7	SULFATE	6.5
11187	6/16/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	5	SULFATE	4
11187	6/23/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	6	SULFATE	3
11187	7/7/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	15	SULFATE	4
11187	7/14/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	9	SULFATE	5
11187	7/16/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	5	SULFATE	5
11187	7/28/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	7		
11187	7/28/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	14	SULFATE	2.5
11187	7/28/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	12	SULFATE	5
11187	8/6/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	14		
13610	8/12/1987	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	21	SULFATE	11
11187	8/13/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	14		
11187	8/18/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	16		
11187	8/25/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	17		
11187	9/15/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	74		
11187	9/22/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	16		
11187	10/8/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	27		
11187	10/13/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	26		
11187	10/15/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	22		
11187	10/20/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	22		
11187	10/28/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	22		
11187	11/5/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	25		
11187	11/12/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	23		
11187	11/17/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	25		
11187	11/19/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	22		
11187	11/24/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	24	SULFATE	9
11187	12/3/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	26	SULFATE	12
11187	12/8/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	15	SULFATE	10
11187	12/10/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	18		
11187	12/16/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	29	SULFATE	1
11187	12/22/1987	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	7	SULFATE	2
11187	1/5/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	18	SULFATE	6
11187	1/12/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	14	SULFATE	4
11187	1/14/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	8	SULFATE	3
11187	1/20/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	16	SULFATE	1
11187	1/26/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	20	SULFATE	3
11187	2/2/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	29	SULFATE	3
11187	2/9/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	23	SULFATE	5
13610	2/9/1988	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	31	SULFATE	14
11187	2/23/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	26	SULFATE	6
11187	3/3/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	6	SULFATE	1
11187	3/8/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	53	SULFATE	1
11187	3/15/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	20	SULFATE	5
11187	3/22/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	5	SULFATE	3
11187	3/29/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	14	SULFATE	3

Station ID	End date	Station Description	Latitude	Longitude	Segment ID	County	Parameter (MG/L)	Value	Parameter (MG/L)3	Value2	Parameter (MG/L)2	Value3
11187	4/5/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	16	SULFATE	4
11187	4/12/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	14	SULFATE	3
11187	4/14/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	13	SULFATE	5
11187	4/19/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	29	SULFATE	5
11187	4/26/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	15	SULFATE	3
11187	5/3/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	18	SULFATE	7
11187	5/10/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	21	SULFATE	4
11187	5/17/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	20	SULFATE	2
11187	5/24/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	25	SULFATE	1
11187	5/31/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	32	SULFATE	4
11187	6/2/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	33	SULFATE	5
11187	6/6/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	13	SULFATE	4
13610	6/6/1988	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	17	SULFATE	17
11187	6/20/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	30	SULFATE	3
11187	6/23/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	26	SULFATE	2
11187	6/27/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	29	SULFATE	2
11187	7/5/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	27	SULFATE	1
11187	7/12/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	22	SULFATE	1
11187	7/19/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	30	SULFATE	1
11187	7/26/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	20	SULFATE	3
11187	8/2/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris					SULFATE	2
11187	8/9/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	28	SULFATE	4
11187	8/16/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	18	SULFATE	6
11187	8/23/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	10	SULFATE	4
13610	8/23/1988	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	11	SULFATE	10
11187	8/30/1988	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	17	SULFATE	1
13610	1/10/1989	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	26	SULFATE	15
11187	6/6/1989	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	1	SULFATE	1
11187	6/13/1989	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	5	SULFATE	1
11187	7/11/1989	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	1	SULFATE	27
11187	8/8/1989	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	13	SULFATE	2
13610	9/6/1989	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	26	SULFATE	5
11187	9/12/1989	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	10	SULFATE	1
11187	10/17/1989	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	17	SULFATE	1
11187	11/14/1989	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	1	SULFATE	2
11187	12/7/1989	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	80	SULFATE	3
11187	1/15/1990	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	21	SULFATE	10
13610	2/2/1990	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	12	SULFATE	11
11187	2/26/1990	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	22	SULFATE	6
11187	3/22/1990	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	11	SULFATE	5
11187	4/17/1990	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	5	SULFATE	8
11187	5/24/1990	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	7	SULFATE	1
13610	7/11/1990	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	39	SULFATE	6.2
11187	7/12/1990	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	18	SULFATE	1
13610	8/8/1990	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	34	SULFATE	5.1
11187	8/14/1990	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	63	CHLORIDE	26	SULFATE	1
11187	1/15/1991	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	16	CHLORIDE	2	SULFATE	1
13610	3/27/1991	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	27	SULFATE	5.2
11187	8/5/1991	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	44	CHLORIDE	13	SULFATE	1
13610	8/6/1991	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	23	SULFATE	3.6
13610	9/18/1991	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	30	SULFATE	6.7

Station ID	End date	Station Description	Latitude	Longitude	Segment ID	County	Parameter (MG/L)	Value	Parameter (MG/L)3	Value2	Parameter (MG/L)2	Value3
11187	1/7/1992	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	39	CHLORIDE	10	SULFATE	1
13610	5/13/1992	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	19	SULFATE	3
13610	6/25/1992	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	25	SULFATE	3.2
11187	7/2/1992	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	37	CHLORIDE	26	SULFATE	1
13610	8/21/1992	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	20	SULFATE	2.4
13610	6/2/1993	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	12	SULFATE	3
13610	7/8/1993	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	14	SULFATE	2.4
13610	8/24/1993	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	28	SULFATE	2.7
11187	10/15/1993	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	24	SULFATE	6
11187	1/4/1994	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	17	SULFATE	10
13610	2/2/1994	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	12	SULFATE	6.4
11187	4/6/1994	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	22	SULFATE	8
13610	6/23/1994	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	14	SULFATE	3.4
11187	7/12/1994	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	8	SULFATE	4
13610	8/15/1994	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	16	SULFATE	2.5
11187	1/9/1995	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	16	SULFATE	7
13610	2/3/1995	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	9	SULFATE	2.2
11187	4/18/1995	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	10	SULFATE	7
13610	6/7/1995	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	10	SULFATE	2.9
11187	7/6/1995	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	8	SULFATE	3
13610	9/5/1995	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	28	SULFATE	3.6
11187	10/5/1995	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	15	SULFATE	7
11187	1/4/1996	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	14	SULFATE	1
13610	1/30/1996	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	37	SULFATE	8.2
11187	4/2/1996	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	33	SULFATE	9.5
13610	6/4/1996	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	30	SULFATE	2.6
11187	7/2/1996	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	24	SULFATE	8
13610	8/16/1996	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	15	SULFATE	5.6
13610	2/5/1997	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	17	SULFATE	4.9
13610	3/13/1997	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	7	SULFATE	2.257
13610	8/18/1997	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	19.06	SULFATE	1.622
13610	2/11/1998	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	19	SULFATE	4.245
13610	6/23/1998	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	76	SULFATE	4.018
13610	8/25/1998	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	26.308	SULFATE	10.04
18671	3/9/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6
18671	3/23/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5
18671	3/30/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6
18671	4/15/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4
13610	4/20/1999	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	21.465	SULFATE	4.74
18671	4/21/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4
18671	4/27/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5
18671	5/3/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	9
18671	5/6/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5
18671	5/13/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6
18671	5/27/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6
18671	6/2/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5
18671	6/9/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5
18671	6/15/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5
18671	6/21/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6
18671	6/24/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5
18671	7/1/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5

Station ID	End date	Station Description	Latitude	Longitude	Segment ID	County	Parameter (MG/L)	Value	Parameter (MG/L)3	Value2	Parameter (MG/L)2	Value3
18671	7/1/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5
18671	7/8/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4.49
18671	7/14/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4.03
18671	7/20/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	3.66
18671	7/26/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	3.92
13610	7/27/1999	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	11.26	SULFATE	2.59
18671	7/29/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4.86
18671	8/4/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4.4
18671	8/16/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4.92
18671	8/19/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5.08
13610	8/23/1999	LUCE BAYOU NEAR HUFFMAN	30.109444	-95.059723	1002B	Liberty			CHLORIDE	12.58	SULFATE	1.31
18671	8/25/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4.4
18671	8/31/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	3.97
18671	9/13/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5.9
18671	9/16/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.94
18671	10/12/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.06
18671	10/21/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5.91
18671	10/28/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.1
18671	11/2/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5.33
18671	11/4/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.17
18671	11/9/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.36
18671	11/16/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.46
18671	11/18/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.27
18671	11/23/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.26
18671	11/30/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.34
18671	12/2/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.87
18671	12/7/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5.1
18671	12/9/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.74
18671	12/14/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.43
18671	12/16/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	7.45
18671	12/21/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.85
18671	12/28/1999	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	8.03
18671	1/4/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	9.87
18671	1/6/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	9.12
18671	1/11/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	9.13
11187	1/12/2000	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	50	CHLORIDE	26	SULFATE	7
18671	1/13/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	8.22
18671	1/18/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	10.4
18671	1/20/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	9
18671	1/25/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	9.28
18671	1/27/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	9.55
18671	2/3/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	9.28
18671	2/8/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	9.32
18671	2/10/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	9.5
11187	2/15/2000	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	68	CHLORIDE	55	SULFATE	14
18671	2/17/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	9.29
18671	2/24/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	9.23
18671	2/29/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	9.22
18671	3/7/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	8.63
11187	3/14/2000	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	57	CHLORIDE	55	SULFATE	13
18671	3/14/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	8.21

Station ID	End date	Station Description	Latitude	Longitude	Segment ID	County	Parameter (MG/L)	Value	Parameter (MG/L)3	Value2	Parameter (MG/L)2	Value3
11187	4/11/2000	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	50	CHLORIDE	23	SULFATE	12
18671	4/11/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.97
18671	4/18/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	7.31
11187	5/16/2000	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	50	CHLORIDE	19	SULFATE	11
18671	5/23/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5.28
18671	5/30/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4.95
18671	6/6/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5.16
11187	6/13/2000	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	48	CHLORIDE	23	SULFATE	9
18671	7/6/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5.53
11187	7/11/2000	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	42	CHLORIDE	25	SULFATE	10
18671	7/18/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.05
18671	8/2/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5.94
18671	8/10/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.5
11187	8/15/2000	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	48	CHLORIDE	35	SULFATE	13
18671	9/6/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5.97
11187	9/12/2000	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	62	CHLORIDE	32	SULFATE	11
18671	9/13/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.13
11187	10/10/2000	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	76	CHLORIDE	35	SULFATE	11
18671	10/10/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	11.4
18671	10/17/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	7.3
18671	11/7/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	8.05
11187	11/14/2000	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	52	CHLORIDE	30	SULFATE	12
18671	11/14/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	7.11
18671	12/5/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5.83
11187	12/12/2000	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	44	CHLORIDE	3	SULFATE	3
18671	12/13/2000	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.03
18671	1/3/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	8.6
18671	1/10/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	9.9
11187	1/16/2001	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	52	CHLORIDE	3	SULFATE	6
18671	2/6/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.06
11187	2/13/2001	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	52	CHLORIDE	9	SULFATE	3
18671	2/14/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.37
18671	3/7/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4.78
11187	3/13/2001	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	52	CHLORIDE	3	SULFATE	2
18671	3/13/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4.83
18671	4/3/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4.26
11187	4/10/2001	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	56	CHLORIDE	11	SULFATE	15
18671	4/12/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4.89
18671	5/3/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5.95
11187	5/8/2001	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	64	CHLORIDE	16	SULFATE	10
18671	5/17/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	7.07
18671	6/5/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	7.52
11187	6/12/2001	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	46	CHLORIDE	4		
18671	6/19/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4.65
11187	7/9/2001	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	52	CHLORIDE	7	SULFATE	4
18671	7/17/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5.47
18671	7/26/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5.57
18671	8/1/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	6.01
11187	8/14/2001	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	52	CHLORIDE	17	SULFATE	6
18671	9/4/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5.55
11187	9/11/2001	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	52	CHLORIDE	24	SULFATE	7

Station ID	End date	Station Description	Latitude	Longitude	Segment ID	County	Parameter (MG/L)	Value	Parameter (MG/L)3	Value2	Parameter (MG/L)2	Value3
18671	9/12/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4.41
18671	10/4/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4
11187	10/9/2001	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	26	CHLORIDE	4	SULFATE	3
18671	10/9/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	4
18671	11/8/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	5
11187	11/13/2001	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	50	CHLORIDE	14	SULFATE	5
18671	11/27/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris					SULFATE	10
11187	12/4/2001	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	52	CHLORIDE	16	SULFATE	5
18671	12/6/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	10	SULFATE	10
18671	12/27/2001	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	10	SULFATE	10
11187	1/15/2002	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	40	CHLORIDE	14	SULFATE	5
18671	1/17/2002	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	15	SULFATE	10
11187	2/12/2002	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	35	CHLORIDE	14	SULFATE	51
18671	2/14/2002	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	15	SULFATE	10
11187	3/13/2002	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	45	CHLORIDE	23	SULFATE	6
18671	3/13/2002	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	19	SULFATE	10
11187	4/10/2002	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	55	CHLORIDE	9	SULFATE	5
18671	4/17/2002	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	10	SULFATE	10
18671	5/8/2002	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	16.2	SULFATE	10
11187	5/15/2002	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	49	CHLORIDE	21	SULFATE	7
11187	6/12/2002	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	56	CHLORIDE	27	SULFATE	9
18671	6/20/2002	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	23.5	SULFATE	10
11187	7/17/2002	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	75	CHLORIDE	14	SULFATE	7
18671	7/24/2002	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	18.3	SULFATE	10
11187	8/14/2002	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	50	CHLORIDE	17	SULFATE	6
18671	8/29/2002	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	19	SULFATE	10
11187	9/11/2002	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	52				
18671	9/26/2002	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	5.3	SULFATE	7.5
11187	10/9/2002	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	45	CHLORIDE	32	SULFATE	9
11187	11/13/2002	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	76			SULFATE	9
18671	11/20/2002	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	8.1	SULFATE	10
18671	12/31/2002	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	9.6	SULFATE	10
11187	1/15/2003	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	40	CHLORIDE	21	SULFATE	16
18671	1/29/2003	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	13.5	SULFATE	10
11187	2/12/2003	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	25	CHLORIDE	11	SULFATE	5
18671	2/28/2003	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	8.1	SULFATE	10
11187	3/12/2003	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	40	CHLORIDE	11	SULFATE	7
18671	3/26/2003	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	20.4	SULFATE	10
11187	4/9/2003	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	58	CHLORIDE	25	SULFATE	11
18671	4/28/2003	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	26	SULFATE	10
11187	5/14/2003	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	88	CHLORIDE	30	SULFATE	17
18671	5/14/2003	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	29	SULFATE	10
11187	6/11/2003	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	65				
18671	6/25/2003	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	21	SULFATE	10
11187	7/17/2003	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	50	CHLORIDE	169	SULFATE	5
18671	7/28/2003	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	10	SULFATE	10
11187	8/13/2003	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	50	CHLORIDE	20	SULFATE	6
18671	8/27/2003	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	19	SULFATE	7.5
11187	9/10/2003	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	44	CHLORIDE	7	SULFATE	6
18671	9/30/2003	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	10	SULFATE	5
11187	10/8/2003	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	50	CHLORIDE	13	SULFATE	5

Station ID	End date	Station Description	Latitude	Longitude	Segment ID	County	Parameter (MG/L)	Value	Parameter (MG/L)3	Value2	Parameter (MG/L)2	Value3
18671	10/29/2003	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	8	SULFATE	5
11187	11/12/2003	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	50	CHLORIDE	11	SULFATE	5
18671	11/25/2003	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	6	SULFATE	7
11187	12/10/2003	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	51	CHLORIDE	11	SULFATE	13
18671	12/30/2003	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	20	SULFATE	7
11187	1/14/2004	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	47	CHLORIDE	16	SULFATE	4
18671	1/22/2004	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	10	SULFATE	5
18671	1/29/2004	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	7	SULFATE	5
18671	2/4/2004	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	10	SULFATE	5
11187	2/11/2004	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	25	CHLORIDE	6	SULFATE	3
18671	3/4/2004	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	13	SULFATE	5
11187	3/10/2004	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	44	CHLORIDE	17	SULFATE	3
11187	4/13/2004	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	35	CHLORIDE	8	SULFATE	4
18671	4/21/2004	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	13	SULFATE	5
11187	5/12/2004	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	10	SULFATE	4
18671	5/26/2004	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	8	SULFATE	5
11187	6/9/2004	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	7	SULFATE	3
18671	6/16/2004	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	8	SULFATE	5
11187	7/7/2004	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	7	SULFATE	3
18671	7/27/2004	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	13	SULFATE	5
11187	8/11/2004	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	24	SULFATE	6
18671	8/18/2004	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	18	SULFATE	5
18671	9/1/2004	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	22	SULFATE	5
11187	9/8/2004	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	19	SULFATE	5
11187	10/13/2004	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	75	CHLORIDE	22	SULFATE	4
18671	10/13/2004	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	25	SULFATE	5
18671	11/2/2004	LUCE BAYOU AT FM 2100	30.066994	-95.09832	1002B	Harris			CHLORIDE	10	SULFATE	5
11187	11/10/2004	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	62	CHLORIDE	14	SULFATE	6
11187	12/2/2004	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	9	SULFATE	5
11187	12/7/2004	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	47	CHLORIDE	7	SULFATE	4
11187	1/6/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	17	SULFATE	6
11187	1/12/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	76	CHLORIDE	47	SULFATE	23
11187	2/9/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	84	CHLORIDE	3	SULFATE	2
11187	2/15/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	6	SULFATE	5
11187	3/1/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	8	SULFATE	5
11187	3/9/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	50	CHLORIDE	14	SULFATE	4
11187	4/5/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	21	SULFATE	5
11187	4/13/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	49	CHLORIDE	19	SULFATE	4
11187	5/3/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	28	SULFATE	6
11187	5/11/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	52	CHLORIDE	21	SULFATE	6
11187	6/8/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	56	CHLORIDE	33	SULFATE	10
11187	7/13/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	68	CHLORIDE	30	SULFATE	7
11187	8/10/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	55	CHLORIDE	25	SULFATE	6
11187	9/14/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	25	SULFATE	6
11187	9/17/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	39	CHLORIDE	21	SULFATE	5
11187	10/12/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	49	CHLORIDE	20	SULFATE	6
11187	10/25/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	22	SULFATE	7
11187	11/9/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	50	CHLORIDE	26	SULFATE	8
11187	11/17/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	24	SULFATE	7
11187	12/7/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	25	SULFATE	7
11187	12/8/2005	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	51	CHLORIDE	28	SULFATE	10

Station ID	End date	Station Description	Latitude	Longitude	Segment ID	County	Parameter (MG/L)	Value	Parameter (MG/L)3	Value2	Parameter (MG/L)2	Value3
11187	1/10/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	31	CHLORIDE	10	SULFATE	5
11187	1/10/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	13	SULFATE	7
11187	2/8/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	62	CHLORIDE	16	SULFATE	5
11187	2/17/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	15	SULFATE	8
11187	3/9/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	74	CHLORIDE	19	SULFATE	7
11187	3/29/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	19	SULFATE	7
11187	4/19/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	59	CHLORIDE	33	SULFATE	9
11187	4/25/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	29	SULFATE	8
11187	5/10/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	47	CHLORIDE	24	SULFATE	6
11187	5/16/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	19	SULFATE	6
11187	6/8/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	14	SULFATE	6
11187	6/14/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	42	CHLORIDE	15	SULFATE	6
11187	7/6/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	8	SULFATE	5
11187	7/12/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	43	CHLORIDE	21	SULFATE	6
11187	8/1/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	6	SULFATE	5
11187	8/9/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	33	CHLORIDE	8	SULFATE	3
11187	9/6/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	52	CHLORIDE	18	SULFATE	5
11187	9/26/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	16	SULFATE	5
11187	10/19/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	88	CHLORIDE	2	SULFATE	2
11187	10/30/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	5	SULFATE	5
11187	11/8/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	27	CHLORIDE	4	SULFATE	2
11187	11/16/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	5	SULFATE	5
11187	12/13/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	47	CHLORIDE	11	SULFATE	4
11187	12/13/2006	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	10	SULFATE	5
11187	1/10/2007	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	54	CHLORIDE	4	SULFATE	2
11187	1/31/2007	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	6	SULFATE	5
11187	2/14/2007	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	23	CHLORIDE	4	SULFATE	2
11187	2/27/2007	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	10	SULFATE	8
11187	3/8/2007	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	14	SULFATE	5
11187	4/5/2007	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	7	SULFATE	5
11187	5/17/2007	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	7	SULFATE	5
11187	6/28/2007	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	12	SULFATE	5
11187	7/30/2007	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	8	SULFATE	8
11187	8/31/2007	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	14	SULFATE	5
11187	9/28/2007	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	15	SULFATE	5
11187	10/18/2007	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	10	SULFATE	5
11187	11/28/2007	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	13	SULFATE	5
11187	1/23/2008	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	10	SULFATE	5
11187	2/14/2008	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	17	SULFATE	5
11187	3/19/2008	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	13	SULFATE	5
11187	4/17/2008	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	25	SULFATE	5
11187	6/25/2008	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	22	SULFATE	5
11187	8/20/2008	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	17	SULFATE	5
11187	10/7/2008	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	5	SULFATE	5
11187	10/30/2008	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	5	SULFATE	5
11187	12/1/2008	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	6	SULFATE	5
11187	1/21/2009	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	24	SULFATE	5
11187	3/12/2009	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	34	SULFATE	6
11187	4/23/2009	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	5	SULFATE	5
11187	6/17/2009	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	19	SULFATE	5
11187	7/15/2009	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	28	SULFATE	6

Station ID	End date	Station Description	Latitude	Longitude	Segment ID	County	Parameter (MG/L)	Value	Parameter (MG/L)3	Value2	Parameter (MG/L)2	Value3
11187	8/13/2009	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	26	SULFATE	5
11187	9/15/2010	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	43	CHLORIDE	20	SULFATE	5
11187	11/10/2010	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	57	CHLORIDE	26	SULFATE	8
11187	1/20/2011	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	55	CHLORIDE	23	SULFATE	7
11187	3/16/2011	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	45	CHLORIDE	22	SULFATE	8
11187	5/25/2011	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	73	CHLORIDE	43	SULFATE	11
11187	7/20/2011	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris	HARDNESS TOTAL	72	CHLORIDE	53	SULFATE	10
11187	9/28/2011	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	61	SULFATE	12
11187	11/30/2011	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	31	SULFATE	11
11187	3/22/2012	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	5	SULFATE	5
11187	5/16/2012	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	14	SULFATE	6
11187	7/12/2012	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	22	SULFATE	5
11187	9/19/2012	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	13	SULFATE	5
11187	11/21/2012	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	25	SULFATE	8
11187	1/16/2013	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	25	SULFATE	6
11187	3/21/2013	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	25	SULFATE	8
11187	5/23/2013	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	33	SULFATE	10
11187	8/21/2013	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	36	SULFATE	8
11187	9/18/2013	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	37	SULFATE	7
11187	11/13/2013	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	5	SULFATE	5
11187	1/22/2014	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	12	SULFATE	6
11187	3/19/2014	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	8	SULFATE	5
11187	5/21/2014	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	7	SULFATE	5
11187	7/30/2014	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	15	SULFATE	5
11187	9/17/2014	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	15	SULFATE	5
11187	11/19/2014	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	13	SULFATE	5
11187	1/21/2015	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	7	SULFATE	5
11187	3/25/2015	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	5	SULFATE	5
11187	5/13/2015	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	8	SULFATE	5
11187	7/15/2015	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	8	SULFATE	5
11187	9/9/2015	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	140	SULFATE	66
11187	11/12/2015	LUCE BAYOU AT HUFFMAN-NEW CANE	30.055834	-95.099724	1002B	Harris			CHLORIDE	7	SULFATE	12

Appendix C
TWDB Comments on Draft Feasibility Study Report

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Texas Water Development Board

P.O. Box 13231, 1700 N. Congress Ave.
Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847, Fax (512) 475-2053

October 21, 2016

Ms. Lori Traweek
Gulf Coast Waste Disposal Authority
910 Bay Area Boulevard
Houston, Texas 77058

RE: Regional Water and/or Wastewater Facility Grant Contract between the Texas Water Development Board (TWDB) and Gulf Coast Waste Disposal Authority (GCWDA); TWDB Contract No. 1548321871, "Feasibility Study: Regional Industrial Wastewater Treatment and Reuse Facility"

Dear Ms. Traweek:

Staff members of the TWDB have completed a review of the draft report prepared under the above-referenced contract. ATTACHMENT 1 provides the comments resulting from this review. As stated in the TWDB contract, the GCWDA will consider revising the final report in response to comments from the Executive Administrator and other reviewers. In addition, the GCWDA will include a copy of the Executive Administrator's draft report comments in the Final Report.

The TWDB looks forward to receiving one (1) electronic copy of the entire Final Report in Portable Document Format (PDF) and six (6) bound double-sided copies. **Please further note, that in compliance with Texas Administrative Code Chapters 206 and 213 (related to Accessibility and Usability of State Web Sites), the digital copy of the final report must comply with the requirements and standards specified in statute. For more information, visit http://www.sos.state.tx.us/tac/index.shtml.** If you have any questions on accessibility, please contact David Carter with the Contract Administration Division at (512) 936-6079 or David.Carter@twdb.texas.gov.

The GCWDA shall also submit one (1) electronic copy of any computer programs or models, and, if applicable, an operations manual developed under the terms of this Contract.

If you have any questions concerning the contract, please contact Tom Entsminger, the TWDB's designated contract manager for this project at (512) 936-0802 or tom.entsminger@twdb.texas.gov.

Sincerely,

Jessica Zuba
Deputy Executive Administrator
Water Supply and Infrastructure

Attachment

c: Tom Entsminger, TWDB

Attachment 1
TWDB Comments on "NAME OF REPORT"
TWDB Contract No. 1548321871

Category A. 2.

- Page 1-3. The report includes municipal and manufacturing demand projections for Region H based on the 2012 State Water Plan. Recommend including water demand projections based on the 2017 State Water Plan. Projections can be found at: https://2017.texasstatewaterplan.org/region/H
- Page 2-15, 1st paragraph. The text references the "2016 Regional Water Plan Initially Prepared Plan for Region H". Recommend referencing the final 2016 Region H Regional Water Plan. This plan can be found here: http://www.twdb.texas.gov/waterplanning/rwp/plans/2016/H/Region_H_2016_RWP.pdf
- Page 2-15, Table 2-2. The source for the table cites the "TWDB 2016 State Water Plan Projections". Recommend updating the reference to the 2017 State Water Plan.
- Page 2-15, Table 2-4. The source for the table cites the "2016 Regional Water Plan Initially Prepared Plan, Region H". Recommend updating the reference for this source: the TWDB is not an author of the Regional Water Plans. It is also recommended to cite the final 2016 Region H Plan or the 2017 State Water Plan. These sources can be found here http://www.twdb.texas.gov/waterplanning/rwp/plans/2016/H/Region_H_2016_RWP.pdf and here https://2017.texasstatewaterplan.org/region/H
- Page 2-16, Table 2-5. The source for the table cites the Draft 2017 State Water Plan. Recommend citing the adopted 2017 State Water Plan. The final plan may be found here: http://www.twdb.texas.gov/waterplanning/swp/2017/doc/2017_SWP_Adopted.pdf

Category C. 1.a

- The report does not appear to include a proposed implementation schedule.

Category C.1.f

- The report does not appear to include a list of applicable funding programs.

Category C.3

- The report does not appear to include address water conservation or drought contingency plans.