DRAFT FEASIBILITY REPORT
FEASIBILITY ANALYSIS OF WATER SUPPLY FOR SMALL PUBLIC WATER SYSTEMS

FREER WCID
PWS ID# 0660002, CCN# P0138

Prepared for:

THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Prepared by:

THE UNIVERSITY OF TEXAS BUREAU OF ECONOMIC GEOLOGY

AND

PARSONS

Preparation of this report was financed by the Texas Commission on Environmental Quality through the Drinking Water State Revolving Fund Small Systems Assistance Program

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AUGUST 2008

EXECUTIVE SUMMARY

INTRODUCTION

The University of Texas Bureau of Economic Geology (BEG) and its subcontractor, Parsons Transportation Group Inc. (Parsons), was contracted by the Texas Commission on Environmental Quality (TCEQ) to conduct a project to assist with identifying and analyzing alternatives for use by Public Water Systems (PWS) to meet and maintain Texas drinking water standards.

The overall goal of this project was to promote compliance using sound engineering and financial methods and data for PWSs that had recently recorded sample results exceeding maximum contaminant levels (MCL). The primary objectives of this project were to provide feasibility studies for PWSs and the TCEQ Water Supply Division that evaluate water supply compliance options, and to suggest a list of compliance alternatives that may be further investigated by the subject PWS for future implementation.

This feasibility report provides an evaluation of water supply alternatives for the Freer Water Control and Improvement District (WCID) PWS, ID #0660002, Certificate of Convenience and Necessity (CCN) #P0138, located in Duval County. The water supply system serves a population of 4,038 and contains 1,394 connections (includes wholesale population of 759 and 73 connections). The water source for the Freer WCID comes from six wells completed to depths ranging from 620 feet to 680 feet deep in the Catahoula Formation. Freer WCID also has three wells that are inactive.

The Freer WCID PWS recorded arsenic concentrations of 0.0418 milligrams per liter (mg/L) in June 2001 and 0.0385 mg/L in January 2002. While these results were below the arsenic MCL of 0.050 mg/L in effect at that time, the values were above the 0.010 mg/L MCL for arsenic that went into effect on January 23, 2006 (USEPA 2008a; TCEQ 2004). Additionally, arsenic concentrations ranged from 0.0189 mg/L to 0.039 mg/L between April 2006 and December 2006 and from 0.0404 mg/L to 0.0423 mg/L between January 2007 and September 2007. Therefore, the Freer WCID faces compliance issues under the water quality standard for arsenic.

Basic system information for the Freer WCID PWS is shown in Table ES.1.

Table ES.1 Freer WCID PWS
Basic System Information

Population served	4,038
Connections	1,394
Average daily flow rate	0.60 million gallons per day (mgd)
Peak demand flow rate	1,667 gallons per minute
Water system peak capacity	1.094 mgd
Typical arsenic range	0.0189 – 0.0423 mg/L

STUDY METHODS

The methods used for this project were based on a pilot project performed in 2004 and 2005 by TCEQ, BEG, and Parsons. Methods for identifying and analyzing compliance options were developed in the pilot project (a decision tree approach).

The process for developing the feasibility study used the following general steps:

- Gather data from the TCEQ and Texas Water Development Board databases, from TCEQ files, and from information maintained by the PWS;
- Conduct financial, managerial, and technical (FMT) evaluations of the PWS;
- Perform a geologic and hydrogeologic assessment of the study area;
- Develop treatment and non-treatment compliance alternatives which, in general, consist of the following possible options:
- Connecting to neighboring PWSs via new pipeline or by pumping water from a newly installed well or an available surface water supply within the jurisdiction of the neighboring PWS;
- Installing new wells within the vicinity of the PWS into other aquifers with confirmed water quality standards meeting the MCLs;
- Installing a new intake system within the vicinity of the PWS to obtain water from a surface water supply with confirmed water quality standards meeting the MCLs;
- Treating the existing non-compliant water supply by various methods depending on the type of contaminant; and
- Delivering potable water by way of a bottled water program or a treated water dispenser as an interim measure only.
- Assess each of the potential alternatives with respect to economic and non-economic criteria;
- Prepare a feasibility report and present the results to the PWS.

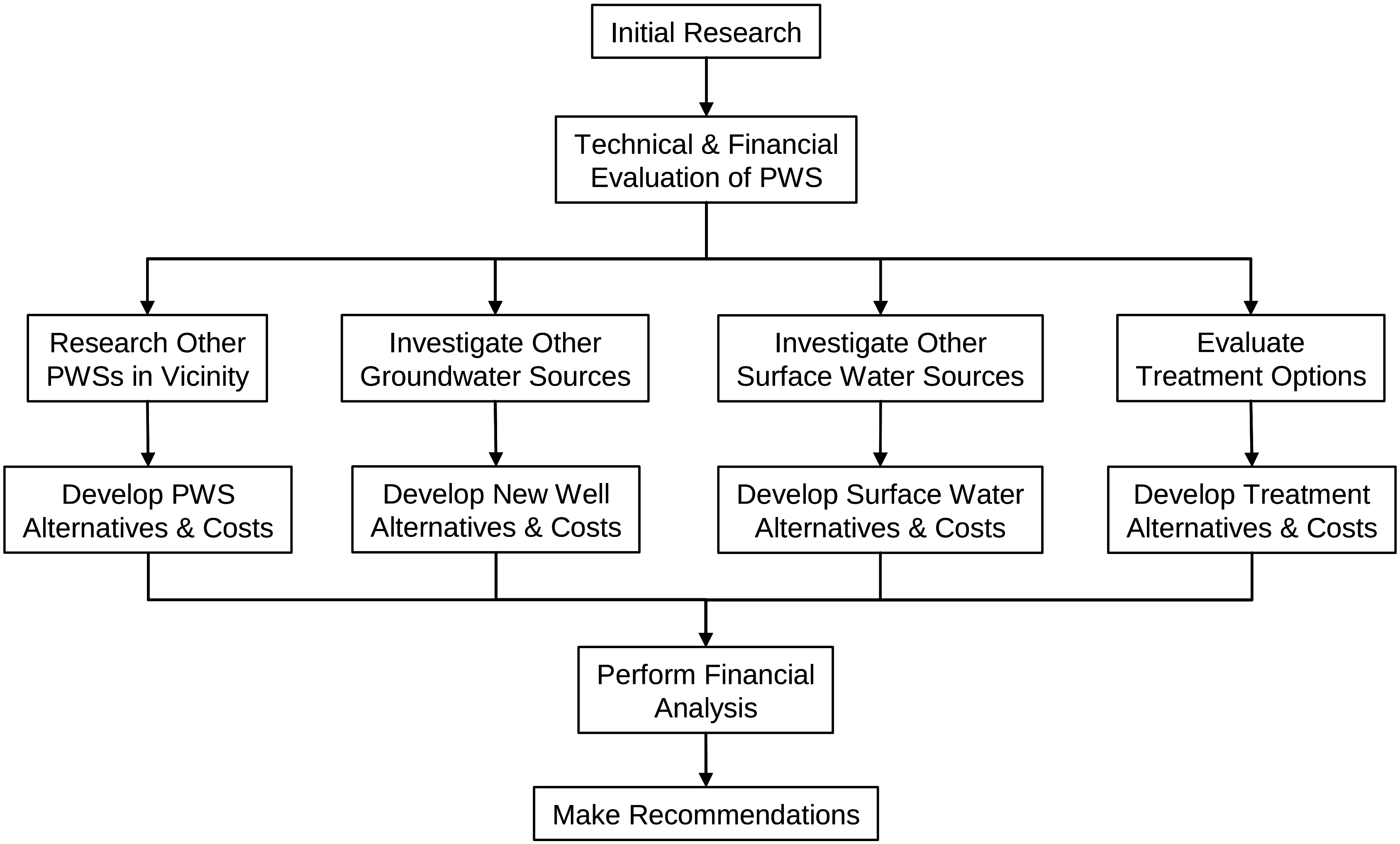
This basic approach is summarized in Figure ES.1.

HYDROGEOLOGICAL ANALYSIS

The Freer WCID PWS obtains groundwater from the Catahoula Formation (122CTHL), which underlies the Jasper Aquifer. Arsenic is commonly found in area wells at concentrations greater than the MCL. No wells with acceptable water quality were identified within 6.2 miles of Freer WCID. Regionally, the Freer WCID is located within an area of high arsenic groundwater along the updip edge of the Gulf Coast aquifer system. The regional assessment also found that arsenic levels may decrease with decreasing depth, so drilling a new shallow well or casing the deeper part of existing wells might improve arsenic concentrations

It is possible that testing each well separately could identify specific wells with particularly high or low arsenic concentrations. Based on this information, it might be possible to increase or decrease the use of water from certain wells to meet the MCL for arsenic. In addition, depth-specific sampling could be done to evaluate whether casing off portions of a well might lower arsenic concentrations in some of the wells.

Figure ES.1 Summary of Project Methods



COMPLIANCE ALTERNATIVES

Overall, the system had a good level of FMT capacity. The system had some areas that needed improvement to be able to address future compliance issues; however, the system does have many positive aspects, including maintaining a water rehabilitation/reserve account, dedicated and knowledgeable staff, taking advantage of funding opportunities, and a recent meter replacement program. Areas of concern for the system included lack of compliance with the arsenic standard, and a potential shortfall in staffing level.

There are few PWSs within 30 miles of Freer WCID and most of them have water quality problems. In general, feasibility alternatives were developed based on obtaining water from water systems within 30 miles of the PWSs, either by directly purchasing water, or by expanding an existing well field. There is a minimum of surface water available in the area.

Centralized treatment alternatives for arsenic removal have been developed and were considered for this report; for example, reverse osmosis, coagulation and filtration, and iron-based adsorption. Point-of-use (POU) and point-of-entry treatment alternatives were also considered. Temporary solutions such as providing bottled water or providing a centralized dispenser for treated or trucked-in water, were also considered as alternatives.

Developing a new well close to Freer WCID is likely to be the best solution if compliant groundwater can be found. Having a new well close to Freer WCID is likely to be one of the lower cost alternatives since the PWS already possesses the technical and managerial expertise needed to implement this option. The cost of new well alternatives quickly increases with pipeline length, making proximity of the alternate source a key concern. A new compliant well or obtaining water from a neighboring compliant PWS has the advantage of providing compliant water to all taps in the system.

Central treatment can be cost-competitive with the alternative of new nearby wells, but would require significant institutional changes to manage and operate. Similar to obtaining an alternate compliant water source, central treatment would provide compliant water to all water taps.

POU treatment can be cost competitive, but does not supply compliant water to all taps. Additionally, significant efforts would be required for maintenance and monitoring of the POU treatment units.

Providing compliant water through a central dispenser is significantly less expensive than providing bottled water to 100 percent of the population, but a significant effort is required for clients to fill their containers at the central dispenser.

FINANCIAL ANALYSIS

Financial analysis of the Freer WCID PWS indicated that current water and wastewater revenue are sufficient to cover operation and maintenance at this time. The current average water and wastewater bill represents approximately 2.5 percent of the median household income (MHI). Separate financial data for water and wastewater were not readily available. To understand the impact of compliance alternatives for the water system, cost for operation and maintenance were determined from similar sized systems. Table ES.2 provides a summary of the financial impact of implementing selected compliance alternatives. The alternatives were selected to highlight results for the best alternatives from each different type or category.

Table ES.2 Selected Financial Analysis Results

Alternative	Funding Option	Average Annual Water Bill	Percent of MHI
Current	NA	$283*	1.1
To meet current expenses	NA	$283	1.1
Nearby well within approximately 1 mile	100% Grant	$283	1.1
	Loan/Bond	$312	1.2
Central coagulation/filtration treatment	100% Grant	$360	1.4
	Loan/Bond	$432	1.7
Point-of-use	100% Grant	$1,032	4.1
	Loan/Bond	$1,121	4.5
Public dispenser	100% Grant	$457	1.8
	Loan/Bond	$464	1.8

** Water system revenue was assumed equal to estimated water system expenses.*

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ACRONYMS AND ABBREVIATIONS

µg/L	Micrograms per liter
ºF	Fahrenheit
ANSI	American National Standards Institute
APU	arsenic package unit
AFY	acre-feet per year
BEG	Bureau of Economic Geology
CCN	Certificate of Convenience and Necessity
CD	Community Development
CDBG	Community Development Block Grant
CFR	Code of Federal Regulations
DWSRF	Drinking Water State Revolving Fund
EDR	Electrodialysis reversal
EDAP	Economically distressed Areas Program
FMT	Financial, managerial, and technical
GAM	Groundwater Availability Model
gpd	gallons per day
IX	Ion exchange
MCL	Maximum contaminant level
mg/L	Milligram per liter
mgd	Million gallons per day
MHI	Median household income
NMEFC	New Mexico Environmental Financial Center
NPDWR	National Primary Drinking Water Regulations
NURE	National Uranium Resource Evaluation
O&M	Operation and Maintenance
ORCA	Office of Rural Community Affairs
Parsons	Parsons Transportation Group, Inc.
pCi/L	picoCuries per liter
POE	Point-of-entry
POU	Point-of-use
psi	pounds per square inch
PWS	Public Water System
RFP	Revolving Fund Program
RO	Reverse osmosis
RUS	Rural Utilities Service
RWAF	Rural Water Assistance Fund
SDWA	Safe Drinking Water Act

STEP	Small Towns Environment Program
SWAP	Source Water Assessment and Protection
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TSS	total suspended solids
TWDB	Texas Water Development Board
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WAM	Water Availability Model
WCID	Water Control Improvement District
WEP	Water and Environment Program
WSC	water supply corporation

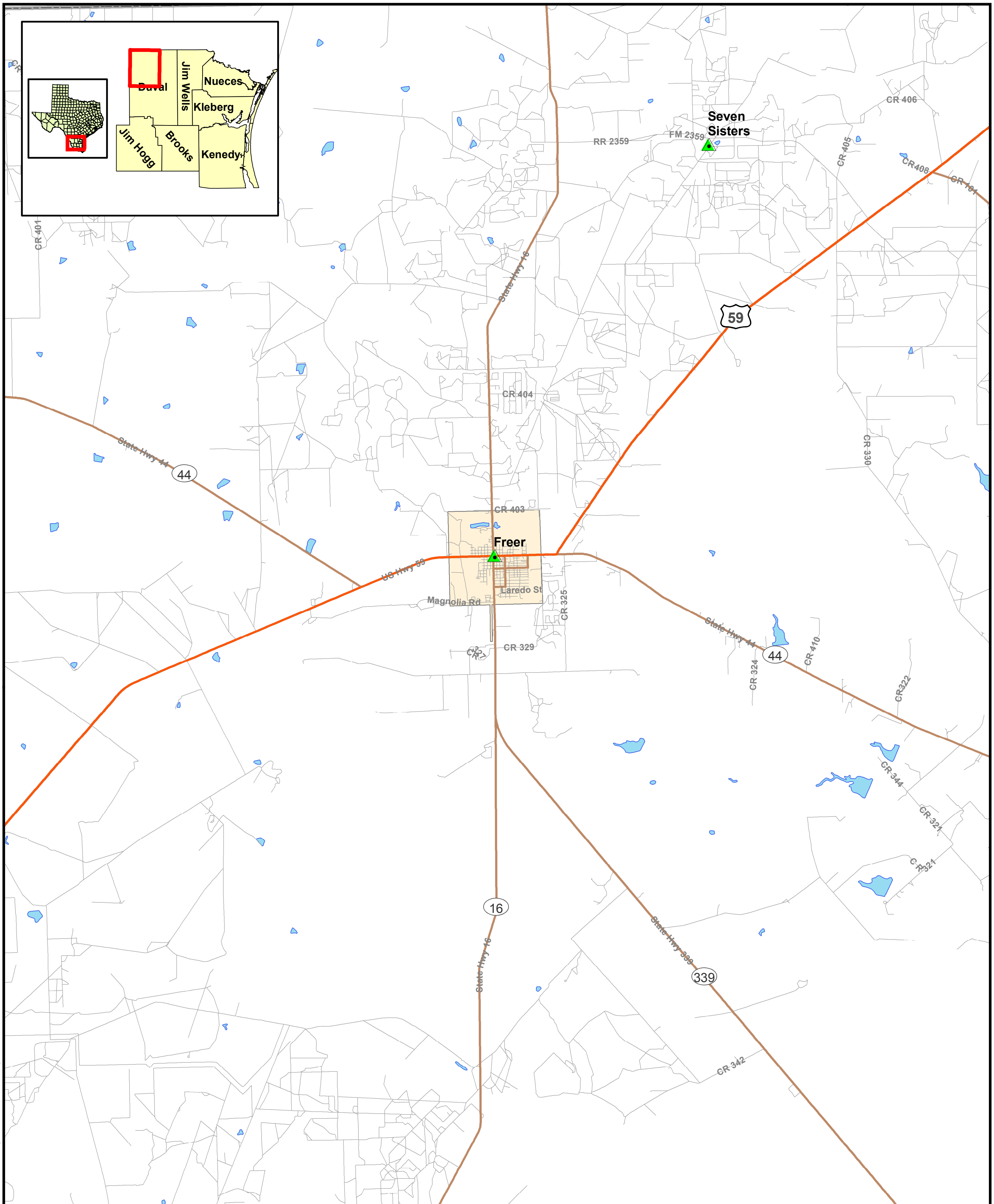
SECTION 1
INTRODUCTION

The University of Texas Bureau of Economic Geology (BEG) and its subcontractor, Parsons Transportation Group Inc. (Parsons), were contracted by the Texas Commission on Environmental Quality (TCEQ) to assist with identifying and analyzing compliance alternatives for use by Public Water Systems (PWS) to meet and maintain Texas drinking water standards.

The overall goal of this project is to promote compliance using sound engineering and financial methods and data for PWSs that have recently had sample results that exceed maximum contaminant levels (MCL). The primary objectives of this project are to provide feasibility studies for PWSs and the TCEQ Water Supply Division that evaluate water supply compliance options, and to suggest a list of compliance alternatives that may be further investigated by the subject PWS with regard to future implementation. The feasibility studies identify a range of potential compliance alternatives, and present basic data that can be used for evaluating feasibility. The compliance alternatives addressed include a description of what would be required for implementation, conceptual cost estimates for implementation, and non-cost factors that could be used to differentiate between alternatives. The cost estimates are intended for comparing compliance alternatives, and to give a preliminary indication of potential impacts on water rates resulting from implementation.

It is anticipated the PWS will review the compliance alternatives in this report to determine if there are promising alternatives, and then select the most attractive alternative(s) for more detailed evaluation and possible subsequent implementation. This report contains a decision tree approach that guided the efforts for this project, and also contains steps to guide a PWS through the subsequent evaluation, selection, and implementation of a compliance alternative.

This feasibility report provides an evaluation of water supply compliance options for the Freer Water Control and Improvement District (WCID) Water System, PWS ID# 0660002, Certificate of Convenience and Necessity (CCN) #P0138, located in Duval County, hereinafter referred to in this document as the "Freer WCID PWS." Recent sample results from the Freer WCID water system exceeded the MCL for arsenic of 10 micrograms per liter (µg/L) (USEPA 2008a, TCEQ 2004). The location of the Freer WCID PWS is shown on Figure 1.1. Various water supply and planning jurisdictions are shown on Figure 1.2. These water supply and planning jurisdictions are used in the evaluation of alternate water supplies that may be available in the area.



N

Miles
0 1.5 3

Legend

- Study System
- PWS's
- Cities
- City Limits
- Counties
- Interstate
- Highway
- Major Road
- Minor Road

Figure 1.1

FREER WCID

Location Map

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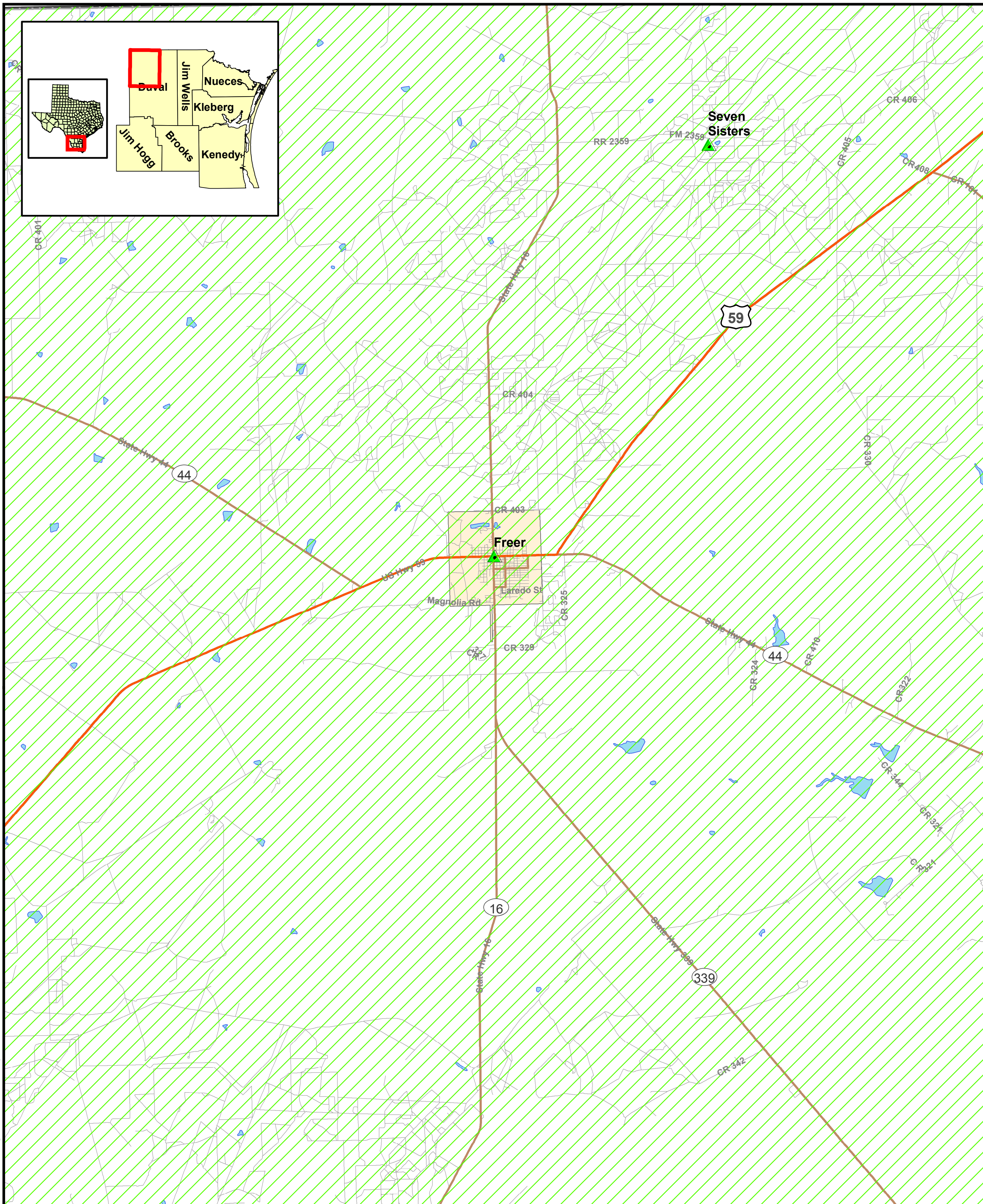

Legend

N

- Study System
- PWS's
- Cities
- City Limits
- Counties
- Interstate
- Highway
- Major Road
- Minor Road
- Duval County GCD

Miles

0 1.5 3

Figure 1.2

FREER WCID

Groundwater Conservation Districts

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1.1 PUBLIC HEALTH AND COMPLIANCE WITH MCLs

The goal of this project is to promote compliance for PWSs that supply drinking water exceeding regulatory MCLs. This project only addresses those contaminants and does not address any other violations that may exist for a PWS. As mentioned above, the Freer WCID water system had recent sample results exceeding the MCL for arsenic. In general, contaminant(s) in drinking water above the MCL(s) can have both short-term (acute) and long-term or lifetime (chronic) effects. Potential health effects from long-term ingestion of water with levels of arsenic above the MCL (0.01 milligrams per liter [mg/L]) include non-cancerous effects, such as cardiovascular, pulmonary, immunological, neurological and endocrine effects, and cancerous effects, including skin, bladder, lung, kidney, nasal passage, liver and prostate cancer (USEPA 2008b).

1.2 METHOD

The method for this project follows that of a pilot project performed by TCEQ, BEG, and Parsons. The pilot project evaluated water supply alternatives for PWSs that supplied drinking water with contaminant concentrations above U.S. Environmental Protection Agency (USEPA) and Texas drinking water standards. Three PWSs were evaluated in the pilot project to develop the method (*i.e.*, decision tree approach) for analyzing options for provision of compliant drinking water. This project is performed using the decision tree approach that was developed for the pilot project, and which was also used for subsequent projects.

Other tasks of the feasibility study are as follows:

- Identifying available data sources;
- Gathering and compiling data;
- Conducting financial, managerial, and technical (FMT) evaluations of the selected PWSs;
- Performing a geologic and hydrogeologic assessment of the area;
- Developing treatment and non-treatment compliance alternatives;
- Assessing potential alternatives with respect to economic and non-economic criteria;
- Preparing a feasibility report; and
- Suggesting refinements to the approach for future studies.

The remainder of Section 1 of this report addresses the regulatory background, and provides a summary of arsenic abatement options. Section 2 describes the method used to develop and assess compliance alternatives. The groundwater sources of arsenic are addressed in Section 3. Findings for the Freer WCID PWS, along with compliance alternatives development and evaluation, can be found in Section 4. Section 5 references the sources used in this report.

1.3 REGULATORY PERSPECTIVE

The Utilities & Districts and Public Drinking Water Sections of the TCEQ Water Supply Division are responsible for implementing requirements of the Federal Safe Drinking Water Act (SDWA), which include oversight of PWSs and water utilities. These responsibilities include:

- Monitoring public drinking water quality;
- Processing enforcement referrals for MCL violators;
- Tracking and analyzing compliance options for MCL violators;
- Providing FMT assessment and assistance to PWSs;
- Participating in the Drinking Water State Revolving Fund program to assist PWSs in achieving regulatory compliance; and
- Setting rates for privately owned water utilities.

This project was conducted to assist in achieving these responsibilities.

1.4 ABATEMENT OPTIONS

When a PWS exceeds a regulatory MCL, the PWS must take action to correct the violation. The MCL exceedances at the Freer WCID PWS involve arsenic. The following subsections explore alternatives considered as potential options for obtaining/providing compliant drinking water.

1.4.1 Existing Public Water Supply Systems

A common approach to achieving compliance is for the PWS to make arrangements with a neighboring PWS for water supply. For this arrangement to work, the PWS from which water is being purchased (supplier PWS) must have water in sufficient quantity and quality, the political will must exist, and it must be economically feasible.

1.4.1.1 Quantity

For purposes of this report, quantity refers to water volume, flowrate, and pressure. Before approaching a potential supplier PWS, the non-compliant PWS should determine its water demand on the basis of average day and maximum day. Peak instantaneous demands can be met through proper sizing of storage facilities. Further, the potential for obtaining the appropriate quantity of water to blend to achieve compliance should be considered. The concept of blending involves combining water with low levels of contaminants with non-compliant water in sufficient quantity that the resulting blended water is compliant. The exact blend ratio would depend on the quality of the water a potential supplier PWS can provide, and would likely vary over time. If high quality water is purchased, produced or otherwise obtained, blending can reduce the amount of high quality water required. Implementation of blending will require a control system to ensure the blended water is compliant.

If the supplier PWS does not have sufficient quantity, the non-compliant community could pay for the facilities necessary to increase the quantity to the extent necessary to supply the needs of the non-compliant PWS. Potential improvements might include, but are not limited to:

- Additional wells;
- Developing a new surface water supply,
- Additional or larger-diameter piping;
- Increasing water treatment plant capacity
- Additional storage tank volume;
- Reduction of system losses,
- Higher-pressure pumps; or
- Upsized, or additional, disinfection equipment.

In addition to the necessary improvements, a transmission pipeline would need to be constructed to tie the two PWSs together. The pipeline must tie-in at a point in the supplier PWS where all the upstream pipes and appurtenances are of sufficient capacity to handle the new demand. In the non-compliant PWS, the pipeline must tie in at a point where no down stream bottlenecks are present. If blending is the selected method of operation, the tie-in point must be selected to ensure all the water in the system is blended to achieve regulatory compliance.

1.4.1.2 Quality

If a potential supplier PWS obtains its water from the same aquifer (or same portion of the aquifer) as the non-compliant PWS, the quality of water may not be significantly better. However, water quality can vary significantly due to well location, even within the same aquifer. If localized areas with good water quality cannot be identified, the non-compliant PWS would need to find a potential supplier PWS that obtains its water from a different aquifer or from a surface water source. Additionally, a potential supplier PWS may treat non-compliant raw water to an acceptable level.

Surface water sources may offer a potential higher-quality source. Since there are significant treatment requirements, utilization of surface water for drinking water is typically most feasible for larger local or regional authorities or other entities that may provide water to several PWSs. Where PWSs that obtain surface water are neighbors, the non-compliant PWS may need to deal with those systems as well as with the water authorities that supply the surface water.

1.4.2 Potential for New Groundwater Sources

1.4.2.1 Existing Non-Public Supply Wells

Often there are wells not associated with PWSs located in the vicinity of the non-compliant PWS. The current use of these wells may be for irrigation, industrial purposes, domestic supply, stock watering, and other purposes. The process for investigating existing wells is as follows:

- Existing data sources (see below) will be used to identify wells in the areas that have satisfactory quality. For the Freer WCID PWS, the following standards could be used in a rough screening to identify compliant groundwater in surrounding systems:
    - Nitrate (measured as nitrogen) concentrations less than 8 mg/L (below the MCL of 10 mg/L);
    - Fluoride concentration less than 2.0 mg/L (below the Secondary MCL of 2 mg/L);
    - Arsenic concentration less than 0.008 mg/L (below the MCL of 0.01 mg/L);
    - Uranium concentration less than 0.024 mg/L (below the MCL of 0.030 mg/L; and
    - Selenium concentration less than 0.04 mg/L (below the MCL of 0.05 mg/L).
- The recorded well information will be reviewed to eliminate those wells that appear to be unsuitable for the application. Often, the "Remarks" column in the Texas Water Development Board (TWDB) hard-copy database provides helpful information. Wells eliminated from consideration generally include domestic and stock wells, dug wells, test holes, observation wells, seeps and springs, destroyed wells, wells used by other communities, etc.
- Wells of sufficient size are identified. Some may be used for industrial or irrigation purposes. Often the TWDB database will include well yields, which may indicate the likelihood that a particular well is a satisfactory source.
- At this point in the process, the local groundwater control district (if one exists) should be contacted to obtain information about pumping restrictions. Also, preliminary cost estimates should be made to establish the feasibility of pursuing further well development options.
- If particular wells appear to be acceptable, the owner(s) should be contacted to ascertain their willingness to work with the PWS. Once the owner agrees to participate in the program, questions should be asked about the wells. Many owners have more than one well, and would probably be the best source of information regarding the latest test dates, who tested the water, flowrates, and other well characteristics.
- After collecting as much information as possible from cooperative owners, the PWS would then narrow the selection of wells and sample and analyze them for quality. Wells with good quality water would then be potential candidates for test pumping. In

some cases, a particular well may need to be refurbished before test pumping. Information obtained from test pumping would then be used in combination with information about the general characteristics of the aquifer to determine whether a well at that location would be suitable as a supply source.

- It is recommended that new wells be installed instead of using existing wells to ensure the well characteristics are known and the well meets construction standards.
- Permit(s) would then be obtained from the groundwater control district or other regulatory authority, and an agreement with the owner (purchase or lease, access easements, etc.) would then be negotiated.

1.4.2.2 Develop New Wells

If no existing wells are available for development, the PWS or group of PWSs has an option of developing new wells. Records of existing wells, along with other hydrogeologic information and modern geophysical techniques, should be used to identify potential locations for new wells. In some areas, the TWDB's Groundwater Availability Model (GAM) may be applied to indicate potential sources. Once a general area is identified, land owners and regulatory agencies should be contacted to determine an exact location for a new well or well field. Pump tests and water quality tests would be required to determine if a new well will produce an adequate quantity of good quality water. Permits from the local groundwater control district or other regulatory authority could also be required for a new well.

1.4.3 Potential for Surface Water Sources

Water rights law dominates the acquisition of water from surface water sources. For a PWS, 100 percent availability of water is required, except where a back-up source is available. For PWSs with an existing water source, although it may be non-compliant because of elevated concentrations of one or more parameters, water rights may not need to be 100 percent available.

1.4.3.1 Existing Surface Water Sources

"Existing surface water sources" of water refers to municipal water authorities and cities that obtain water from surface water sources. The process of obtaining water from such a source is generally less time consuming and less costly than the process of developing a new source; therefore, it should be a primary course of investigation. An existing source would be limited by its water rights, the safe yield of a reservoir or river, or by its water treatment or water conveyance capability. The source must be able to meet the current demand and honor contracts with communities it currently supplies. In many cases, the contract amounts reflect projected future water demand based on population or industrial growth.

A non-compliant PWS would look for a source with sufficient spare capacity. Where no such capacity exists, the non-compliant PWS could offer to fund the improvements necessary to obtain the capacity. This approach would work only where the safe yield could be increased (perhaps by enlarging a reservoir) or where treatment capacity could be increased. In some instances water rights, where they are available, could possibly be purchased.

In addition to securing the water supply from an existing source, the non-compliant PWS would need to arrange for transmission of the water to the PWS. In some cases, that could require negotiations with, contracts with, and payments to an intermediate PWS (an intermediate PWS is one where the infrastructure is used to transmit water from a "supplier" PWS to a "supplied" PWS, but does not provide any additional treatment to the supplied water). The non-compliant PWS could be faced with having to fund improvements to the intermediate PWS in addition to constructing its own necessary transmission facilities.

1.4.3.2 New Surface Water Sources

Communication with the TCEQ and relevant planning groups from the beginning is essential in the process of obtaining a new surface water source. Preliminary assessment of the potential for acquiring new rights may be based on surface water availability maps located on the TWDB website. Where water rights appear to be available, the following activities need to occur:

- Discussions with TCEQ to indicate the likelihood of obtaining those rights. The TCEQ may use the Water Availability Model (WAM) to assist in the determination.
- Discussions with land owners to indicate potential treatment plant locations.
- Coordination with U.S. Army Corps of Engineers and local river authorities.
- Preliminary engineering design to determine the feasibility, costs, and environmental issues of a new treatment plant.

Should these discussions indicate that a new surface water source is the best option, the community would proceed with more intensive planning (initially obtaining funding), permitting, land acquisition, and detailed designs.

1.4.4 Identification of Treatment Technologies

Various treatment technologies were also investigated as compliance alternatives for treatment of arsenic to regulatory levels (*i.e.*, MCL). According to a recent USEPA report for small water systems with <10,000 customers (EPA/600/R-05/001) a number of drinking water treatment technologies are available to reduce arsenic concentrations in source water to below the new MCL of 10 µg/L, including:

- Ion exchange (IX);
- Reverse osmosis (RO);
- Electrodialysis reversal (EDR);
- Adsorption; and
- Coagulation/filtration.

1.4.5 Treatment Technologies Description

Many of the most effective arsenic removal processes available are iron-based treatment technologies such as chemical coagulation/filtration with iron salts, and adsorptive media with iron-based products. These processes are particularly effective at removing arsenic from aqueous systems because iron surfaces have a strong affinity for adsorbing arsenic. Other arsenic removal processes such as activated alumina and enhanced lime softening are more applicable to larger water systems because of their operational complexity and cost. A description and discussion of arsenic removal technologies applicable to smaller systems follow.

1.4.5.1 Ion Exchange

Process – In solution, salts separate into positively charged cations and negatively charged anions. Ion exchange is a reversible chemical process in which ions attached to an insoluble, permanent, solid resin bed are exchanged for ions in water. The process relies on the fact that certain ions are preferentially adsorbed on the ion exchange resin. Operation begins with a fully charged cation or anion bed, having enough positively or negatively charged ions to carry out the cation or anion exchange. Usually a polymeric resin bed is composed of millions of spherical beads about the size of medium sand grains. As water passes the resin bed, the charged ions are released into the water, being substituted or replaced with the contaminants in the water (IX). When the resin becomes exhausted of positively or negatively charged ions, the bed must be regenerated by passing a strong, sodium chloride solution over the resin bed, displacing the contaminant ions with sodium ions for cation exchange and chloride ion for anion exchange. Many different types of resins can be used to reduce dissolved contaminant concentrations. The IX treatment train for groundwater typically includes cation or anion resin beds with a regeneration system, chlorine disinfection, and clear well storage. Treatment trains for surface water may also include raw water pumps, debris screens, and filters for pre-treatment. Additional treatment or management of the concentrate and the removed solids will be necessary prior to disposal. For arsenic removal, an anion exchange resin in the chloride form is used to remove arsenate [As(V)]. Because arsenite [As(III)] occurs in water below pH 9 with no ionic charge, As(III) is not consistently removed by the anionic exchange process.

Pretreatment – Pretreatment guidelines are available on accepted limits for pH, organics, turbidity, and other raw water characteristics. Pretreatment may be required to reduce excessive amounts of total suspended solids (TSS), iron, and manganese, which could plug the resin bed, and typically includes media or carbon filtration. In addition, chlorination or oxidation may be required to convert As(III) to As(V) for effective removal.

Maintenance – The IX resin requires regular on-site regeneration, the frequency of which depends on raw water characteristics, the contaminant concentration, and the size and number of IX vessels. Many systems have undersized the IX vessels only to realize higher than necessary operating costs. Preparation of the sodium chloride solution is required. If used, a pretreatment filter would require filter replacement and/or backwashing.

Waste Disposal – Approval from local authorities is usually required for disposal of concentrate from the regeneration cycle (highly concentrated salt solution); occasional solid wastes (in the form of broken resin beads) which are backwashed during regeneration; and if used, spent filters and backwash wastewater.

Advantages (IX)

- Well established process for arsenic removal.
- Fully automated and highly reliable process.
- Suitable for small and large installations.

Disadvantages (IX)

- Requires salt storage; regular regeneration.
- Disposal of spent regenerate containing high salt and arsenic levels.
- Resins are sensitive to the presence of competing ions such as sulfate.
- Oxidation via pre-chlorination required if source water arsenic occurs as the arsenite [As(III)] species.

In considering application of IX for inorganics removal, it is important to understand what the effect of competing ions will be, and to what extent the brine can be recycled. Similar to activated alumina, IX exhibits a selectivity sequence, which refers to an order in which ions are preferred. Sulfate competes with both nitrate and arsenic, but more aggressive with arsenic in anion exchange. Source waters with TDS levels above 500 mg/L or 120 mg/L sulfate are not amenable to IX treatment for arsenic removal. Spent regenerant is produced during IX bed regeneration, and this spent regenerant may have high concentrations of sorbed contaminants which can be expensive to treat and/or dispose. Research has been conducted to minimize this effect; recent research on arsenic removal shows that the brine can be reduced as many as 25 times.

1.4.5.2 Reverse Osmosis

Process – RO is a pressure-driven membrane separation process capable of removing dissolved solutes from water by means of molecule size and electrical charge. The raw water is typically called feed; the product water is called permeate, and the concentrated reject is called concentrate. Common RO membrane materials include asymmetric cellulose acetate and polyamide thin film composite. Common RO membrane configurations include spiral wound hollow fine fiber, but most of RO systems to date are of the spiral wound type. A typical RO installation includes a high pressure feed pump with chemical feed; parallel first and second stage membrane elements in pressure vessels; and valves and piping for feed, permeate, and concentrate streams. Factors influencing membrane selection are cost, recovery, rejection, raw water characteristics, and pretreatment. Factors influencing performance are raw water characteristics, pressure, temperature, and regular monitoring and maintenance. RO is capable of achieving over 97 percent removal of As(V) and 92 percent removal of As(III). The treatment process is relatively insensitive to pH. Water recovery is typically 60-80 percent, depending on the raw water characteristics. The concentrate volume for disposal can be significant.

Pretreatment – RO requires careful review of raw water characteristics and pretreatment needs to prevent membranes from fouling, scaling or other membrane degradation. Removal or sequestering of suspended and colloidal solids is necessary to prevent fouling, and removal of sparingly soluble constituents such as calcium, magnesium, silica, sulfate, barium, etc. may be required to prevent scaling. Pretreatment can include media filters, ion exchange softening, acid and antiscalant feed, activated carbon of bisulfite feed to dechlorinate, and cartridge filters to remove any remaining suspended solids to protect membranes from upsets.

Maintenance – Monitoring rejection percentage is required to ensure contaminant removal below MCL. Regular monitoring of membrane performance is necessary to determine fouling, scaling, or other membrane degradation. Acidic or caustic solutions are regularly flushed through the system at high volume/low pressure with a cleaning agent to remove foulants and scalants. Frequency of membrane replacement is dependent on raw water characteristics, pretreatment, and maintenance. With good operation and pretreatment, membranes can last3 to 5 years.

Waste Disposal – Pretreatment waste streams, concentrate flows, spent filters, and membrane elements all require approved disposal methods.

Advantages (RO)

- Can remove both As(III) and As(V) effectively; and
- Can remove other undesirable dissolved constituents and excessive TDS, if required.

Disadvantages (RO)

- Relatively expensive to install and operate.
- Need sophisticated monitoring systems.
- Need to handle multiple chemicals.
- Waste of water because of the significant concentrate flows
- High silica concentrations (>35 mg/L) may limit water recovery rate
- Concentrate disposal required.

RO is a relatively expensive alternative to remove arsenic and is usually not economically competitive with other processes unless nitrate and/or TDS removal is also required. The biggest drawback for using RO to remove arsenic is the waste of water through concentrate disposal, which is also difficult or expensive because of the large volumes involved.

1.4.5.3 Electrodialysis Reversal

Process. EDR is an electrochemical process in which ions migrate through ion-selective semi-permeable membranes as a result of their attraction to two electrically charged electrodes. A typical EDR system includes a membrane stack with a number of cell pairs, each consisting of a cation transfer membrane, a demineralized flow spacer, an anion transfer membrane, and a concentrate flow spacer. Electrode compartments are at opposite ends of the stack. The influent feed water (chemically treated to prevent precipitation) and the concentrated reject flow in parallel across the membranes and through the demineralized and concentrate flow spaces, respectively. The electrodes are continually flushed to reduce fouling or scaling. Careful consideration of flush feed water is required. Typically, the membranes are cation or anion exchange resins cast in sheet form; the spacers are high density polyethylene; and the electrodes are inert metal. EDR stacks are tank-contained and often staged. Membrane selection is based on review of raw water characteristics. A single-stage EDR system usually removes 40-50 percent of arsenic and TDS. Additional stages are required to achieve higher removal efficiency if necessary. EDR uses the technique of regularly reversing the polarity of the electrodes, thereby freeing accumulated ions on the membrane surface. This process requires additional plumbing and electrical controls, but it increases membrane life, may require less added chemicals, and eases cleaning. The conventional EDR treatment train typically includes EDR membranes, chlorine disinfection, and clearwell storage. Treatment of surface water may also require pretreatment steps such as raw water pumps, debris screens, rapid mix with addition of a coagulant, slow mix flocculator, sedimentation basin or clarifier, and gravity filters. Microfiltration could be used in placement of flocculation, sedimentation and filtration. Additional treatment or management of the concentrate and the removed solids would be necessary prior to disposal.

Pretreatment. There are pretreatment requirements for pH, organics, turbidity, and other raw water characteristics. EDR typically requires chemical feed to prevent scaling, acid addition for pH adjustment, and a cartridge filter for prefiltration. If arsenite [As(III)] occurs, oxidation via pre-chlorination is required since the arsenite specie at pH below 9 has no ionic charge and will not be removed by EDR.

Maintenance. EDR membranes are durable, can tolerate a pH range from 1 to 10, and temperatures to 115 degrees Fahrenheit (ºF) for cleaning. They can be removed from the unit and scrubbed. Solids can be washed off by turning the power to the electrodes off and letting water circulate through the stack. Electrode washes flush out byproducts of electrode reaction. The byproducts are hydrogen, formed in the cathode space, and oxygen and chlorine gas, formed in the anode space. If the chlorine is not removed, toxic chlorine gas may form. Depending on raw water characteristics, the membranes would require regular maintenance or replacement (4 to 6 years). EDR requires reversing the polarity. Flushing at high volume/low pressure continuously is required to clean electrodes. If used, pretreatment filter replacement and backwashing would be required. The EDR stack must be disassembled, mechanically cleaned, and reassembled at regular intervals.

Waste Disposal. Highly concentrated reject flows, electrode cleaning flows, and spent membranes require approved disposal methods. Pretreatment processes and spent materials also require approved disposal methods.

Advantages (EDR)

- EDR can operate with minimal fouling or scaling or chemical addition.
- Low pressure requirements; typically quieter than RO.
- Long membrane life expectancy; EDR extends membrane life and reduces maintenance.
- More flexible than RO in tailoring treated water quality requirements.
- Removes many constituents in addition to arsenic.

Disadvantages (EDR)

- Not suitable for high levels of iron, manganese, and hydrogen sulfide.
- High energy usage at higher TDS water.
- Waste of water because of the significant concentrate flows.
- Generates relatively large saline waste stream requiring disposal.
- Pre-oxidation required for arsenite (if present).

EDR can be quite expensive to run because of the energy it uses. However, because it is generally automated and allows for small systems. It can be used to simultaneously reduce arsenic and TDS.

1.4.5.4 Adsorption

Process – The adsorptive media process is a fixed-bed process by which ions in solution, such as arsenic, are removed by available adsorptive sites on an adsorptive media. When the available adsorptive sites are filled, spent media may be regenerated or simply thrown away and replaced with new media. Granular activated alumina was the first adsorptive media successfully applied for the removal of arsenic from water supplies. More recently, other adsorptive media (mostly iron-based) have been developed and marketed for arsenic removal. Recent USEPA studies demonstrated that iron-based adsorption media typically have much higher arsenic removal capacities compared to alumina-based media. In the USEPA-sponsored Round 1 full-scale demonstration of arsenic removal technologies for small water systems program, the selected arsenic treatment technologies included nine adsorptive media systems, one IX system, one coagulation/filtration system, and one process modification.

The selected adsorptive media systems used four different adsorptive media, including three iron-based media (*e.g.,* ADI's G2, Severn Trent and AdEdge's E33, and U.S. Filter's GFH), and one iron-modified AA media (*e.g.,* Kinetico's AAFS50, a product of Alcan). The G2 media is a dry powder of diatomaceous earth impregnated with a coating of ferric hydroxide, developed by ADI specifically for arsenic adsorption. ADI markets G2 for both As(V) and As(III) removal, but it preferentially removes As(V). G2 media adsorbs arsenic most effectively at pH values within the 5.5 to 7.5 range, and less effectively at a higher pH value.

The Bayoxide E33 media was developed by Bayer AG for removal of arsenic from drinking water supplies. It is a dry granular iron oxide media designed to remove dissolved arsenic via adsorption onto its ferric oxide surface. Severn Trent markets the media in the U.S. for As(III) and As(V) removal as Sorb-33, and offers several arsenic package units (APU) with flowrates ranging from 150 to 300 gpm. Another company, AdEdge, provides similar systems using the same media (marketed as AD-33) with flowrates ranging from 5 to 150 gpm. E33 adsorbs arsenic and other ions, such as antimony, cadmium, chromate, lead, molybdenum, selenium, and vanadium. The adsorption is effective at pH values ranging between 6.0 and 9.0. At greater than 8.0 to 8.5, pH adjustment is recommended to maintain its adsorption capacity. Two competing ions that can reduce the adsorption capacity are silica (at levels greater than 40 mg/L) and phosphate (at levels greater than 1 mg/L).

GFH is a moist granular ferric hydroxide media produced by GFH Wasserchemie GmbH of Germany and marketed by U.S. Filter under an exclusive marketing agreement. GFH is capable of adsorbing both As(V) and As(III). GFH media adsorb arsenic with a pH range of 5.5 to 9.0, but less effectively at the upper end of this range. Competing ions such as silica and phosphate in source water can adsorb onto GFH media, thus reducing the arsenic removal capacity of the media.

The AAFS50 is a dry granular media of 83 percent alumina and a proprietary iron-based additive to enhance the arsenic adsorption performance. Standard AA was the first adsorptive media successfully applied for the removal of arsenic from water supplies. However, it often requires pH adjustment to 5.5 to achieve optimum arsenic removal. The AAFS50 product is modified with an iron-based additive to improve its performance and increase the pH range within which it can achieve effective removal. Optimum arsenic removal efficiency is achieved with a pH of the feed water less than 7.7. Competing ions such as fluoride, sulfate, silica, and phosphate can adsorb onto AAFS50 media, and potentially reduce its arsenic removal capacity. The adsorption capacity of AAFS50 can be impacted by both high levels of silica (>40 mg/L) and phosphate (>1 mg/L). The vendor recommended that the system be operated in a series configuration to minimize the chance for arsenic breakthrough to impact drinking water quality.

All iron-based or iron-modified adsorptive media are of the single use or throwaway type after exhaustion. The operations of these adsorption systems are quite similar and simple. Some of the technologies such as the E33 and GFH media have been operated successfully on large scale plants in Europe for several years.

<u>Pretreatment</u> – The adsorptive media are primarily used to remove dissolved arsenic and not for suspended solids removal. Pretreatment to remove TSS may be required if raw water turbidity is >0.3 NTU. However, most well waters are low in turbidity and hence, pre-filtration

is usually not required. Pre-chlorination may be required to oxidize As(III) to As(V) if the proportion of As(III) is high. No pH adjustment is required unless pH is relatively high.

Maintenance – Maintenance for the adsorption media system is minimal if no pretreatment is required. Backwash is required infrequently (monthly) to remove silt and sediments that occur in source waters and replacement and disposal of the exhausted media occur between 1 to 3 years, depending on average water consumption, the concentrations of arsenic and competing ions in the raw water, the media bed volume and the specific media used.

Waste Disposal – If no pretreatment is required there is minimal waste disposal involved with the adsorptive media system. Disposal of backwash wastewater is required especially during startup. Regular backwash is infrequent, and disposal of the exhausted media occurs once every 1 to 3 years, depending on operating conditions. The exhausted media are usually considered non-hazardous waste.

Advantages (Adsorption)

- Some adsorbents can remove both As(III) and As(V); and
- Very simple to operate.
- Selective to arsenic.
- Long media lives.
- Spent media generally not classified as hazardous.

Disadvantages (Adsorption)

- Relatively new technology; and
- Need replacement of adsorption media when exhausted.

The adsorption media process is the most simple and requires minimal operator attention compared to other arsenic removal processes. The process is most applicable to small wellhead systems with low or moderate arsenic concentrations with no treatment process in place (*e.g.,* iron and manganese removal; if treatment facilities for iron and/or manganese removal are already in place, incorporating ferric chloride coagulation in the existing system would be a more cost-effective alternative for arsenic removal). The choice of media will depend on raw water characteristics, life cycle cost, and experience of the vendor. Many of the adsorption media have been demonstrated at the field-trial stage, while others are in full-scale applications throughout Europe and the U.S. Pilot testing may or may not be necessary prior to implementation depending on the experience of the vendor with similar water characteristics.

1.4.5.5 Coagulation/Filtration and Iron Removal Technologies

Process – Iron oxides have an affinity for arsenic and iron removal processes can be used to removal arsenic from drinking water supplies. The iron filtration can be accomplished with granular media filter or microfilter. For effective arsenic removals, there needs to be a minimum amount of iron present if the source water. When iron in the source water is inadequate, an iron salt such as ferric chloride is added to the water to form ferric hydroxide. The iron removal process is commonly called coagulation/filtration because iron in the form of ferric chloride is a common coagulant. The actual capacity to remove arsenic during iron removal depends on a number of factors, including the amount of arsenic present, arsenic speciation, pH, amount and form of iron present, and existence of competing ions, such as phosphate, silicate, and natural organic matter. The filters used in groundwater treatment are usually pressure filters fed directly by the well pumps. The filter media can be regular dual media filters or proprietary media such as the engineered ceramic filtration media, Macrolite, developed by Kinetico. Macrolite is a low-density, spherical media designed to allow for filtration rates up to 10 gpm/ft^2, which is a higher loading rate than commonly used for conventional filtration media.

Pretreatment – Pre-chlorination to oxidize As(III) to As(V) is usually required for most groundwater sources since As(V) adsorbs to the iron much more strongly than As(III). The adjustment of pH is required only for relatively high pH value. Coagulation with the feed of ferric chloride is required for this process. Sometimes a 5-minute contact tank is required ahead the filters if the pH is high.

Maintenance – Maintenance is mainly to handle ferric chloride chemical and feed system, and for regular backwash of the filters. No filter replacement is required for this process.

Waste Disposal – The waste from the coagulation/filtration process is mainly the iron hydroxide sludge with adsorbed arsenic in the backwash water. The backwash water can be discharged to a public sewer if it is available. If a sewer is not available, the backwash water can be discharged to a storage and settling tank from where the supernatant is recycled in a controlled rate to the front of the treatment system and the settled sludge can be disposed of periodically to a landfill. The iron hydroxide sludge is usually not classified as hazardous waste.

Advantages (Coagulation/Filtration)

- Very established technology for arsenic removal; and
- Most economical process for arsenic removal.

Disadvantages (Coagulation/Filtration)

- Need to handle chemical;
- Need to dispose of regular backwash wastewater; and
- Need to dispose of sludge.

The coagulation/filtration process is usually the most economical arsenic removal alternative, especially if a public sewer is available for accepting the discharge of the backwash water. However, because of the regular filter backwash requirements, more operation and maintenance attention is required from the utilities. Because of potential interference by competing ions bench-scale or pilot scaling testing may be required to ensure that the arsenic MCL can be met with this process alternative.

1.4.6 Point-of-Entry and Point-of-Use Treatment Systems

Point-of-entry (POE) and Point-of-use (POU) treatment devices or systems rely on many of the same treatment technologies used in central treatment plants. However, while central treatment plants treat all water distributed to consumers to the same level, POU and POE treatment devices are designed to treat only a portion of the total flow. POU devices treat only the water intended for direct consumption, typically at a single tap or limited number of taps, while POE treatment devices are typically installed to treat all water entering a single home, business, school, or facility. POU and POE treatment systems may be an option for PWSs where central treatment is not affordable. Updated USEPA guidance on use of POU and POE treatment devices is provided in "*Point-of-Use or Point-of-Entry Treatment Options for Small Drinking Water Systems,*" EPA 815-R-06-010, April 2006 (USEPA 2006).

Point-of-entry and POU treatment systems can be used to provide compliant drinking water. These systems typically use small adsorption or reverse osmosis treatment units installed "under the sink" in the case of POU, and where water enters a house or building in the case of POE. It should be noted that the POU treatment units would need to be more complex than units typically found in commercial retail outlets to meet regulatory requirements, making purchase and installation more expensive. Point-of-entry and POU treatment units would be purchased and owned by the PWS. These solutions are decentralized in nature, and require utility personnel entry into houses or at least onto private property for installation, maintenance, and testing. Due to the large number of treatment units that would be employed and would be largely out of the control of the PWS, it is very difficult to ensure 100 percent compliance. Prior to selection of a POE or POU program for implementation, consultation with TCEQ would be required to address measurement and determination of level of compliance.

The National Primary Drinking Water Regulations (NPDWR), 40 Code of Federal Regulations (CFR) Section 141.100, covers criteria and procedures for PWSs using POE devices and sets limits on the use of these devices. According to the regulations (July 2005 Edition), the PWS must develop and obtain TCEQ approval for a monitoring plan before POE devices are installed for compliance with an MCL. Under the plan, POE devices must provide health protection equivalent to central water treatment meaning the water must meet all NPDWR and would be of acceptable quality similar to water distributed by a well-operated central treatment plant. In addition, monitoring must include physical measurements and observations such as total flow treated and mechanical condition of the treatment equipment. The system would have to track the POE flow for a given time period, such as monthly, and maintain records of device inspection. The monitoring plan should include frequency of monitoring for the contaminant of concern and number of units to be monitored. For instance, the system may propose to monitor every POE device during the first year for the contaminant of concern and then monitor one-third of the units annually, each on a rotating schedule, such that each unit would be monitored every three years. To satisfy the requirement that POE devices must provide health protection, the water system may be required to conduct a pilot study to verify the POE device can provide treatment equivalent to central treatment. Every building connected to the system must have a POE device installed, maintained, and properly monitored. Additionally, TCEQ must be assured that every building is subject to treatment and monitoring, and that the rights and responsibilities of the PWS customer convey with title upon sale of property.

Effective technology for POE devices must be properly applied under the monitoring plan approved by TCEQ and the microbiological safety of the water must be maintained. TCEQ requires adequate certification of performance, field testing, and, if not included in the certification process, a rigorous engineering design review of the POE devices. The design and application of the POE devices must consider the tendency for increase in heterotrophic bacteria concentrations in water treated with activated carbon. It may be necessary to use frequent backwashing, post-contactor disinfection, and Heterotrophic Plate Count monitoring to ensure that the microbiological safety of the water is not compromised.

The SDWA [§1412(b)(4)(E)(ii)] regulates the design, management and operation of POU and POE treatment units used to achieve compliance with an MCL. These restrictions, relevant to MCL compliance are:

- POU and POE treatment units must be owned, controlled, and maintained by the water system, although the utility may hire a contractor to ensure proper operation and maintenance (O&M) and MCL compliance. The water system must retain unit ownership and oversight of unit installation, maintenance and sampling; the utility ultimately is the responsible party for regulatory compliance. The water system staff need not perform all installation, maintenance, or management functions, as these tasks may be contracted to a third party-but the final responsibility for the quality and quantity of the water supplied to the community resides with the water system, and the utility must monitor all contractors closely. Responsibility for O&M of POU or POE devices installed for SDWA compliance may not be delegated to homeowners.
- POU and POE units must have mechanical warning systems to automatically notify customers of operational problems. Each POU or POE treatment device must be equipped with a warning device (e.g., alarm, light) that would alert users when their unit is no longer adequately treating their water. As an alternative, units may be equipped with an automatic shut-off mechanism to meet this requirement.
- If the American National Standards Institute (ANSI) issued product standards for a specific type of POU or POE treatment unit, only those units that have been independently certified according to those standards may be used as part of a compliance strategy.

The following observations with regard to using POE and POU devices for SDWA compliance were made by Raucher, *et al.* (2004):

- If POU devices are used as an SDWA compliance strategy, certain consumer behavioral changes will be necessary (e.g., encouraging people to drink water only from certain treated taps) to ensure comprehensive consumer health protection.
- Although not explicitly prohibited in the SDWA, USEPA indicates that POU treatment devices should not be used to treat for radon or for most volatile organic contaminants (VOC) to achieve compliance, because POU devices do not provide 100 percent protection against inhalation or contact exposure to those contaminants at untreated taps (e.g., shower heads).
- Liability – PWSs considering unconventional treatment options (POU, POE, or bottled water) must address liability issues. These could be meeting drinking water standards, property entry and ensuing liabilities, and damage arising from improper installation or improper function of the POU and POE devices.

1.4.7 Water Delivery or Central Drinking Water Dispensers

Current USEPA regulations 40 CFR 141.101 prohibit the use of bottled water to achieve compliance with an MCL, except on a temporary basis. State regulations do not directly address the use of bottled water. Use of bottled water at a non-compliant PWS would be on a temporary basis. Every 3 years, the PWSs that employ interim measures are required to present the TCEQ with estimates of costs for piping compliant water to their systems. As long as the projected costs remain prohibitively high, the bottled water interim measure is extended. Until USEPA amends the noted regulation, the TCEQ is unable to accept water delivery or central drinking water dispensers as compliance solutions.

Central provision of compliant drinking water would consist of having one or more dispensers of compliant water where customers could come to fill containers with drinking water. The centralized water source could be from small to medium-sized treatment units or could be compliant water delivered to the central point by truck.

Water delivery is an interim measure for providing compliant water. As an interim measure for a small impacted population, providing delivered drinking water may be cost effective. If the susceptible population is large, the cost of water delivery would increase significantly.

- Water delivery programs require consumer participation to a varying degree. Ideally, consumers would have to do no more than they currently do for a piped-water delivery system. Least desirable are those systems that require maximum effort on the part of the customer (*e.g.,* customer has to travel to get the water, transport the water, and physically handle the bottles).

SECTION 2
EVALUATION METHOD

2.1 DECISION TREE

The decision tree is a flow chart for conducting feasibility studies for a non-compliant PWS. The decision tree is shown in Figures 2.1 through 2.4. The tree guides the user through a series of phases in the design process. Figure 2.1 shows Tree 1, which outlines the process for defining the existing system parameters, followed by optimizing the existing treatment system operation. If optimizing the existing system does not correct the deficiency, the tree leads to six alternative preliminary branches for investigation. The groundwater branch leads through investigating existing wells to developing a new well field. The treatment alternatives address centralized and on-site treatment. The objective of this phase is to develop conceptual designs and cost estimates for the six types of alternatives. The work done for this report follows through Tree 1 and Tree 2, as well as a preliminary pass through Tree 4.

Tree 3, which begins at the conclusion of the work for this report, starts with a comparison of the conceptual designs, selecting the two or three alternatives that appear to be most promising, and eliminating those alternatives that are obviously infeasible. It is envisaged that a process similar to this would be used by the study PWS to refine the list of viable alternatives. The selected alternatives are then subjected to intensive investigation, and highlighted by an investigation into the socio-political aspects of implementation. Designs are further refined and compared, resulting in the selection of a preferred alternative. The steps for assessing the financial and economic aspects of the alternatives (one of the steps in Tree 3) are given in Tree 4 in Figure 2.4.

2.2 DATA SOURCES AND DATA COLLECTION

2.2.1 Data Search

2.2.1.1 Water Supply Systems

The TCEQ maintains a set of files on public water systems, utilities, and districts at its headquarters in Austin, Texas. The files are organized under two identifiers: a PWS identification number and a CCN number. The PWS identification number is used to retrieve four types of files:

- CO – Correspondence,
- CA – Chemical analysis,
- MOR – Monthly operating reports (quality/quantity), and
- FMT – Financial, managerial and technical issues.

Figure 2.1

TREE 1 – EXISTING FACILITY ANALYSIS

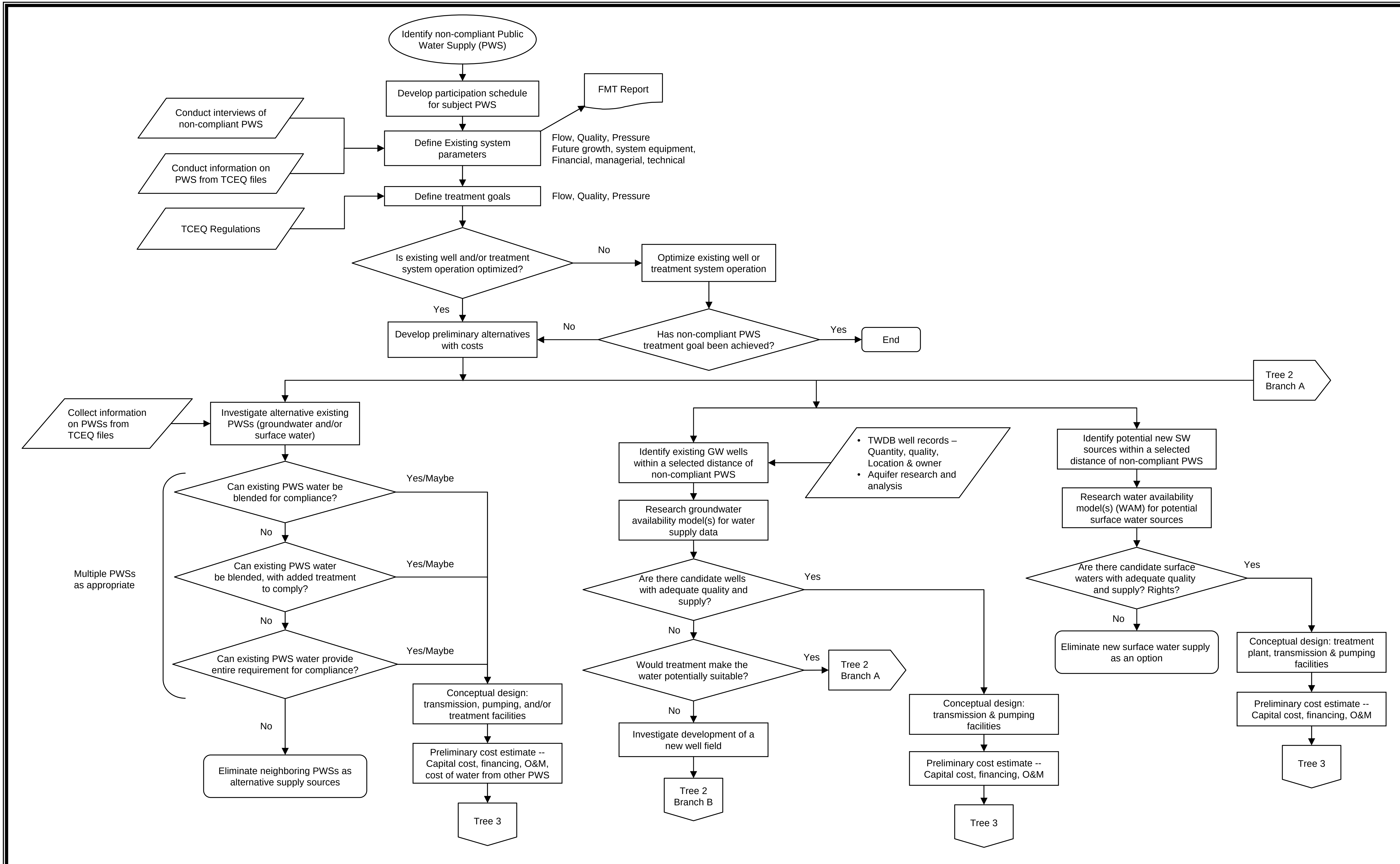


Figure 2.2
TREE 2 – DEVELOP TREATMENT ALTERNATIVES

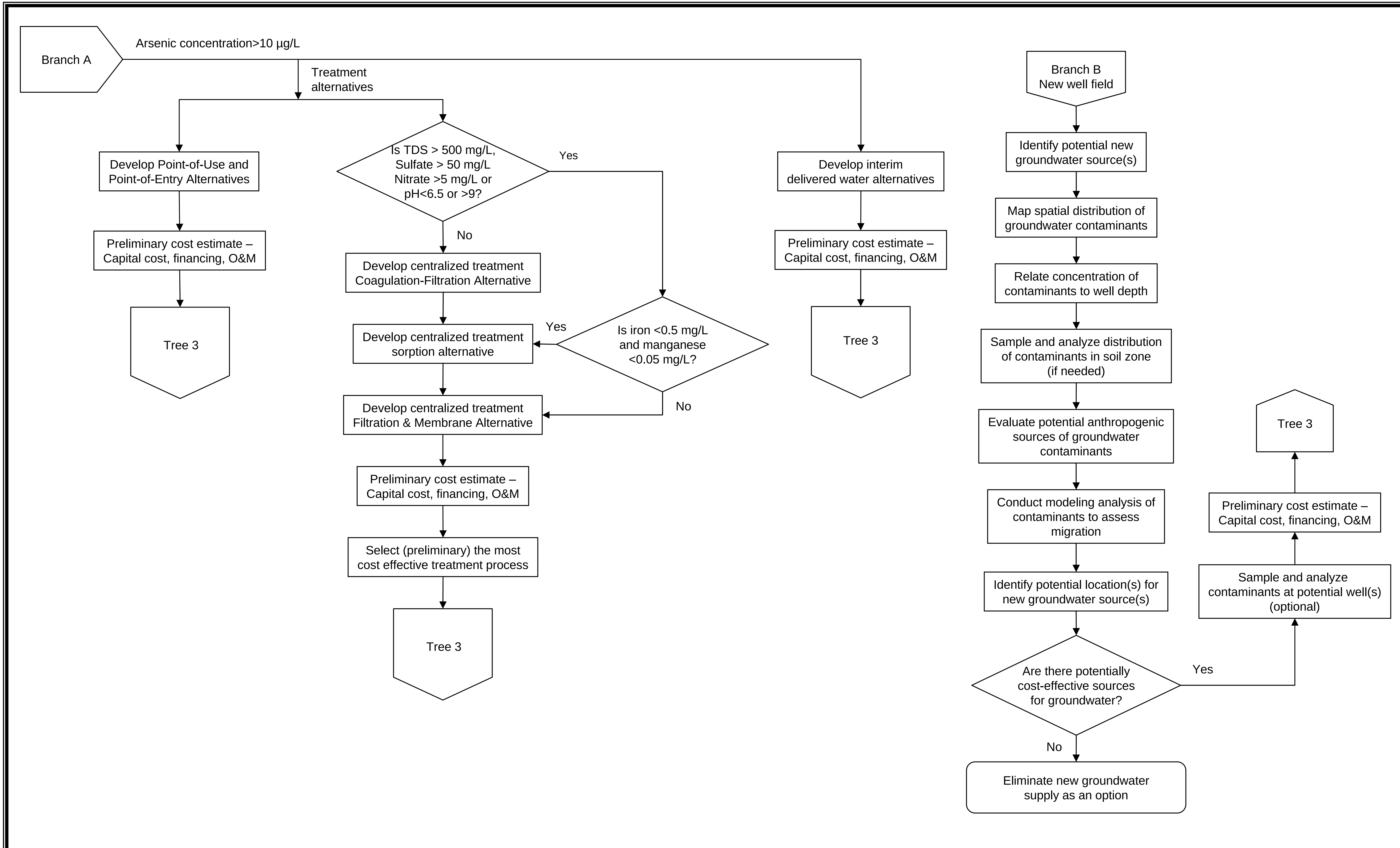


Figure 2.3
Tree 3 – PRELIMINARY ANALYSIS

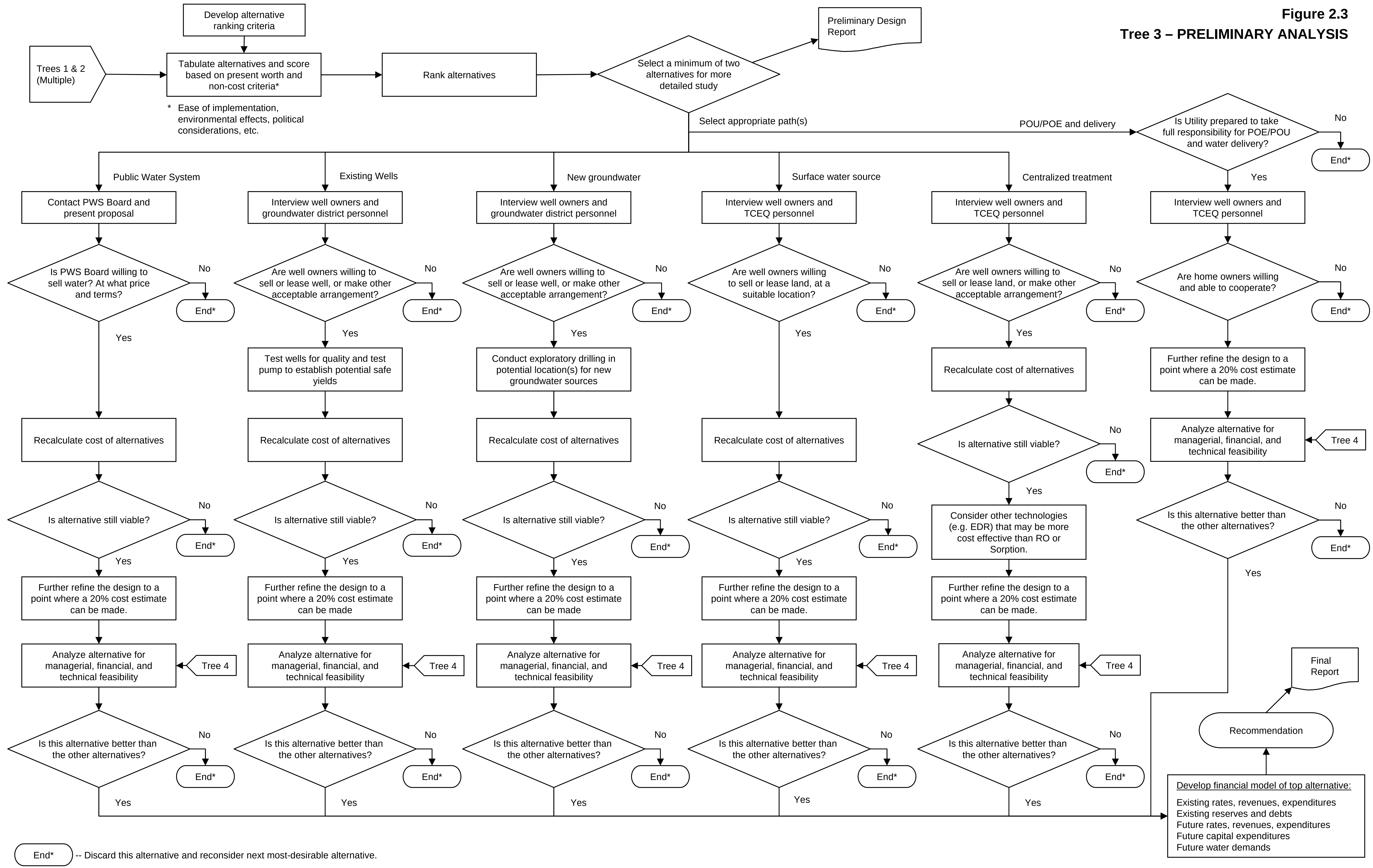
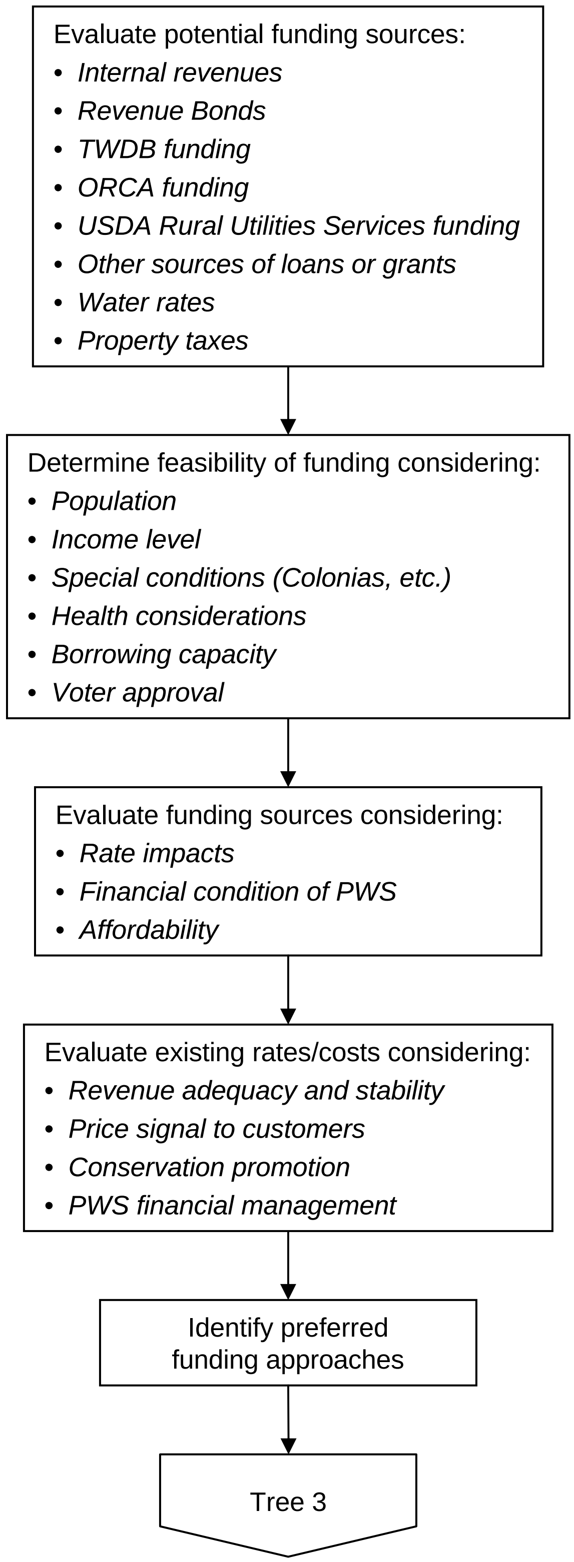


Figure 2.4
TREE 4 – FINANCIAL



The CCN files generally contain a copy of the system's Certificate of Convenience and Necessity, along with maps and other technical data.

These files were reviewed for the PWS and surrounding systems.

The following websites were consulted to identify the water supply systems in the area:

- Texas Commission on Environmental Quality
  www3.tceq.state.tx.us/iwud/.
- USEPA Safe Drinking Water Information System
  www.epa.gov/safewater/data/getdata.html

Groundwater Control Districts were identified on the TWDB web site, which has a series of maps covering various groundwater and surface water subjects. One of those maps shows groundwater control districts in the State of Texas.

2.2.1.2 Existing Wells

The TWDB maintains a groundwater database available at www.twdb.state.tx.us that has two tables with helpful information. The "Well Data Table" provides a physical description of the well, owner, location in terms of latitude and longitude, current use, and for some wells, items such as flowrate, and nature of the surrounding formation. The "Water Quality Table" provides information on the aquifer and the various chemical concentrations in the water.

2.2.1.3 Surface Water Sources

Regional planning documents were consulted for lists of surface water sources.

2.2.1.4 Groundwater Availability Model

GAMs, developed by the TWDB, are planning tools and should be consulted as part of a search for new or supplementary water sources. The GAM for the southern section of the Gulf Coast Aquifer was investigated as a potential tool for identifying available and suitable groundwater resources.

2.2.1.5 Water Availability Model

The WAM is a computer-based simulation predicting the amount of water that would be in a river or stream under a specified set of conditions. WAMs are used to determine whether water would be available for a newly requested water right or amendment. If water is available, these models estimate how often the applicant could count on water under various conditions (*e.g.*, whether water would be available only one month out of the year, half the year, or all year, and whether that water would be available in a repeat of the drought of record).

WAMs provide information that assist TCEQ staff in determining whether to recommend the granting or denial of an application.

2.2.1.6 Financial Data

An evaluation of existing data will yield an up-to-date assessment of the financial condition of the water system. As part of a site visit, financial data were collected in various forms such as electronic files, hard copy documents, and focused interviews. Data sought included:

- Annual Budget
- Audited Financial Statements
  - Balance Sheet
  - Income & Expense Statement
  - Cash Flow Statement
  - Debt Schedule
- Water Rate Structure
- Water Use Data
  - Production
  - Billing
  - Customer Counts

2.2.1.7 Demographic Data

Basic demographic data were collected from the 2000 Census to establish incomes and eligibility for potential low cost funding for capital improvements. Median household income (MHI) and number of families below poverty level were the primary data points of significance. If available, MHI for the customers of the PWS should be used. In addition, unemployment data were collected from current U.S. Bureau of Labor Statistics. These data were collected for the following levels: national, state, and county.

2.2.2 PWS Interviews

2.2.2.1 PWS Capacity Assessment Process

Capacity assessment is the industry standard term for evaluation of a water system's FMT capacity to effectively deliver safe drinking water to its customers now and in the future at a reasonable cost, and to achieve, maintain and plan for compliance with applicable regulations. The assessment process involves interviews with staff and management who have a responsibility in the operations and management of the system.

Financial, managerial, and technical capacity are individual yet highly interrelated components of a system's capacity. A system cannot sustain capacity without maintaining adequate capability in all three components.

Financial capacity is a water system's ability to acquire and manage sufficient financial resources to allow the system to achieve and maintain compliance with SDWA regulations. Financial capacity refers to the financial resources of the water system, including but not limited to, revenue sufficiency, credit worthiness, and fiscal controls.

Managerial capacity is the ability of a water system to conduct its affairs so the system is able to achieve and maintain compliance with SDWA requirements. Managerial capacity refers to the management structure of the water system, including but not limited to, ownership accountability, staffing and organization, and effective relationships with customers and regulatory agencies.

Technical capacity is the physical and operational ability of a water system to achieve and maintain compliance with SDWA regulations. It refers to the physical infrastructure of the water system, including the adequacy of the source water, treatment, storage and distribution infrastructure. It also refers to the ability of system personnel to effectively operate and maintain the system and to otherwise implement essential technical knowledge.

Many aspects of water system operations involve more than one component of capacity. Infrastructure replacement or improvement, for example, requires financial resources, management planning and oversight, and technical knowledge. A deficiency in any one area could disrupt the entire operation. A system that is able to meet both its immediate and long-term challenges demonstrates that it has sufficient FMT capacity.

Assessment of FMT capacity of the PWS was based on an approach developed by the New Mexico Environmental Finance Center (NMEFC), which is consistent with the TCEQ FMT assessment process. This method was developed from work the NMEFC did while assisting USEPA Region 6 in developing and piloting groundwater comprehensive performance evaluations. The NMEFC developed a standard list of questions that could be asked of water system personnel. The list was then tailored slightly to have two sets of questions – one for managerial and financial personnel, and one for operations personnel (the questions are included in Appendix A). Each person with a role in the FMT capacity of the system was asked the applicable standard set of questions individually. The interviewees were not given the questions in advance and were not told the answers others provided. Also, most of the questions are open ended type questions so they were not asked in a fashion to indicate what would be the "right" or "wrong" answer. The interviews lasted between 45 minutes to 75 minutes depending on the individual's role in the system and the length of the individual's answers.

In addition to the interview process, visual observations of the physical components of the system were made. A technical information form was created to capture this information. This form is also contained in Appendix A. This information was considered supplemental to the interviews because it served as a check on information provided in the interviews. For example, if an interviewee stated he or she had an excellent preventative maintenance schedule and the visit to the facility indicated a significant amount of deterioration (more than would be expected for the age of the facility) then the preventative maintenance program could be further investigated or the assessor could decide that the preventative maintenance program was inadequate.

Following interviews and observations of the facility, answers that all personnel provided were compared and contrasted to provide a clearer picture of the true operations at the water system. The intent was to go beyond simply asking the question, "Do you have a budget?" to actually finding out if the budget was developed and being used appropriately. For example, if a water system manager was asked the question, "Do you have a budget?" he or she may say, "yes" and the capacity assessor would be left with the impression that the system is doing well in this area. However, if several different people are asked about the budget in more detail, the assessor may find that although a budget is present, operations personnel do not have input into the budget, the budget is not used by the financial personnel, the budget is not updated regularly, or the budget is not used in setting or evaluating rates. With this approach, the inadequacy of the budget would be discovered and the capacity deficiency in this area would be noted.

Following the comparison of answers, the next step was to determine which items noted as a potential deficiency truly had a negative effect on the system's operations. If a system had what appeared to be a deficiency, but this deficiency was not creating a problem in terms of the operations or management of the system, it was not considered critical and may not have needed to be addressed as a high priority. As an example, the assessment may have revealed an insufficient number of staff members to operate the facility. However, it may also have been revealed that the system was able to work around that problem by receiving assistance from a neighboring system, so no severe problems resulted from the number of staff members. Although staffing may not be ideal, the system does not need to focus on this particular issue. The system needs to focus on items that are truly affecting operations. As an example of this type of deficiency, a system may lack a reserve account which can then lead the system to delay much-needed maintenance or repair on its storage tank. In this case, the system needs to address the reserve account issue so that proper maintenance can be completed.

The intent was to develop a list of capacity deficiencies with the greatest impact on the system's overall capacity. Those were the most critical items to address through follow-up technical assistance or by the system itself.

2.2.2.2 Interview Process

PWS personnel were interviewed by the project team, and each was interviewed separately. Interview forms were completed during each interview.

2.3 ALTERNATIVE DEVELOPMENT AND ANALYSIS

The initial objective for developing alternatives to address compliance issues is to identify a comprehensive range of possible options that can be evaluated to determine the most promising for implementation. Once the possible alternatives are identified, they must be defined in sufficient detail so a conceptual cost estimate (capital and O&M costs) can be developed. These conceptual cost estimates are used to compare the affordability of compliance alternatives, and to give a preliminary indication of rate impacts. Consequently, these costs are pre-planning level and should not be viewed as final estimated costs for alternative implementation. The basis for the unit costs used for the compliance alternative cost estimates is summarized in Appendix B. Other non-economic factors for the alternatives, such as reliability and ease of implementation, are also addressed

2.3.1 Existing PWS

The neighboring PWSs were identified, and the extents of their systems were investigated. PWSs farther than 30 miles from the non-compliant PWSs were not considered because the length of the pipeline required would make the alternative cost prohibitive. The quality of water provided was also investigated. For neighboring PWSs with compliant water, options for water purchase and/or expansion of existing well fields were considered. The neighboring PWSs with non-compliant water were considered as possible partners in sharing the cost for obtaining compliant water either through treatment or developing an alternate source.

The neighboring PWSs were investigated to get an idea of the water sources in use and the quantity of water that might be available for sale. They were contacted to identify key locations in their systems where a connection might be made to obtain water, and to explore on a preliminary basis their willingness to partner or sell water. Then, the major system components that would be required to provide compliant water were identified. The major system components included treatment units, wells, storage tanks, pump stations, and pipelines.

Once the major components were identified, a preliminary design was developed to identify sizing requirements and routings. A capital cost estimate was then developed based on the preliminary design of the required system components. An annual O&M cost was also estimated to reflect the change in O&M expenditures that would be needed if the alternative was implemented.

Non-economic factors were also identified. Ease of implementation was considered, as well as the reliability for providing adequate quantities of compliant water. Additional factors were whether implementation of an alternative would require significant increase in the management or technical capability of the PWS, and whether the alternative had the potential for regionalization.

2.3.2 New Groundwater Source

It was not possible in the scope of this project to determine conclusively whether new wells could be installed to provide compliant drinking water. To evaluate potential new groundwater source alternatives, three test cases were developed based on distance from the PWS intake point. The test cases were based on distances of 10 miles, 5 miles, and 1 mile. It was assumed that a pipeline would be required for all three test cases, and a storage tank and pump station would be required for the 10-mile and 5-mile alternatives. It was also assumed that new wells would be installed, and that their depths would be similar to the depths of the existing wells, or other existing drinking water wells in the area.

A preliminary design was developed to identify sizing requirements for the required system components. A capital cost estimate was then developed based on the preliminary design of the required system components. An annual O&M cost was also estimated to reflect the change (*i.e*., from current expenditures) in O&M expenditures that would be needed if the alternative was implemented.

Non-economic factors were also identified. Ease of implementation was considered, as well as the reliability for providing adequate quantities of compliant water. Additional factors were whether implementation of an alternative would require significant increase in the management or technical capability of the PWS, and whether the alternative had the potential for regionalization.

2.3.3 New Surface Water Source

New surface water sources were investigated. Availability of adequate quality water was investigated for the main rivers in the area, as well as the major reservoirs. TCEQ WAMs were inspected, and the WAM was run, where appropriate.

2.3.4 Treatment

Treatment technologies considered potentially applicable to arsenic removal are IX, RO, EDR, adsorption, and coagulation/filtration. However, because of the high TDS in the well water (>1,000 mg/L), IX is not economically feasible. RO and EDR have the advantage of reducing TDS which is greater than the state secondary MCL of 1,000 mg/L. Adsorption and coagulation/filtration processes remove arsenic only without significantly affecting TDS. RO treatment is considered for central treatment alternatives, as well as POU and POE alternatives. EDR, adsorption, and coagulation/filtration are considered for central treatment alternatives only. Both RO and EDR treatments produce a liquid waste: a reject stream from RO treatment and a concentrate stream from EDR treatment. As a result, the treated volume of water is less than the volume of raw water that enters the treatment system. The amount of raw water used increases to produce the same amount of treated water if RO or EDR treatment is implemented. Partial treatment and blending treated and untreated water to meet the arsenic MCL would reduce the amount of raw water used. RO has an advantage over EDR in that RO will remove As(III) without pre-oxidation. Since the arsenic speciation is not known at this time [As(III) or As(IV)] EDR is not considered further. Adsorption and coagulation filtration treatments produce periodic backwash wastewater for disposal. The treatment units were sized based on flow rates, and capital and annual O&M cost estimates were made based on the size of the treatment equipment required. Neighboring non-compliant PWSs were identified to look for opportunities where the costs and benefits of central treatment could be shared between systems.

Non-economic factors were also identified. Ease of implementation was considered, as well as the reliability for providing adequate quantities of compliant water. Additional factors were whether implementation of an alternative would require significant increases in the management or technical capability of the PWS, and whether the alternative had the potential for regionalization.

2.4 COST OF SERVICE AND FUNDING ANALYSIS

The primary purpose of the cost of service and funding analysis is to determine the financial impact of implementing compliance alternatives, primarily by examining the required rate increases, and also the fraction of household income that water bills represent. The current financial situation is also reviewed to determine what rate increases are necessary for the PWS to achieve or maintain financial viability.

2.4.1 Financial Feasibility

A key financial metric is the comparison of an average annual household water bill for a PWS customer to the MHI for the area. MHI data from the 2000 census are used at the most detailed level available for the community. Typically, county level data are used for small rural water utilities due to small population sizes. Annual water bills are determined for existing base conditions, including consideration of additional rate increases needed under current conditions. Annual water bills are also calculated after adding incremental capital and operating costs for each of the alternatives to determine feasibility under several potential funding sources. It has been suggested by agencies such as USEPA that federal and state programs consider several criteria to determine "disadvantaged communities" with one based on the typical residential water bill as a percentage of MHI.

Additionally, the use of standard ratios provides insight into the financial condition of any business. Three ratios are particularly significant for water utilities:

- Current Ratio = current assets (items that could be converted to cash) divided by current liabilities (accounts payable, accrued expenses, and debt) provides insight into the ability to meet short-term payments. For a healthy utility, the value should be greater than 1.0.
- Debt to Net Worth Ratio = total debt (total amount of money borrowed) divided by net worth (total assets minus total liabilities) shows to what degree assets of the company have been funded through borrowing. A lower ratio indicates a healthier condition.
- Operating Ratio = total operating revenues divided by total operating expenses show the degree to which revenues cover ongoing expenses. The value is greater than 1.0 if the utility is covering its expenses.

2.4.2 Median Household Income

The 2000 U.S. Census is used as the basis for MHI. In addition to consideration of affordability, the annual MHI may also be an important factor for sources of funds for capital programs needed to resolve water quality issues. Many grant and loan programs are available to lower income rural areas, based on comparisons of local income to statewide incomes. In the 2000 Census, MHI for the State of Texas was $39,927, compared to the U.S. level of $41,994. The census broke down MHIs geographically by block group and ZIP code. The MHIs can vary significantly for the same location, depending on the geographic subdivision chosen. The MHI for each PWS was estimated by selecting the most appropriate value based on block group or ZIP code based on results of the site interview and a comparison with the surrounding area.

2.4.3 Annual Average Water Bill

The annual average household water bill was calculated for existing conditions and for future conditions incorporating the alternative solutions. Average residential consumption is estimated and applied to the existing rate structure to estimate the annual water bill. The estimates are generated from a long-term financial planning model that details annual revenue, expenditure, and cash reserve requirements over a 30-year period.

2.4.4 Financial Plan Development

The financial planning model uses available data to establish base conditions under which the system operates. The model includes, as available:

- Accounts and consumption data
- Water tariff structure
- Beginning available cash balance
- Sources of receipts:
    - Customer billings
    - Membership fees
    - Capital Funding receipts from:
        - Grants
        - Proceeds from borrowing
- Operating expenditures:
    - Water purchases
    - Utilities
    - Administrative costs
    - Salaries
- Capital expenditures
- Debt service:
    - Existing principal and interest payments
    - Future principal and interest necessary to fund viable operations
- Net cash flow
- Restricted or desired cash balances:

- Working capital reserve (based on 1-4 months of operating expenses)
- Replacement reserves to provide funding for planned and unplanned repairs and replacements

From the model, changes in water rates are determined for existing conditions and for implementing the compliance alternatives.

2.4.5 Financial Plan Results

Results from the financial planning model are summarized in two areas: percentage of household income and total water rate increase necessary to implement the alternatives and maintain financial viability.

2.4.5.1 Funding Options

Results are summarized in a table that shows the following according to alternative and funding source:

- Percentage of the median annual household income the average annual residential water bill represents.
- The first year in which a water rate increase would be required
- The total increase in water rates required, compared to current rates

Water rates resulting from the incremental capital costs of the alternative solutions are examined under a number of funding options. The first alternative examined is always funding from existing reserves plus future rate increases. Several funding options were analyzed to frame a range of possible outcomes.

- Grant funds for 100 percent of required capital. In this case, the PWS is only responsible for the associated O&M costs.
- Grant funds for 75 percent of required capital, with the balance treated as if revenue bond funded.
- Grant funds for 50 percent of required capital, with the balance treated as if revenue bond funded.
- State revolving fund loan at the most favorable available rates and terms applicable to the communities.
- If local MHI > 75 percent of state MHI, standard terms, currently at 3.8 percent interest for non-rated entities. Additionally:
    - If local MHI = 70-75 percent of state MHI, 1 percent interest rate on loan.
    - If local MHI = 60-70 percent of state MHI, 0 percent interest rate on loan.
    - If local MHI = 50-60 percent of state MHI, 0 percent interest and 15 percent forgiveness of principal.

- If local MHI less than 50 percent of state MHI, 0 percent interest and 35 percent forgiveness of principal.

- Terms of revenue bonds assumed to be 25-year term at 6.0 percent interest rate.

2.4.5.2 General Assumptions Embodied in Financial Plan Results

The basis used to project future financial performance for the financial plan model includes:

- No account growth (either positive or negative).
- No change in estimate of uncollectible revenues over time.
- Average consumption per account unchanged over time.
- No change in unaccounted for water as percentage of total (more efficient water use would lower total water requirements and costs).
- No inflation included in the analyses (although the model has provisions to add escalation of O&M costs, doing so would mix water rate impacts from inflation with the impacts from the alternatives being examined).
- Minimum working capital fund established for each district, based on specified months of O&M expenditures.
- O&M for alternatives begins 1 year after capital implementation.
- Balance of capital expenditures not funded from primary grant program is funded through debt (bond equivalent).
- Cash balance drives rate increases, unless provision chosen to override where current net cash flow is positive.

2.4.5.3 Interpretation of Financial Plan Results

Results from the financial plan model are presented in a Table 4.4 which shows the percentage of MHI represented by the annual water bill that results from any rate increases necessary to maintain financial viability over time. In some cases, this may require rate increases even without implementing a compliance alternative (the no action alternative). The table shows any increases such as these separately. The results table shows the total increase in rates necessary, including both the no-action alternative increase and any increase required for the alternative. For example, if the no action alternative requires a 10 percent increase in rates and the results table shows a rate increase of 25 percent, then the impact from the alternative is an increase in water rates of 15 percent. Likewise, the percentage of household income in the table reflects the total impact from all rate increases.

2.4.5.4 Potential Funding Sources

A number of potential funding sources exist for Water Supply Corporations, which typically provide service to less than 50,000 people. Both state and federal agencies offer grant and loan programs to assist rural communities in meeting their infrastructure needs. Most are available to "political subdivisions" such as counties, municipalities, school districts, special districts, or authorities of the state with some programs providing access to private individuals. Grant funds are made more available with demonstration of economic stress, typically indicated with MHI below 80 percent that of the state. The funds may be used for planning, design, and construction of water supply construction projects including, but not limited to, line extensions, elevated storage, purchase of well fields, and purchase or lease of rights to produce groundwater. Interim financing of water projects and water quality enhancement projects such as wastewater collection and treatment projects are also eligible. Some funds are used to enable a rural water utility to obtain water or wastewater service supplied by a larger utility or to finance the consolidation or regionalization of neighboring utilities. Three Texas agencies that offer financial assistance for water infrastructure are:

- Texas Water Development Board has several programs that offer loans at interest rates lower than the market offers to finance projects for public drinking water systems that facilitate compliance with primary drinking water regulations. Additional subsidies may be available for disadvantaged communities. Low interest rate loans with short and long-term finance options at tax exempt rates for water or water-related projects give an added benefit by making construction purchases qualify for a sales tax exemption. Generally, the program targets customers with eligible water supply projects for all political subdivisions of the state (at tax exempt rates) and Water Supply Corporations (at taxable rates) with projects.
- Office of Rural Community Affairs (ORCA) is a Texas state agency with a focus on rural Texas by making state and federal resources accessible to rural communities. Funds from the U.S. Department of Housing and Urban Development Community Development Block Grants (CDBG) are administered by ORCA for small, rural communities with populations less than 50,000 that cannot directly receive federal grants. These communities are known as non-entitlement areas. One of the program objectives is to meet a need having a particular urgency, which represents an immediate threat to the health and safety of residents, principally for low- and moderate-income persons.
- U.S. Department of Agriculture Rural Development Texas (Texas Rural Development) coordinates federal assistance to rural Texas to help rural Americans improve their quality of life. The Rural Utilities Service (RUS) programs provide funding for water and wastewater disposal systems.
- The application process, eligibility requirements, and funding structure vary for each of these programs. There are many conditions that must be considered by each agency to determine eligibility and ranking of projects. The principal factors that affect this choice are population, percent of the population under the state MHI, health concerns, compliance with standards, Colonia status, and compatibility with regional and state plans.

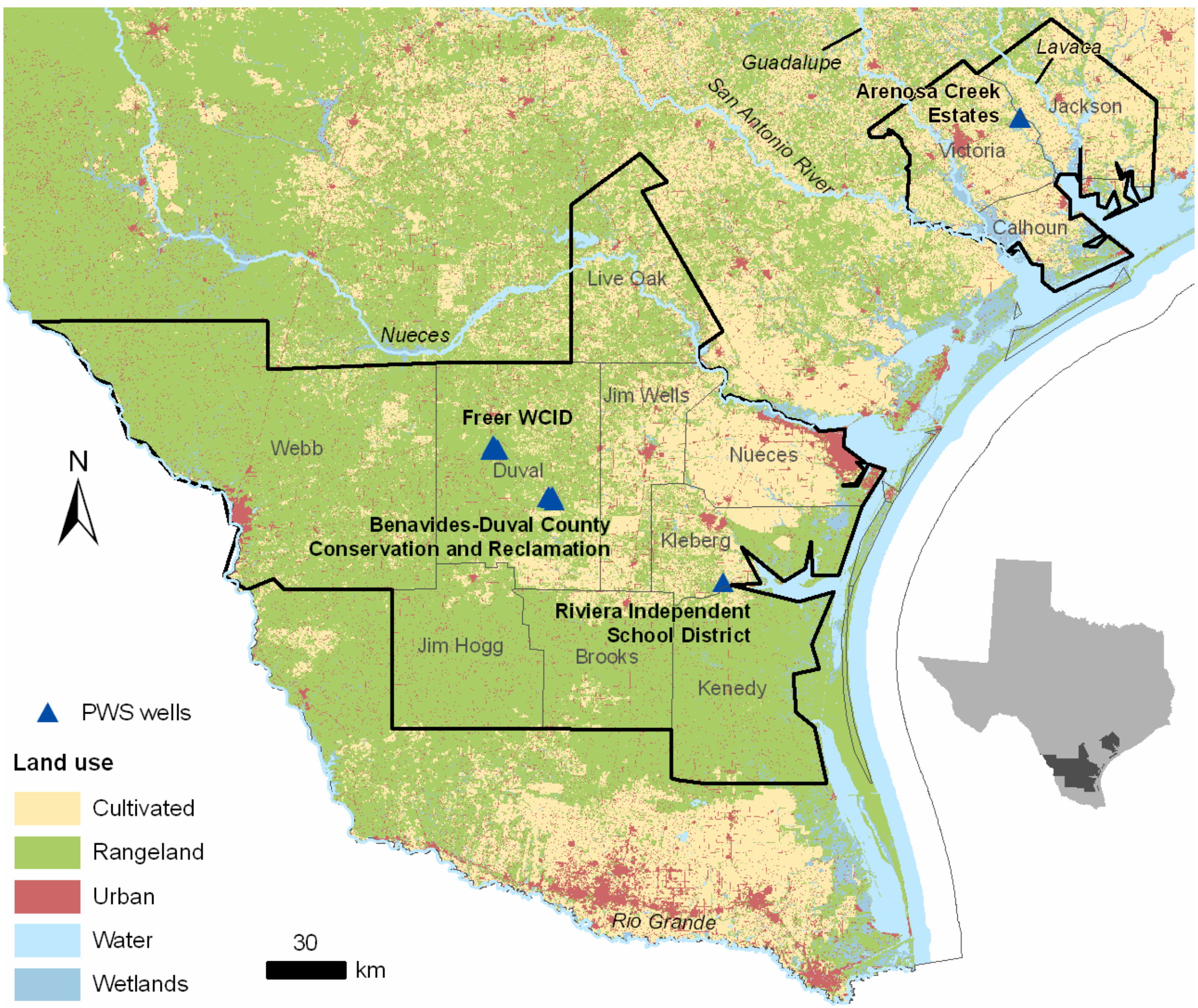
SECTION 3
UNDERSTANDING SOURCES OF CONTAMINANTS

3.1 REGIONAL ANALYSIS

3.1.1 Overview of the Study Area

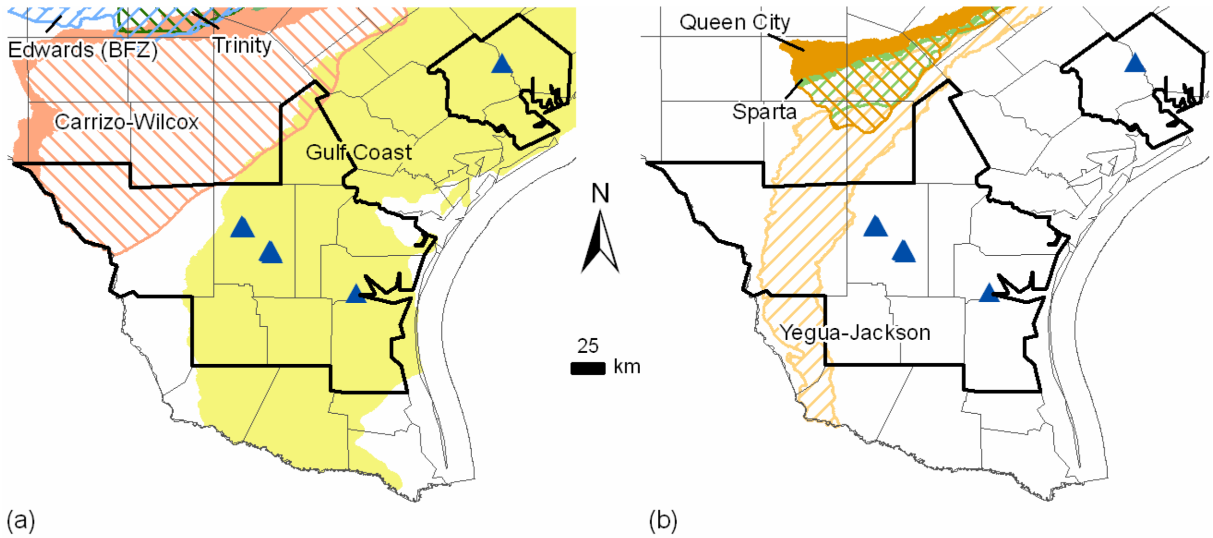
The regional overview below includes data from 12 counties in southeastern Texas, along the coast of the Gulf of Mexico: Brooks, Calhoun, Duval, Jackson, Jim Hogg, Jim Wells, Kenedy, Kleberg, Live Oak, Nueces, Victoria, and Webb (Figure 3.1). Land uses shown here are based on the National Land Cover Database for 2001 (U.S. Department of Agriculture Service Center Agencies 2007).

Figure 3.1 Regional Study Area and Locations of the PWS Wells Assessed



Major and minor aquifers found in this region are shown in Figure 3.2. All PWS wells of concern were drilled within the Gulf Coast aquifer system, which consists of a number of distinct aquifers and is described in more detail below. From oldest to youngest, and from northwest to southeast, these aquifers are known as the Jasper, Evangeline, and Chicot. In addition, the Carrizo-Wilcox and Yegua-Jackson aquifers are present in the western part of the study area. Other aquifers that are near, but not within, the study area include the Edwards (Balcones Fault Zone), Queen City, Sparta, and Trinity aquifers.

Figure 3.2 Major (a) and Minor (b) Aquifers in the Study Area



Solid indicates a portion of an aquifer that lies at the land surface. Hatched indicates a portion of an aquifer that underlies other formations.

Data used for this study include information from three sources:

- Texas Water Development Board groundwater database available at www.twdb.state.tx.us. The database includes information on the location and construction of wells throughout the state as well as historical measurements of water chemistry and levels in the wells.
- Texas Commission on Environmental Quality Public Water Supply database (not publicly available). The database includes information on the location, type, and construction of water sources used by PWSs in Texas, along with historical measurements of water levels and chemistry.
- National Uranium Resource Evaluation (NURE) database available at: tin.er.usgs.gov/nure/water. The NURE dataset includes groundwater quality data collected between 1975 and 1980. The database provides well locations and depths with an array of analyzed chemical data.

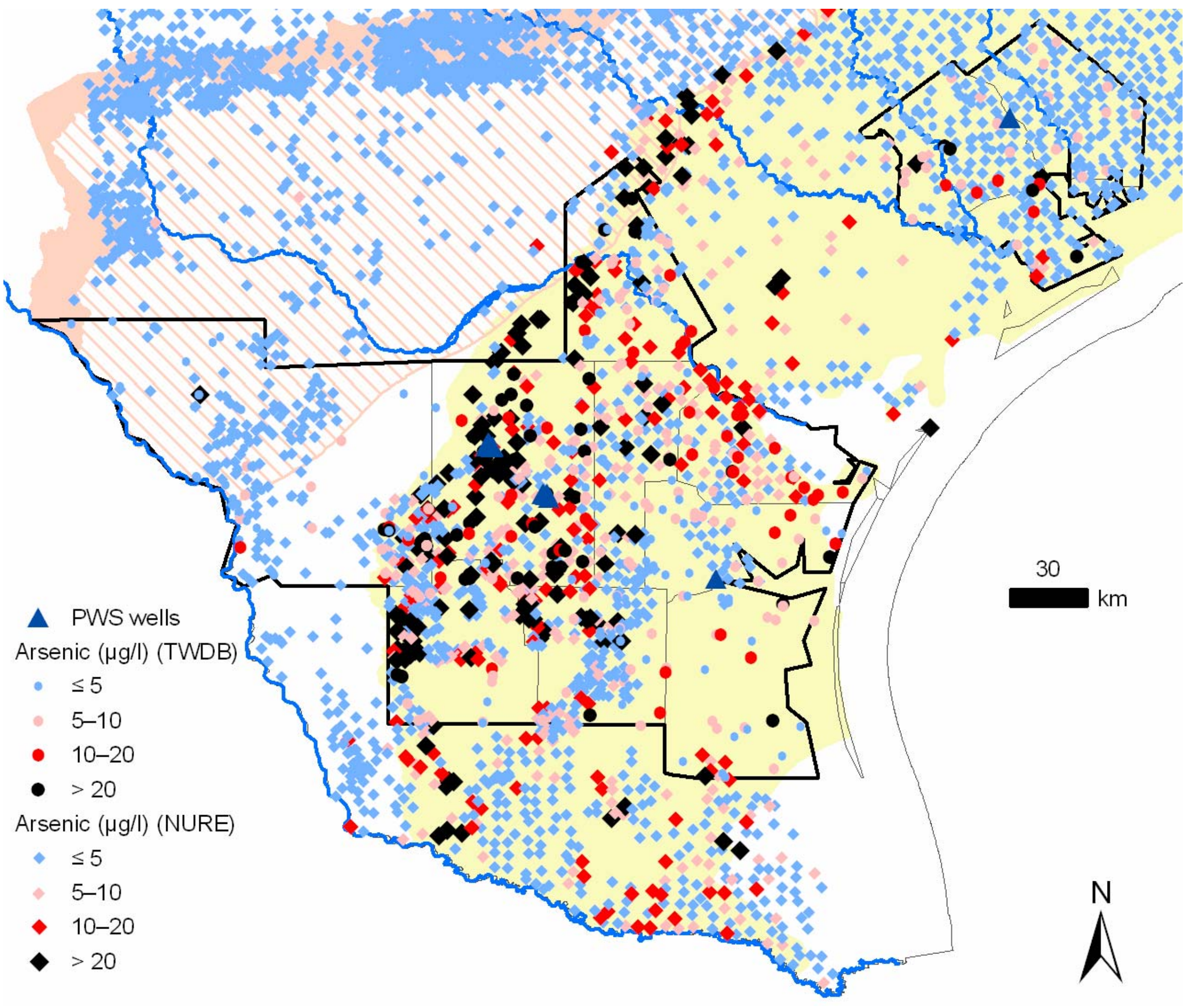
3.1.2 Contaminants of Concern in the Study Area

Contaminants addressed in this study include arsenic, combined radium, gross alpha, and uranium. Groundwater supplies from PWSs in the study area assessed in Section 2 have been found to contain levels of one or more of these contaminants in excess of the USEPA's MCL. The database or databases used to assess each constituent are those with the most available measurements. For individual wells sampled for a given constituent multiple times, the most recent measurement is shown.

Arsenic

Arsenic levels exceed the MCL (10 µg/L) in many wells drilled within the Gulf Coast aquifer system (Figure 3.3). The values shown in these figures are based on the most recent sample for each well. In particular, these maps show many wells with high arsenic concentrations along the western, updip area of the aquifer system.

Figure 3.3 Spatial Distribution of Arsenic Concentrations



The distribution of arsenic within the study area can be further described by looking at the number of wells in each aquifer that exceeds the MCL (Table 3.1). Arsenic concentrations are distinctively higher in the Jasper aquifer, where 62 percent of the wells exceed the MCL for arsenic, than in the rest of the Gulf Coast aquifer system, where 13–24 percent of wells exceed the MCL. Because the units in the aquifer system become progressively older from southeast to northwest, many of the high arsenic wells along the northwest edge of the aquifer likely belong to the Jasper aquifer, the oldest aquifer in the system. All wells in the Carrizo-Wilcox and Yegua-Jackson aquifers contain acceptable levels of arsenic.

The data in Table 3.1 were obtained from the TWDB groundwater database (samples from the NURE database were not included because the database does not associate sampled wells with aquifers). TWDB aquifer codes used to define the aquifers within the Gulf Coast aquifer system include

- Chicot Aquifer: Codes 110AVLS, 112BMLG, 112BMLS, 112BMNT, 112CHCT, 112CHCTL, 112CHCTU, and 112LISS
- Evangeline Aquifer: Codes 110AVGL, 121EVGL, 112GOLD, and 121GOLD.
- Jasper Aquifer: Codes 112CTHL, 112JSPR, 112LGRT, and 112OKVC.

Wells in the Gulf Coast aquifer system that are not identified as being within one of these aquifers are not included.

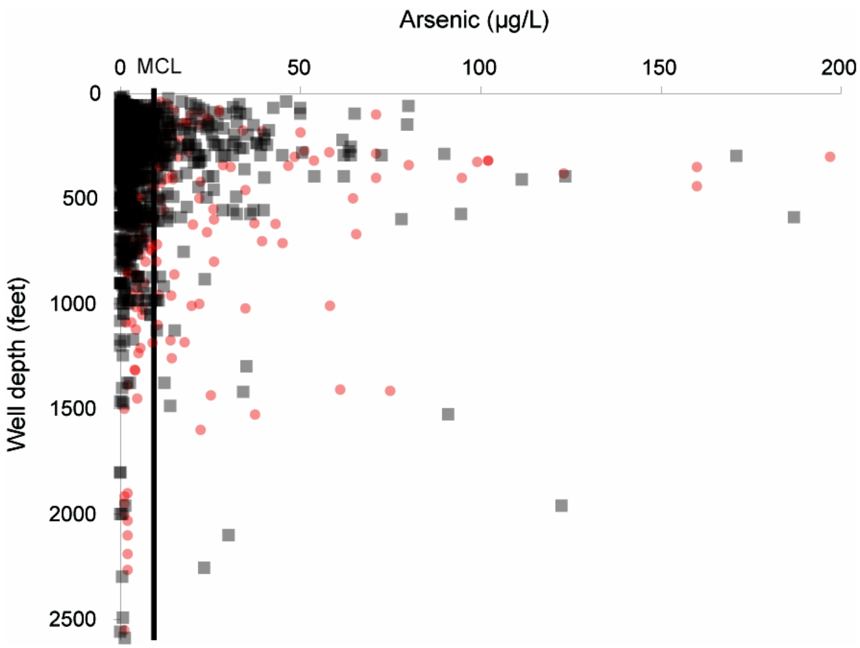
Table 3.1 Summary of Wells that Exceed the MCL for Arsenic, by Aquifer

Aquifer	Wells with measurements	Wells that exceed 10 μg/L	Percentage of wells that exceed 10 μg/L
Chicot	39	5	13
Evangeline	175	42	24
Jasper	69	43	62
Carrizo-Wilcox	16	0	0
Yegua-Jackson	4	0	0
other	21	6	29

Data from the TWDB database

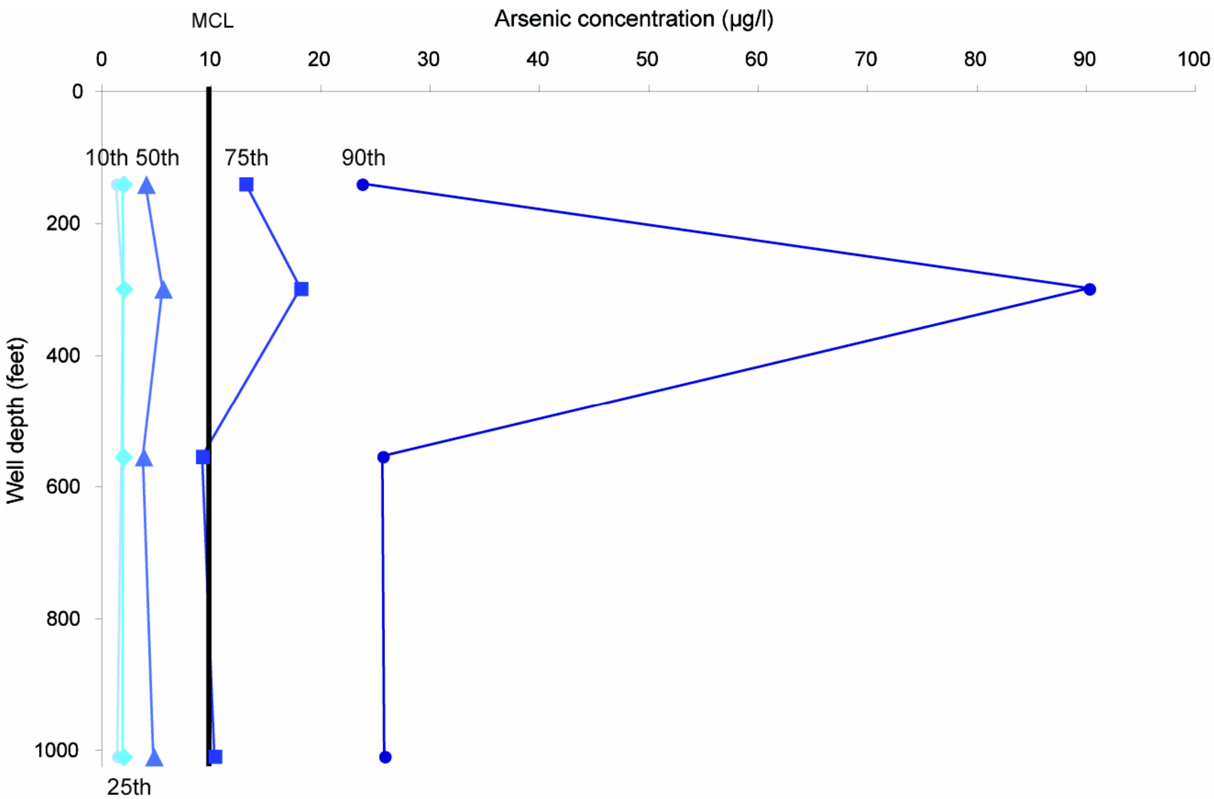
In addition, arsenic concentrations are generally associated with well depths within the study area (Figures 3.4 and 3.5). Wells between about 230 and 400 feet deep are more likely to have arsenic concentrations above the MCL (Figure 3.5). This suggests that deepening shallow wells or casing off portions of wells above or below this depth range might decrease arsenic concentrations. However, the thickness of the Gulf Coast aquifer system, and thus the depth of the aquifer, increases toward the coast. Along the updip edge of the aquifer, where the saturated thickness may be limited to relatively shallow depths, deepening wells might not be a viable option.

Figure 3.4 Arsenic Concentrations and Well Depths within the Study Area



Gray squares indicate NURE data; red circles indicate TWDB data.

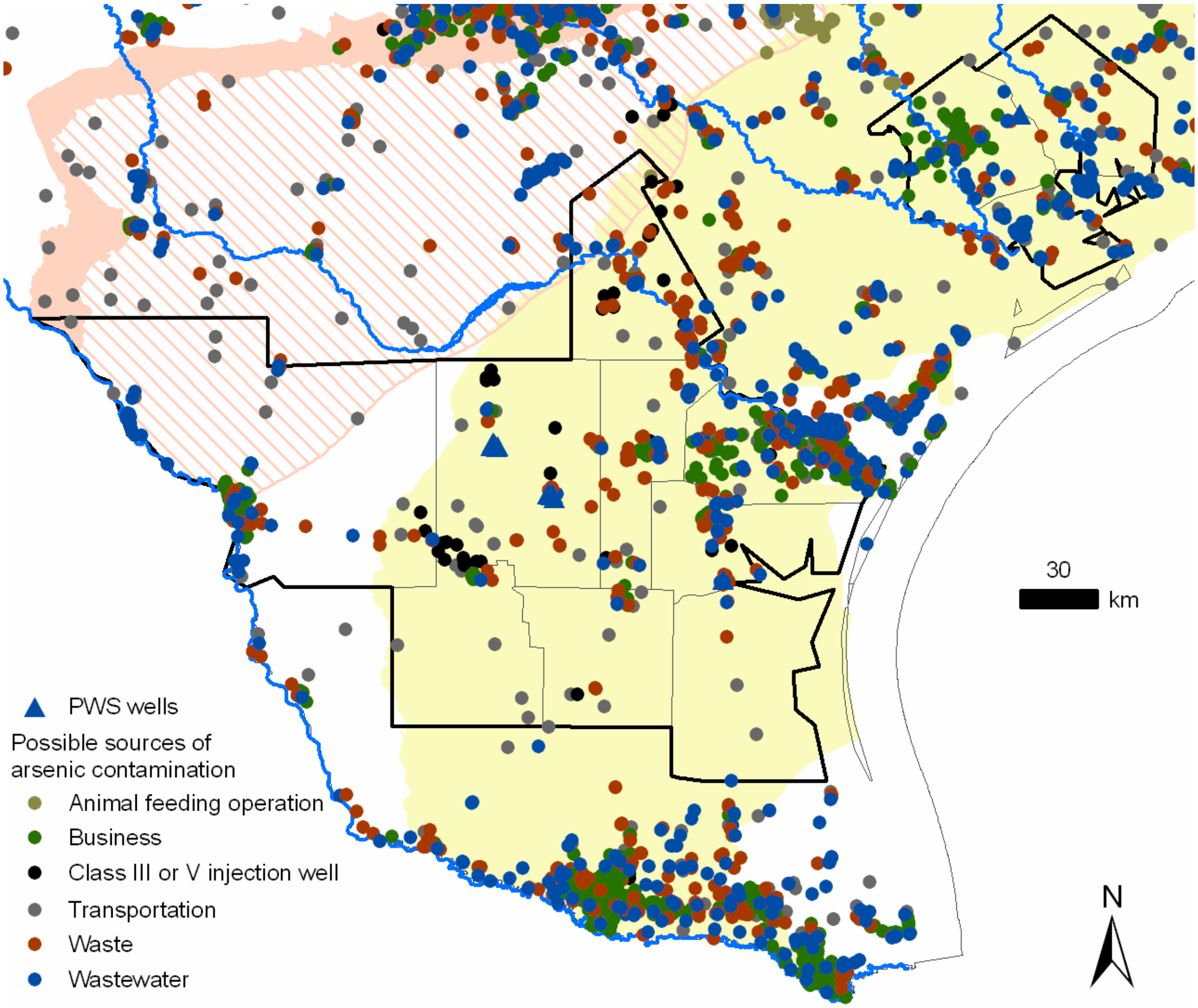
Figure 3.5 Arsenic Concentrations and Well Depths in the Study Area from the TWDB Database



Depths plotted are the medians of the 25th, 50th, 75th, and 100th percentiles. Concentrations represent the 10th, 25th, 50th, 75th, and 90th percentiles of values within each depth range.

Some of the high arsenic levels in the region might be explained by point source contaminants. The TCEQ Source Water Assessment and Protection (SWAP) program compiled a database of potential sources of arsenic contamination, such as animal feeding operations, certain businesses, injection wells used in oil production, transportation-related sites, and sites that store waste and wastewater (Figure 3.6). These anthropogenic sources of arsenic might explain high arsenic levels along the Rio Grande, Nueces, and Guadalupe Rivers (Figure 3.3).

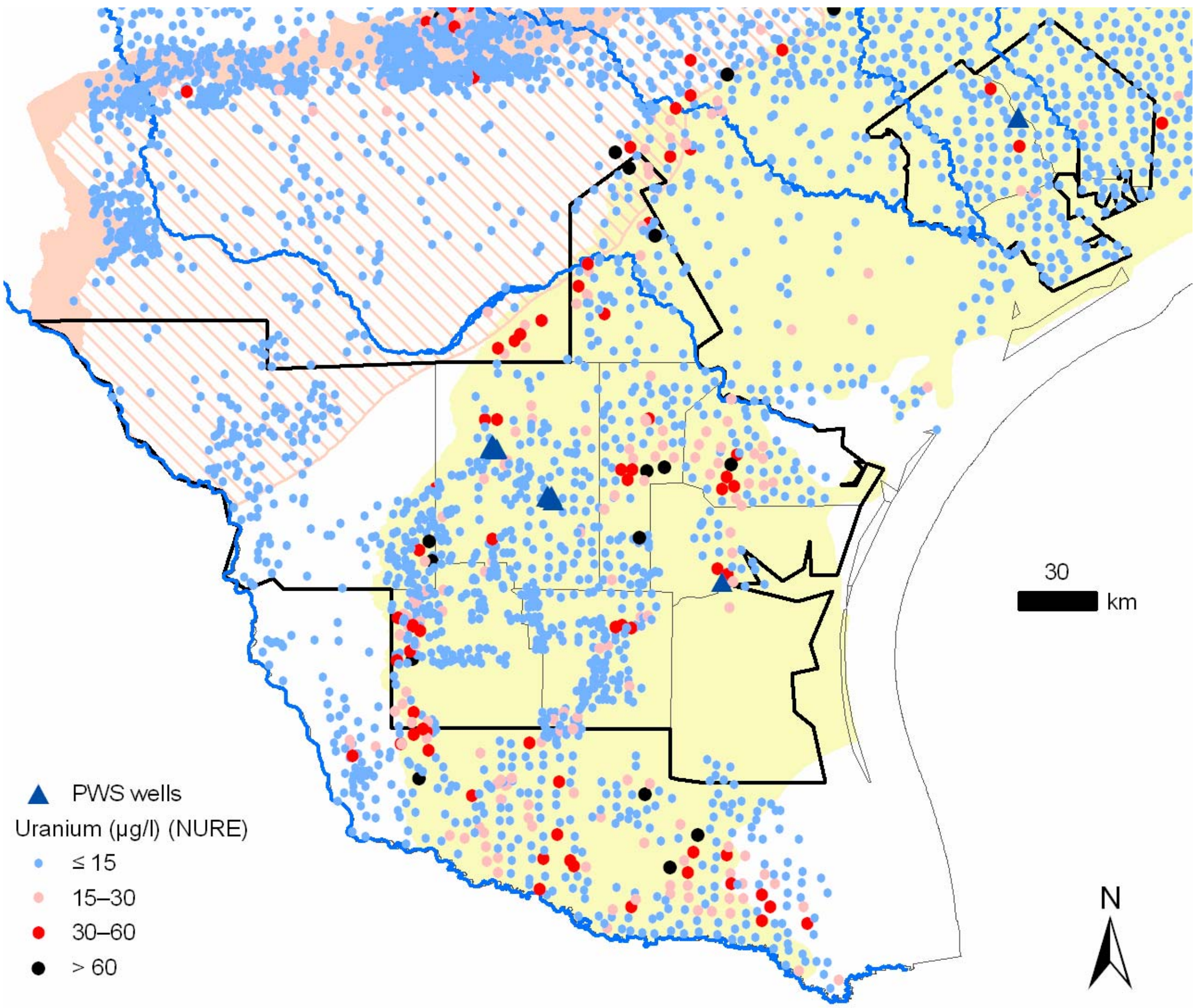
1 **Figure 3.6 Locations of Possible Sources of Arsenic Contamination**

2 

Uranium

A small but significant number of wells in the area contain uranium concentrations that exceed the MCL for uranium (30 µg/L). The distribution of measured uranium levels in groundwater in the study area from the NURE database is shown in Figure 3.7. This map indicates that many of the high uranium levels occur along the updip edge of the Gulf Coast aquifer system and in the Rio Grande valley.

Figure 3.7 Spatial Distribution of Uranium Concentrations



Because the NURE database does not include information about which aquifer the sampled wells represent, it is not possible to compare uranium concentrations by aquifer. However, because well depths are included in the database, differences in uranium concentrations in wells of different depths can be compared (Figure 3.8 and 3.9). Based on Figure 3.9, the lowest uranium concentrations are generally found in wells between about 140 and 260 feet deep. However, only three wells below 800 feet exceed the MCL for uranium. The relatively small number of wells more than about 900 feet deep make the trend in uranium levels in these deeper wells more difficult to discern.

Figure 3.8 Uranium Concentrations and Well Depths within the Study Area

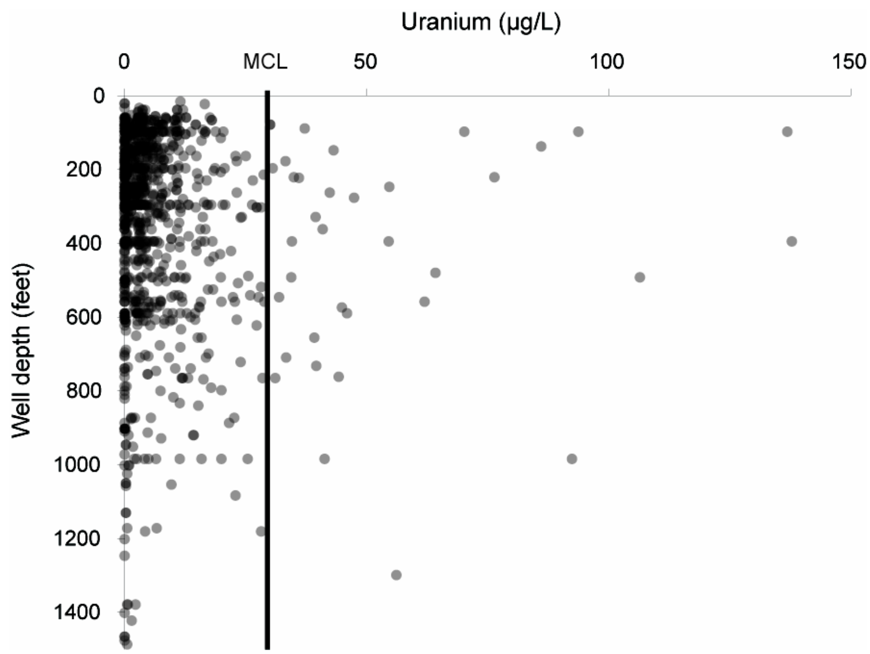
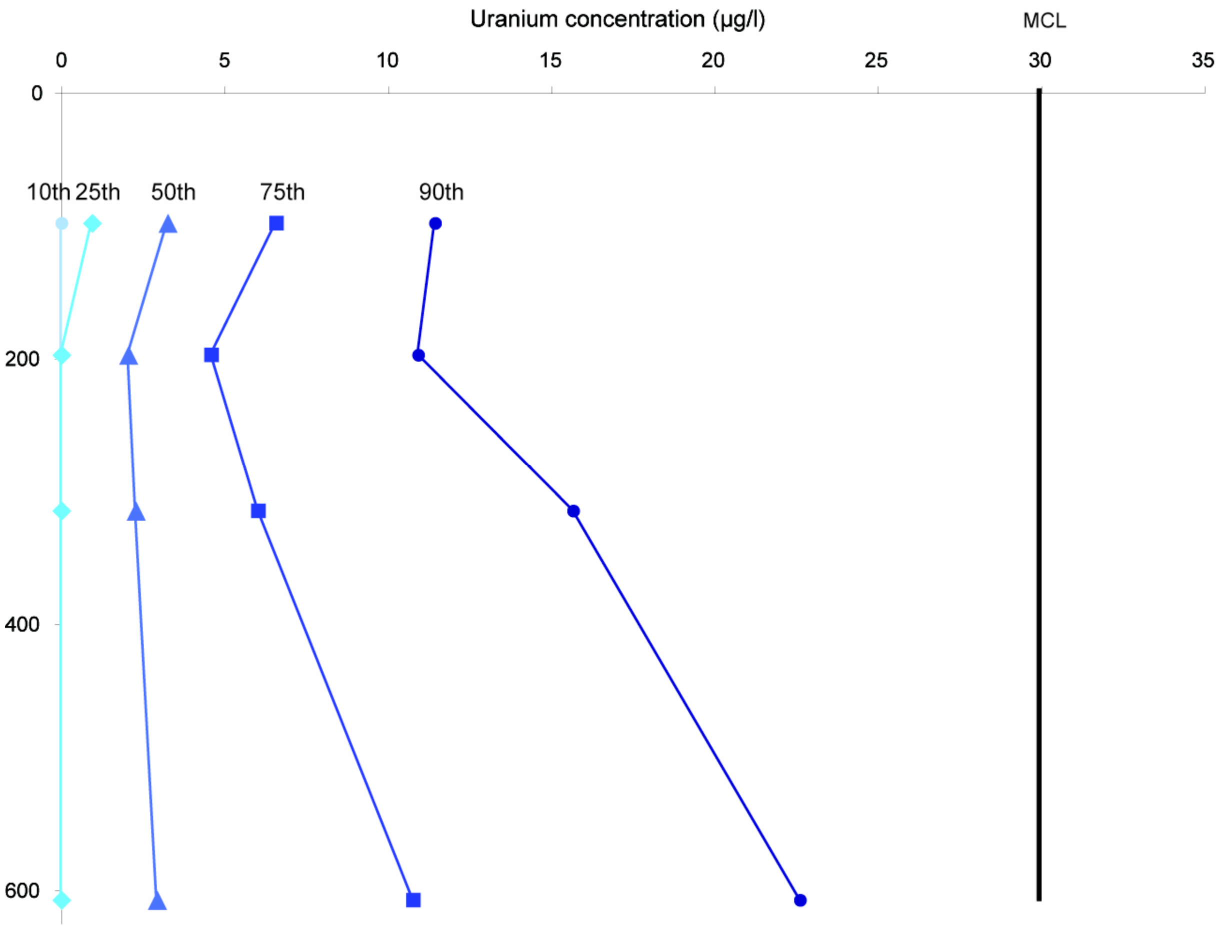


Figure 3.9 Uranium Concentrations and Well Depths in the Study Area from the NURE Database

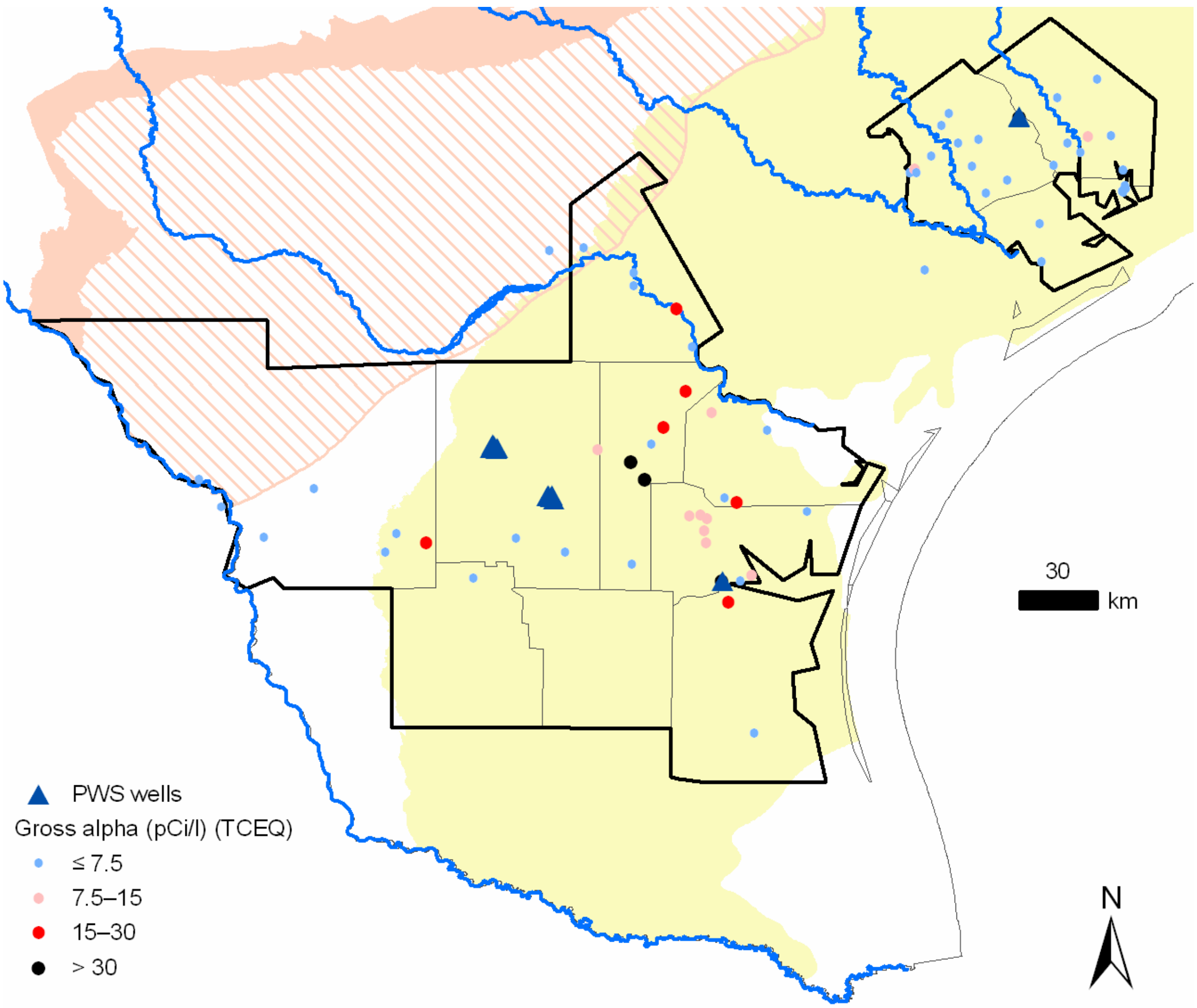


Depths plotted are the medians of the 25th, 50th, 75th, and 100th percentiles. Concentrations represent the 10th, 25th, 50th, 75th, and 90th percentiles of values within each depth range.

Gross Alpha

Based on the small number of gross alpha measurements available, the highest concentrations appear to occur in the central part of the study area, while most other wells show acceptable levels. Figure 3.10 shows the distribution of gross alpha measured in wells in the study area. Because measurements from the TCEQ database are commonly from samples that are a mixture of water from multiple wells, an assessment of how gross alpha concentrations vary with well depth or aquifer is not possible.

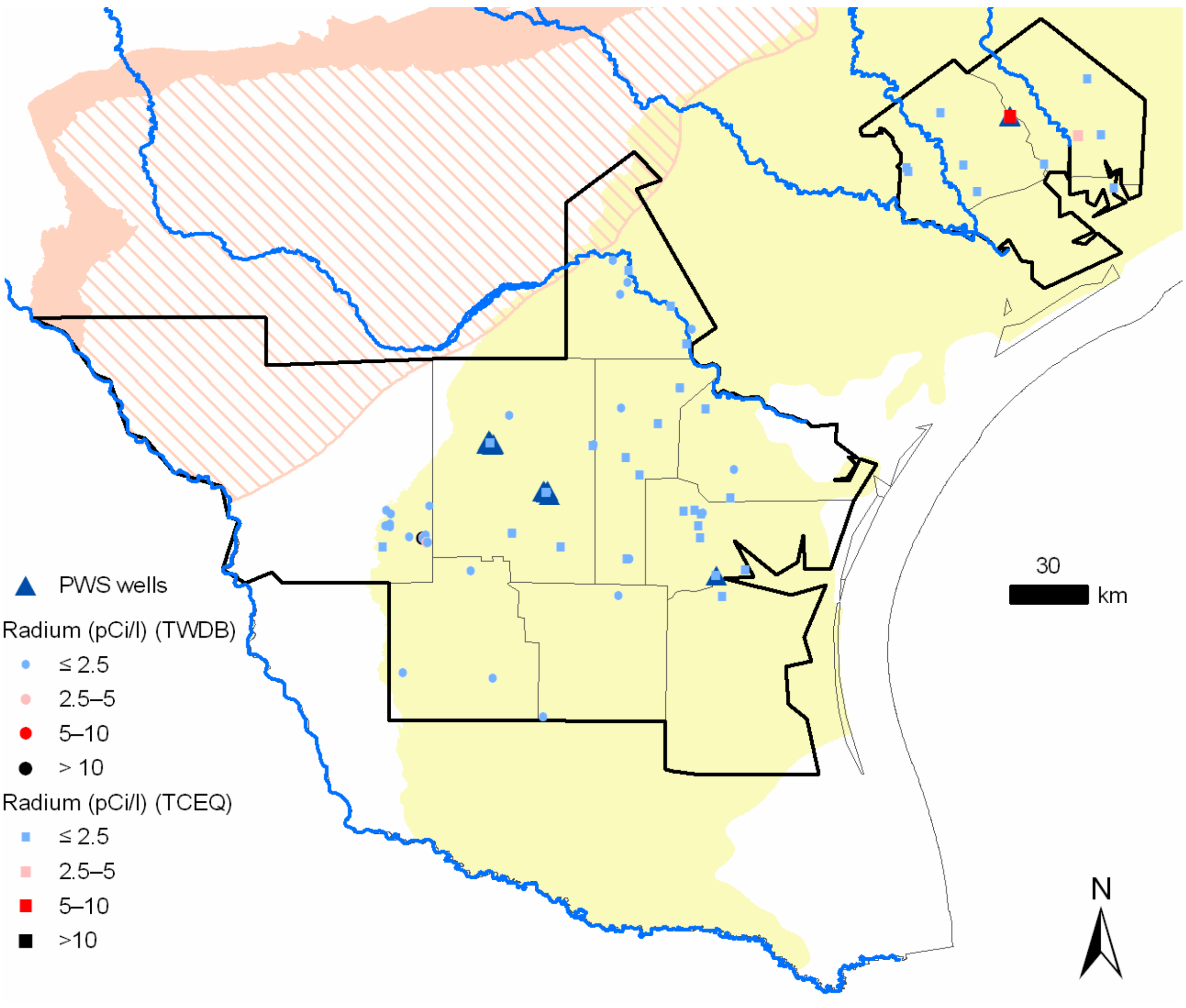
Figure 3.10 Spatial Distribution of Gross Alpha Concentrations in the Study Area



Combined Radium

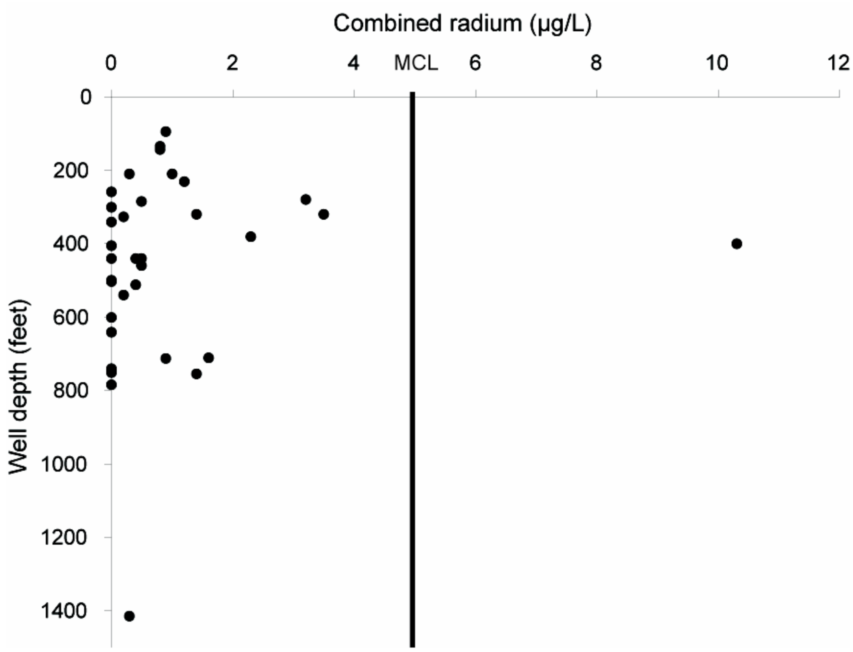
The concentration of combined radium, which refers to radium 226 plus radium 228, is generally below the MCL (5 pCi/L) throughout the study area. An exception is the combined radium measured at the Arenosa Creek Estates PWS, discussed in more detail below. The distribution of available combined radium measurements is shown in Figure 3.11. The values shown in this analysis represent an upper limit of the possible concentration, because in wells that contained less than 1 pCi/L of radium 228 (the detection limit), 1 pCi/L was used in the combined concentration.

Figure 3.11 Spatial Distribution of Combined Radium Concentrations in the Study Area



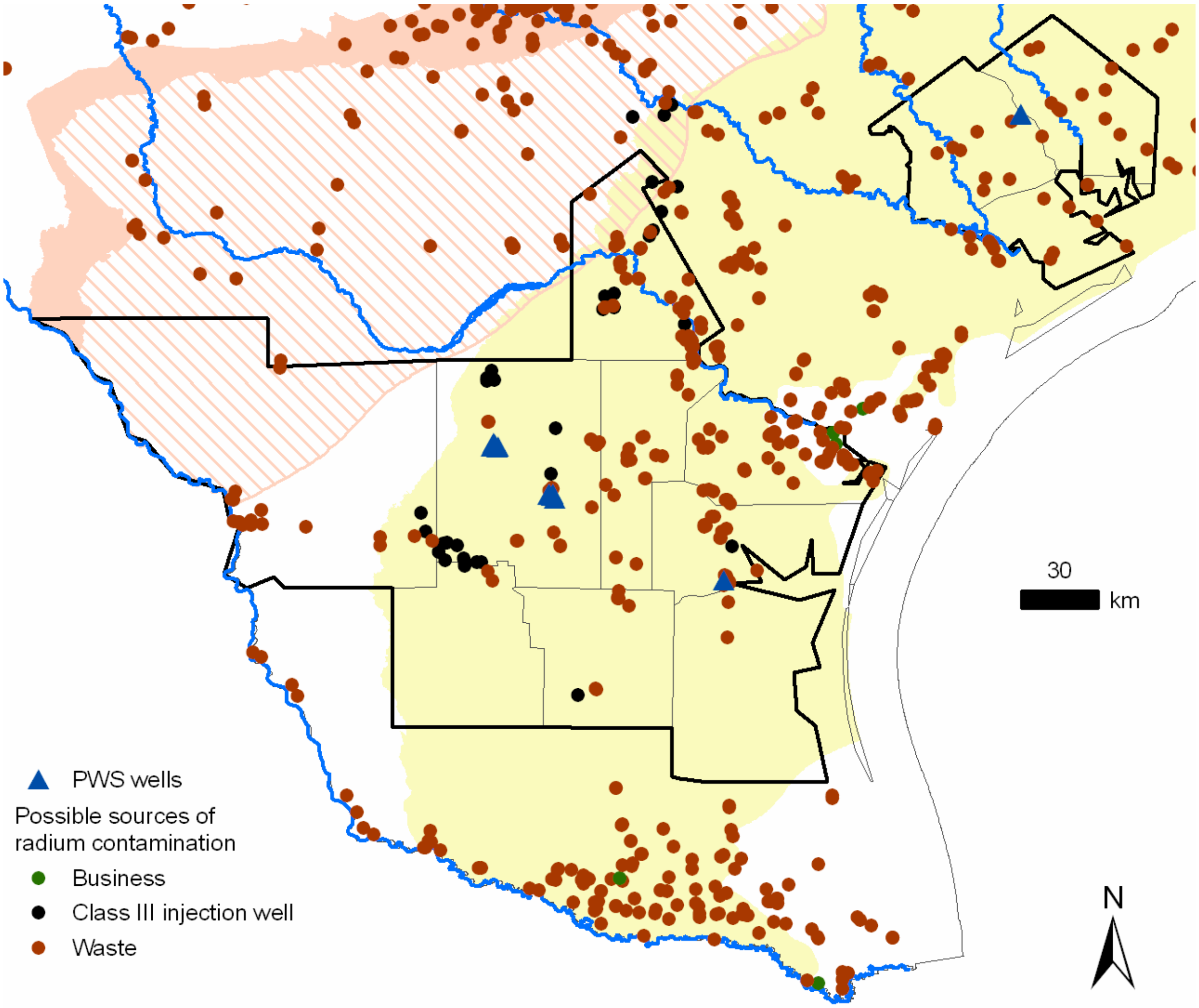
There is no clear correlation between combined radium concentration and well depth in the study area (Figure 3.12). Although the highest measured concentrations occur in shallower wells, the small number of measurements available makes it difficult to conclusively demonstrate any trend.

Figure 3.12 Combined Radium Concentrations and Well Depths within the Study Area



High radium concentrations can also be caused by anthropogenic sources of contamination. The TCEQ SWAP compiled a database of potential sources of radium contamination, including certain businesses, injection wells related to oil production, and waste disposal sites (Figure 3.13). The low measured levels of combined radium in the region do not indicate significant contamination caused by these sources.

Figure 3.13 Locations of Possible Sources of Radium Contamination in the Study Area



3.1.3 Regional Hydrogeology

The Gulf Coast aquifer system is the primary source of groundwater along the coastal plains of Texas, extending about 62 miles inland from the Gulf of Mexico. South of the study area, this aquifer system extends across the Rio Grande and into Mexico. North of the study area, it extends along the Gulf Coast into Louisiana. The aquifer system consists of several hydrologically connected sedimentary units, Miocene age and younger, composed of interbedded gravels, sands, silts, and clays. These sediments were deposited in alluvial, deltaic, lagoon, beach, and continental shelf environments as the depositional basin that forms the Gulf of Mexico. As a result of the gradual subsidence of the basin, these units all dip toward the coast (Ryder 1996), so the geologic units at the surface are youngest at the coast and oldest inland (Ashworth and Hopkins 1995). The units also generally thicken toward the coast, so the main producing units are very thin at the inland boundary of the aquifer and increase to nearly 6,000 feet thick at the coast within the study area (Baker 1979).

The oldest and deepest formation is the Miocene age Catahoula Tuff or Sandstone, which in most places serves as a confining unit between the Gulf Coast aquifer system and the underlying Jackson Group. Overlying the Catahoula is the Miocene age Jasper aquifer, in which the Oakville Sandstone forms a productive aquifer unit. Above the Jasper aquifer is the Burkeville confining unit, made up primarily of a clay-rich unit known as the Fleming Formation (Baker 1979) or the Lagarto Clay (Shafer and Baker 1973), which separates the Jasper from the overlying Evangeline aquifer. The Evangeline aquifer consists of the Pliocene age Goliad Sand. Above the Evangeline, the top of the Gulf Coast aquifer system, known as the Chicot aquifer, includes the Pleistocene age Lissie, Willis, Bentley, Montgomery, and Beaumont formations, as well as recent alluvial deposits (Baker 1979). Locally, formations that make up the Chicot aquifer might not all be present or discernable (Shafer 1968; Shafer and Baker 1973; Shafer 1974).

Water quality in the Gulf Coast aquifer system is generally good in the shallower parts of the aquifer, but worsens toward the Rio Grande valley. Along the coast, the quality is poor in some locations due to saltwater encroachment (Ashworth and Hopkins 1995). In some areas, including Kleberg, Kenedy, and Jim Wells Counties, improperly cased wells in the Evangeline aquifer have experienced increases in salinity due to leakage of shallow saline water from overlying formations (Shafer and Baker 1973). Saline waters near the surface might be natural or a result of human activities such as oil production or pesticide application, although historically pesticides have not been a known source of contamination (Shafer 1968; Shafer and Baker, 1973; Shafer, 1974).

Other aquifers that provide water supplies in the western part of the study area include the Carrizo-Wilcox and the Yegua-Jackson. The Carrizo-Wilcox aquifer includes the Tertiary age Wilcox Group and the Carrizo Formation (Ashworth and Hopkins 1995). Where it is present in the study area, the Carrizo-Wilcox is primarily located only at depth; it outcrops only in a small area in northwestern Webb County. The Yegua-Jackson aquifer consists of the Eocene age Yegua Formation and the Eocene–Pleistocene Jackson Group, both of which are made up of interbedded sands, silts, and clays, some of which include volcanic sediments, lignite, and uranium (Preston 2006). This aquifer only occurs in the subsurface within the study area.

3.2 DETAILED ASSESSMENT FOR FREER WCID

The Freer WCID PWS has nine wells: G0660002A–I. These wells are between 590 and 680 feet deep and are all within the Catahoula Formation, which underlies the Jasper aquifer. Chemical analyses from this water supply system represent a mixture of water from all these wells. Table 3.2 lists historical measurements of arsenic from samples collected at this PWS.

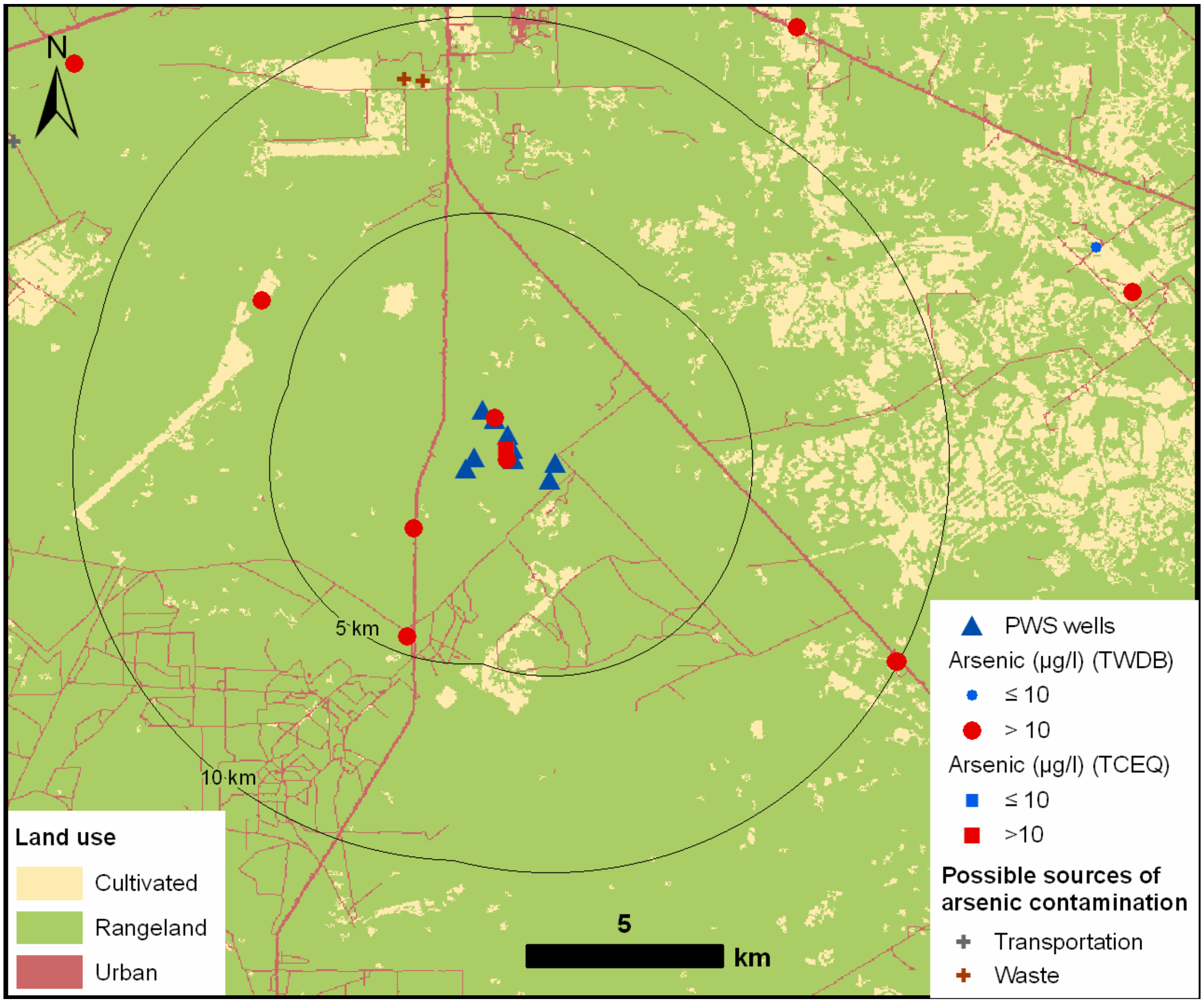
Table 3.2 Arsenic Concentrations in the Freer WCID PWS

Date	Arsenic (μg/L)	Wells sampled
1/6/1999	40.6	G0660002A–I
6/25/2001	41.8	G0660002A–I
1/23/2002	38.5	G0660002A–I
1/23/2002	38.5	G0660002A–I
6/17/2005	47.6	G0660002A–I
8/22/2005	38.0	G0660002A–I
11/1/2005	40.8	G0660002A–I
11/1/2005	39.8	G0660002A–I
12/1/2005	43.5	G0660002A–I
3/15/2006	36.1	G0660002A–I
6/26/2006	39.3	G0660002A–I
9/26/2006	42.5	G0660002A–I
11/29/2006	39.0	G0660002A–I
2/27/2007	40.9	G0660002A–I
4/3/2007	45.0	G0660002A–I

Data from the TCEQ PWS Database

All 15 historical measurements of arsenic at this entry point exceed the MCL (10 μg/L). Figure 3.14 shows the distribution of measured arsenic concentrations in the vicinity of the PWS wells.

Figure 3.14 Arsenic Concentrations within 5- and 10-km Buffers around the Freer WCID PWS



Data are from the TCEQ and TWDB databases. Two types of samples were included in the analysis. Samples from the TCEQ database (shown as squares on the map) represent the most recent sample taken at a PWS, which can be raw samples from a single well or entry point samples that may combine water from multiple sources. Samples from the TWDB database are taken from single wells (shown as circles in the map). Where more than one measurement has been made from a source, the most recent concentration is shown.

All arsenic samples taken within 6.2 miles of the PWS exceed the MCL (Figure 3.14). Therefore, there are no known wells that might serve as an alternative water supply. There are few possible sources of anthropogenic arsenic contamination in the area. Regionally, the Freer WCID is located within the area of high arsenic along the updip edge of the Gulf Coast aquifer system (Figure 3.3). The regional assessment also found that arsenic levels are more consistently high in the Jasper than in the Evangeline or Chicot aquifers. Although the Catahoula Formation is not included in this assessment, this suggests that drilling a new shallow well or casing existing wells below the Evangeline aquifer might improve arsenic concentrations in the PWS wells. However, it is also possible that the Evangeline aquifer is not present in this updip part of the aquifer.

All existing chemical analyses for the PWS are based on samples that are a mixture of waters from all the PWS wells. Therefore, it is possible that testing each well separately could identify specific wells with particularly high or low arsenic concentrations. Based on this information, it might be possible to increase or decrease the use of water from certain wells to meet the MCL for arsenic. In addition, depth-specific sampling could be done to evaluate whether casing off portions of a well might lower arsenic concentrations in some of the wells.

3.2.1 Summary of Alternative Groundwater Sources for the Freer WCID PWS

Based on the regional analyses, drilling a new well within the Evangeline or Chicot aquifers, or casing existing wells below this part of the aquifer system, might improve arsenic concentrations in the PWS wells.

There is currently no information on the arsenic content in individual PWS wells. Testing the wells individually, and perhaps at different depths, might identify mixtures of well waters or changes in well casing that would allow the PWS to meet the arsenic MCL.

SECTION 4
ANALYSIS OF THE FREER WCID PWS

4.1 DESCRIPTION OF EXISTING SYSTEM

4.1.1 Existing System

The location of the Freer WCID PWS is shown in Figure 4.1. The Freer WCID PWS is located in the city of Freer, Texas. The water supply system serves a population of 4,038 and has 1,394 connections (includes wholesale population of 759 and 73 connections). The water sources for this community water system are six wells, completed in the Catahoula Formation, that range in depth from 620 feet to 680 feet deep and have a total production 1.094 mgd.

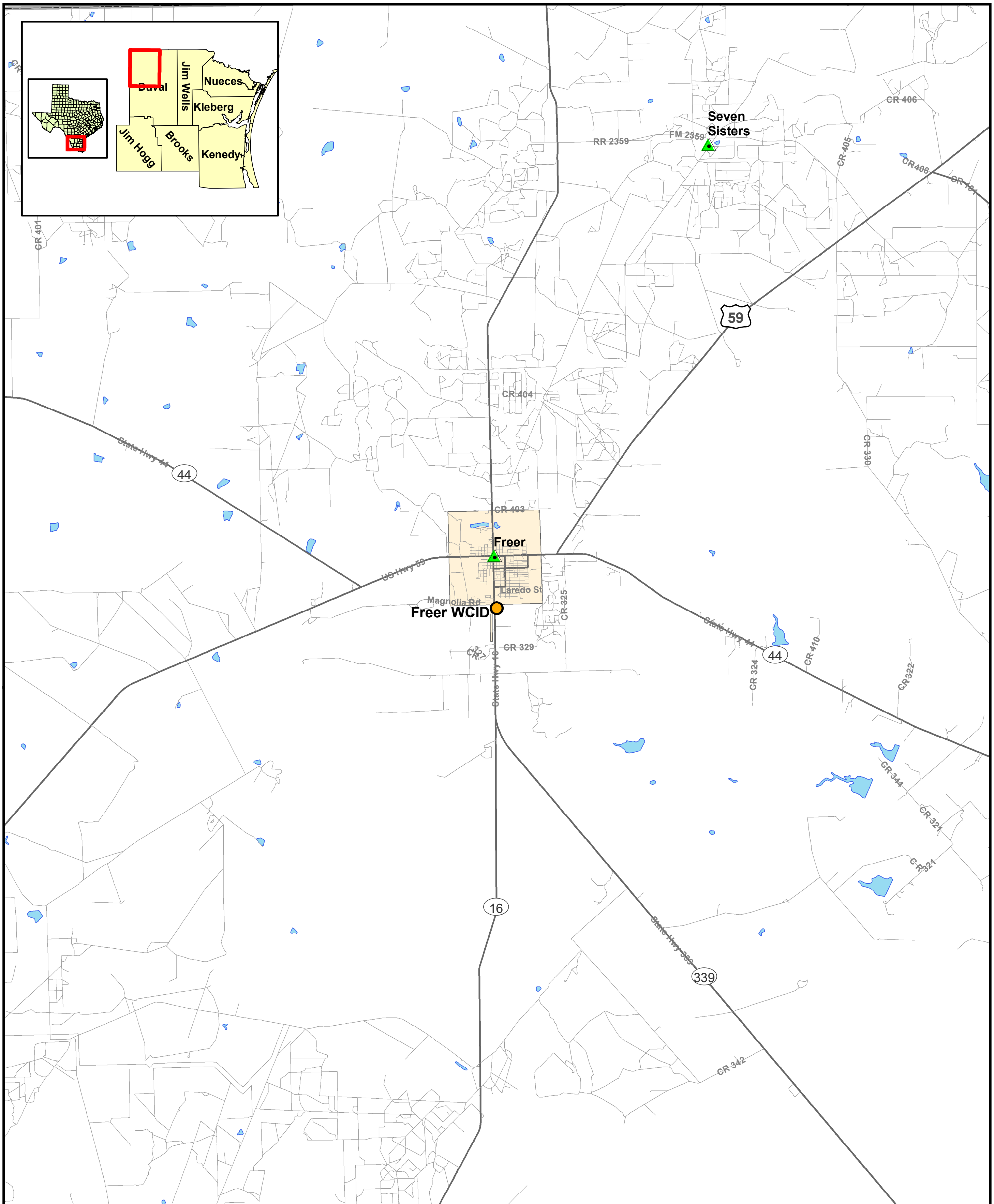
All six wells are located approximately 7 miles south of Freer off Highway 16. The water is chlorinated before being transferred to a ground storage tank (1.0 million gallon capacity). Water then flows by gravity to a standpipe (0.75 million gallon capacity) that feeds the distribution system. A second chlorination station is located off Highway 16 north of Freer.

The treatment employed for disinfection is not appropriate or effective for removal of arsenic, so optimization is not expected to be effective for increasing removal of this contaminant. However, there is a potential opportunity for system optimization to reduce the arsenic concentration. The system has more than one well, and since arsenic concentrations can vary significantly between wells, arsenic concentrations should be determined for each well. If one or more wells happens to produce water with acceptable arsenic levels, as much production as possible should be shifted to that well. It may also be possible to identify arsenic-producing strata through comparison of well logs or through sampling of water produced by various strata intercepted by the well screen.

The Freer WCID PWS recorded arsenic concentrations of 0.0418 mg/L in June 2001 and 0.0385 mg/L in January 2002. While these results were below the arsenic MCL of 0.050 mg/L in effect at that time, the values were above the 0.010 mg/L MCL for arsenic that went into effect on January 23, 2006 (USEPA 2008a; TCEQ 2004). Additionally, arsenic concentrations ranged from 0.0189 mg/L to 0.039 mg/L between April 2006 and December 2006 and from 0.0404 mg/L to 0.0423 mg/L between January 2007 and September 2007. Therefore, the Freer WCID faces compliance issues under the water quality standard for arsenic.

Basic system information is as follows:

- Population served: 4,038
- Connections: 1,394
- Average daily flow: 0.60 mgd
- Total production capacity: 1.094 mgd



Legend

N

Miles

0 1.5 3

- Study System
- PWS's
- Cities
- City Limits
- Counties
- Major Road
- Minor Road
- CRMWA Pipeline
- Lubbock Pipeline
- Grass Valley Pipeline

No PWS with excess capacity and complaint water was found within 30-miles of Freer WCID.

Figure 4.1

FREER WCID

Pipeline Alternative

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Basic system raw water quality data are as follows:

- Typical arsenic range: 0.0189 - 0.0423 mg/L
- Typical calcium range: 19 – 54 mg/L
- Typical chloride range: 391 – 500 mg/L
- Typical fluoride range: 0.2 – 1.19 mg/L
- Typical iron range: <0.051 – 0.79 mg/L
- Typical magnesium range: 8 – 24 mg/L
- Typical manganese range: <0.001 – 0.0054 mg/L
- Typical nitrate range: 6.17 – 7.26 mg/L
- Typical selenium range: 0.0053 – 0.011 mg/L
- Typical sodium range: 389 – 454 mg/L
- Typical sulfate range: 142 – 209 mg/L
- Total hardness as CaCO3 range: 83.7 – 97 mg/L
- Typical pH range: 7.7 – 8.03
- Total alkalinity as CaCO3 range: 242 – 266 mg/L
- Typical bicarbonate (HCO_3) range: 295 – 325 mg/L
- Typical total dissolved solids range: 1270 – 1370 mg/L

The typical ranges for water quality data listed above are based on a TCEQ database that contains data updated through the beginning of 2005.

4.1.2 Capacity Assessment for Freer WCID

The project team conducted a capacity assessment of the Freer WCID water system in Freer on August 5, 2008. Results of this evaluation are separated into four categories: general assessment of capacity, positive aspects of capacity, capacity deficiencies, and capacity concerns. The general assessment of capacity describes the overall impression of FMT capability of the water system. The positive aspects of capacity describe the strengths of the system. These factors can provide the building blocks for the system to improve capacity deficiencies. The capacity deficiencies noted are those aspects creating a particular problem for the system related to long-term sustainability. Primarily, those problems are related to the system's ability to meet current or future compliance, ensure proper revenue to pay the expenses of running the system, and ensure proper operation of the system. The last category, capacity concerns, consists of items not causing significant problems for the system at this time. However, the system may want to address them before they become problematic.

Because of the challenges facing very small water systems, it is increasingly important for them to develop the internal capacity to comply with all state and federal requirements for public drinking water systems. For example, it is especially important for very small water systems to develop long-term plans, set aside money in reserve accounts, and track system expenses and revenues because they cannot rely on increased growth and economies of scale to offset their costs. In addition, it is crucial for the owner, manager, and operator of a very small water system to understand the regulations and participate in appropriate training. Providing safe drinking water is the responsibility of every public water system, including those very small water systems that face increased challenges with compliance.

The project team interviewed Vince Guerra, General Manager and Operator.

4.1.2.1 General Structure of the Water System

The Freer WCID provides water, wastewater, and billing for garbage pick-up for the City of Freer. The Freer WCID water system has 1,250 service connections, and is governed by a five-member board of directors, which meets twice a month. The District employs an office manager, bookkeeper, field supervisor, and four additional operators/maintenance crew. Monthly water rates are $22.00 for the first 3,000 gallons and $3.25 for the next 3,000 gallons. The District is proposing to increase rates every year, starting in 2008, to repay the $3,000,000 U.S. Department of Agriculture grant/loan for the arsenic treatment plant. Currently, the District exceeds the standards for arsenic.

4.1.2.2 General Assessment of Capacity

Based on the team's assessment, this system has a good level of capacity. There are several positive FMT aspects of the water system, but there are also some areas that need improvement. The deficiencies noted could prevent the water system from being able to meet compliance now or in the future and may also impact the water system's long-term sustainability.

4.1.2.3 Positive Aspects of Capacity

In assessing a system's overall capacity, it is important to look at all aspects – positive and negative. It is important for systems to understand those characteristics that are working well, so those activities can be continued or strengthened. In addition, these positive aspects can assist the system in addressing the capacity deficiencies or concerns. The factors particularly important for the Freer WCID are listed below.

- **Water Rehabilitation/Reserve Account –** The District is able to fund a water rehabilitation account through its water revenues. The account currently has funds of $222,000 that will be used for capital projects. In addition, the revenues fund a separate emergency account.
- **Dedicated and Knowledgeable Staff** – The District general manager/operator has been with the district for 43 years in various positions. The office manager has been with the District for 25 years and is also a licensed water operator. The field supervisor has been with the District for 28 years. It appears that all the employees are knowledgeable about the water system and committed to providing safe drinking water.

- **Funding Opportunities** – The District secured a U.S. Department of Agriculture loan/grant funding package to install an arsenic treatment plant.
- **Meter Replacement** – The WCID started a meter replacement program three years ago, which should reduce apparent losses in the water systems due to slow/stopped meters and generate revenues for the WCID.

4.1.2.4 Capacity Deficiencies

The following capacity deficiency was noted in conducting the assessment and seriously impacts the ability of the water system to meet compliance with current and future regulations and to ensure long-term sustainability.

- **Lack of Compliance with Arsenic Standards –** While the District has secured funding, it is still is under a Compliance Agreement with TCEQ. The District does not yet have a contract in place for an arsenic treatment system.

4.1.2.5 Potential Capacity Concerns

The following item is of concern regarding capacity but no specific operational, managerial, or financial problems can be attributed to these items at this time. The system should address the items listed below to further improve FMT capabilities to improve the system's long-term sustainability.

- **Staffing Level** – The District provides in-kind services to fulfill the match requirements of grants it receives. This work is in addition to the staffs' regular responsibilities. The operators could be placed in a position to delay needed maintenance on the water system to provide the in-kind services. The District should be aware of this situation and work with the operators to prioritize tasks.

4.2 ALTERNATIVE WATER SOURCE DEVELOPMENT

4.2.1 Identification of Alternative Existing Public Water Supply Sources

Using data drawn from the TCEQ drinking water and TWDB groundwater well databases, the PWSs surrounding the Freer WCID PWS were reviewed with regard to their reported drinking water quality and production capacity. PWSs that appeared to have water supplies with water quality issues were ruled out from evaluation as alternative sources, while those without identified water quality issues were investigated further. Small systems were only considered if they were within 15 miles of the Freer WCID PWS. Large systems or systems capable of producing greater than four times the daily volume produced by the study system were considered if they were within 30 miles of the study system. A distance of 30 miles was considered to be the upper limit of economic feasibility for constructing a new water line. Table 4.1 is a list of the selected PWSs based on these criteria for large and small PWSs within 30 miles of the Freer WCID. If it was determined these PWSs had excess supply capacity and might be willing to sell the excess, or might be a suitable location for a new groundwater well, the system was taken forward for further consideration and identified with "EVALUATE FURTHER" in the comments column of Table 4.1.

Table 4.1 Selected Public Water Systems within 30 Miles of the Freer WCID

PWS ID	PWS Name	Distance from Freer WCID (miles)	Comments/Other Issues
0660001	DUVAL CNTY CONS & RECLAM BENAV	16.98	Small GW system. WQ issue: arsenic
0660003	SAN DIEGO MUD 1	21.94	Small GW system. WQ issue: arsenic
0660014	DUVAL CNTY CONS & RECLAM REALITOS	22.5	Small GW system. WQ issue: arsenic
0660016	COGEMA MALAPAI RESOURCES CO	25.18	Small non-residential GW system. No WQ issues
2400009	WEBB CONSOLIDTED SCHOOLS BRUNI	27.12	Small GW system. WQ issue: arsenic
2400003	BRUNI RURAL WATER SUPPLY CORP	27.24	Small GW system. WQ issue: arsenic and gross alpha
1250005	PALITO BLANCO ELEMENTARY SCHOOL	28.06	Small GW system. No WQ issues
0660015	DUVAL CNTY CONS & RECLA CONCEPCION	29.56	Small GW system. WQ issues: arsenic and nitrate
1250033	ENGLISH ACRES	29.71	Small GW system. WQ issues: arsenic and combined uranium
2400006	OILTON RURAL WATER SUPPLY CORP	29.86	Small non-residential GW system. No WQ issues

WQ = water quality
GW = groundwater

After the PWSs in Table 4.1 with water quality problems were eliminated from further consideration, the remaining PWSs were screened by proximity to Freer WCID PWS and sufficient total production capacity for selling or sharing water. Based on the initial screening summarized in Table 4.1, there are no alternatives to consider for further evaluation for larger groundwater PWSs that are within 30 miles of the study system.

4.2.2 Potential for New Groundwater Sources

4.2.2.1 Installing New Compliant Wells

Developing new wells or well fields is recommended, provided good quality groundwater available in sufficient quantity can be identified. Since a number of water systems in the area have water quality problems, it should be possible to share in the cost and effort of identifying compliant groundwater and constructing well fields.

Installation of a new well in the vicinity of the system intake point is likely to be an attractive option provided compliant groundwater can be found, since the PWS is already familiar with operation of a water well. As a result, existing nearby wells with good water quality should be investigated. Re-sampling and test pumping would be required to verify and determine the quality and quantity of water at those wells.

The use of existing wells should probably be limited to use as indicators of groundwater quality and availability. If a new groundwater source is to be developed, it is recommended that a new well or wells be installed instead of using existing wells. This would ensure well characteristics are known and meet standards for drinking water wells.

Some of the alternatives suggest new wells be drilled in areas where existing wells have acceptable water quality. In developing the cost estimates, Parsons assumed the aquifer in these areas would produce the required amount of water with only one well. Site investigations and geological research, which are beyond the scope of this study, could indicate whether the aquifer at a particular site and depth would provide the amount of water needed or if more than one well would need to be drilled in separate areas.

4.2.2.2 Results of Groundwater Availability Modeling

The southern section of the Gulf Coast Aquifer supplies groundwater throughout Duval County, where the PWS is located, as well as surrounding counties. The groundwater source for the Freer PWS is the Catahoula Sandstone Formation, the deepest of five hydrogeological units that comprise the Gulf Coast Aquifer.

The Freer WCID operates nine wells, all completed in the Catahoula Sandstone Formation at depths ranging from 590 feet to 680 feet. A search of registered wells was conducted using TCEQ's Public Water Supply database to assess groundwater sources utilized within a 10-mile radius of the PWS. The search indicated that domestic and public supply wells with search area, as well as numerous stock watering wells, are also completed in the Catahoula Sandstone Formation. This hydrogeological unit of the Gulf Coast Aquifer also supplies a few irrigation and industrial wells located over 8 miles from the PWS. A few wells used for livestock watering are completed in a second hydrogeological unit of the Gulf Coast Aquifer, the Evangeline Aquifer.

Groundwater Supply

The Gulf Coast Aquifer, the main groundwater source in Duval and surrounding counties, is a high-yield aquifer composed of discontinuous sand, silt, clay and gravel beds that extends over the entire Texas coastal region. Municipal and irrigation uses account for 90 percent of the total pumpage from the aquifer. The Gulf Coast Aquifer, which has an average freshwater thickness of 1,000 feet (TWDB 2007), consists of five hydrogeologic units; from the land surface downward, those units are the Chicot Aquifer, the Evangeline Aquifer, the Burkenville Formation, the Jasper Aquifer, and the Catahoula Sandstone Formation.

In the southern section of the Gulf Coast Aquifer, where the PWS is located, the groundwater yield is relatively low compared to the north section and central sections of the aquifer, and of lower water quality due to a high content of total dissolved solids (TWDB 2007). The State Water Plan, updated in 2007 by the TWDB, estimated that availability of water from the Gulf Coast Aquifer water will have a moderate decrease, from over 1.8 million acre-feet per year (AFY) in 2010 to slightly less that 1.7 million AFY in the year 2060.

Groundwater Availability

Regional groundwater withdrawal in the PWS area is extensive, and likely to increase over current levels over the next decades. The 2007 State Water Plan summarized estimates of groundwater supply and demand over a 50-year planning period, from current values extrapolated to the year 2010 to projections for the year 2060. For Duval County it was estimated that, without implementation of additional water management strategies, the increasing water demand will exceed projected water supply estimates. For the 50-year planning period, the additional water need by the year 2060 would be 1,826 AFY. This deficit would be associated with increased water use for mining.

A GAM was developed by TWDB for the southern section of the Gulf Coast Aquifer, including Duval and adjacent counties. On a regional basis, the GAM model predicted that by the year 2050, current aquifer utilization would increase more than 10 percent (Chowdhury and Mace, 2003). A GAM evaluation was not run for the PWS. Water use by the system would represent a minor addition to regional withdrawal conditions, making potential changes in aquifer levels beyond the spatial resolution of the regional GAM model.

4.2.3 Potential for New Surface Water Sources

There is a minimum potential for development of new surface water sources for the Freer WCID because water availability is very limited over the entire river basin, at the county level, and within the site vicinity.

The PWS is located in the Nueces Basin which occupies a relatively arid region of Texas. The State Water Plan, updated in 2007 by the TWDB, estimates that the basin average watershed yield is only 0.6 inches per year, the third lowest yield among major river basins of Texas. Water rights are assigned primarily to industrial and municipal uses (43% and 41%, respectively). Over a 50-year planning period, the State Plan anticipates a significant increase in surface water use due to the steady decline in the groundwater supply due to aquifer depletion and salinization. Despite the increasing demand, the 2007 State Water Plan anticipates an increase in water supply over the next 50 years, from a projected 2010 value of 194,300 AFY, as several proposed long-term management strategies are implemented in the Nueces Basin.

The 2007 State Water Plan estimated that, without implementation of additional water management strategies, the increasing water demand in Duval County will exceed projected water supply estimates. For the 50-year planning period, the additional water need by the year 2060 would be 1,826 AFY. This deficit would be associated with increased water use for mining.

The TWDB developed a surface water availability model for the Nueces Basin as a tool to determine, at a regional level, the maximum amount of water available during the drought of record over the simulation period (regardless of whether the supply is physically or legally available). For the PWS vicinity, simulation data indicate that there is a minimum availability of surface water for new uses. Surface water availability maps were developed by TCEQ for the Nueces Basin, illustrating percent of months of flow per year. Availability maps indicate that in the site vicinity, and over all of Duval County, unappropriated flows for new applications are typically available less than 50 percent of the time. This availability is inadequate for development of new municipal water supplies as a 100 percent year-round availability is required by TCEQ for new surface water source permit applications.

4.2.4 Options for Detailed Consideration

The initial review of alternative sources of water results in the following options for more-detailed consideration:

- New Wells at 10, 5, and 1 mile. Installing a new well within 10, 5, or 1 mile of the Freer WCID PWS may produce compliant water in place of the water produced by the existing active well. A pipeline and pump station would be constructed to transfer the water to the Freer WCID PWS (Alternatives FR-1, FR-2, and FR-3).

4.3 TREATMENT OPTIONS

4.3.1 Centralized Treatment Systems

Centralized treatment of the well water is identified as a potential option. Reverse osmosis, coagulation/filtration, and iron-based adsorption treatment could be potential applicable processes. The central RO treatment alternative is Alternative FR-4, the coagulation/filtration alternative is Alternative FR-5, and the iron-based adsorption treatment alternative is Alternative FR-6.

4.3.2 Point-of-Use Systems

POU treatment using RO technology is valid for arsenic removal. The POU treatment alternative is FR-7.

4.3.3 Point-of-Entry Systems

POE treatment using RO technology is valid for arsenic removal. The POE treatment alternative is FR-8.

4.4 BOTTLED WATER

Providing bottled water is considered an interim measure to be used until a compliance alternative is implemented. Even though the community is small and people know each other; it would be reasonable to require a quarterly communication advising customers of the need to take advantage of the bottled water program. An alternative to providing delivered bottled water is to provide a central, publicly accessible dispenser for treated drinking water. Alternatives addressing bottled water are FR9, FR-10, and FR-11.

4.5 ALTERNATIVE DEVELOPMENT AND ANALYSIS

A number of potential alternatives for compliance with the MCL for arsenic have been identified. Each of the potential alternatives is described in the following subsections. It should be noted that the cost information given is the capital cost and change in O&M costs associated with implementing the particular alternative. Appendix C contains cost estimates for the compliance alternatives. These compliance alternatives represent a range of possibilities, and a number of them are likely not feasible. However, all have been presented to provide a complete picture of the range of alternatives considered. It is anticipated that a PWS will be able to use the information contained herein to select the most attractive alternative(s) for more detailed evaluation and possible subsequent implementation.

4.5.1 Alternative FR-1: New Wells at 10 miles

This alternative consists of installing two new wells within 10 miles of the Freer WCID that would produce compliant water in place of the water produced by the existing wells. At this level of study, it is not possible to positively identify existing compliant wells or the location where new wells could be installed.

This alternative would require constructing two new 680-foot wells, a new pump station with a 5,000-gallon feed tank near the new wells, an additional pump station and feed tank along the pipeline, and a pipeline from the new well/feed tank to the existing intake point for the Freer WCID system. The pump stations and feed tanks would be necessary to overcome pipe friction and changes in elevation. For this alternative, the pipeline is assumed to be approximately 10 miles long, and would be a 4-inches in diameter. Each pump station would include a feed tank, two transfer pumps, including one standby, and would be housed in a building.

Depending on well location and capacity, this alternative could present some options for a more regional solution. It may be possible to share water and costs with another nearby system.

The estimated capital cost for this alternative includes installing the wells, constructing the pipeline, the pump stations, the feed tanks, service pumps and pump houses. The estimated O&M cost for this alternative includes O&M for the pipeline and pump stations. The estimated capital cost for this alternative is $2.46 million, and the estimated annual O&M cost for this alternative is $94,500.

The reliability of adequate amounts of compliant water under this alternative should be good, since water wells, pump stations and pipelines are commonly employed. From the perspective of the Freer WCID, this alternative would be similar to operate as the existing system. Freer WCID personnel have experience with O&M of wells, pipelines, and pump stations.

The feasibility of this alternative is dependent on the ability to find adequate existing wells or success in installing wells that produces an adequate supply of compliant water. It is likely that an alternate groundwater source would not be found on land owned by Freer WCID, so landowner cooperation would likely be required.

4.5.2 Alternative FR-2: New Wells at 5 miles

This alternative consists of installing two new wells within 5 miles of the Freer WCID that would produce compliant water in place of the water produced by the existing wells. At this level of study, it is not possible to positively identify existing wells or the location where new wells could be installed.

This alternative would require constructing two new 680-foot wells, a new pump station with a 5,000 gallon feed tank near the new well, and a pipeline from the new well/feed tank to the existing intake point for the Freer WCID system. The pump station and feed tank would be necessary to overcome pipe friction and changes in land elevation. For this alternative, the pipeline is assumed to be 4-inches in diameter, and approximately 5 miles long. The pump station near the wells would include two transfer pumps, including one standby, and would be housed in a building.

Depending on well location and capacity, this alternative could present some options for a more regional solution. It may be possible to share water and costs with another nearby system.

The estimated capital cost for this alternative includes installing the wells, and constructing the pipeline and pump station. The estimated O&M cost for this alternative includes O&M for the pipeline and pump station. The estimated capital cost for this alternative is $1.37 million, and the estimated annual O&M cost for this alternative is $50,900.

The reliability of adequate amounts of compliant water under this alternative should be good, since water wells, pump stations and pipelines are commonly employed. From the perspective of the Freer WCID, this alternative would be similar to operate as the existing system. Freer WCID personnel have experience with O&M of wells, pipelines and pump stations.

The feasibility of this alternative is dependent on the ability to find adequate existing wells or success in installing wells that produces an adequate supply of compliant water. It is likely an alternate groundwater source would not be found on land owned by Freer WCID, so landowner cooperation would likely be required.

4.5.3 Alternative FR-3: New Wells at 1 mile

This alternative consists of installing two new wells within 1 mile of the Freer WCID PWS that would produce compliant water in place of the water produced by the existing wells. At this level of study, it is not possible to positively identify existing wells or the location where a new wells could be installed.

This alternative would require constructing two new 680-foot wells and a pipeline from the new well to the existing intake point for the Freer WCID system. Since the new wells are relatively close, a pump station would not be necessary. For this alternative, the pipeline is assumed to be 4 inches in diameter, and approximately 1 mile long.

Depending on well location and capacity, this alternative could present some options for a more regional solution. It may be possible to share water and costs with another nearby system.

The estimated capital cost for this alternative includes installing the wells, and constructing the pipeline. The estimated O&M cost for this alternative includes O&M for the pipeline. The estimated capital cost for this alternative is $520,600, and the estimated annual O&M cost for this alternative is $7,400.

The reliability of adequate amounts of compliant water under this alternative should be good, since water wells and pipelines are commonly employed. From the perspective of the Freer WCID, this alternative would be similar to operate as the existing system. Freer WCID personnel have experience with O&M of wells, pipelines and pump stations.

The feasibility of this alternative is dependent on the ability to find adequate existing wells or success in installing wells that produces an adequate supply of compliant water. It is possible an alternate groundwater source would not be found on land owned by Freer WCID, so landowner cooperation may be required.

4.5.4 Alternative FR-4: Central RO Treatment

This system would continue to pump water from the existing wells, and would treat the water through an RO system prior to distribution. For this option, 100 percent of the raw water would be treated to obtain compliant water. The RO process concentrates impurities in the reject stream which would require disposal. It is estimated the RO reject generation would be approximately 190,000 gallons per day (gpd) when the system is operated at the average daily consumption (0.60 mgd).

This alternative consists of constructing the RO treatment plant near the existing wells. The plant is composed of a 2,200 square foot building with a paved driveway; a skid with the pre-constructed RO plant; two transfer pumps, a 5,000-gallon tank for storing the treated water, and a connection to the sewer system for discharge of reject water. The treated water would be chlorinated and stored in the new treated water tank prior to being pumped into the distribution system. The entire facility is fenced.

The estimated capital cost for this alternative is $2.36 million, and the estimated annual O&M cost is $638,700.

The reliability of adequate amount of compliant water under this alternative is good, since RO treatment is a common and well-understood treatment technology. However, O&M efforts required for the central RO treatment plant may be significant, and O&M personnel would require training with RO. The feasibility of this alternative is not dependent on the cooperation, willingness, or capability of other water supply entities.

4.5.5 Alternative FR-5: Coagulation/filtration Treatment

The system would treat groundwater from the wells using a coagulation/filtration system prior to distribution. This alternative consists of constructing the coagulation/filtration plant at the existing well site. The new treatment plant requires a 2,300 ft^2 building with a paved driveway, the pre-constructed coagulation/filtration system on a skid (*e.g.*, two Macrolite filters from Kinetico), a ferric chloride feed and storage system, and a 35,000-gallon backwash wastewater equalization tank. The water would be pre-chlorinated to oxidize As(III) to As(V) and post-chlorinated for disinfection prior to flowing to the distribution system. Ferric chloride solution would be fed to the well water after pre-chlorination and before entering the filters. The filters would be backwashed every one to two days by well water directly from the well pump. The backwash wastewater would be equalized in the 8,000-gallon tanks and discharged to the central wastewater collection system. The Macrolite media do not need replacement.

The estimated capital cost for this alternative is $1.28 and the estimated annual O&M cost is $107,000. This alternative requires more O&M labor cost and sludge disposal than the adsorption alternative. Reliability of supply of adequate amounts of compliant water under this alternative is good as the coagulation/filtration process is a well-established technology for arsenic removal. The technology is simple but requires significant effort for chemical handling and backwash monitoring. The feasibility of this alternative is not dependent on the cooperation, willingness, or capability of other water supply entities.

4.5.6 Alternative FR-6: Iron-based Adsorption Treatment

The system would treat groundwater from the existing wells using an iron-based adsorption system prior to distribution. This alternative consists of constructing the adsorption treatment plant near the well. The plant comprises a 2,300 ft^2 building with a paved driveway, the pre-constructed adsorption system on a skid (*e.g.,* one AdEdge APU-100 package units), and a 5,000-gallon backwash wastewater equalization tank. The water would be pre-chlorinated to oxidize AS(III) to AS(V) and post chlorinated for disinfection prior to pumping to the existing standpipe. Backwash would be required monthly with raw well water supplied directly by the well pump. The backwash would be equalized in the 5,000-gallon tank, allowed to settle, and the settled material would be discharged to the sewer system. The adsorption media are expected to last up to 2 years before replacement and disposal. The life of the media could be increased by lowering the raw water arsenic concentration.

The estimated capital cost for this alternative is $1.19 million, and the estimated annual O&M cost is $175,400 which includes the annual media replacement cost of $88,300. Reliability of supply of adequate amounts of compliant water under this alternative is good as the adsorption technology has been demonstrated effective in full-scale and pilot-scale facilities. The technology is simple and requires minimal O&M effort.

4.5.7 Alternative FR-7: Point-of-Use Treatment

This alternative consists of the continued operation of the Freer WCID well field, plus treatment of water to be used for drinking or food preparation at the point of use to remove arsenic. The purchase, installation, and maintenance of POU treatment systems to be installed "under the sink" would be necessary for this alternative. Blending is not an option in this case.

This alternative would require installing the POU treatment units in residences and other buildings that provide drinking or cooking water. Freer WCID staff would be responsible for purchase and maintenance of the treatment units, including membrane and filter replacement, periodic sampling, and necessary repairs. In houses, the most convenient point for installation of the treatment units is typically under the kitchen sink, with a separate tap installed for dispensing treated water. Installation of the treatment units in kitchens will require the entry of Freer WCID or contract personnel into the houses of customers. As a result, cooperation of customers would be important for success implementing this alternative. The treatment units could be installed for access without house entry, but that would complicate the installation and increase costs.

Treatment processes would involve RO. Treatment processes produce a reject waste stream. The reject waste streams result in a slight increase in the overall volume of water used. POU systems have the advantage that only a minimum volume of water is treated (only that for human consumption). This minimizes the size of the treatment units, the increase in water required, and the waste for disposal. For this alternative, it is assumed the increase in water consumption is insignificant in terms of supply cost, and that the reject waste stream can be discharged to the house septic or sewer system.

This alternative does not present options for a regional solution.

The estimated capital cost for this alternative includes purchasing and installing the POU treatment systems. The estimated O&M cost for this alternative includes the purchase and replacement of filters and membranes, as well as periodic sampling and record keeping as required by the Texas Administrative Code (TAC) (Title 30, Part I, Chapter 290, Subchapter F, Rule 290.106). The estimated capital cost for this alternative is $1.77 million, and the estimated annual O&M cost for this alternative is $1.16 million. For the cost estimate, it is assumed that one POU treatment unit will be required for each of the 1,394 connections in the Freer WCID PWS. It should be noted that the POU treatment units would need to be more complex than units typically found in commercial retail outlets in order to meet regulatory requirements, making purchase and installation more expensive. Additionally, capital cost would increase if POU treatment units are placed at other taps within a home, such as refrigerator water dispensers, ice makers, and bathroom sinks. In school settings, all taps where children and faculty receive water may need POU treatment units or clearly mark those taps suitable for human consumption. Additional considerations may be necessary for preschools or other establishments where individuals cannot read.

The reliability of adequate amounts of compliant water under this alternative is fair, since it relies on the active cooperation of the customers for system installation, use, and maintenance, and only provides compliant water to single tap within a house. Additionally, the O&M efforts (including monitoring of the devices to ensure adequate performance) required for the POU systems will be significant, and the current personnel are inexperienced in this type of work. From the perspective of the Freer WCID PWS, this alternative would be characterized as more difficult to operate owing to the in-home requirements and the large number of individual units.

The feasibility of this alternative is not dependent on the cooperation, willingness, or capability of other water supply entities.

4.5.8 Alternative FR-8: Point-of-Entry Treatment

This alternative consists of the continued operation of the Freer WCID well field, plus treatment of water as it enters residences to remove arsenic. The purchase, installation, and maintenance of the treatment systems at the point of entry to a household would be necessary for this alternative. Blending is not an option in this case.

This alternative would require the installation of the POE treatment units at houses and other buildings that provide drinking or cooking water. Every building connected to the system must have a POE device installed, maintained, and adequately monitored. TCEQ must be assured the system has 100 percent participation of all property and or building owners. A way to achieve 100 percent participation is through a public announcement and education program. Example public programs are provided in the document "*Point-of-Use or Point-of-Entry Treatment Options for Small Drinking Water Systems*" published by USEPA. The property owner's responsibilities for the POE device must also be contained in the title to the property and "run with the land" so subsequent property owners understand their responsibilities (USEPA 2006).

Freer WCID would be responsible for purchase, operation, and maintenance of the treatment units, including membrane and filter replacement, periodic sampling, and necessary repairs. It may also be desirable to modify piping so water for non-consumptive uses can be withdrawn upstream of the treatment unit. The POE treatment units would be installed outside the residences, so entry would not be necessary for O&M. Some cooperation from customers would be necessary for installation and maintenance of the treatment systems.

POE treatment for arsenic would involve RO. Treatment processes produce a reject stream that requires disposal. The reject water stream results in a slight increase in overall volume of water used. POE systems treat a greater volume of water than POU systems. For this alternative, it is assumed the increase in water consumption is insignificant in terms of supply cost, and that the backwash reject waste stream can be discharged to the house septic or sewer system.

This alternative does not present options for a regional solution.

The estimated capital cost for this alternative includes purchasing and installing the POE treatment systems. The estimated O&M cost for this alternative includes the purchase and replacement of filters and membranes, as well as periodic sampling and record keeping. The estimated capital cost for this alternative is $21.22 million, and the estimated annual O&M cost for this alternative is $2.99 million. For the cost estimate, it is assumed that one POE treatment unit will be required for each of the 1,394 existing connections to the Freer WCID system.

The reliability of adequate amounts of compliant water under this alternative are fair, but better than POU systems since it relies less on the active cooperation of the customers for system installation, use, and maintenance, and compliant water is supplied to all taps within a house. Additionally, the O&M efforts required for the POE systems will be significant, and the current personnel are inexperienced in this type of work. From the perspective of the Freer WCID PWS, this alternative would be characterized as more difficult to operate owing to the on-property requirements and the large number of individual units.

The feasibility of this alternative is not dependent on the cooperation, willingness, or capability of other water supply entities.

4.5.9 Alternative FR-9: Public Dispenser for Treated Drinking Water

This alternative consists of the continued operation of the Freer WCID wells, plus dispensing treated water for drinking and cooking at a publicly accessible location. Implementing this alternative would require purchasing and installing nine treatment units where customers would be able to come and fill their own containers. This alternative also includes notifying customers of the importance of obtaining drinking water from the dispenser. In this way, only a relatively small volume of water requires treatment, but customers would be required to pick up and deliver their own water. Blending is not an option in this case. It should be noted that this alternative would be considered an interim measure until a compliance alternative is implemented.

Freer WCID personnel would be responsible for maintenance of the treatment unit, including media or membrane replacement, periodic sampling, and necessary repairs. The spent media or membranes will require disposal. This alternative relies on a great deal of cooperation and action from the customers in order to be effective.

This alternative does not present options for a regional solution.

The estimated capital cost for this alternative includes purchasing and installing the treatment system to be used for the drinking water dispenser. The estimated O&M cost for this alternative includes purchasing and replacing filters and media or membranes, as well as periodic sampling and record keeping. The estimated capital cost for this alternative is $160,500, and the estimated annual O&M cost for this alternative is $311,500.

The reliability of adequate amounts of compliant water under this alternative is fair, because of the large amount of effort required from the customers and the associated inconvenience. Freer WCID has not provided this type of service in the past. From Freer WCID's perspective this alternative would be characterized as relatively easy to operate, since these types of treatment units are highly automated, and there are only nine units.

The feasibility of this alternative is not dependent on the cooperation, willingness, or capability of other water supply entities.

4.5.10 Alternative FR-10: 100 Percent Bottled Water Delivery

This alternative consists of the continued operation of the Freer WCID wells, but compliant drinking water will be delivered to customers in containers. This alternative involves setting up and operating a bottled water delivery program to serve all customers in the system. It is expected that Freer WCID would find it most convenient and economical to contract a bottled water service. The bottle delivery program would have to be flexible enough to allow the delivery of smaller containers should customers be incapable of lifting and manipulating 5-gallon bottles. Blending is not an option in this case. It should be noted that this alternative would be considered an interim measure until a compliance alternative is implemented.

This alternative does not involve capital cost for construction, but would require some initial costs for system setup, and then ongoing costs to have the bottled water furnished. It is assumed for this alternative that bottled water is provided to 100 percent of the Freer WCID PWS customers.

This alternative does not present options for a regional solution.

The estimated initial capital cost is for setting up the program. The estimated O&M cost for this alternative includes program administration and purchase of the bottled water. The estimated capital cost for this alternative is $27,000, and the estimated annual O&M cost for this alternative is $2.02 million. For the cost estimate, it is assumed that each person requires one gallon of bottled water per day.

The reliability of adequate amounts of compliant water under this alternative is fair, since it relies on the active cooperation of customers to order and utilize the water. Management and administration of the bottled water delivery program will require attention from Freer WCID.

The feasibility of this alternative is not dependent on the cooperation, willingness, or capability of other water supply entities.

4.5.11 Alternative FR-11: Public Dispenser for Trucked Drinking Water

This alternative consists of continued operation of the Freer WCID wells, plus dispensing compliant water for drinking and cooking at a publicly accessible location. The compliant water would be purchased from Falfurrias Utility Board, and delivered by truck to a tank at a central location where customers would be able to fill their own containers. This alternative also includes notifying customers of the importance of obtaining drinking water from the dispenser. In this way, only a relatively small volume of water requires treatment, but customers are required to pick up and deliver their own water. Blending is not an option in this case. It should be noted that this alternative would be considered an interim measure until a compliance alternative is implemented.

Freer WCID would purchase a truck suitable for hauling potable water, and install a storage tank. It is assumed the storage tank would be filled once a week, and that the chlorine residual would be tested for each truckload. The truck would have to meet requirements for potable water, and each load would be treated with bleach. This alternative relies on a great deal of cooperation and action from the customers for it to be effective.

This alternative presents limited options for a regional solution if two or more systems share the purchase and operation of the water truck.

The estimated capital cost for this alternative includes purchasing a water truck and construction of the storage tank to be used for the drinking water dispenser. The estimated O&M cost for this alternative includes O&M for the truck, maintenance for the tank, water quality testing, record keeping, and water purchase, The estimated capital cost for this alternative is $171,200, and the estimated annual O&M cost for this alternative is $67,100.

The reliability of adequate amounts of compliant water under this alternative is fair because of the large amount of effort required from the customers and the associated inconvenience. Current personnel have not provided this type of service in the past. From the perspective of Freer WCID, this alternative would be characterized as relatively easy to operate, but the water hauling and storage would have to be done with care to ensure sanitary conditions.

The feasibility of this alternative is not dependent on the cooperation, willingness, or capability of other water supply entities.

4.5.12 Summary of Alternatives

Table 4.2 provides a summary of the key features of each alternative for Freer WCID PWS.

Table 4.2 Summary of Compliance Alternatives for Freer WCID PWS

Alt No.	Alternative Description	Major Components	Capital Cost[1]	Annual O&M Cost	Total Annualized Cost	Reliability	System Impact	Remarks
FR-1	Install new compliant wells within 10 miles	- Two new wells - Two pump stations/ feed tanks - 10-mile pipeline	$2,462,900	$ 94,500	$309,300	Good	N	May be difficult to find well with good water quality.
FR-2	Install new compliant wells within 5 miles	- Two new wells - Pump station / feed tank - 5-mile pipeline	$1,371,300	$50,900	$170,400	Good	N	May be difficult to find well with good water quality.
FR-3	Install new compliant wells within 1 mile	- Two new wells - 1-mile pipeline	$520,600	$7,400	$52,800	Good	N	May be difficult to find well with good water quality.
FR-4	Continue operation of Freer WCID well field with central RO treatment	- Central RO treatment plant	$2,362,900	$638,700	$844,700	Good	T	No nearby system to possibly share treatment plant cost.
FR-5	Continue operation of Freer WCID well field with central coagulation/filtration treatment	- Central coagulation/filtration treatment plant	$1,277,900	$107,000	$218,400	Good	T	No nearby system to possibly share treatment plant cost.
FR-6	Continue operation of Freer WCID well field with central iron-based adsorption treatment	- Central iron-based adsorption treatment plant	$1,189,100	$175,400	$279,100	Good	T	No nearby system to possibly share treatment plant cost.
FR-7	Continue operation of Freer WCID well field, and POU treatment	- POU treatment units.	$1,771,100	$1,164,000	$1,318,400	Fair	T, M	Only one compliant tap in home. Cooperation of residents required for installation, maintenance, and testing.
FR-8	Continue operation of Freer WCID well field, and POE treatment	- POE treatment units.	$21,218,400	$2,990,100	$4,840,000	Fair (*better than POU*)	T, M	All home taps compliant and less resident cooperation required.
FR-9	Continue operation of Freer WCID well field, but furnish public dispenser for treated drinking water	- Water treatment and dispenser unit	$160,500	$311,500	$325,500	Fair/interim measure	T	Does not provide compliant water to all taps, and requires customers to order and use. Management of program may be significant.
FR-10	Continue operation of Freer WCID well field, but furnish bottled drinking water for all customers	- Set up bottled water system	$27,000	$2,015,900	$2,018,300	Fair/interim measure	M	Does not provide compliant water to all taps, and requires a lot of effort by customers.

Alt No.	Alternative Description	Major Components	Capital Cost[1]	Annual O&M Cost	Total Annualized Cost	Reliability	System Impact	Remarks
FR-11	Continue operation of Freer WCID well field, but furnish public dispenser for trucked drinking water.	- Construct storage tank and dispenser - Purchase potable water truck	$171,200	$67,100	$82,000	Fair/interim measure	M	Does not provide compliant water to all taps, and requires a lot of effort by customers.

Notes: *N – No significant increase required in technical or management capability*
T – Implementation of alternative will require increase in technical capability
M – Implementation of alternative will require increase in management capability
1 – See cost breakdown in Appendix C
2 – 20-year return period and 6 percent interest

4.6 COST OF SERVICE AND FUNDING ANALYSIS

To evaluate the financial impact of implementing the compliance alternatives, a 30-year financial planning model was developed. This model can be found in Appendix D. The financial model is based on estimated cash flows, with and without implementation of the compliance alternatives. Data for such models are typically derived from established budgets, audited financial reports, published water tariffs, and consumption data. Freer WCID operates a PWS with 1,394 connections serving a population of 4,038, which includes a wholesale population of 759 and 73 wholesale connections (wastewater services are also provided). . Information that was available for 2007 to complete the financial analysis included revenues and expenses, water usage records, and current water rates for the Freer WCID as well as data from other similar sized systems.

This analysis will need to be performed in a more detailed fashion and applied to alternatives deemed attractive and worthy of more detailed evaluation. A more detailed analysis should include additional factors such as:

- Cost escalation,
- Price elasticity effects where increased rates may result in lower water consumption,
- Costs for other system upgrades and rehabilitation needed to maintain compliant operation.

4.6.1 Financial Plan Development

The financial documents obtained included numbers that combined water and wastewater operations. For the financial model, water system expenses were estimated based on expenses for water systems of similar size, and water system revenues were assumed sufficient to cover operation and maintenance. According to the Freer WCID's financial statements for FY2007 and water use records, a total of 219 million gallons of water were sold in fiscal year 2007. The base residential rate for water is $22.00 per month for the first 3,000 gallons of water. Freer WCID uses a tiered system for water usage greater than the first 3,000 gallons.

4.6.2 Current Financial Condition

4.6.2.1 Cash Flow Needs

Using the financial data for water and wastewater services and water usage rates as noted above, the current average annual bill for Freer WCID customers is estimated at $658 or about 2.5 percent of the Freer WCID median household income of $25,112, as given in the 2000 Census.

4.6.2.2 Ratio Analysis

Since the financial documents did not separate liabilities, assets, revenues, and expenses for the water and wastewater operations, the calculated current ratio and debt to net worth ratio are for the combined water and wastewater system.

Current Ratio = 11.8

The Current Ratio is a measure of liquidity. It is defined as the ratio of Current Assets to current Liabilities. Current liabilities are defined as all debt due within 1 year. A Current Ratio of 11.8 indicates that the Freer WCID would be able to meet all its current obligations, with total current assets of $1.1 million exceeding the current liabilities of $93,018.

Debt to Net Worth Ratio = 0.918

A Debt to Net Worth ratio is another measure of financial liquidity and stability. The Freer WCID has a net worth of $1.27 million, and a total debt of $1.17, resulting in a debt to net worth ratio of 0.918. Ratios less than 1.25 are indicative of financial stability, with lower ratios indicating greater financial stability and better credit risks for future borrowings. Based on the present ratio, Freer WCID is financially stable.

Operating Ratio = 1.18

Since the financial documents did not separate liabilities, assets, revenues, and expenses for the water and wastewater operations, the calculated operating ratio is for the combined water and wastewater system. The Operating Ratio is a financial term defined as a company's revenues divided by the operating expenses. An operating ratio of 1.0 means that a utility is collecting just enough money to meet expenses. In general, an operating ratio of 1.25 or higher is desirable. An operating ratio of 1.18 indicates that Freer WCID is collecting enough to sustain operations.

4.6.3 Financial Plan Results

Each of the compliance alternatives for Freer WCID was evaluated using the financial model to determine the overall increase in water rates that would be necessary to pay for the improvements. Each alternative was examined under the various funding options described in Section 2.4.

Results of the financial impact analysis are provided in Table 4.3 and Figure 4.2. Table 4.3 and Figure 4.2 present rate impacts assuming that revenues match expenses, without funding reserve accounts, and that operations and implementation of compliance alternatives are funded with revenue and are not paid for from reserve accounts. Figure 4.2 provides a bar chart that, in terms of the yearly billing to an average customer (13,815 gallons/month consumption), shows the following:

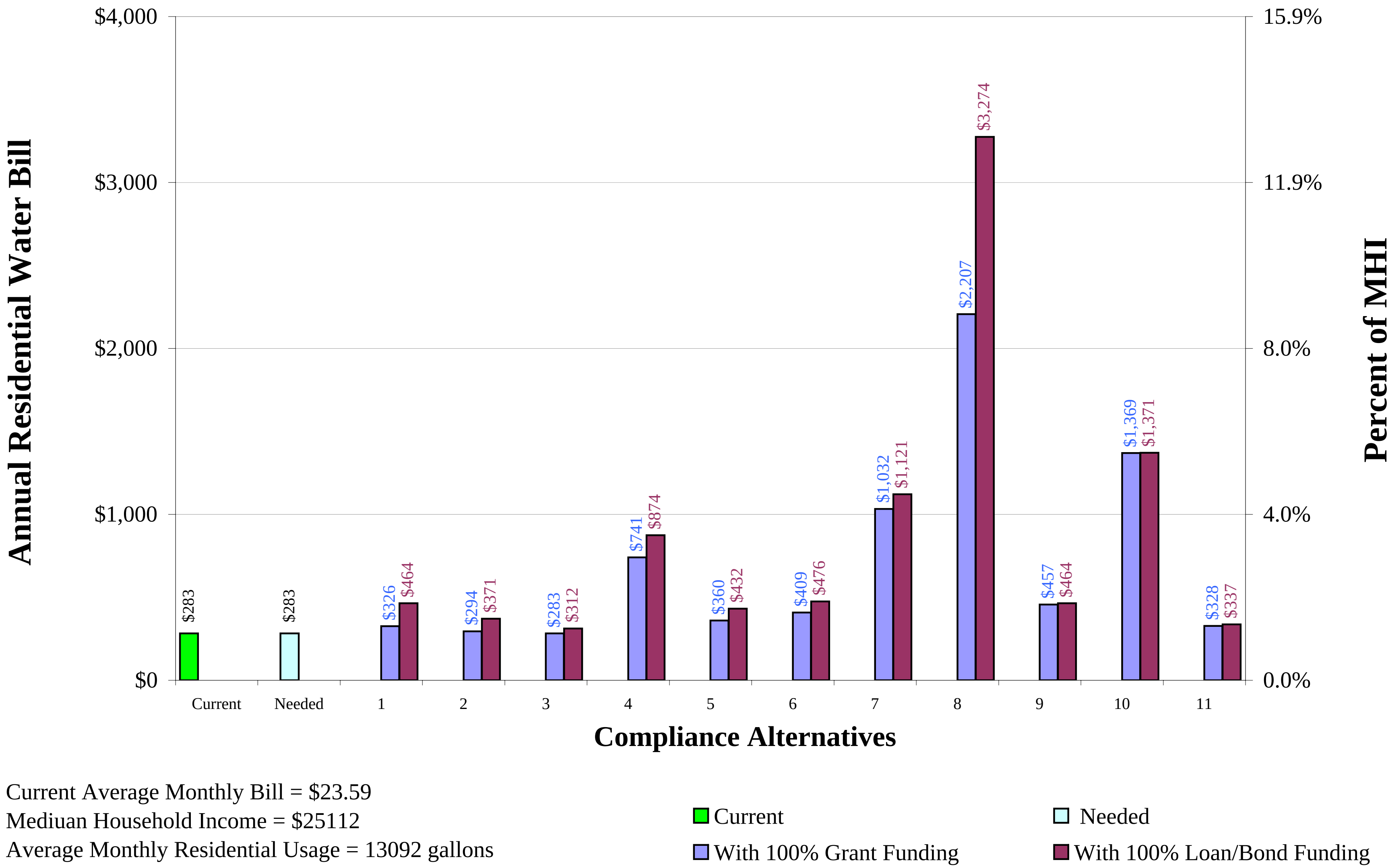
- Current annual average bill,
- Projected annual average bill including rate increase, if needed, to match existing expenditures, and
- Projected annual bill including rate increases needed to fund implementation of a compliance alternative (this does not include funding for reserve accounts).

Freer WCID

Table 4.3 Financial Impact on Households

Alternative	Description		All Revenue	100% Grant	75% Grant	50% Grant	SRF	Bond
1	New Well at 10 Miles	Maximum % of MHI	8.2%	1.3%	1.4%	1.6%	1.6%	1.8%
		Percentage Rate Increase Compared to Current	624%	15%	27%	40%	46%	64%
		Average Annual Water Bill	$2,050	$326	$360	$395	$414	$464
2	New Well at 5 Miles	Maximum % of MHI	5.0%	1.2%	1.2%	1.3%	1.4%	1.5%
		Percentage Rate Increase Compared to Current	347%	4%	11%	18%	21%	31%
		Average Annual Water Bill	$1,267	$294	$314	$333	$344	$371
3	New Well at 1 Mile	Maximum % of MHI	2.6%	1.1%	1.2%	1.2%	1.2%	1.2%
		Percentage Rate Increase Compared to Current	132%	0%	3%	5%	7%	10%
		Average Annual Water Bill	$657	$283	$290	$298	$302	$312
4	Central Treatment - RO	Maximum % of MHI	7.9%	3.0%	3.1%	3.2%	3.3%	3.5%
		Percentage Rate Increase Compared to Current	599%	162%	174%	185%	192%	209%
		Average Annual Water Bill	$1,978	$741	$774	$808	$826	$874
5	Central Treatment - Coag/Filt	Maximum % of MHI	4.8%	1.4%	1.5%	1.6%	1.6%	1.7%
		Percentage Rate Increase Compared to Current	324%	27%	33%	40%	43%	52%
		Average Annual Water Bill	$1,200	$360	$378	$396	$406	$432
6	Central Treatment - Iron Adsorp	Maximum % of MHI	4.5%	1.6%	1.7%	1.8%	1.8%	1.9%
		Percentage Rate Increase Compared to Current	301%	44%	50%	56%	60%	68%
		Average Annual Water Bill	$1,136	$409	$426	$442	$452	$476
7	Point-of-Use Treatment	Maximum % of MHI	5.7%	4.1%	4.2%	4.3%	4.3%	4.5%
		Percentage Rate Increase Compared to Current	402%	264%	272%	280%	285%	296%
		Average Annual Water Bill	$1,422	$1,032	$1,054	$1,076	$1,089	$1,121
8	Point-of-Entry Treatment	Maximum % of MHI	55.5%	8.8%	9.8%	10.9%	11.5%	13.0%
		Percentage Rate Increase Compared to Current	4821%	679%	774%	868%	920%	1057%
		Average Annual Water Bill	$13,932	$2,207	$2,473	$2,740	$2,889	$3,274
9	Public Dispenser for Treated Drinking Water	Maximum % of MHI	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%
		Percentage Rate Increase Compared to Current	61%	61%	62%	63%	63%	64%
		Average Annual Water Bill	$457	$457	$459	$460	$461	$464
10	Supply Bottled Water to 100% of Population	Maximum % of MHI	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
		Percentage Rate Increase Compared to Current	384%	384%	384%	384%	384%	384%
		Average Annual Water Bill	$1,369	$1,369	$1,370	$1,370	$1,370	$1,371
11	Central Trucked Drinking Water	Maximum % of MHI	1.6%	1.3%	1.3%	1.3%	1.3%	1.3%
		Percentage Rate Increase Compared to Current	43%	16%	17%	17%	18%	19%
		Average Annual Water Bill	$406	$328	$330	$332	$334	$337

Figure 4.2
Alternative Cost Summary: Freer WCID



Current Average Monthly Bill = $23.59
Mediuan Household Income = $25112
Average Monthly Residential Usage = 13092 gallons

The two bars shown for each compliance alternative represent the rate changes necessary for revenues to match total expenditures assuming 100 percent grant funding and 100 percent loan/bond funding. Most funding options will fall between 100 percent grant and 100 percent loan/bond funding, with the exception of 100 percent revenue financing. Establishing or increasing reserve accounts would require an increase in rates. If existing reserves are insufficient to fund a compliance alternative, rates would need to be raised before implementing the compliance alternative. This would allow for accumulation of sufficient reserves to avoid larger but temporary rate increases during the years the compliance alternative was being implemented.

4.6.4 Evaluation of Potential Funding Options

There are a variety of funding programs available to entities as described in Section 2.4. Freer WCID PWS is most likely to obtain funding from programs administered by the TWDB, ORCA, and Rural Development. This report contains information that would be used for an application for funding. Information such as financial analyses, water supply assessment, and records demonstrating health concerns, failing infrastructure, and financial need, may be required by these agencies. This section describes the candidate funding agencies and their appropriate programs as well as information and steps needed to begin the application process.

This report should serve to document the existing water quality issues, infrastructure need and costs, and water system information needed to begin the application process. Although this report is at the conceptual level, it demonstrates that significant funding will be needed to meet Safe Drinking Water Standards. The information provided in this report may serve as the needed documentation to justify a project that may only be possible with significant financial assistance.

4.6.4.1 TWDB Funding Options

TWDB programs include the Drinking Water State Revolving Fund (DWSRF), Rural Water Assistance Fund (RWAF), State Loan Program (Development Fund II), and Economically Distressed Areas Program (EDAP). Additional information on these programs can be found online at the TWDB website under the Assistance tab, Financial Assistance section, under the Public Works Infrastructure Construction subsection.

Drinking Water State Revolving Fund

The DWSRF offers net long-term interest lending rates below the rate the borrower would receive on the open market for a period of 20 years. Because the Freer WCID PWS is a “disadvantaged community,” it can receive a 30-year loan term. A cost-recovery loan origination charge is imposed to cover the administrative costs of operating the DWSRF, but an additional interest rate subsidy is offered to offset the charge. The terms of the loan typically require a revenue or tax pledge. Depending on how the origination charge is handled, interest rates can be as low as 0.95 percent below market rates with the possibility of additional federal subsidies for total interest rates 1.95 percent below market rates. Disadvantaged communities may obtain loans at interest rates between 0 percent and 1 percent.

The loan application process has several steps: pre-application, application and commitment, loan closing, funding and construction monitoring, and any other special requirements. In the pre-application phase, prospective loan applicants are asked to submit a brief DWSRF Information Form to the TWDB that describes the applicant's existing water facilities, additional facility needs and the nature of projects being considered for meeting those needs, project cost estimates, and "disadvantaged community" status. The TCEQ assigns a priority rating that includes an applicant's readiness to proceed. TWDB staff notify prospective applicants of their priority rating and encourage them to schedule a pre-planning conference for guidance in preparing the engineering, planning, environmental, financial, and water conservation portions of the DWSRF application.

Rural Water Assistance Fund

Small rural water utilities can finance water projects with attractive interest rate loans with short and long-term finance options at tax exempt rates. Funding through this program gives an added benefit to nonprofit water supply corporations as construction purchases and qualify for a sales tax exemption. Rural Political Subdivisions are eligible (nonprofit water supply corporations; water districts or municipalities serving a population of up to 10,000; and counties in which no urban area has a population exceeding 50,000). A nonprofit water supply corporation is eligible to apply these funds for design and construction of water projects. Projects can include line extensions, elevated storage, the purchase of well fields, the purchase or lease of rights to produce groundwater, and interim financing of construction projects. The fund may also be used to enable a rural water utility to obtain water service supplied by a larger utility or to finance the consolidation or regionalization of a neighboring utility.

A maximum financing life is 50 years for projects. The average financing period is 20 to 23 years. System revenues and/or tax pledges are typically required. The lending rate scale varies according to several factors, but is set by the TWDB based on cost of funds to the board, risk factors of managing the board loan portfolio, and market rate scales. The TWDB seeks to make reasonable loans with minimal risk to the state. The TWDB posts rates for comparison for applicants, and in August 2008 the TWDB showed its rates for a 22-year, taxable loan at 5.5 percent, where the market was at 7.84 percent. Funds in this program are not restricted.

The TWDB's Office of Project Finance and Construction Assistance staff can discuss the terms of the loan and assist applicants during preparation of the application, and this is encouraged. The application materials must include an engineering feasibility report, environmental information, rates and customer base, operating budgets, financial statements, and project information. The TWDB considers the needs of the area; benefits of the project; the relationship of the project to the overall state water needs; relationship of the project to the State Water Plan; and availability of all sources of revenue to the rural utility for the ultimate repayment of the water supply project cost. The board considers applications monthly.

State Loan Program (Development Fund II)

The State Loan Program is a diverse lending program directly from state funding sources. As it does not receive federal subsidies, it is more streamlined. The loans can incorporate more than one project under the umbrella of one loan. Water supply corporations are eligible, but will have taxable rates. Projects can include purchase of water rights, treatment plants, storage and pumping facilities, transmission lines, well development, and acquisitions.

The loan requires that the applicant pledge revenue or taxes, as well as some collateral for the Freer WCID PWS. The maximum financing life is 50 years. The average financing period is 20 to 23 years. The lending rate scale varies according to several factors, but is set by the TWDB based on cost of funds to the board, risk factors of managing the board loan portfolio, and market rate scales. The TWDB seeks to make reasonable loans with minimal risk to the state. The TWDB post rates for comparison for applicants and in August 2008, the TWDB showed their rates for a 22-year, taxable loan at 5.5 percent where the market was at 7.84 percent.

The TWDB staff can discuss the terms of the loan and assist applicants during preparation of the application, and a preapplication conference is encouraged. The application materials must include an engineering feasibility report, environmental information, rates and customer base, operating budgets, financial statements, and project information. The TWDB considers the needs of the area; benefits of the project; the relationship of the project to the overall state water needs and the State Water Plan; and the availability of all sources of revenue to the rural utility for the ultimate repayment of the loan. The board considers applications monthly.

Economically Distressed Areas Program

The EDAP Program was designed to assist areas along the U.S./Mexico border in areas that were economically distressed. In 2008, this program was extended to apply to the entire state so long as requirements are met. This program provides financial assistance through the provision of grants and loans to communities where present facilities are inadequate to meet residents minimal needs. Eligible communities are those that have median household income less than 75 percent of the state household income. Non-profit water supply corporations can apply, but they must be capable of maintaining and operating the completed system, and hold or be in the process of obtaining a Certificate of Convenience and Necessity. The county where the project is located must adopt model rules for the regulation of subdivisions prior to application for financial assistance. If the applicant is a city, the city must also adopt Model Subdivision Rules of TWDB (31 TAC Chapter 364). The program funds design, construction, improvements, and acquisition, and includes measures to prevent future substandard development. The TWDB works with the applicant to find ways to leverage other state and federal financial resources.

The loan requires that the applicant pledge revenue or taxes, as well as some collateral for Freer WCID. The maximum financing life is 50 years. The average financing period is 20 to 23 years. The lending rate scale varies according to several factors but is set by the TWDB based on cost of funds to the board, risk factors of managing the board loan portfolio, and market rate scales. The TWDB seeks to make reasonable loans with minimal loss to the state. The TWDB posts rates for comparison for applicants and in August 2008 the TWDB showed its rates for a 22-year, tax exempt loan at 5.11 percent where the market was at 5.60 percent. Most projects have a financial package with the majority of the project financed with grants. Many have received 100 percent grants.

The first step in the application process is to meet with TWDB staff to discuss the terms of the loan and assist applicants during preparation of the application. Major components of the application materials must include an engineering feasibility report, environmental information, rates and customer base, operating budgets, financial statements, community information, project information, and other legal information.

4.6.4.2 ORCA Funding Options

Created in 2001, ORCA seeks to strengthen rural communities and assist them with community and economic development and healthcare by providing a variety of rural programs, services, and activities. Of their many programs and funds, the most appropriate programs related to drinking water are the Community Development (CD) Fund, Colonias Program, and Texas Small Towns Environment Program (STEP). These programs offer attractive funding packages to help make improvements to potable water systems to mitigate potential health concerns. These programs are available to counties and cities, which have to submit an ORCA application on behalf of the water supply corporation (WSC). All program requirement would have to be met by the benefiting community receiving services by the WSC. Additional information can be found online at the ORCA website under the Community Development tab, Grant Funds Section, and clicking on the name of the program or grant.

Colonia Economically Distressed Areas Program

In the event a community, which is designated as economically distressed, receives TWDB funding through EDAP for water and sewer system improvement projects, it may be eligible to receive ORCA grants that can be used to connect households to the improved system. Funding may be used for connection fees, plumbing improvements, taps and meters, distribution lines, and other connection projects to a TWDB improvement project. Applications are submitted at the time an EDAP project construction begins and should work with CDBG staff to complete the application. In addition to CD Fund requirements, the community must be within 150 miles of the border and be designated a Colonia. These funds are submitted by the county on behalf of the Colonia and can be part of a project taken on by a nearby city to provide services to a nearby Colonia. Awards are given based on utilization of grant funds in a timely manner, past CDBG contract performance, availability of other resources, and effectiveness of funds to make connections to improve systems. Awards are on a “first-come, first serve” basis with a maximum of award of $500,000.

Community Development Fund

The CD Fund is a competitive grant program for water system improvements as well as other utility services (wastewater, drainage improvements, and housing activities). Funds are distributed between 24 state planning regions where funds are allocated to address each region's utility priorities. Funds can be used for various types of public works projects, including water system improvements. Communities with a population of less than 50,000 that are not eligible for direct CDBG funding from the U.S. Department of Housing and Urban Development are eligible. Funds are awarded on a competitive basis decided twice a year by regional review committees using a defined scoring system (past performance with CDBG is a factor). Awards are no less then $75,000 and cannot exceed $800,000. More information can be found at the Office of Community Affairs website under Community Development Fund.

Texas Small Towns Environment Program

Under special occasions some communities are invited to participate in grant programs when self-help is a feasible method for completing a water project, the community is committed to self-help, and the community has the capacity to complete the project. The purpose is to significantly reduce the cost of the project by using the communities' own human, material, and financial capital. Projects typically are repair, rehabilitation, improvements, service connections, and yard services. Reasonable associated administration and engineering cost can be funded. A letter of interest is first submitted, and after CDBG staff determine eligibility, an application may be submitted. Awards are only given twice per year on a priority basis so long as the project can be fully funded ($350,000 maximum award). Ranking criteria are project impact, local effort, past performance, percent of savings, and benefit to low to medium-income persons.

4.6.4.3 Rural Development

The RUS agency of Rural Development established a Revolving Fund Program (RFP) administered by the staff of the Water and Environment Program (WEP) to assist communities with water and wastewater systems. The purpose is to fund technical assistance and projects to help communities bring safe drinking water and sanitary, environmentally sound, waste disposal facilities to rural Americans in greatest need. WEP provides loans, grants, and loan guarantees for drinking water, sanitary sewer, solid waste, and storm drainage facilities in rural areas and cities and towns with a population of 10,000 or less. Recipients must be public entities such as municipalities, counties, special purpose districts, Indian tribes, and corporations not operated for profit. Projects include all forms of infrastructure improvement, acquisition of land and water rights, and design fees. Rural Development attempts to provide some level of assistance to all communities that apply. Funds are provided on a first come, first serve basis; however, staff do evaluate need and assign priorities as funds are limited. Grant/loan mixes vary on a case by case basis and some communities may have to wait though several funding cycles until funds become available.

Water and Wastewater Disposal Program

The major components of the RFP are loan, loan guarantees, and grant funding for water and waste disposal systems. Entities must demonstrate that they cannot obtain reasonable loans at market rates, but have the capacity to repay loans, pledge security, and operate the facilities.

Grants can be up to 75 percent of the project costs, and loan guarantees can be up to 90 percent of eligible loss. Loans are not to exceed a 40-year repayment period, require tax or revenue pledges, and are offered at three rates:

- Poverty Rate - The lowest rate is the poverty interest rate of 4.5 percent. Loans must be used to upgrade or construct new facilities to meet health standards, and the MHI in the service area must be below the poverty line for a family of four or below 80 percent of the statewide MHI for non-metropolitan communities.
- Market Rate – Where the MHI in the service exceeds the state MHI, the rate is based on the average of the "Bond Buyer" 11-Bond Index over a four week period.
- Intermediate Rate – the average of the Poverty Rate and the Market Rate, but not to exceed seven percent.

Water and Waste Disposal Grants and Loans (Section 306C for Colonias)

Grant funds at 100 percent are provided for areas along the U.S./Mexico border known as Colonias. Projects must construct basic drinking water, sanitary sewer, solid waste disposal, and storm drainage to serve residents of Colonias. Also, the systems can obtain funds to provide grant assistance directly to individuals to install necessary indoor plumbing and pay other costs of connecting to the system. Residents of the rural area to be served must face significant health risks when a significant proportion of the community's residents do not have access to or are not served by adequate, affordable water and/or waste disposal systems. Colonias is a term used to describe subdivisions that exist outside incorporated areas located along the United States-Mexico border. Colonias are generally characterized as small communities with inadequate drinking water, poor sanitary waste disposal facilities, and substandard housing. Aside from demonstrating health risks, areas not designated as a Colonia must show that (1) per capita income of the residents is not more than 70 percent of the most recent national average per capita income, as determined by the Department of Commerce; and (2) unemployment rate of the residents is not less than 125 percent of the most recent national average unemployment rate, as determined by the Bureau of Labor Statistics. Projects are ranked according to eligibility, a state preapplication review, RUS administrative review, population, income, other matching funds, Colonia status, and natural disaster effect.

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APPENDIX A
PWS INTERVIEW FORM

CAPACITY DEVELOPMENT ASSESSMENT FORM

*Prepared By*___________________________________ *Date*___________________________

Section 1. Public Water System Information

1. PWS ID # [ ] 2. Water System Name [ ]

3. County [ ]

4. Owner [ ] Address [ ]

   Tele. [ ] E-mail [ ]

   Fax [ ] Message [ ]

5. Admin [ ] Address [ ]

   Tele. [ ] E-mail [ ]

   Fax [ ] Message [ ]

6. Operator [ ] Address [ ]

   Tele. [ ] E-mail [ ]

   Fax [ ] Message [ ]

7. Population Served [ ] 8. No. of Service Connections [ ]

9. Ownership Type [ ] 10. Metered (Yes or No) [ ]

11. Source Type [ ]

12. Total PWS Annual Water Used [ ]

13. Number of Water Quality Violations (Prior 36 months)

    Total Coliform [ ] Chemical/Radiological [ ]

    Monitoring (CCR, Public Notification, etc.) [ ] Treatment Technique, D/DBP [ ]

A. Basic Information

1. Name of Water System:

2. Name of Person Interviewed:

3. Position:

4. Number of years at job:

5. Number of years experience with drinking water systems:

6. Percent of time (day or week) on drinking water system activities, with current position (how much time is dedicated exclusively to the water system, not wastewater, solid waste or other activities):

7. Certified Water Operator (Yes or No):

   If Yes,
   7a. Certification Level (water):

   7b. How long have you been certified?

8. Describe your water system related duties on a typical day.

B. Organization and Structure

1. Describe the organizational structure of the Utility. Please provide an organizational chart. (Looking to find out the governance structure (who reports to whom), whether or not there is a utility board, if the water system answers to public works or city council, etc.)

2. If not already covered in Question 1, to whom do you report?

3. Do all of the positions have a written job description?

   3a. If yes, is it available to employees?

   3b. May we see a copy?

C. Personnel

1. What is the current staffing level (include all personnel who spend more than 10% of their time working on the water system)?

2. Are there any vacant positions? How long have the positions been vacant?

3. In your opinion, is the current staffing level adequate? If not adequate, what are the issues or staffing needs (how many and what positions)?

4. What is the rate of employee turnover for management and operators? What are the major issues involved in the turnover (e.g., operator pay, working conditions, hours)?

5. Is the system staffed 24 hours a day? How is this handled (on-site or on-call)? Is there an alarm system to call an operator if an emergency occurs after hours?

D. Communication

1. Does the utility have a mission statement? If yes, what is it?

2. Does the utility have water quality goals? What are they?

3. How are your work priorities set?

4. How are work tasks delegated to staff?

5. Does the utility have regular staff meetings? How often? Who attends?

6. Are there separate management meetings? If so, describe.

7. Do management personnel ever visit the treatment facility? If yes, how often?

8. Is there effective communication between utility management and state regulators (e.g., NMED)?

9. Describe communication between utility and customers.

E. Planning and Funding

1. Describe the rate structure for the utility.

2. Is there a written rate structure, such as a rate ordinance? May we see it?

   2a. What is the average rate for 6,000 gallons of water?

3. How often are the rates reviewed?

4. What process is used to set or revise the rates?

5. In general, how often are the new rates set?

6. Is there an operating budget for the water utility? Is it separate from other activities, such as wastewater, other utilities, or general city funds?

7. Who develops the budget, how is it developed and how often is a new budget created or the old budget updated?

8. How is the budget approved or adopted?

9. In the last 5 years, how many budget shortfalls have there been (i.e., didn't collect enough money to cover expenses)? What caused the shortfall (e.g., unpaid bills, an emergency repair, weather conditions)?

    9a. How are budget shortfalls handled?

10. In the last 5 years how many years have there been budget surpluses (i.e., collected revenues exceeded expenses?

    10a. How are budget surpluses handled (i.e., what is done with the money)?

11. Does the utility have a line-item in the budget for emergencies or some kind of emergency reserve account?

12. How do you plan and pay for short-term system needs?

13. How do you plan and pay for long- term system needs?

14. How are major water system capital improvements funded? Does the utility have a written capital improvements plan?

15. How is the facility planning for future growth (either new hook-ups or expansion into new areas)?

16. Does the utility have and maintain an annual financial report? Is it presented to policy makers?

17. Has an independent financial audit been conducted of the utility finances? If so, how often? When was the last one?

18. Will the system consider any type of regionalization with any other PWS, such as system interconnection, purchasing water, sharing operator, emergency water connection, sharing bookkeeper/billing or other?

F. Policies, Procedures, and Programs

1. Are there written operational procedures? Do the employees use them?

2. Who in the utility department has spending authorization? What is the process for obtaining needed equipment or supplies, including who approves expenditures?

3. Does the utility have a source water protection program? What are the major components of the program?

4. Are managers and operators familiar with current SDWA regulations?

5. How do the managers and operators hear about new or proposed regulations, such as arsenic, DBP, Groundwater Rule? Are there any new regulations that will be of particular concern to the utility?

6. What are the typical customer complaints that the utility receives?

7. Approximately how many complaints are there per month?

8. How are customer complaints handled? Are they recorded?

9. (If not specifically addressed in Question 7) If the complaint is of a water quality nature, how are these types of complaints handled?

10. Does the utility maintain an updated list of critical customers?

11. Is there a cross-connection control plan for the utility? Is it written? Who enforces the plan's requirements?

12. Does the utility have a written water conservation plan?

13. Has there been a water audit of the system? If yes, what were the results?

14. (If not specifically answered in 11 above) What is the estimated percentage for loss to leakage for the system?

15. Are you, or is the utility itself, a member of any trade organizations, such as AWWA or Rural Water Association? Are you an active member (i.e., attend regular meetings or participate in a leadership role)? Do you find this membership helpful? If yes, in what ways does it help you?

G. Operations and Maintenance

1. How is decision-making authority split between operations and management for the following items:

    a. Process Control

    b. Purchases of supplies or small equipment

    c. Compliance sampling/reporting

    d. Staff scheduling

2. Describe your utility's preventative maintenance program.

3. Do the operators have the ability to make changes or modify the preventative maintenance program?

4. How does management prioritize the repair or replacement of utility assets? Do the operators play a role in this prioritization process?

5. Does the utility keep an inventory of spare parts?

6. Where does staff have to go to buy supplies/minor equipment? How often?

    6a. How do you handle supplies that are critical, but not in close proximity (for example if chlorine is not available in the immediate area or if the components for a critical pump are not in the area)

7. Describe the system's disinfection process. Have you had any problems in the last few years with the disinfection system?

    7a. Who has the ability to adjust the disinfection process?

8. How often is the disinfectant residual checked and where is it checked?

    8a. Is there an official policy on checking residuals or is it up to the operators?

9. Does the utility have an O & M manual? Does the staff use it?

10. Are the operators trained on safety issues? How are they trained and how often?

11. Describe how on-going training is handled for operators and other staff. How do you hear about appropriate trainings? Who suggests the trainings – the managers or the operators? How often do operators, managers, or other staff go to training? Who are the typical trainers used and where are the trainings usually held?

12. In your opinion is the level of your on-going training adequate?

13. In your opinion is the level of on-going training for other staff members, particularly the operators, adequate?

14. Does the facility have mapping of the water utility components? Is it used on any routine basis by the operators or management? If so, how is it used? If not, what is the process used for locating utility components?

15. In the last sanitary survey, were any deficiencies noted? If yes, were they corrected?

16. How often are storage tanks inspected? Who does the inspection?

    16a. Have you experienced any problems with the storage tanks?

H. SDWA Compliance

1. Has the system had any violations (monitoring or MCL) in the past 3 years? If so, describe.

2. How were the violations handled?

3. Does the system properly publish public notifications when notified of a violation?

4. Is the system currently in violation of any SDWA or state regulatory requirements, including failure to pay fees, fines, or other administrative type requirements?

5. Does the utility prepare and distribute a Consumer Confidence Report (CCR)? Is it done every year? What type of response does the utility get to the CCR from customers?

I. Emergency Planning

1. Does the system have a written emergency plan to handle emergencies such as water outages, weather issues, loss of power, loss of major equipment, etc?

2. When was the last time the plan was updated?

3. Do all employees know where the plan is? Do they follow it?

4. Describe the last emergency the facility faced and how it was handled.

Attachment A

A. Technical Capacity Assessment Questions

1. Based on available information of water rights on record and water pumped has the system exceeded its water rights in the past year? YES ☐ NO ☐

   In any of the past 5 years? YES ☐ NO ☐ How many times? _____

2. Does the system have the proper level of certified operator? *(Use questions a – c to answer.)*
   YES ☐ NO ☐

   a. What is the Classification Level of the system by NMED? _____

   b. Does the system have one or more certified operator(s)? [20 NMAC 7.4.20]

   YES ☐ NO ☐

   c. If YES, provide the number of operators at each New Mexico Certification Level. [20 NMAC 7.4.12]

   _____NM Small System _____Class 2

   _____NM Small System Advanced _____Class 3

   _____Class 1 _____Class 4

3. Did the system correct any sanitary deficiency noted on the most recent sanitary survey within 6 months of receiving that information? [20 NMAC 7.20.504]

   YES ☐ NO ☐ No Deficiencies ☐

   What was the type of deficiency? *(Check all that are applicable.)*

   Source ☐ Storage ☐

   Treatment ☐ Distribution ☐

   Other _____

   From the system's perspective, were there any other deficiencies that were not noted on the sanitary survey? Please describe.

4. Will the system's current treatment process meet known future regulations?

   Radionuclides YES ☐ NO ☐ Doesn't Apply ☐

   Arsenic YES ☐ NO ☐ Doesn't Apply ☐

   Stage 1 Disinfectants and Disinfection By-Product (DBP)

   YES ☐ NO ☐ Doesn't Apply ☐

   Surface Water Treatment Rule YES ☐ NO ☐ Doesn't Apply ☐

5. Does the system have a current site plan/map? [20 NMAC 7.10.302 A.1.]

   YES ☐ NO ☐

6. Has the system had a water supply outage in the prior 24 months?

YES ☐ NO ☐

What were the causes of the outage(s)? *(Include number of outages for each cause.)*

Drought _____ Limited Supply _____

System Failure _____ Other _____

7. Has the system ever had a water audit or a leak evaluation?

YES ☐ NO ☐ Don’t Know ☐

If YES, please complete the following table.

Type of Investigation	Date Done	Water Loss (%)	What approach or technology was used to complete the investigation?	Was any follow-up done? If so, describe

8. Have all drinking water projects received NMED review and approval? [20 NMAC 7.10.201]

YES ☐ NO ☐

If NO, what types of projects have not received NMED review and approval.

Source ☐ Storage ☐

Treatment ☐ Distribution ☐

Other ☐ _____

9. What are the typical customer complaints that the utility receives?

10. Approximately how many complaints are there per month? _____

11. How are customer complaints handled? Are they recorded?

12. What is the age and composition of the distribution system? ***(Collect this information from the Sanitary Survey)***

Pipe Material	Approximate Age	Percentage of the system	Comments
			Sanitary Survey Distribution System Records Attached

13. Are there any dead end lines in the system?

YES ☐ NO ☐

14. Does the system have a flushing program?

YES ☐ NO ☐

If YES, please describe.

15. Are there any pressure problems within the system?

YES ☐ NO ☐

If YES, please describe.

16. Does the system disinfect the finished water?

YES ☐ NO ☐

If yes, which disinfectant product is used? ______

Interviewer Comments on Technical Capacity:

B. Managerial Capacity Assessment Questions

17. Has the system completed a 5-year Infrastructure Capital Improvement Plan (ICIP) plan?

YES ☐ NO ☐

If YES, has the plan been submitted to Local Government Division?

YES ☐ NO ☐

18. Does the system have written operating procedures?

YES ☐ NO ☐

19. Does the system have written job descriptions for all staff?

YES ☐ NO ☐

20. Does the system have:

A preventative maintenance plan?
YES ☐ NO ☐
A source water protection plan?
YES ☐ NO ☐ N/A ☐
An emergency plan?
YES ☐ NO ☐
A cross-connection control program?
YES ☐ NO ☐
An emergency source?
YES ☐ NO ☐
System security measures?
YES ☐ NO ☐

21. Does the system report and maintain records in accordance with the drinking water regulations concerning:

Water quality violations
YES ☐ NO ☐

Public notification
YES ☐ NO ☐

Sampling exemptions
YES ☐ NO ☐

22. Please describe how the above records are maintained:

23. Describe the management structure for the water system, including board and operations staff. Please include examples of duties, if possible.

24. Please describe type and quantity of training or continuing education for staff identified above.

25. Describe last major project undertaken by the water system, including the following: project in detail, positive aspects, negative aspects, the way in which the project was funded, any necessary rate increases, the public response to the project, whether the project is complete or not, and any other pertinent information.

26. Does the system have any debt? YES ☐ NO ☐

If yes, is the system current with all debt payments?
YES ☐ NO ☐

If no, describe the applicable funding agency and the default.

27. Is the system currently contemplating or actively seeking funding for any project?
YES ☐ NO ☐

If yes, from which agency and how much?

Describe the project?

Is the system receiving assistance from any agency or organization in its efforts?

28. Will the system consider any type of regionalization with other PWS? *(Check YES if the system has already regionalized.)*

YES ☐ NO ☐

If YES, what type of regionalization has been implemented/considered/discussed? *(Check all that apply.)*

System interconnection ☐
Sharing operator ☐
Sharing bookkeeper ☐
Purchasing water ☐
Emergency water connection ☐
Other: _____

29. Does the system have any of the following? *(Check all that apply.)*

Water Conservation Policy/Ordinance ☐ Current Drought Plan ☐
Water Use Restrictions ☐ Water Supply Emergency Plan ☐

Interviewer Comments on Managerial Capacity:

C. Financial Capacity Assessment

30. Does the system have a budget?

YES ☐ NO ☐

If YES, what type of budget?

Operating Budget ☐

Capital Budget ☐

31. Have the system revenues covered expenses and debt service for the past 5 years?

YES ☐ NO ☐

If NO, how many years has the system had a shortfall? _____

32. Does the system have a written/adopted rate structure?

YES ☐ NO ☐

33. What was the date of the last rate increase? _____

34. Are rates reviewed annually?

YES ☐ NO ☐

IF YES, what was the date of the last review? _____

35. Did the rate review show that the rates covered the following expenses? *(Check all that apply.)*

Operation & Maintenance ☐

Infrastructure Repair & replacement ☐

Staffing ☐

Emergency/Reserve fund ☐

Debt payment ☐

36. Is the rate collection above 90% of the customers?

YES ☐ NO ☐

37. Is there a cut-off policy for customers who are in arrears with their bill or for illegal connections?

YES ☐ NO ☐

If yes, is this policy implemented?

38. What is the residential water rate for 6,000 gallons of usage in one month. _____

39. In the past 12 months, how many customers have had accounts frozen or dropped for non-payment? _____

[Convert to % of active connections

Less than 1% ☐ 1% - 3% ☐ 4% - 5% ☐ 6% - 10% ☐

11% - 20% ☐ 21% - 50% ☐ Greater than 50% ☐]

40. The following questions refer to the process of obtaining needed equipment and supplies.

a. Can the water system operator buy or obtain supplies or equipment when they are needed?

YES ☐ NO ☐

b. Is the process simple or burdensome to the employees?

c. Can supplies or equipment be obtained quickly during an emergency?

YES ☐ NO ☐

d. Has the water system operator ever experienced a situation in which he/she couldn't purchase the needed supplies?

YES ☐ NO ☐

e. Does the system maintain some type of spare parts inventory?

YES ☐ NO ☐

If yes, please describe.

41. Has the system ever had a financial audit?

YES ☐ NO ☐

If YES, what is the date of the most recent audit? ______

42. Has the system ever had its electricity or phone turned off due to non-payment? Please describe.

Interviewer Comments on Financial Assessment:

43. What do you think the system capabilities are now and what are the issues you feel your system will be facing in the future? In addition, are there any specific needs, such as types of training that you would like to see addressed by NMED or its contractors?

APPENDIX B
COST BASIS

This section presents the basis for unit costs used to develop the conceptual cost estimates for the compliance alternatives. Cost estimates are conceptual in nature (+50%/-30%), and are intended to make comparisons between compliance options and to provide a preliminary indication of possible rate impacts. Consequently, these costs are pre-planning level and should not be viewed as final estimated costs for alternative implementation. Capital cost includes an allowance for engineering and construction management. It is assumed that adequate electrical power is available near the site. The cost estimates specifically do not include costs for the following:

- Obtaining land or easements.
- Surveying.
- Mobilization/demobilization for construction.
- Insurance and bonds

In general, unit costs are based on recent construction bids for similar work in the area; when possible, consultations with vendors or other suppliers; published construction and O&M cost data; and USEPA cost guidance. Unit costs used for the cost estimates are summarized in Table B.1.

Unit costs for pipeline components are based on 2008 RS Means Site Work & Landscape Cost Data. The number of borings and encasements and open cuts and encasements is estimated by counting the road, highway, railroad, stream, and river crossings for a conceptual routing of the pipeline. The number of air release valves is estimated by examining the land surface profile along the conceptual pipeline route. It is assumed that gate valves and flush valves would be installed, on average, every 5,000 feet along the pipeline. Pipeline cost estimates are based on the use of C-900 PVC pipe. Other pipe materials could be considered for more detailed development of attractive alternatives.

Pump station unit costs are based on experience with similar installations. The cost estimate for the pump stations include two pumps, station piping and valves, station electrical and instrumentation, minor site improvement, installation of a concrete pad, fence and building, and tools. The number of pump stations is based on calculations of pressure losses in the proposed pipeline for each alternative. Back-flow prevention is required in cases where pressure losses are negligible, and pump stations are not needed. Construction cost of a storage tank is based on consultations with vendors and 2008 RS Means Site Work & Landscape Cost Data.

Labor costs are estimated based on 2008 RS Means Site Work & Landscape Cost Data specific to the Nueces County region.

Electrical power cost is estimated to be $0.136 per kWH, as an area average. The annual cost for power to a pump station is calculated based on the pumping head and volume, and includes 11,800 kWH for pump building heating, cooling, and lighting, as recommended in USEPA publication, *Standardized Costs for Water Supply Distribution Systems* (1992).

In addition to the cost of electricity, pump stations have other maintenance costs. These costs cover: materials for minor repairs to keep the pumps operating; purchase of a maintenance vehicle, fuel costs, and vehicle maintenance costs; utilities; office supplies, small tools and equipment; and miscellaneous materials such as safety, clothing, chemicals, and paint. The non-power O&M costs are estimated based on the USEPA publication, *Standardized Costs for Water Supply Distribution Systems* (1992), which provides cost curves for O&M components. Costs from the 1992 report are adjusted to 2008 dollars based on the ENR construction cost index.

Pipeline maintenance costs include routine cleaning and flushing, as well as minor repairs to lines. The unit rate for pipeline maintenance is calculated based on the USEPA technical report, *Innovative and Alternate Technology Assessment Manual MCD 53* (1978). Costs from the 1978 report are adjusted to 2008 dollars based on the ENR construction cost index.

Storage tank maintenance costs include cleaning and renewal of interior lining and exterior coating. Unit costs for storage tank O&M are based on USEPA publication *Standardized Costs for Water Supply Distribution Systems* (1992). Costs from the 1992 report are adjusted to 2008 dollars based on the ENR construction cost index.

The purchase price for point-of-use (POU) water treatment units is based on vendor price lists for treatment units, plus installation. O&M costs for POU treatment units are also based on vendor price lists. It is assumed that a yearly water sample would be analyzed for the contaminant of concern.

The purchase price for point-of-entry (POE) water treatment units is based on vendor price lists for treatment units, plus an allowance for installation, including a concrete pad and shed, piping modifications, and electrical connection. O&M costs for POE treatment units are also based on vendor price lists. It is assumed that a yearly water sample would be analyzed for the contaminant of concern.

Central treatment plant costs, include pricing for buildings, utilities, and site work. Costs are based on pricing given in the various R.S. Means Construction Cost Data References, as well as prices obtained from similar work on other projects. Pricing for treatment equipment was obtained from vendors.

Well installation costs are based on 2008 R.S. Means Site Work & Landscape Cost Data. Well installation costs include drilling, a well pump, electrical and instrumentation installation, well finishing, piping, and water quality testing. O&M costs for water wells include power, materials, and labor. It is assumed that new wells located more than 1 mile from the intake point of an existing system would require a storage tank and pump station.

Purchase price for the treatment unit dispenser is based on vendor price lists, plus an allowance for installation at a centralized public location. The O&M costs are also based on vendor price lists. It is assumed that weekly water samples would be analyzed for the contaminant of concern.

Costs for bottled water delivery alternatives are based on consultation with vendors that deliver residential bottled water. The cost estimate includes an initial allowance for set-up of the program, and a yearly allowance for program administration.

The cost estimate for a public dispenser for trucked water includes the purchase price for a water truck and construction of a storage tank. Annual costs include labor for purchasing the water, picking up and delivering the water, truck maintenance, and water sampling and testing. It is assumed the water truck would be required to make one trip each week, and that chlorine residual would be determined for each truck load.

Table B.1
Summary of General Data
Freer WCID
0660002
General PWS Information

Service Population	4,038	**Number of Connections**	1394
Total PWS Daily Water Usage	0.6 (mgd)	**Source**	Site visit list

Unit Cost Data

General Items	**Unit**	**Unit Cost**
Treated water purchase cost	*See alternative*	
Water purchase cost (trucked)	$/1,000 gals	$ 13.20
Contingency	20%	n/a
Engineering & Constr. Management	25%	n/a
Procurement/admin (POU/POE)	20%	n/a
Pipeline Unit Costs	**Unit**	**Unit Cost**
PVC water line, Class 200, 06"	LF	$ 18
Bore and encasement, 10"	LF	$ 240
Open cut and encasement, 10"	LF	$ 130
Gate valve and box, 04"	EA	$ 710
Air valve	EA	$ 2,050
Flush valve	EA	$ 1,025
Metal detectable tape	LF	$ 2.00
Bore and encasement, length	Feet	200
Open cut and encasement, length	Feet	50
Pump Station Unit Costs	**Unit**	**Unit Cost**
Pump	EA	$ 8,000
Pump Station Piping, 04"	EA	$ 550
Gate valve, 04"	EA	$ 710
Check valve, 04"	EA	$ 755
Electrical/Instrumentation	EA	$ 10,250
Site work	EA	$ 2,560
Building pad	EA	$ 5,125
Pump Building	EA	$ 10,250
Fence	EA	$ 6,150
Tools	EA	$ 1,025
5,000 gal feed tank	EA	$ 10,000
Backflow preventer, 4"	EA	$ 2,295
Backflow Testing/Certification	EA	$ 105
Well Installation Unit Costs	**Unit**	**Unit Cost**
Well installation	*See alternative*	
Water quality testing	EA	$ 1,280
25 HP Well Pump	EA	$ 7,550
Well electrical/instrumentation	EA	$ 5,635
Well cover and base	EA	$ 3,075
Piping	EA	$ 3,075
100,000 gal ground storage tank	EA	$ 100,000
Electrical Power	$/kWH	$ 0.136
Building Power	kWH	11,800
Labor	$/hr	$ 60
Materials	EA	$ 1,540
Transmission main O&M	$/mile	$ 275
Tank O&M	EA	$ 1,025
POU/POE Unit Costs		
POU treatment unit purchase	EA	$ 615
POU treatment unit installation	EA	$ 155
POE treatment unit purchase	EA	$ 5,125
POE - pad and shed, per unit	EA	$ 2,050
POE - piping connection, per unit	EA	$ 1,025
POE - electrical hook-up, per unit	EA	$ 1,025
POU Treatment O&M, per unit	$/year	$ 230
POE Treatment O&M, per unit	$/year	$ 1,540
Treatment analysis	$/year	$ 205
POU/POE labor support	$/hr	$ 40
Dispenser/Bottled Water Unit Costs		
POE-Treatment unit purchase	EA	$ 7,175
POE-Treatment unit installation	EA	$ 5,125
Treatment unit O&M	EA	$ 2,050
Administrative labor	hr	$ 45
Bottled water cost (inc. delivery)	gallon	$ 1.35
Water use, per capita per day	gpcd	1.0
Bottled water program materials	EA	$ 5,125
30,000 gal ground storage tank	EA	$ 40,000
Site improvements	EA	$ 3,075
Potable water truck	EA	$ 75,000
Water analysis, per sample	EA	$ 205
Potable water truck O&M costs	$/mile	$ 3.00

Central Treatment Unit Costs	**Unit**	**Unit Cost**
General		
Site preparation	acre	$ 4,000
Slab	CY	$ 1,000
Building	SF	$ 60
Building electrical	SF	$ 8.00
Building plumbing	SF	$ 8.00
Heating and ventilation	SF	$ 7.00
Fence	LF	$ 15
Paving	SF	$ 2.00
Chlorination point	EA	$ 4,000
Building power	kwh/yr	$ 0.136
Equipment power	kwh/yr	$ 0.136
Labor, O&M	hr	$ 40
Analyses	test	$ 200
Adsorption		
Electrical	JOB	$ 80,000
Piping	JOB	$ 50,000
Adsorption package plant	UNIT	$ 395,000
Backwash tank	GAL	$ 2.00
Sewer connection fee	EA	$ 15,000
Spent media disposal	CY	$ 20
Adsorption materials replacement	kgal	$ 0.40
Backwash discharge to sewer	MG/year	$ 5,000
Coagulation/filtration		
Electrical	JOB	$ 80,000
Piping	JOB	$ 40,000
Coagulation package plant	UNIT	$ 396,000
Backwash tank	GAL	$ 2.00
Coagulant tank	GAL	$ 3.00
Sewer connection fee	EA	$ 15,000
Coagulation/Filtration Materials	year	$ 8,000
Chemicals, Coagulation	year	$ 2,000
Backwash discharge to sewer	MG/year	$ 5,000
Reverse Osmosis		
Electrical	JOB	$ 100,000
Piping	JOB	$ 50,000
RO package plant	UNIT	$ 1,070,000
Transfer pumps (5 hp)	EA	$ 5,000
Permeate tank	gal	$ 3
RO materials and chemicals	kgal	$ 0.43
RO chemicals	year	$ 2,000
Backwash disposal mileage cost	miles	$ 1.50
Reject (brine) disposal fee	per 1,000 gal	$ 5.00
Analyses	test	$ 50
Reject Pond		
Reject pond, excavation	CYD	$ 3
Reject pond, compacted fill	CYD	$ 7
Reject pond, lining	SF	$ 1.50
Reject pond, vegetation	SY	$ 1.50
Reject pond, access road	LF	$ 30
Reject water haulage truck	EA	$ 100,000

APPENDIX C
COMPLIANCE ALTERNATIVE CONCEPTUAL COST ESTIMATES

This appendix presents the conceptual cost estimates developed for the compliance alternatives. The conceptual cost estimates are given in Tables C.1 through C.11. The cost estimates are conceptual in nature (+50%/-30%), and are intended for making comparisons between compliance options and to provide a preliminary indication of possible water rate impacts. Consequently, these costs are pre-planning level and should not be viewed as final estimated costs for alternative implementation.

Table C.1

PWS Name ***Freer WCID***
Alternative Name ***New Well at 10 Miles***
Alternative Number ***FR-1***

Distance from PWS to new well location	10.0	miles	600000	gpd
Estimated well depth	680	feet	417	gpm
Number of wells required	2		0.92833708	cfs
Well installation cost (location specific)	$147	per foot	6	diameter inches
Pump Stations needed w/ 1 feed tank each	2		0.19634954	area ft2
On site storage tanks / pump sets needed	0		4.72798194	velocity

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	3	n/a	n/a	n/a
Number of Crossings, open cut	12	n/a	n/a	n/a
PVC water line, Class 200, 06"	52,800	LF	$ 18	$ 950,400
Bore and encasement, 10"	600	LF	$ 240	$ 144,000
Open cut and encasement, 10"	600	LF	$ 130	$ 78,000
Gate valve and box, 04"	11	EA	$ 710	$ 7,498
Air valve	13	EA	$ 2,050	$ 26,650
Flush valve	11	EA	$ 1,025	$ 10,824
Metal detectable tape	52,800	LF	$ 2	$ 105,600
Subtotal				**$ 1,322,972**
Pump Station(s) Installation				
Pump	4	EA	$ 8,000	$ 32,000
Pump Station Piping, 04"	2	EA	$ 550	$ 1,100
Gate valve, 04"	8	EA	$ 710	$ 5,680
Check valve, 04"	4	EA	$ 755	$ 3,020
Electrical/Instrumentation	2	EA	$ 10,250	$ 20,500
Site work	2	EA	$ 2,560	$ 5,120
Building pad	2	EA	$ 5,125	$ 10,250
Pump Building	2	EA	$ 10,250	$ 20,500
Fence	2	EA	$ 6,150	$ 12,300
Tools	2	EA	$ 1,025	$ 2,050
5,000 gal feed tank	2	EA	$ 10,000	$ 20,000
100,000 gal ground storage tank	-	EA	$ 100,000	$ -
Subtotal				**$ 132,520**
Well Installation				
Well installation	1,360	LF	$ 147	$ 199,240
Water quality testing	4	EA	$ 1,280	$ 5,120
Well pump	2	EA	$ 7,550	$ 15,100
Well electrical/instrumentation	2	EA	$ 5,635	$ 11,270
Well cover and base	2	EA	$ 3,075	$ 6,150
Piping	2	EA	$ 3,075	$ 6,150
Subtotal				**$ 243,030**
Subtotal of Component Costs				**$ 1,698,522**
Contingency	20%			$ 339,704
Design & Constr Management	25%			$ 424,630
TOTAL CAPITAL COSTS				**$ 2,462,856**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	10.0	mile	$ 275	$ 2,750
Subtotal				**$ 2,750**
Pump Station(s) O&M				
Building Power	23,600	kWH	$ 0.136	$ 3,210
Pump Power	361,460	kWH	$ 0.136	$ 49,159
Materials	2	EA	$ 1,540	$ 3,080
Labor	730	Hrs	$ 40.00	$ 29,200
Tank O&M	-	EA	$ 1,025	$ -
Subtotal				**$ 84,648**
Well O&M				
Pump power	1,100,162	kWH	$ 0.136	$ 149,622
Well O&M matl	2	EA	$ 1,540	$ 3,080
Well O&M labor	360	Hrs	$ 40	$ 14,400
Subtotal				**$ 167,102**
O&M Credit for Existing Well Closure				
Pump power	1,047,580	kWH	$ 0.136	$ (142,471)
Well O&M matl	2	EA	$ 1,540	$ (3,080)
Well O&M labor	360	Hrs	$ 40	$ (14,400)
Subtotal				**$ (159,951)**
TOTAL ANNUAL O&M COSTS				**$ 94,549**

Table C.2

PWS Name *Freer WCID*
Alternative Name *New Well at 5 Miles*
Alternative Number *FR-2*

Distance from PWS to new well location	5.0	miles
Estimated well depth	680	feet
Number of wells required	2	
Well installation cost (location specific)	$147	per foot
Pump Stations needed w/ 1 feed tank each	1	
On site storage tanks / pump sets needed	0	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	1	n/a	n/a	n/a
Number of Crossings, open cut	6	n/a	n/a	n/a
PVC water line, Class 200, 06"	26,400	LF	$ 18	$ 475,200
Bore and encasement, 10"	200	LF	$ 240	$ 48,000
Open cut and encasement, 10"	300	LF	$ 130	$ 39,000
Gate valve and box, 04"	5	EA	$ 710	$ 3,749
Air valve	6	EA	$ 2,050	$ 12,300
Flush valve	5	EA	$ 1,025	$ 5,412
Metal detectable tape	26,400	LF	$ 2	$ 52,800
Subtotal				**$ 636,461**
Pump Station(s) Installation				
Pump	2	EA	$ 8,000	$ 16,000
Pump Station Piping, 04"	1	EA	$ 550	$ 550
Gate valve, 04"	4	EA	$ 710	$ 2,840
Check valve, 04"	2	EA	$ 755	$ 1,510
Electrical/Instrumentation	1	EA	$ 10,250	$ 10,250
Site work	1	EA	$ 2,560	$ 2,560
Building pad	1	EA	$ 5,125	$ 5,125
Pump Building	1	EA	$ 10,250	$ 10,250
Fence	1	EA	$ 6,150	$ 6,150
Tools	1	EA	$ 1,025	$ 1,025
5,000 gal feed tank	1	EA	$ 10,000	$ 10,000
100,000 gal ground storage tank	-	EA	$ 100,000	$ -
Subtotal				**$ 66,260**
Well Installation				
Well installation	1,360	LF	$ 147	$ 199,240
Water quality testing	4	EA	$ 1,280	$ 5,120
Well pump	2	EA	$ 7,550	$ 15,100
Well electrical/instrumentation	2	EA	$ 5,635	$ 11,270
Well cover and base	2	EA	$ 3,075	$ 6,150
Piping	2	EA	$ 3,075	$ 6,150
Subtotal				**$ 243,030**
Subtotal of Component Costs				**$ 945,751**
Contingency	20%			$ 189,150
Design & Constr Management	25%			$ 236,438
TOTAL CAPITAL COSTS				**$ 1,371,339**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	5.0	mile	$ 275	$ 1,375
Subtotal				**$ 1,375**
Pump Station(s) O&M				
Building Power	11,800	kWH	$ 0.136	$ 1,605
Pump Power	180,730	kWH	$ 0.136	$ 24,579
Materials	1	EA	$ 1,540	$ 1,540
Labor	365	Hrs	$ 40.00	$ 14,600
Tank O&M	-	EA	$ 1,025	$ -
Subtotal				**$ 42,324**
Well O&M				
Pump power	1,100,162	kWH	$ 0.136	$ 149,622
Well O&M matl	2	EA	$ 1,540	$ 3,080
Well O&M labor	360	Hrs	$ 40	$ 14,400
Subtotal				**$ 167,102**
O&M Credit for Existing Well Closure				
Pump power	1,047,580	kWH	$ 0.136	$ (142,471)
Well O&M matl	2	EA	$ 1,540	$ (3,080)
Well O&M labor	360	Hrs	$ 40	$ (14,400)
Subtotal				**$ (159,951)**
TOTAL ANNUAL O&M COSTS				**$ 50,850**

Table C.3

PWS Name	***Freer WCID***
Alternative Name	***New Well at 1 Mile***
Alternative Number	***FR-3***

Distance from PWS to new well location	1.0	miles
Estimated well depth	680	feet
Number of wells required	2	
Well installation cost (location specific)	$147	per foot
Pump Stations needed w/ 1 feed tank each	0	
On site storage tanks / pump sets needed	0	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	-	n/a	n/a	n/a
Number of Crossings, open cut	1	n/a	n/a	n/a
PVC water line, Class 200, 06"	5,280	LF	$ 18	$ 95,040
Bore and encasement, 10"	-	LF	$ 240	$ -
Open cut and encasement, 10"	50	LF	$ 130	$ 6,500
Gate valve and box, 04"	1	EA	$ 710	$ 750
Air valve	1	EA	$ 2,050	$ 2,050
Flush valve	1	EA	$ 1,025	$ 1,082
Metal detectable tape	5,280	LF	$ 2	$ 10,560
Subtotal				**$ 115,982**
Pump Station(s) Installation				
Pump	-	EA	$ 8,000	$ -
Pump Station Piping, 04"	-	EA	$ 550	$ -
Gate valve, 04"	-	EA	$ 710	$ -
Check valve, 04"	-	EA	$ 755	$ -
Electrical/Instrumentation	-	EA	$ 10,250	$ -
Site work	-	EA	$ 2,560	$ -
Building pad	-	EA	$ 5,125	$ -
Pump Building	-	EA	$ 10,250	$ -
Fence	-	EA	$ 6,150	$ -
Tools	-	EA	$ 1,025	$ -
5,000 gal feed tank	-	EA	$ 10,000	$ -
100,000 gal ground storage tank	-	EA	$ 100,000	$ -
Subtotal				**$ -**
Well Installation				
Well installation	1,360	LF	$ 147	$ 199,240
Water quality testing	4	EA	$ 1,280	$ 5,120
Well pump	2	EA	$ 7,550	$ 15,100
Well electrical/instrumentation	2	EA	$ 5,635	$ 11,270
Well cover and base	2	EA	$ 3,075	$ 6,150
Piping	2	EA	$ 3,075	$ 6,150
Subtotal				**$ 243,030**
Subtotal of Component Costs				**$ 359,012**
Contingency	20%			$ 71,802
Design & Constr Management	25%			$ 89,753
TOTAL CAPITAL COSTS				**$ 520,568**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	1.0	mile	$ 275	$ 275
Subtotal				**$ 275**
Pump Station(s) O&M				
Building Power	-	kWH	$ 0.136	$ -
Pump Power	-	kWH	$ 0.136	$ -
Materials	-	EA	$ 1,540	$ -
Labor	-	Hrs	$ 40.00	$ -
Tank O&M	-	EA	$ 1,025	$ -
Subtotal				**$ -**
Well O&M				
Pump power	1,100,162	kWH	$ 0.136	$ 149,622
Well O&M matl	2	EA	$ 1,540	$ 3,080
Well O&M labor	360	Hrs	$ 40	$ 14,400
Subtotal				**$ 167,102**
O&M Credit for Existing Well Closure				
Pump power	1,047,580	kWH	$ 0.136	$ (142,471)
Well O&M matl	2	EA	$ 1,540	$ (3,080)
Well O&M labor	360	Hrs	$ 40	$ (14,400)
Subtotal				**$ (159,951)**
TOTAL ANNUAL O&M COSTS				**$ 7,426**

Table C.4

PWS Name ***Freer WCID***
Alternative Name ***Central Treatment - Reverse Osmosis***
Alternative Number ***FR-4***

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Reverse Osmosis Unit Purchase/Installation				
Site preparation	1.00	acre	$ 4,000	$ 4,000
Slab	83	CY	$ 1,000	$ 82,500
Building	2,200	SF	$ 60	$ 132,000
Building electrical	2,200	SF	$ 8	$ 17,600
Building plumbing	2,200	SF	$ 8	$ 17,600
Heating and ventilation	2,200	SF	$ 7	$ 15,400
Fence	900	LF	$ 15	$ 13,500
Paving	6,000	SF	$ 2	$ 12,000
Electrical	1	JOB	$ 100,000	$ 100,000
Piping	1	JOB	$ 50,000	$ 50,000
Reverse osmosis package including:				
High pressure pumps - 20 hp				
Cartridge filters and vessels				
RO membranes and vessels				
Control system				
Chemical feed systems				
Freight cost				
Vendor start-up services	1	UNIT	$ 1,070,000	$ 1,070,000
Transfer pumps	4	EA	$ 5,000	$ 20,000
Permeate tank	5,000	gal	$ 3	$ 15,000
Feed Tank	15,000	gal	$ 3	$ 45,000
Brine Pipeline to Sewer	1	EA	$ 35,000	$ 35,000
Subtotal of Design/Construction Costs				**$ 1,629,600**
Contingency	25%			$ 407,400
Design & Constr Management	20%			$ 325,920
TOTAL CAPITAL COSTS				**$ 2,362,920**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Reverse Osmosis Unit O&M				
Building Power	20,000	kwh/yr	$ 0.136	$ 2,720
Equipment power	792,000	kwh/yr	$ 0.136	$ 107,712
Labor	2,000	hrs/yr	$ 40.00	$ 80,000
RO materials and Chemicals	220,800	kgal	$ 0.43	$ 94,944
Analyses	24	test	$ 200	$ 4,800
Subtotal				**$ 290,176**
Reject (brine) disposal				
Reject (brine) disposal fee	69,711	kgal/yr	$ 5.00	$ 348,556
Subtotal				**$ 348,556**
TOTAL ANNUAL O&M COSTS				**$ 638,732**

Table C.5

PWS Name *Freer WCID*
Alternative Name *Central Treatment - Coagulation/Filtration*
Alternative Number *FR-5*

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Coagulation/Filtration Unit Purchase/Installation				
Site preparation	0.50	acre	$ 4,000	$ 2,000
Slab	50	CY	$ 1,000	$ 50,000
Building	2,300	SF	$ 60	$ 138,000
Building electrical	2,300	SF	$ 8	$ 18,400
Building plumbing	2,300	SF	$ 8	$ 18,400
Heating and ventilation	2,300	SF	$ 7	$ 16,100
Fence	1,500	LF	$ 15	$ 22,500
Paving	5,000	SF	$ 2	$ 10,000
Electrical	1	JOB	$ 80,000	$ 80,000
Piping	1	JOB	$ 40,000	$ 40,000
Coagulant/filter package including:				
Chemical feed system				
Pressure ceramic filters				
Controls & Instruments	1	UNIT	$ 396,000	$ 396,000
Backwash Tank	35,000	GAL	$ 2	$ 70,000
Coagulant Tank	300	GAL	$ 3	$ 900
Sewer Connection Fee	1	EA	$ 15,000	$ 15,000
Chlorination Point	1	EA	$ 4,000	$ 4,000
Subtotal of Component Costs				**$ 881,300**
Contingency	20%			$ 176,260
Design & Constr Management	25%			$ 220,325
TOTAL CAPITAL COSTS				**$ 1,277,885**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Coagulation/Filtration Unit O&M				
Building Power	9,000	kwh/yr	$ 0.136	$ 1,224
Equipment power	64,000	kwh/yr	$ 0.136	$ 8,704
Labor	2,000	hrs/yr	$ 40	$ 80,000
Materials	1	year	$ 8,000	$ 8,000
Chemicals	1	year	$ 2,000	$ 2,000
Analyses	24	test	$ 200	$ 4,800
Backwash discharge to sewer	0.45	MG/yr	$ 5,000	$ 2,250
Subtotal				**$ 106,978**
TOTAL ANNUAL O&M COSTS				**$ 106,978**

Table C.6

PWS Name ***Freer WCID***
Alternative Name ***Central Treatment - Iron-Based Adsorption***
Alternative Number ***FR-6***

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Adsorption Unit Purchase/Installation				
Site preparation	0.80	acre	$ 4,000	$ 3,200
Slab	50	CY	$ 1,000	$ 50,000
Building	2,300	SF	$ 60	$ 138,000
Building electrical	2,300	SF	$ 8	$ 18,400
Building plumbing	2,300	SF	$ 8	$ 18,400
Heating and ventilation	2,300	SF	$ 7	$ 16,100
Fence	800	LF	$ 15	$ 12,000
Paving	5,000	SF	$ 2	$ 10,000
Electrical	1	JOB	$ 80,000	$ 80,000
Piping	1	JOB	$ 50,000	$ 50,000
Adsorption package including:				
3 Adsorption vessels				
E33 Iron oxide media				
Controls & instruments	1	UNIT	$ 395,000	$ 395,000
Backwash Tank	5,000	GAL	$ 2	$ 10,000
Sewer Connection Fee	1	EA	$ 15,000	$ 15,000
Chlorination Point	1	EA	$ 4,000	$ 4,000
Subtotal of Component Costs				**$ 820,100**
Contingency	20%			$ 164,020
Design & Constr Management	25%			$ 205,025
TOTAL CAPITAL COSTS				**$ 1,189,145**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Adsorption Unit O&M				
Building Power	9,000	kwh/yr	$ 0.136	$ 1,224
Equipment power	5,000	kwh/yr	$ 0.136	$ 680
Labor	2,000	hrs/yr	$ 40	$ 80,000
Media replacement	220,700	kgal	$ 0.40	$ 88,280
Analyses	24	test	$ 200	$ 4,800
Backwash discharge to sewer	0.03	MG/yr	$ 5,000	$ 150
Spent Media Disposal	14	CY	$ 20	$ 280
Subtotal				**$ 175,414**
TOTAL ANNUAL O&M COSTS				**$ 175,414**

Table C.7

PWS Name ***Freer WCID***
Alternative Name ***Point-of-Use Treatment***
Alternative Number ***FR-7***

Number of Connections for POU Unit Installation 1,394 connections

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
POU-Treatment - Purchase/Installation				
POU treatment unit purchase	1,394	EA	$ 615	$ 857,310
POU treatment unit installation	1,394	EA	$ 155	$ 216,070
Subtotal				**$ 1,073,380**
Subtotal of Component Costs				**$ 1,073,380**
Contingency	20%			$ 214,676
Design & Constr Management	25%			$ 268,345
Procurement & Administration	20%			$ 214,676
TOTAL CAPITAL COSTS				**$ 1,771,077**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
O&M				
POU materials, per unit	1,394	EA	$ 230	$ 320,620
Contaminant analysis, 1/yr per unit	1,394	EA	$ 205	$ 285,770
Program labor, 10 hrs/unit	13,940	hrs	$ 40	$ 557,600
Subtotal				**$ 1,163,990**
TOTAL ANNUAL O&M COSTS				**$ 1,163,990**

Table C.8

PWS Name ***Freer WCID***
Alternative Name ***Point-of-Entry Treatment***
Alternative Number ***FR-8***

Number of Connections for POE Unit Installation 1,394 connections

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
POE-Treatment - Purchase/Installati				
POE treatment unit purchase	1,394	EA	$ 5,125	$ 7,144,250
Pad and shed, per unit	1,394	EA	$ 2,050	$ 2,857,700
Piping connection, per unit	1,394	EA	$ 1,025	$ 1,428,850
Electrical hook-up, per unit	1,394	EA	$ 1,025	$ 1,428,850
Subtotal				**$ 12,859,650**
Subtotal of Component Costs				**$ 12,859,650**
Contingency	20%			$ 2,571,930
Design & Constr Management	25%			$ 3,214,913
Procurement & Administration	20%			$ 2,571,930
TOTAL CAPITAL COSTS				**$ 21,218,423**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
O&M				
POE materials, per unit	1,394	EA	$ 1,540	$ 2,146,760
Contaminant analysis, 1/yr per unit	1,394	EA	$ 205	$ 285,770
Program labor, 10 hrs/unit	13,940	hrs	$ 40	$ 557,600
Subtotal				**$ 2,990,130**
TOTAL ANNUAL O&M COSTS				**$ 2,990,130**

Table C.9

PWS Name *Freer WCID*
Alternative Name *Public Dispenser for Treated Drinking Water*
Alternative Number *FR-9*

Number of Treatment Units Recommended 9

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Public Dispenser Unit Installation				
POE-Treatment unit(s)	9	EA	$ 7,175	$ 64,575
Unit installation costs	9	EA	$ 5,125	$ 46,125
Subtotal				**$ 110,700**
Subtotal of Component Costs				**$ 110,700**
Contingency	20%			$ 22,140
Design & Constr Management	25%			$ 27,675
TOTAL CAPITAL COSTS				**160,515**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Program Operation				
Treatment unit O&M, 1 per unit	9	EA	$ 2,050	$ 18,450
Contaminant analysis, 1/wk per u	468	EA	$ 205	$ 95,940
Sampling/reporting, 1 hr/day	3,285	HRS	$ 60	$ 197,100
Subtotal				**$ 311,490**
TOTAL ANNUAL O&M COSTS				**$ 311,490**

Table C.10

PWS Name ***Freer WCID***
Alternative Name ***Supply Bottled Water to 100% of Population***
Alternative Number ***FR-10***

Service Population	4,038	
Percentage of population requiring supply	100%	
Water consumption per person	1.00	gpcd
Calculated annual potable water needs	1,473,870	gallons

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Program Implementation				
Initial program set-up	500	hours	$ 45	$ 22,500
Subtotal				**$ 22,500**
Subtotal of Component Costs				**$ 22,500**
Contingency	20%			$ 4,500
TOTAL CAPITAL COSTS				**$ 27,000**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Program Operation				
Water purchase costs	1,473,870	gals	$ 1.35	$ 1,989,725
Program admin, 9 hrs/wk	468	hours	$ 45	$ 21,060
Program materials	1	EA	$ 5,125	$ 5,125
Subtotal				**$ 2,015,910**
TOTAL ANNUAL O&M COSTS				**$ 2,015,910**

Table C.11

PWS Name ***Freer WCID***
Alternative Name ***Central Trucked Drinking Water***
Alternative Number ***FR-11***

Service Population	4,038	
Percentage of population requiring supply	100%	
Water consumption per person	1.00	gpcd
Calculated annual potable water needs	1,473,870	gallons
Travel distance to compliant water source	58	miles

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Storage Tank Installation				
30,000 gal ground storage tank	1	EA	$ 40,000	$ 40,000
Site improvements	1	EA	$ 3,075	$ 3,075
Potable water truck	1	EA	$ 75,000	$ 75,000
Subtotal				**$ 118,075**
Subtotal of Component Costs				**$ 118,075**
Contingency	20%			$ 23,615
Design & Constr Management	25%			$ 29,519
TOTAL CAPITAL COSTS				**$ 171,209**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Program Operation				
Water delivery labor, 4 hrs/wk	208	hrs	$ 60	$ 12,480
Truck operation, 1 round trip/wk	6,074	miles	$ 3.00	$ 18,221
Water purchase	1,474	1,000 gals	$ 13.20	$ 19,455
Water testing, 1 test/wk	52	EA	$ 205	$ 10,660
Sampling/reporting, 2 hrs/wk	104	hrs	$ 60	$ 6,240
Subtotal				**$ 67,056**
TOTAL ANNUAL O&M COSTS				**$ 67,056**

APPENDIX D
EXAMPLE FINANCIAL MODEL

Freer WCID

Number of Alternatives 11 Selected from Results Sheet

Input Fields are Indicated by:

General Inputs		
Implementation Year	2009	
Months of Working Capital	0	
Depreciation	$ -	
Percent of Depreciation for Replacement Fund	0%	
Allow Negative Cash Balance (yes or no)	No	
Median Household Income	$ 25,112	Freer WCID
Median HH Income -- Texas	$ 39,927	
Grant Funded Percentage	0%	Selected from Results
Capital Funded from Revenues	$ -	

	Base Year Growth/Escalation	2007
Accounts & Consumption		
Metered Residential Accounts		
Number of Accounts	0.0%	1394
Number of Bills Per Year		12
Annual Billed Consumption		219,000,000
Consumption per Account Per Pay Period	0.0%	13,092
Consumption Allowance in Rates		3,000
Total Allowance		50,184,000
Net Consumption Billed		168,816,000
Percentage Collected		100.0%
Unmetered Residential Accounts		
Number of Accounts	0.0%	0
Number of Bills Per Year		12
Percentage Collected		100.0%
Metered Non-Residential Accounts		
Number of Accounts	0.0%	0
Number of Bills Per Year		12
Non-Residential Consumption		-
Consumption per Account	0.0%	-
Consumption Allowance in Rates		-
Total Allowance		-
Net Consumption Billed		-
Percentage Collected		0.0%
Unmetered Non-Residential Accounts		
Number of Accounts	0.0%	0
Number of Bills Per Year		12
Percentage Collected		100.0%
Water Purchase & Production		
Water Purchased (gallons)	0.0%	-
Average Cost Per Unit Purchased	0.0%	$ -
Bulk Water Purchases	0.0%	$ -
Water Production	0.0%	219,000,000
Unaccounted for Water		-
Percentage Unaccounted for Water		0.0%

Freer WCID		
Number of Alternatives	11	Selected from Results Sheet
Input Fields are Indicated by:		

Residential Rate Structure	Allowance within Tier	
	-	
Estimated Average Water Rate ($/1000gallons)		$ 1.80
Non-Residential Rate Structure		
	-	
Estimated Average Water Rate ($/1000gallons)		$ 1.80
INITIAL YEAR EXPENDITURES	Inflation	Initial Year
Operating Expenditures:		
Salaries & Benefits	0.0%	-
Contract Labor	0.0%	-
Water Purchases	0.0%	-
Chemicals, Treatment	0.0%	-
Utilities	0.0%	-
Repairs, Maintenance, Supplies	0.0%	-
Repairs	0.0%	-
Maintenance	0.0%	-
Supplies	0.0%	-
Administrative Expenses	0.0%	
Accounting and Legal Fees	0.0%	-
Insurance	0.0%	-
Automotive and Travel	0.0%	-
Professional and Directors Fees	0.0%	-
Bad Debts	0.0%	-
Garbage Pick-up	0.0%	-
Miscellaneous	0.0%	-
Other 3	0.0%	394,627
Other 4	0.0%	-
Incremental O&M for Alternative	0.0%	-
Total Operating Expenses		394,627
Non-Operating Income/Expenditures		
Interest Income	0.0%	-
Other Income	0.0%	-
Other Expense	0.0%	-
Transfers In (Out)	0.0%	-
Net Non-Operating		-

Esisting Debt Service		
Bonds Payable, Less Current Maturities		$ -
Bonds Payable, Current		$ -
Interest Expense		$ -

Debt Service for Freer WCID
Alternative Number = 11
Funding Source = Loan/Bond

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Existing Debt Service	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Principal Payments		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest Payment	0.00%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Term	25																															
Revenue Bonds		-	-	171,209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forgiveness	0.00%	-	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Balance		-	-	171,209	168,088	164,781	161,274	157,558	153,618	149,442	145,015	140,323	135,349	130,077	124,489	118,565	112,286	105,630	98,575	91,096	83,169	74,765	65,858	56,417	46,409	35,800	24,555	12,635	0	0	0	0
Principal		-	-	3,121	3,308	3,506	3,717	3,940	4,176	4,427	4,692	4,974	5,272	5,588	5,924	6,279	6,656	7,055	7,479	7,927	8,403	8,907	9,442	10,008	10,609	11,245	11,920	12,635	-	-	-	-
Interest	6.00%	-	-	10,273	10,085	9,887	9,676	9,453	9,217	8,967	8,701	8,419	8,121	7,805	7,469	7,114	6,737	6,338	5,914	5,466	4,990	4,486	3,951	3,385	2,785	2,148	1,473	0	0	0	0	0
Total Debt Service		-	-	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	12,635	0	0	0	0
New Balance		-	-	168,088	164,781	161,274	157,558	153,618	149,442	145,015	140,323	135,349	130,077	124,489	118,565	112,286	105,630	98,575	91,096	83,169	74,765	65,858	56,417	46,409	35,800	24,555	12,635	0	0	0	0	0
Term	20																															
State Revolving Fund		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forgiveness	0.00%	-	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Principal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest	0.00%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Term	10																															
Bank/Interfund Loan				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forgiveness	0.00%	-	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Principal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest	8.00%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Term	25																															
RUS Loan			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forgiveness	0.00%		-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Principal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest	5.00%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Cashflow Projections for Freer WCID
Alternative Number = 11
Funding Source = Loan/Bond

Estimated At Sept. 30 of Each Year

	Growth/	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
	Escalation	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
CASH FLOW PROJECTIONS																																
Beginning Unrestricted Cash Balance		$ -	5	5	-	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	0	0	0
RECEIPTS																																
Operating Revenues																																
Water Base Rate-- Residential	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 1 -- Res	100,000	394,632	394,632	408,020	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	469,413	456,778	456,778	456,778	456,778
Water: Tier 2 -- Res	100,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 3 -- Res	200,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 4 -- Res	300,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unmetered Residential		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Base Rate - Non Residential	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 1 -- NR	100,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 2 -- NR	100,000,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 3 -- NR	200,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 4 -- NR	300,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unmetered Non Residential		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sewer Sales		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 3		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Operating Revenues		$ 394,632	$ 394,632	$ 408,020	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 470,171	$ 469,413	$ 456,778	$ 456,778	$ 456,778	$ 456,778
Capital Receipts																																
Grants Received		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SRF Proceeds		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bank/Interfund Loan Proceeds		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUS Loan Proceeds		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bond Proceeds		-	-	171,209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Capital Receipts		-	-	171,209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Receipts		394,632	394,632	579,229	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	469,413	456,778	456,778	456,778	456,778
EXPENDITURES																																
Operating Expenditures:																																
Salaries & Benefits	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Contract Labor	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Purchases	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chemicals, Treatment	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Utilities	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repairs, Maintenance, Supplies	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repairs	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Supplies	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Administrative Expenses	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Accounting and Legal Fees	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Insurance	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Automotive and Travel	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Professional and Directors Fees	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bad Debts	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Garbage Pick-up	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Miscellaneous	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 3	0.0%	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627	394,627
Other 4	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Incremental O&M for Alternative	0.0%	-	-	-	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151	62,151
Total Operating Expenses		394,627	394,627	394,627	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778	456,778
Non-Operating Income/Expenditures																																
Interest Income	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Income	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Expense	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transfers In (Out)	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Net Non-Operating		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Debt Service																																
Existing		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Proposed:																																
Revenue Bonds		-	-	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	12,635	0	0	0	0
State Revolving Fund		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bank Loan		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUS Loan		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service		-	-	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	13,393	12,635	0	0	0	0
Capital Expenditures	$ 171,209																															
Funded From Revenues/Reserves	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded From Grants	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded From SRF Loans		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded from Bank/Interfund Loans		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded from RUS Loan		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded from Bonds		-	-	171,209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Capital Expenditures		-	-	171,209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Expenditures		394,627	394,627	579,229	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	470,171	469,413	456,778	456,778	456,778	456,778
What Water Rev Needs to be		(394,627)	(394,627)	(408,020)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(470,171)	(469,413)	(456,778)	(456,778)	(456,778)	(456,778)
Water Rate Increase		0.00%	0.00%	3.39%	15.23%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-0.16%	-2.69%	0.00%	0.00%	0.00%
Net Cash Flow		5	5	-	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	0	0	0	0
Reserves:																																
Working Capital (Months O&M)	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Replacement Reserve		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Required Reserves		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average Annual Water Bill	$ 337	$ 283	$ 283	$ 293	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 337	$ 328	$ 328	$ 328	$ 328
Median Household Income		$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112	$ 25,112
Maximum % of MHI	1.3%	1.1%	1.1%	1.2%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%
Percentage Rate Increase Compared to Current	19.1%		0.0%	3.4%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	19.1%	18.9%	15.7%	15.7%	15.7%	15.7%