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

CYNDIE PARK II WSC
PWS ID# 1780050, CCN# 12100

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 2009

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 Cyndie Park II Water Supply Corporation (WSC) PWS (PWS ID# 1780050, Certificate of Convenience and Necessity (CCN) #12100, located in Nueces County. The Cyndie Park II PWS is located approximately 7.5 northwest of Banquete, Texas near the intersection of Cindy Lane and Farm-to-Market Road 1833. The water system serves a population of 50 and has 18 connections. The water source comes from one groundwater well completed to a depth of approximately 398 feet in the Chicot aquifer. Well #1 (G178005A) is rated at 36 gallons per minute. The average daily water demand is approximately 3,030 gallon per day.

During the period from October 2001 through January 2009, Cyndie Park II PWS recorded arsenic concentrations between 0.0098 milligrams per liter (mg/L) and 0.0146 mg/L with an overall average of 0.0113 mg/L, which exceeds than the MCL of 10 mg/L (USEPA 2009a; TCEQ 2008). Therefore, Cyndie Park II PWS faces compliance issues under the water quality standards for arsenic.

Basic system information for the Cyndie Park II PWS is shown in Table ES.1.

Table ES.1 Cyndie Park II PWS
Basic System Information

Population served	50
Connections	18
Average daily flow rate	0.003 million gallons per day (mgd)
Peak demand flow rate	8.4 gallons per minute
Water system peak capacity	0.051 mgd
Typical arsenic range	0.0098 mg/L – 0.0146 mg/L

STUDY METHODS

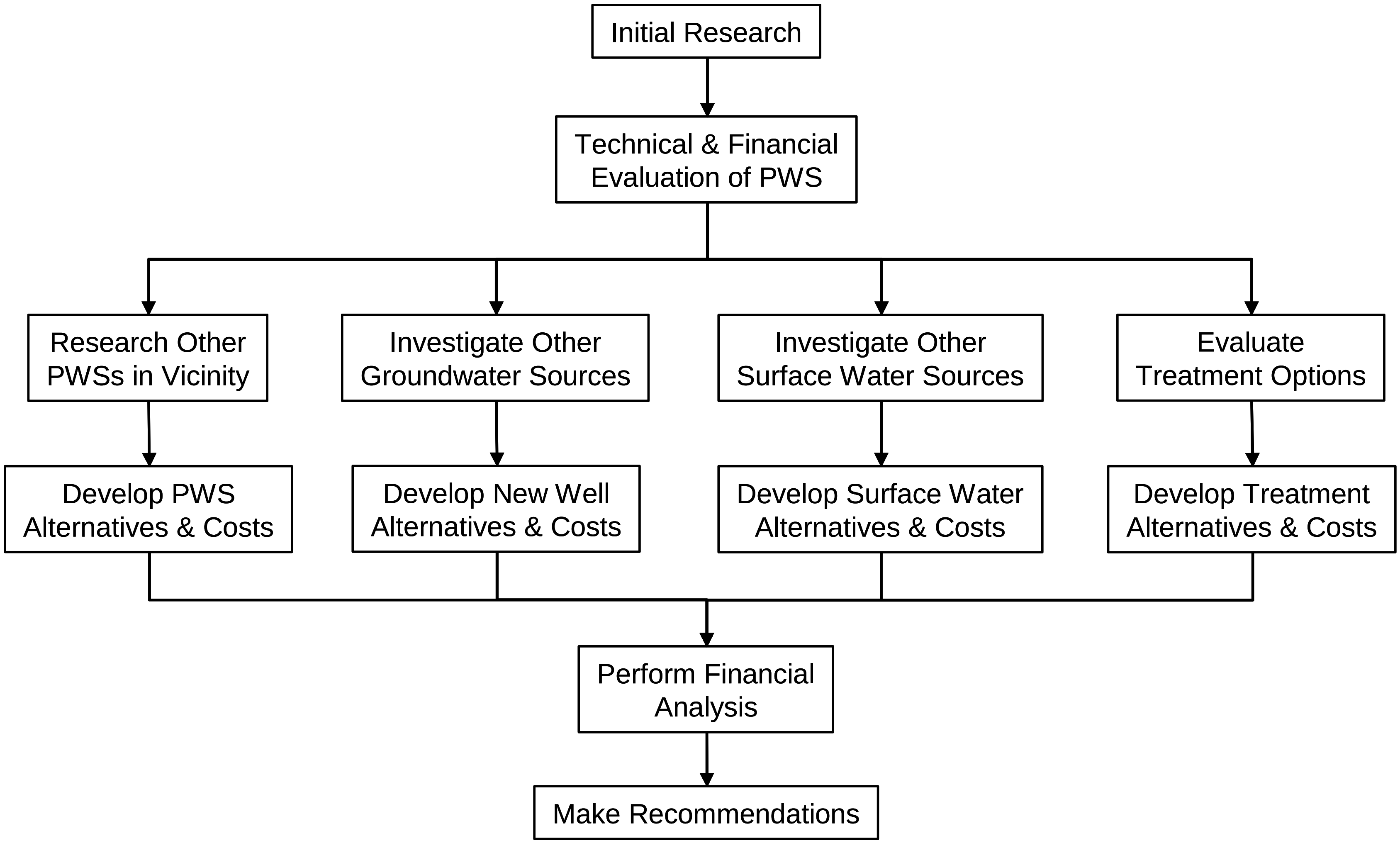
The methods used for this project were based on a pilot project performed in 2004 and 2005 by TCEQ, BEG, and Parsons. Methods for identifying and analyzing compliance options were developed in the pilot project (a decision tree approach).

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

1. Gather data from the TCEQ and Texas Water Development Board databases, from TCEQ files, and from information maintained by the PWS;
2. Conduct financial, managerial, and technical (FMT) evaluations of the PWS;
3. Perform a geologic and hydrogeologic assessment of the study area;
4. Develop treatment and non-treatment compliance alternatives that, in general, consist of the following possible options:
   a. 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;
   b. Installing new wells within the vicinity of the PWS into other aquifers with confirmed water quality standards meeting the MCLs;
   c. 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;
   d. Treating the existing non-compliant water supply by various methods depending on the type of contaminant; and
   e. Delivering potable water by way of a bottled water program or a treated water dispenser as an interim measure only.
5. Assess each of the potential alternatives with respect to economic and non-economic criteria;
6. Prepare a feasibility report and present the results to the PWS.

This basic approach is summarized in Figure ES.1.

1 **Figure ES.1 Summary of Project Methods**



HYDROGEOLOGICAL ANALYSIS

The Cyndie Park II PWS obtains groundwater from the Evangeline subunit of the Gulf Coast Aquifer. Arsenic is commonly found in area wells at concentrations greater than the MCL. Deepening the wells may yield higher quality groundwater. Also, arsenic concentrations can vary significantly over relatively short distances; as a result, there could be good quality groundwater nearby. However, the variability of arsenic concentrations makes it difficult to determine where wells can be located to produce acceptable water. It may be possible to perform down-hole testing on non-compliant wells to determine the source of the contaminants. If the contaminants derive primarily from a single part of the formation, that part could be excluded by modifying the existing well, or avoided altogether by completing a new well.

COMPLIANCE ALTERNATIVES

Overall, the system had an inadequate 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 some positive aspects including staff longevity. Areas of concern for the system included lack of the following:

- Board of Directors,
- Long term operation and management staff,
- Certified operator,
- Sufficient revenue, and
- Long term plan for obtaining compliance.

The Pippen family currently operates the system, but will discontinue providing service within the next year or so. An agreement is currently being negotiated between Cyndie Park II WSC and De-Go-La RC&D, Inc., to provide general management services in operating and maintaining the current system supplying water to the residents of Cyndie Park II.

There are several PWSs within 15 miles of Cyndie Park II. Many of these nearby systems also have water quality problems, but there are some with good quality water. In general, feasibility alternatives were developed based on obtaining water from the nearest PWSs either by directly purchasing water or by expanding the existing well field. There is a minimum of surface water available in the area. Obtaining a new surface water source is considered iftreated water can be obtained from the South Texas Water Authority. Other alternatives for compliant water include obtaining water from the cities of Mathis and Alice.

Centralized treatment alternatives for arsenic removal have been developed and were considered for this report; for example, reverse osmosis, iron-based adsorption and coagulation/filtration. 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 Cyndie Park II is likely to be the best solution if compliant groundwater can be found. Having a new well close to Cyndie Park II 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

A financial analysis of the various alternatives for the Cyndie Park II PWS was performed using actual system revenues and estimated expenses. The estimated average annual water bill is $360 or 1.25 percent of the median household income of $28,777. Actual water system expenses are not documented. However, estimates based on similar sized systems indicate that expenses exceed current revenues if basic FMT capacity requirements are met. Table ES.2 provides a summary of the financial impact of implementing selected compliance alternatives, including the rate increase necessary to meet current operating expenses. The alternatives were selected to highlight results for the best alternatives from each different type or category.

Some of the compliance alternatives offer potential for shared solutions. A group of PWSs could work together to implement alternatives for developing a new groundwater source or expanding an existing source, obtaining compliant water from a large regional provider or for central treatment. Sharing the cost for implementation of these alternatives could reduce the cost on a per user basis. Additionally, merging PWSs or management of several PWSs by a single entity offers the potential for reduction in administrative costs.

Table ES.2 Selected Financial Analysis Results

Alternative	Funding Option	Average Annual Water Bill	Percent of MHI
Current	NA	$360	1.3
To meet current expenses	NA	$543	1.9
Purchase Water from STWA	100% Grant	$3,000	10.4
	Loan/Bond	$6,379	22.2
Central treatment (Iron Absorption)	100% Grant	$1,934	6.7
	Loan/Bond	$3,023	10.5
Point-of-use	100% Grant	$1,099	3.8
	Loan/Bond	$1,145	4.0
Public dispenser	100% Grant	$2,524	8.8
	Loan/Bond	$2,603	9.0

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ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
AFY	acre-foot per year
APU	arsenic package unit
BEG	Bureau of Economic Geology
CCN	Certificate of Convenience and Necessity
CDBG	Community Development Block Grants
CFR	Code of Federal Regulations
CR	county road
DWSRF	Drinking Water State Revolving Fund
EDAP	Economically Distressed Areas Program
EDR	electrodialysis reversal
FM	farm-to-market road
FMT	financial, managerial, and technical
GAM	groundwater availability model
gpm	gallons per minute
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
NWSC	Nueces Water Supply Corporation
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
PWS	public water system
RO	reverse osmosis
RUS	Rural Utilities Service
SDWA	Safe Drinking Water Act
ft^2	square feet
STWA	South Texas Water Authority
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality

TDS	total dissolved solids
TSS	total suspended solids
TWDB	Texas Water Development Board
USEPA	United States Environmental Protection Agency
WAM	water availability model
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 Cyndie Park II Water Supply Corporation (WSC), PWS ID# 1780050, Certificate of Convenience and Necessity (CCN) #12100, located in Nueces County, hereinafter referred to in this document as the "Cyndie Park II PWS." Cyndie Park II PWS is located approximately 7.5 miles northwest of Banquete, Texas off Farm-to-Market Road (FM) 1833. Recent sample results from the Cyndie Park II PWS exceeded the MCL for arsenic of 0.010 milligrams per liter (mg/L) (USEPA 2009a; TCEQ 2008).

The location of the Cyndie Park II 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.

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 Cyndie Park II water system had recent sample results exceeding the MCL for arsenic. According to the USEPA, potential health effects from long-term ingestion of water with levels of arsenic above the MCL (0.010 mg/L) include non-cancerous effects, such as thickening and discoloration of the skin, stomach pain, nausea, vomiting, diarrhea, numbness in hands and feet, partial paralysis, and blindness, and cancerous effects, including skin, bladder, lung, kidney, nasal passage, liver and prostate cancer (USEPA 2009b).

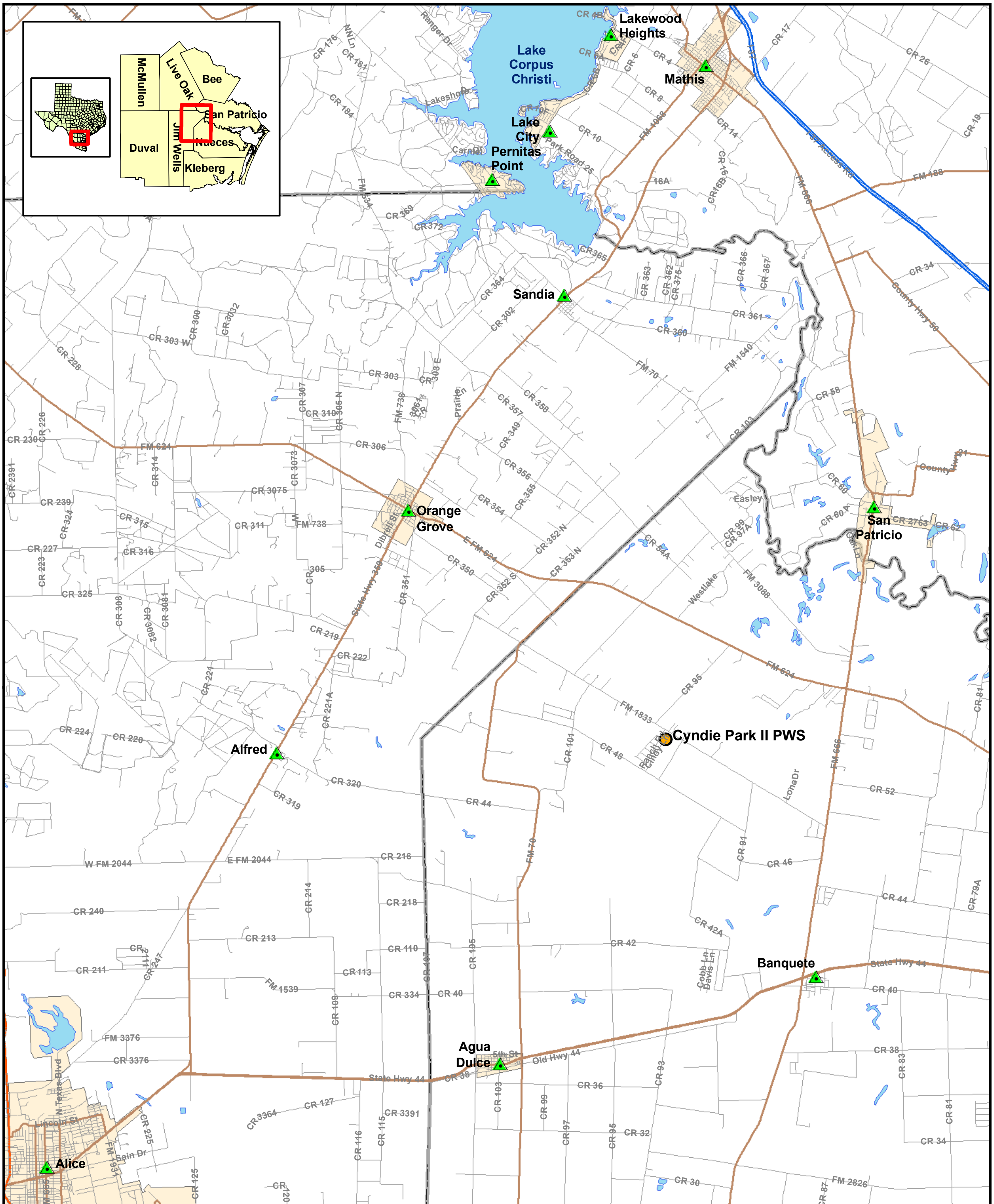
1.2 METHOD

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 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 Cyndie Park II PWS, along with compliance alternatives development and evaluation, can be found in Section 4. Section 5 references the sources used in this report.



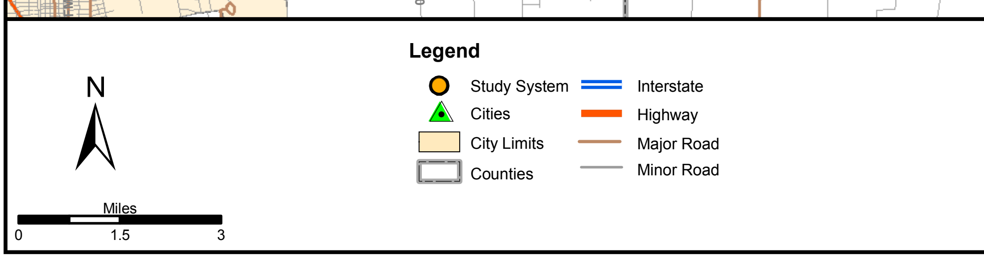


Figure 1.1

CYNIDIE PARK II PWS

Location Map

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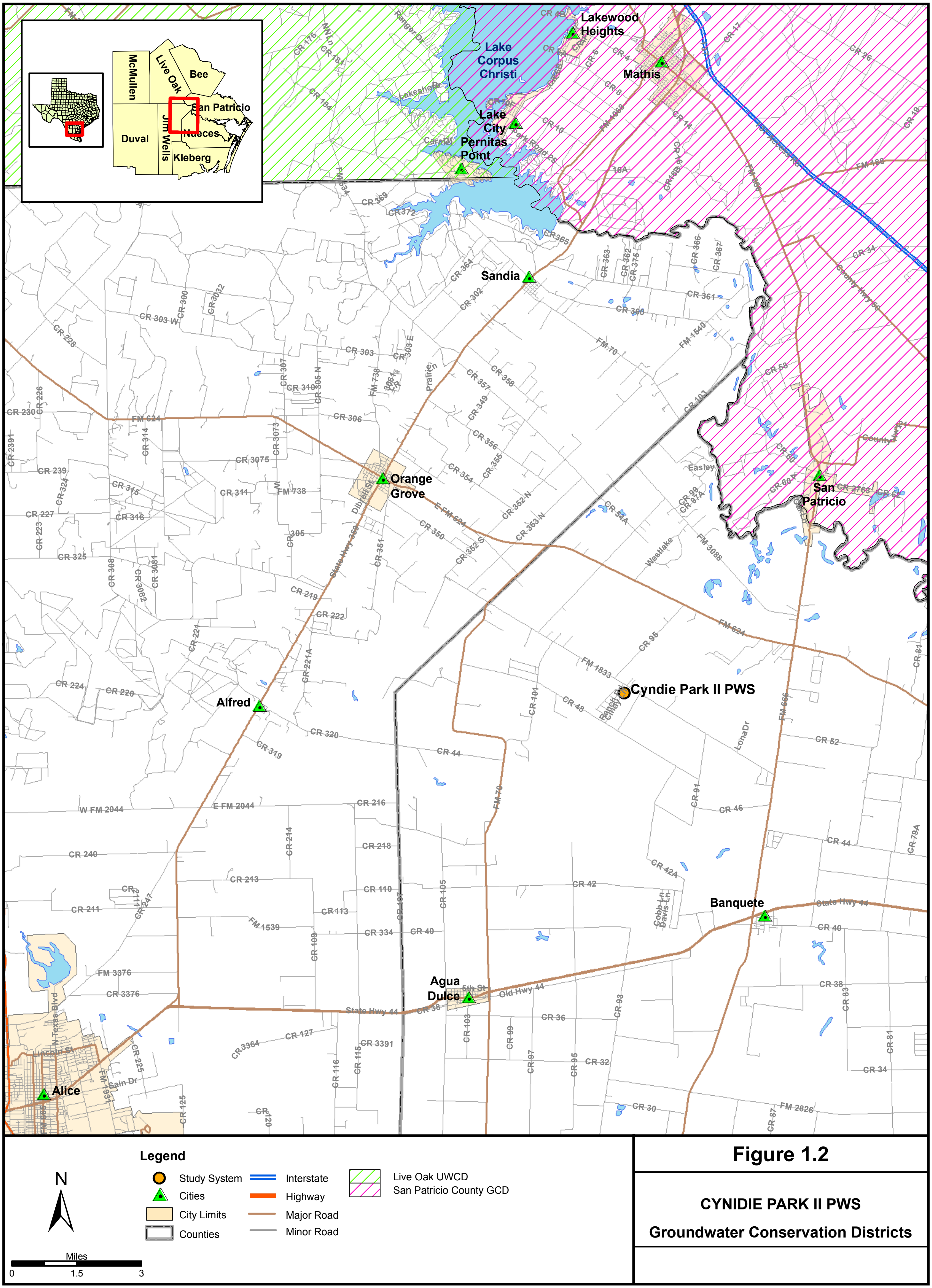

Figure 1.2

CYNIDIE PARK II PWS

Groundwater Conservation Districts

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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 Cyndie Park II 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 so 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 Cyndie Park II 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

In January 2001, the USEPA published a final rule in the Federal Register that established an MCL for arsenic of 0.01 mg/L (USEPA 2009a). The regulation applies to all community water systems and non-transient, non-community water systems, regardless of size.

The new arsenic MCL of 0.01 mg/L became effective January 23, 2006, at which time the running average annual arsenic level would have to be at or below 0.01 mg/L at each entry point to the distribution system, although point-of-use (POU) treatment could be instituted in place of centralized treatment. All surface water systems had to complete initial monitoring for the new arsenic MCL or have a state-approved waiver by December 31, 2006. All groundwater systems are to have completed initial monitoring or have a state-approved waiver by December 31, 2007.

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 less than 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 0.010 mg/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 waste (in the form of broken resin beads) that 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 total dissolved solids (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 that 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). Reported removals of As(III) have varied greatly, some being as low as only 5%. 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 As(V) effectively; and in some cases As(III).
- 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 United States for As(III) and As(V) removal as Sorb-33, and offers several arsenic package units (APU) with flowrates ranging from 150 to 300 gallons per minute (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 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.

Pretreatment – 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 water is 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 in 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

- Often an 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 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"*, USEPA 815-R-06-010, April 2006 (USEPA 2006).

POE 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 point-of-use, and where water enters a house or building in the case of point-of-entry. It should be noted that 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 point-of-entry or point-of-use 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 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 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 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 pipedwater 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

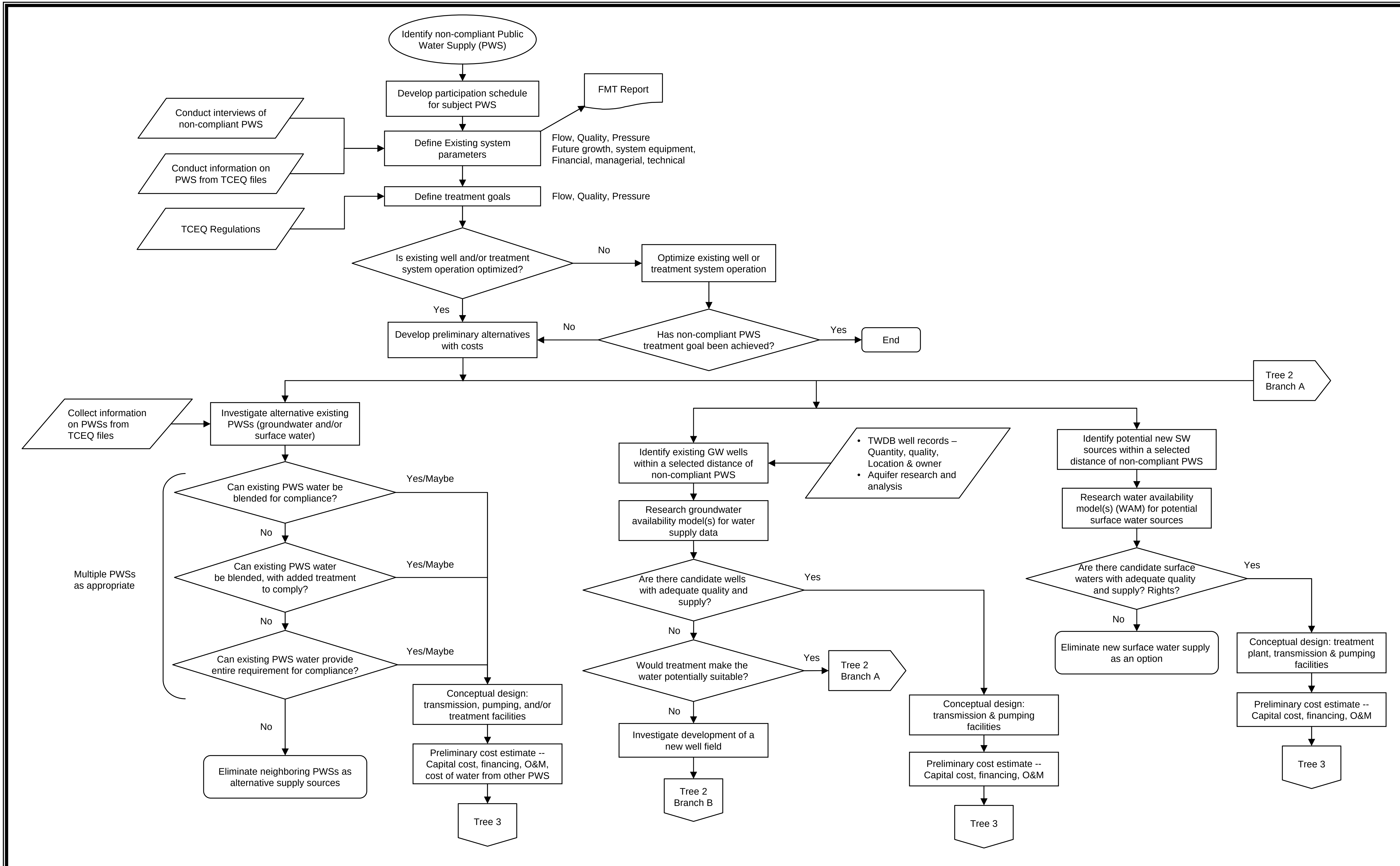
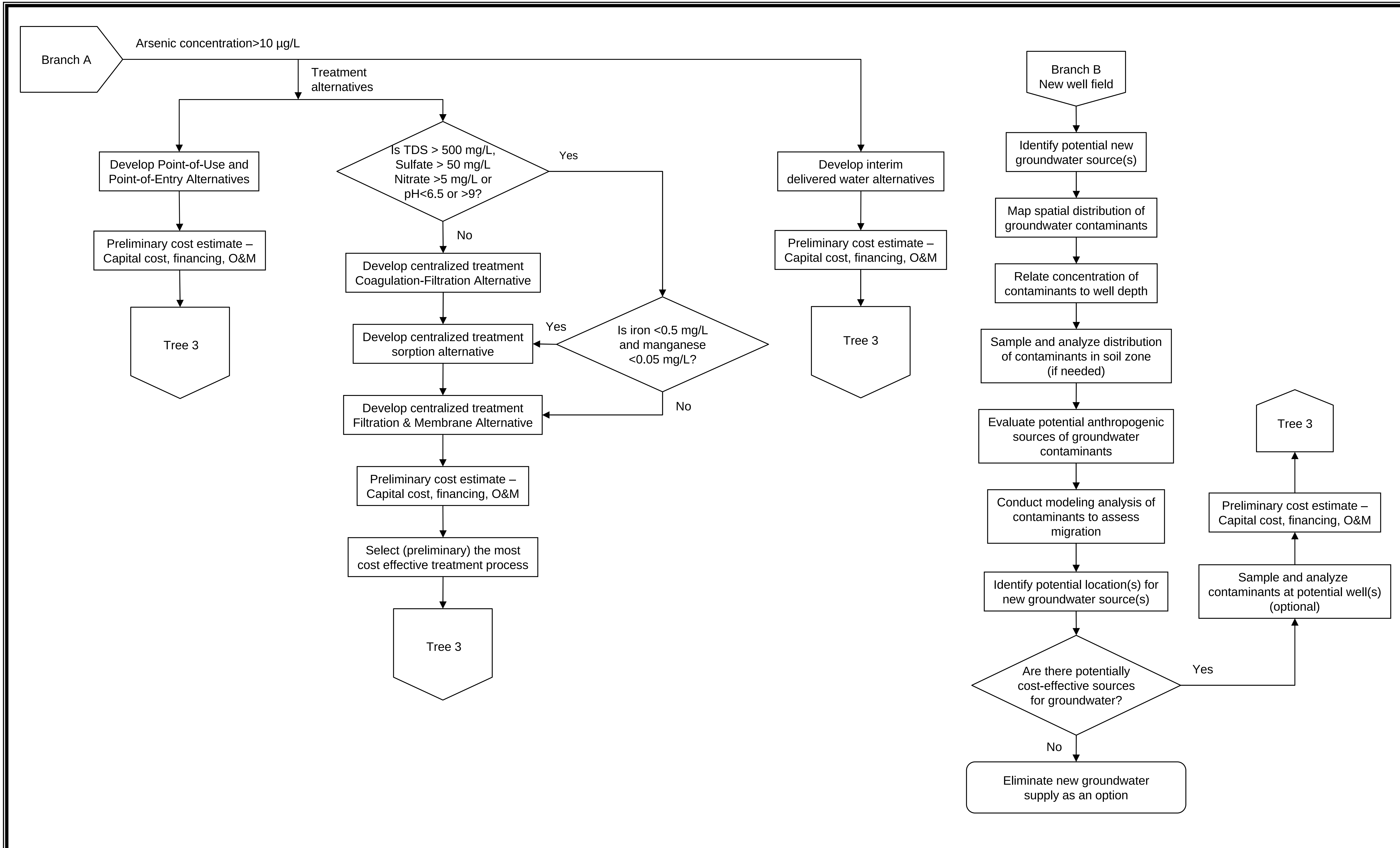


Figure 2.2
TREE 2 – DEVELOP TREATMENT ALTERNATIVES



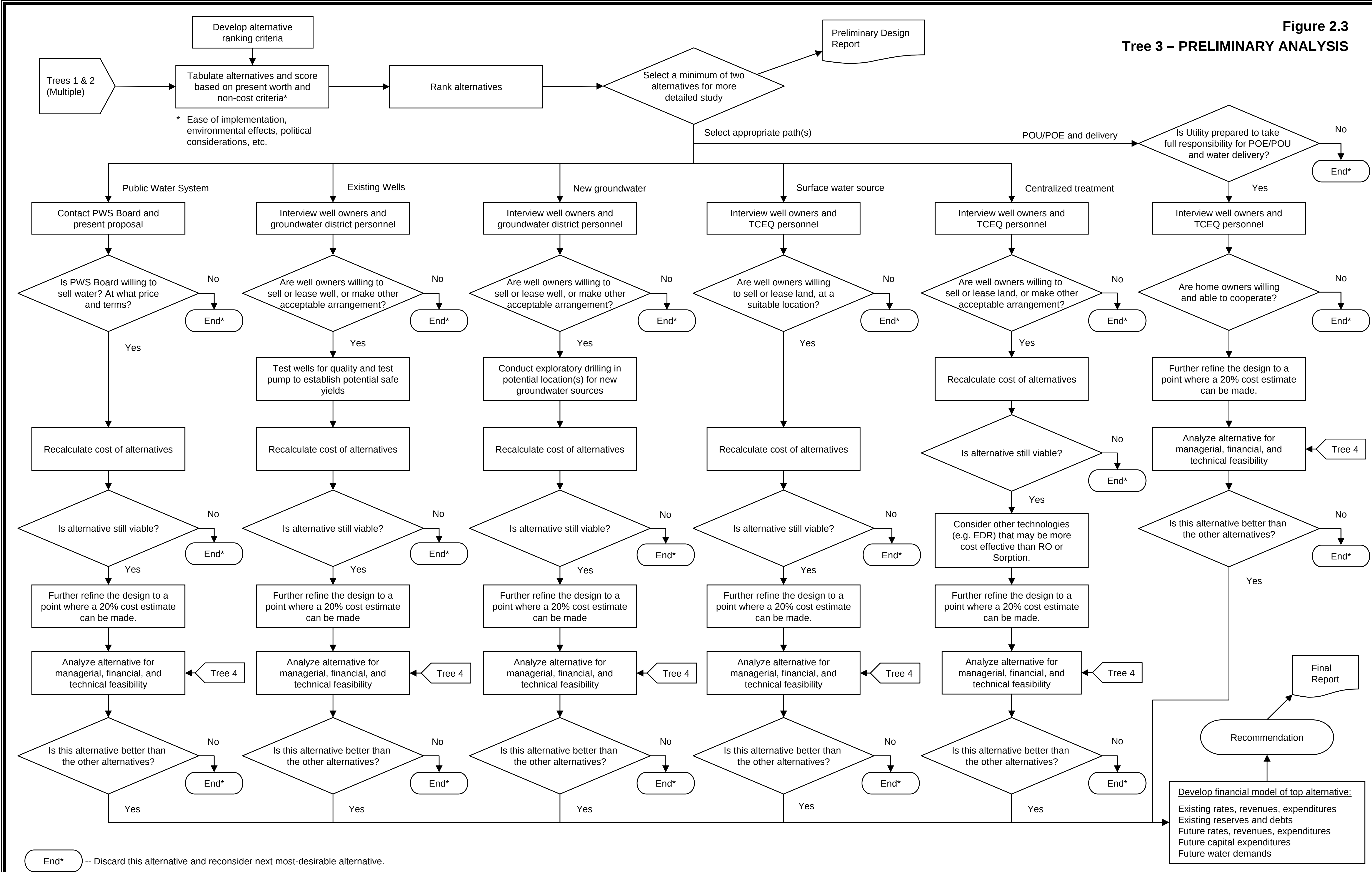
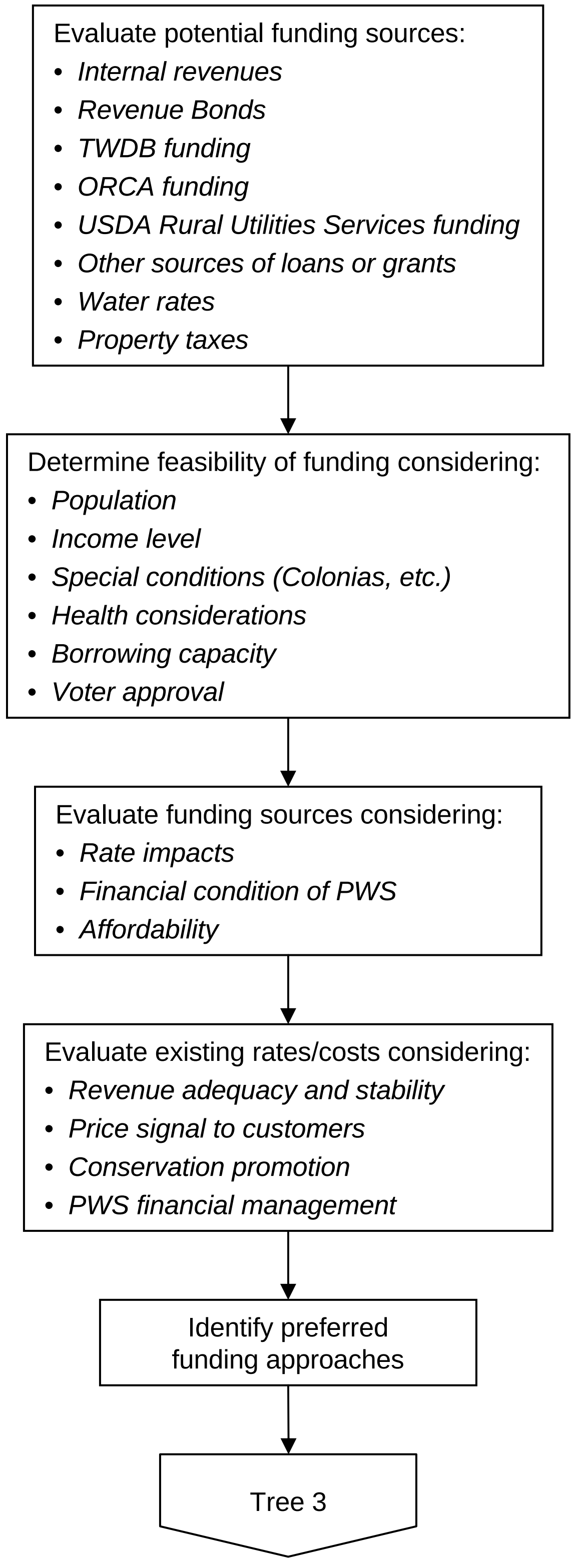


Figure 2.3

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 through a site visit. 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 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 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 15 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 (>1000 mg/L), IX is not economically feasible. RO and EDR have the advantage of reducing TDS. 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, in some cases, 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 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 (liquid assets that could be readily converted to cash) divided by current liabilities (accounts payable, accrued expenses, and other short-term financial obligations) 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 long-term debt) 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.

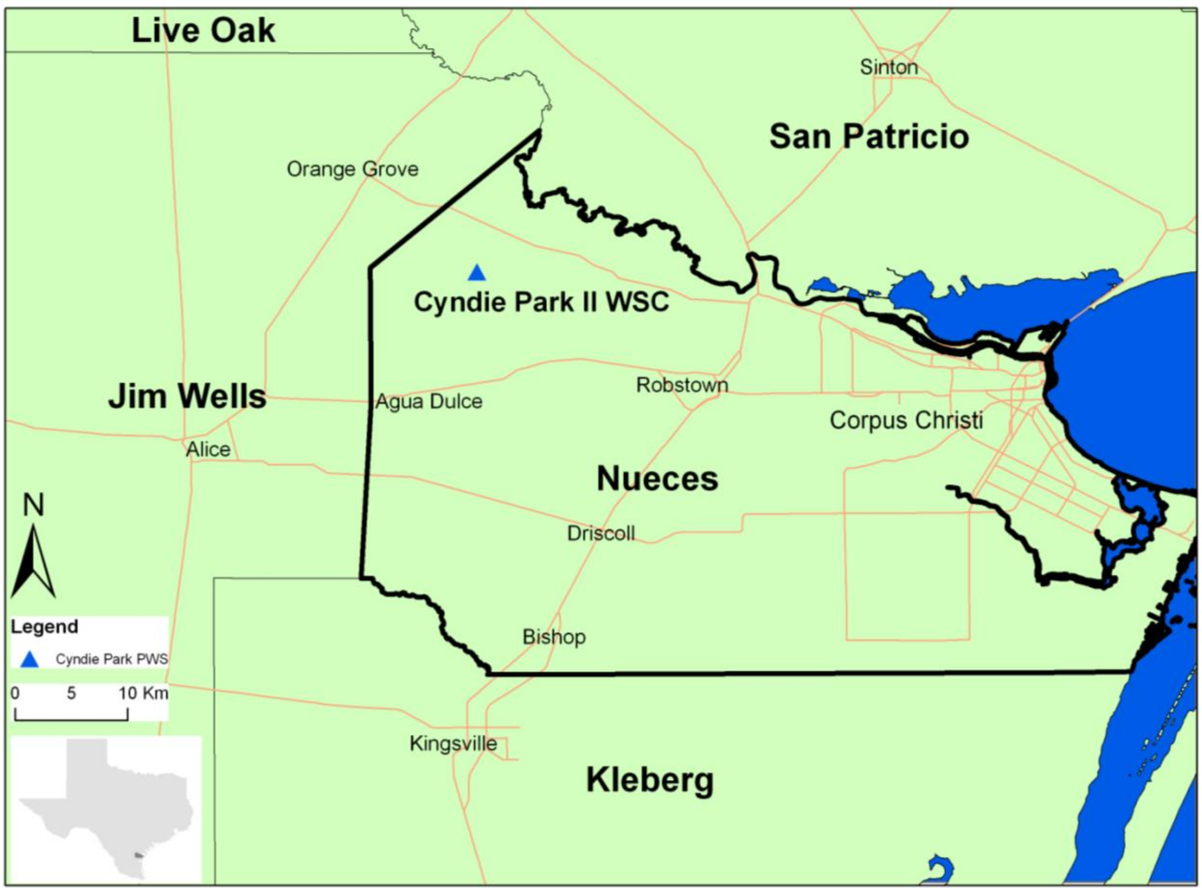
SECTION 3
UNDERSTANDING SOURCES OF CONTAMINANTS

3.1 REGIONAL ANALYSIS

3.1.1 Overview of the Study Area

The public water supply assessed is located in Nueces County, Texas. The regional overview below includes data from five counties in southeastern Texas along the coast of the Gulf of Mexico: Jim Wells, Kleberg, Live Oak, Nueces, and San Patricio (Figure 3.1).

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



The major aquifer found in this region is the Gulf Coast aquifer system that 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.

Data used for this study include information from three sources:

- Texas Water Development Board (TWDB) 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 (TCEQ) 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.

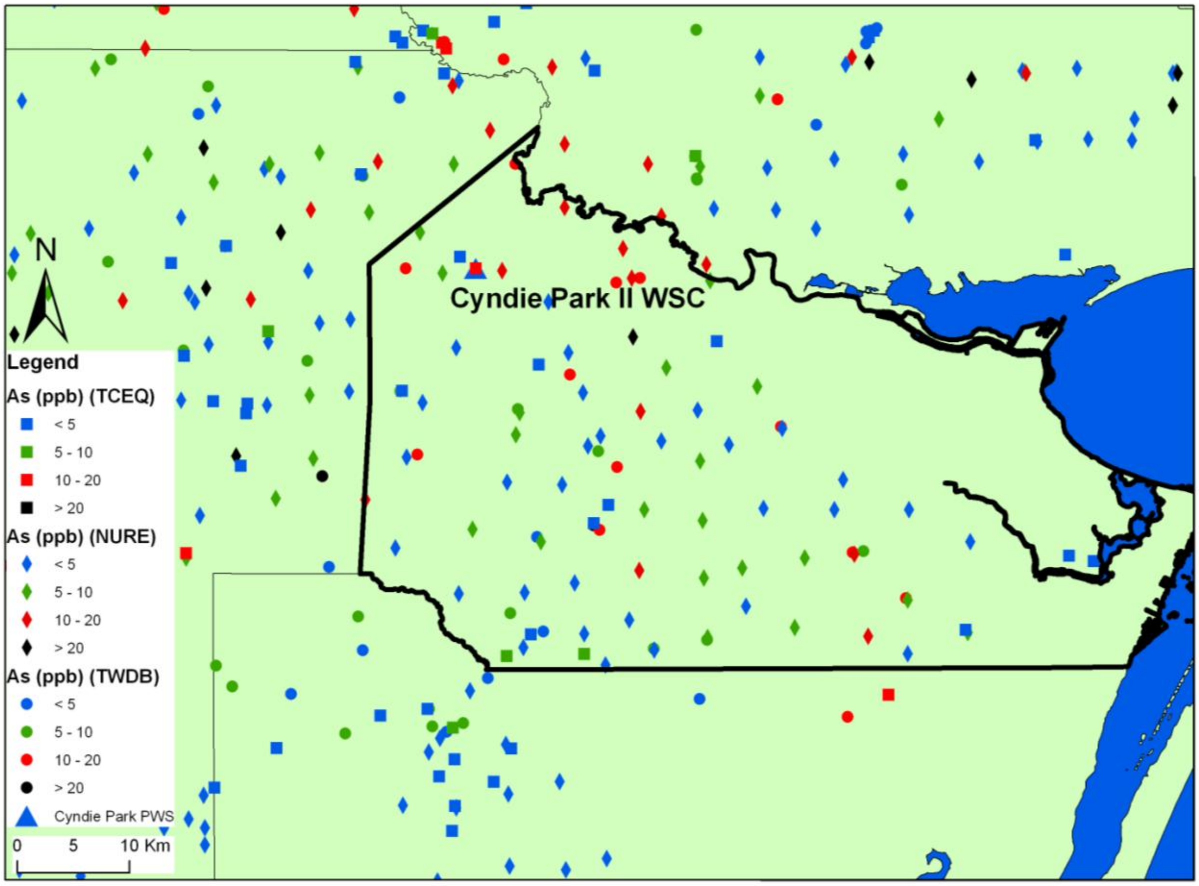
3.1.2 Contaminants of Concern in the Study Area

Contaminants of concern for the area around the PWS in this study include arsenic, fluoride, uranium, and gross alpha particle activity. Groundwater supplies from the PWS have been found to contain levels of one or more of these contaminants in excess of USEPA's maximum contaminant level (MCL). The database or databases used to assess each constituent are those with the most available measurements. For individual wells that have been 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 3.2). 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 3.2 Spatial Distribution of Arsenic Concentrations



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). High arsenic concentrations are distributed similarly in both the Chicot and Evangeline aquifers, where 27-31 percent of the wells exceed the MCL for arsenic.

Data in Table 3.1 were obtained from the TWDB and TECQ groundwater databases (samples from the NURE database were not included because the database does not associate sampled wells with aquifers). Wells in the Gulf Coast aquifer system not identified as being within one of these aquifers are not included.

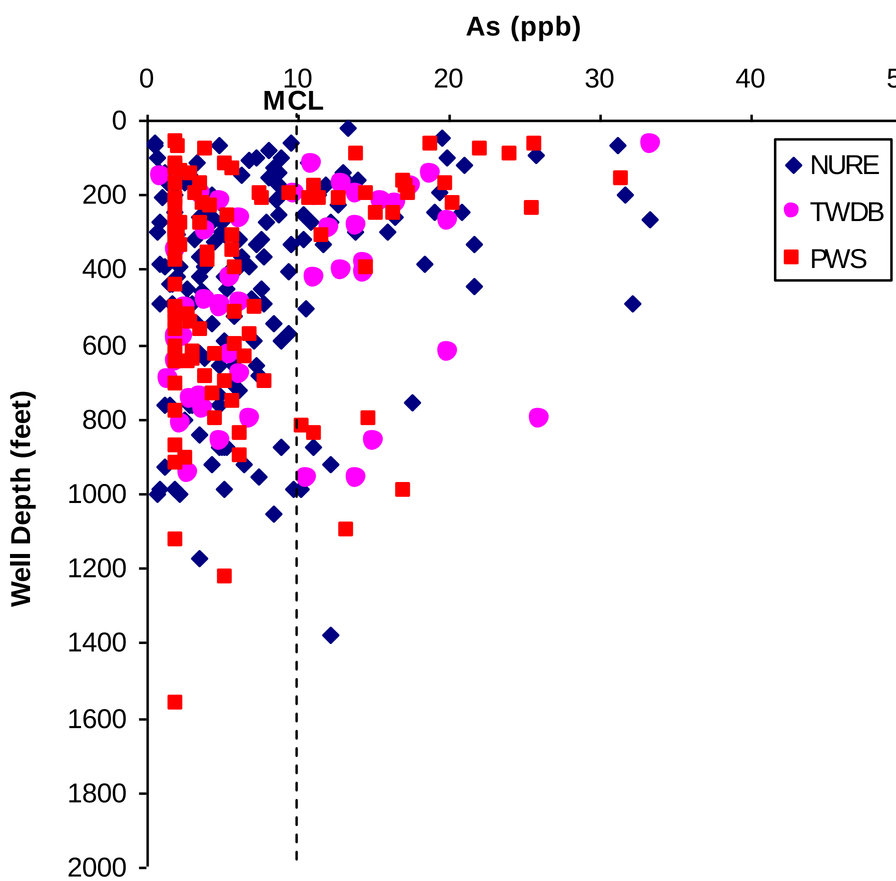
Table 3.1 Summary of Wells that Exceed the MCL for Arsenic, by Aquifer

Aquifer	Wells with measurements	Wells that exceed 10 µg/L	Percentage of wells that exceed 10 µg/L
Chicot	55	17	31%
Evangeline	113	30	27%

Data from the TWDB and TECQ databases

In addition, arsenic concentrations are generally associated with well depths within the study area (Figure 3.3). Wells up to 400 feet deep and wells below 800 feet deep are more likely to have arsenic concentrations above the MCL. This suggests that deepening shallow wells or casing off portions of wells above and 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.

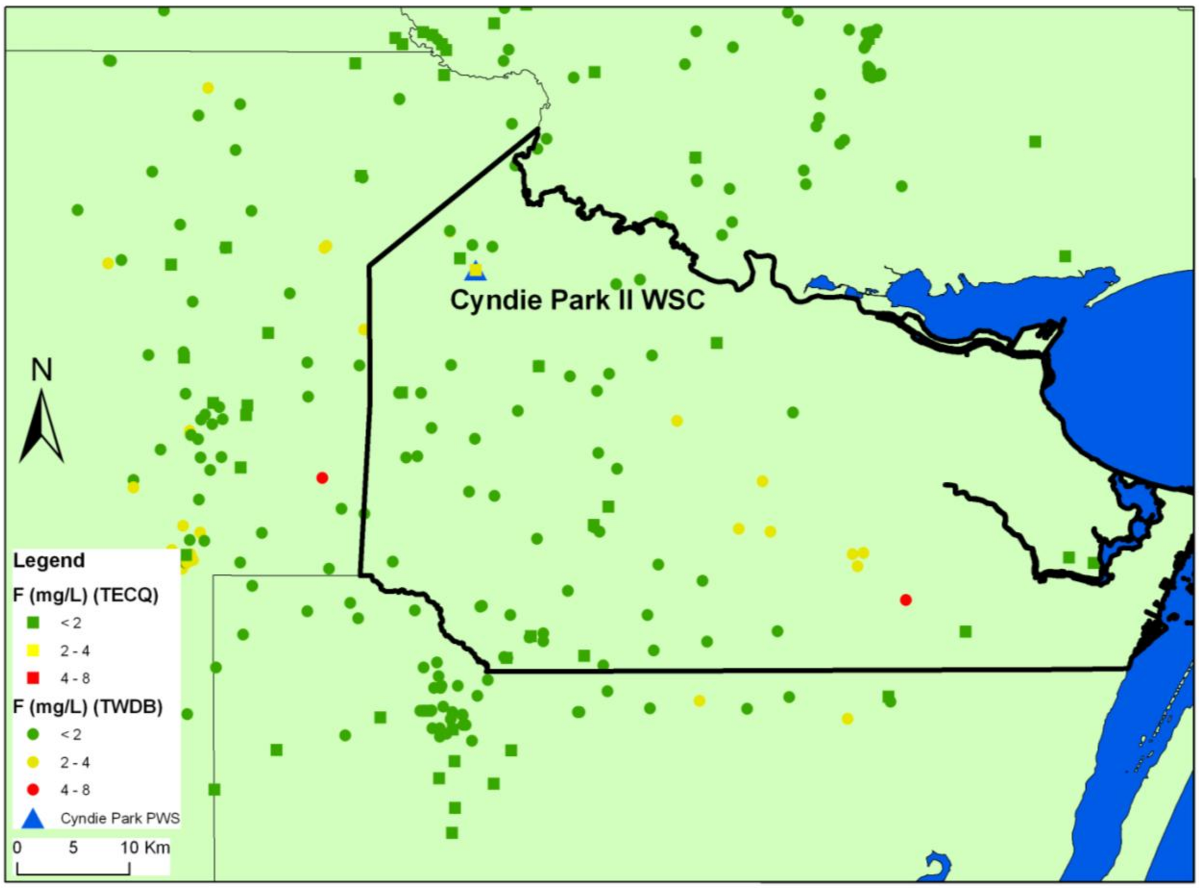
Figure 3.3 Arsenic Concentrations and Well Depths



Fluoride

Fluoride levels do not exceed the MCL (4 mg/L) in most of the wells drilled within the region. Fluoride levels exceed the SMCL (2 mg/L) in nine wells out of 48 in the region (Figure 3.4). Values shown in this figure are based on the most recent sample for each well.

Figure 3.4 Spatial Distribution of Fluoride Concentrations



Distribution of fluoride within the study area can be further described by looking at the number of wells in each aquifer that exceeds the MCL and SMCL (Table 3.2). High fluoride concentrations can be found mainly in the Evangeline aquifer, where 20 percent of the wells exceed the SMCL for fluoride.

Data in Table 3.2 were obtained from the TWDB and TECQ groundwater databases. Wells in the Gulf Coast aquifer system not identified as being within one of these aquifers are not included.

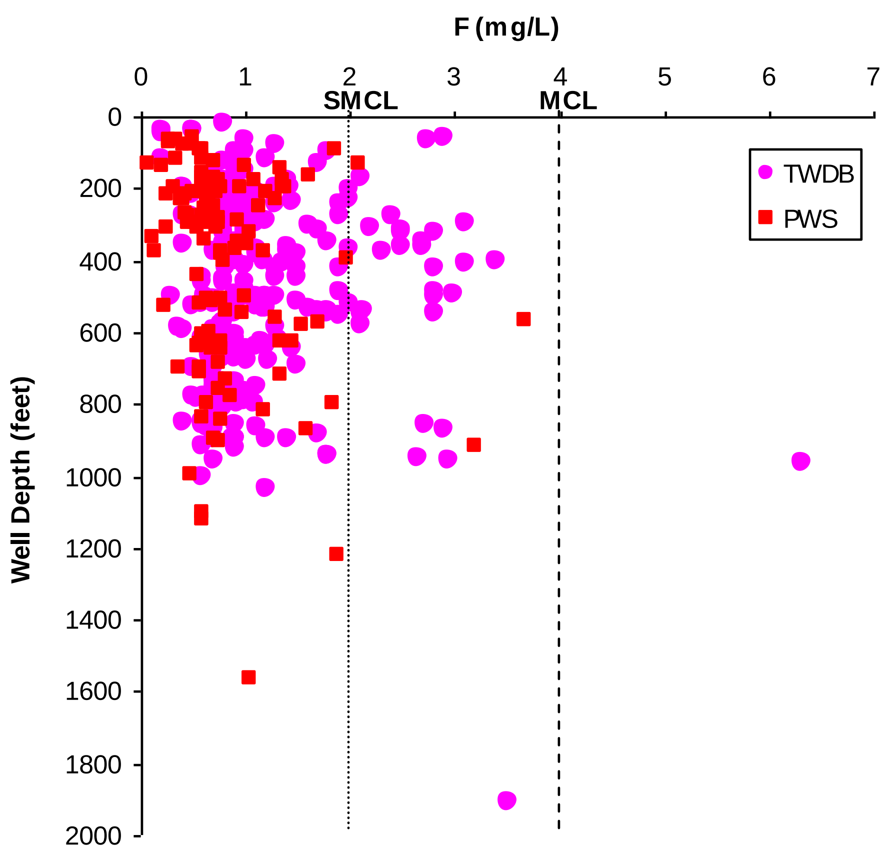
Table 3.2 Summary of Wells that Exceed the MCL for Fluoride, by Aquifer

Aquifer	Wells with measurements	Wells that exceed 4 mg/L	Wells that exceed 2 mg/L	Percentage of wells that exceed 2 mg/L
Chicot	13	0	2	15%
Evangeline	35	2	5	20%

Data from the TWDB and TECQ databases

It is difficult to associate fluoride concentrations with a trend in relation to well depths within the study area (Figures 3.5), but wells up to 580 feet deep and wells below 820 feet deep are more likely to have fluoride concentrations above the SMCL. This suggests that deepening shallow wells or casing off portions of wells above and below this depth range might decrease fluoride 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.

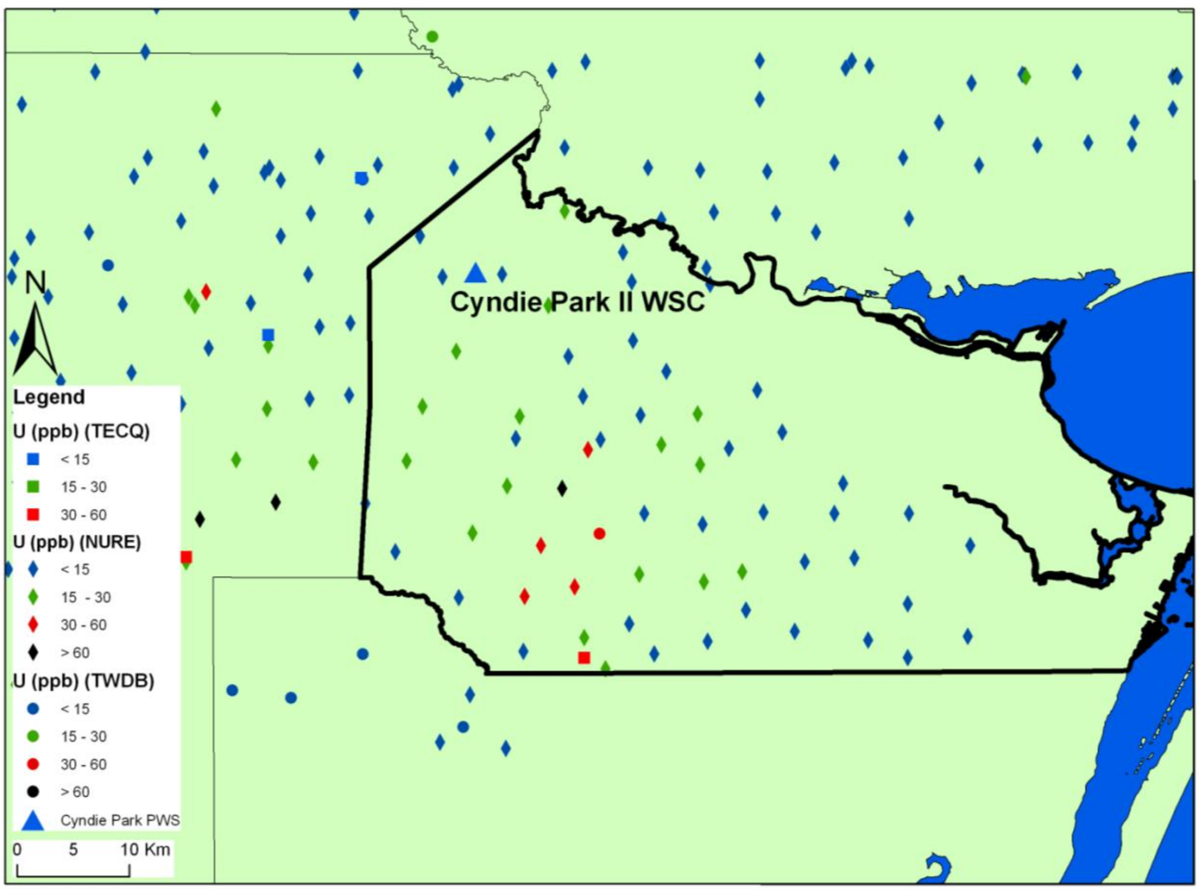
Figure 3.5 Fluoride Concentrations and Well Depths



Uranium

A small 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 is shown in Figure 3.6.

Figure 3.6 Spatial Distribution of Uranium Concentrations



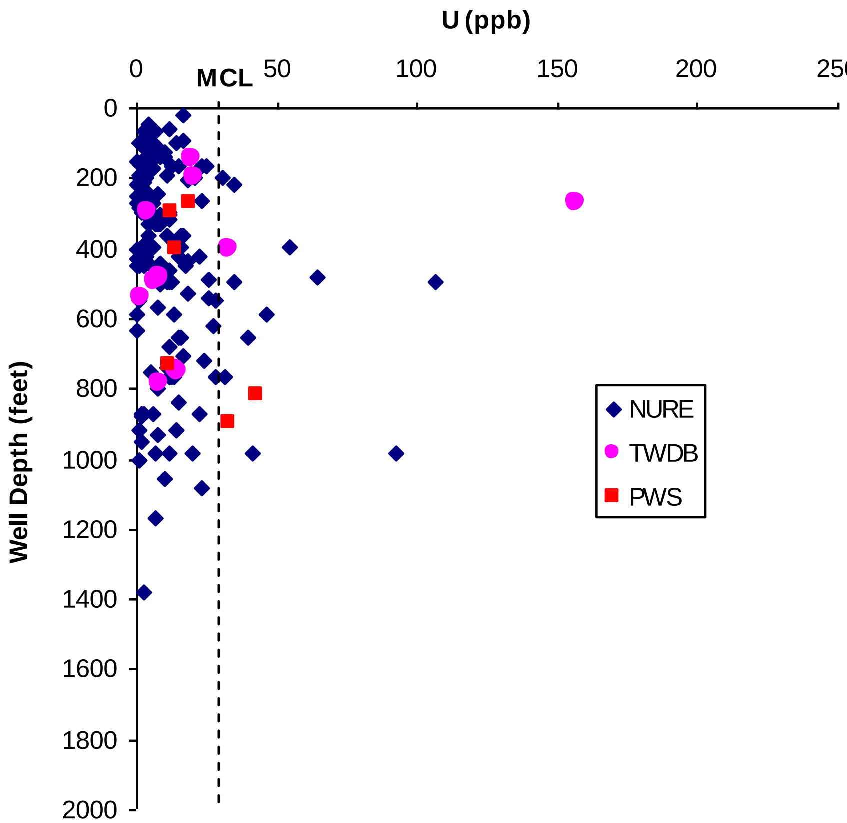
Because of scarce information about which aquifer the sampled wells represent, it is not possible to compare uranium concentrations by aquifer. The only available data are presented in Table 3.3. However, because well depths are included in the database, differences in uranium concentrations in wells of different depths can be compared (Figure 3.7). Based on Figure 3.7, the lowest uranium concentrations are generally found in shallow wells up to 220 feet deep. Although most of the wells that exceed the MCL for uranium are between 400 and 1,000 feet deep, they constitute less than 8 percent of the measured wells.

Table 3.3 Summary of Wells that Exceed the MCL for Uranium, by Aquifer

Aquifer	Wells with measurements	Wells that exceed 30 µg/L	Percentage of wells that exceed 30 µg/L
Evangeline	16	3	19%

Data from the TWDB and TECQ databases

Figure 3.7 Uranium Concentrations and Well Depths



Gross Alpha

Based on the small number of gross alpha particle activity measurements available, the highest concentrations appear to occur south of the study area, while most other wells show acceptable levels. Figure 3.8 shows the distribution of gross alpha measured in wells in the study area.

Data in Table 3.4 were obtained from the TWDB and TECQ groundwater databases (samples from the NURE database were not included because the database does not associate sampled wells with aquifers). Wells in the Gulf Coast aquifer system not identified as being within one of these aquifers are not included.

Figure 3.8 Spatial Distribution of Gross Alpha Concentrations

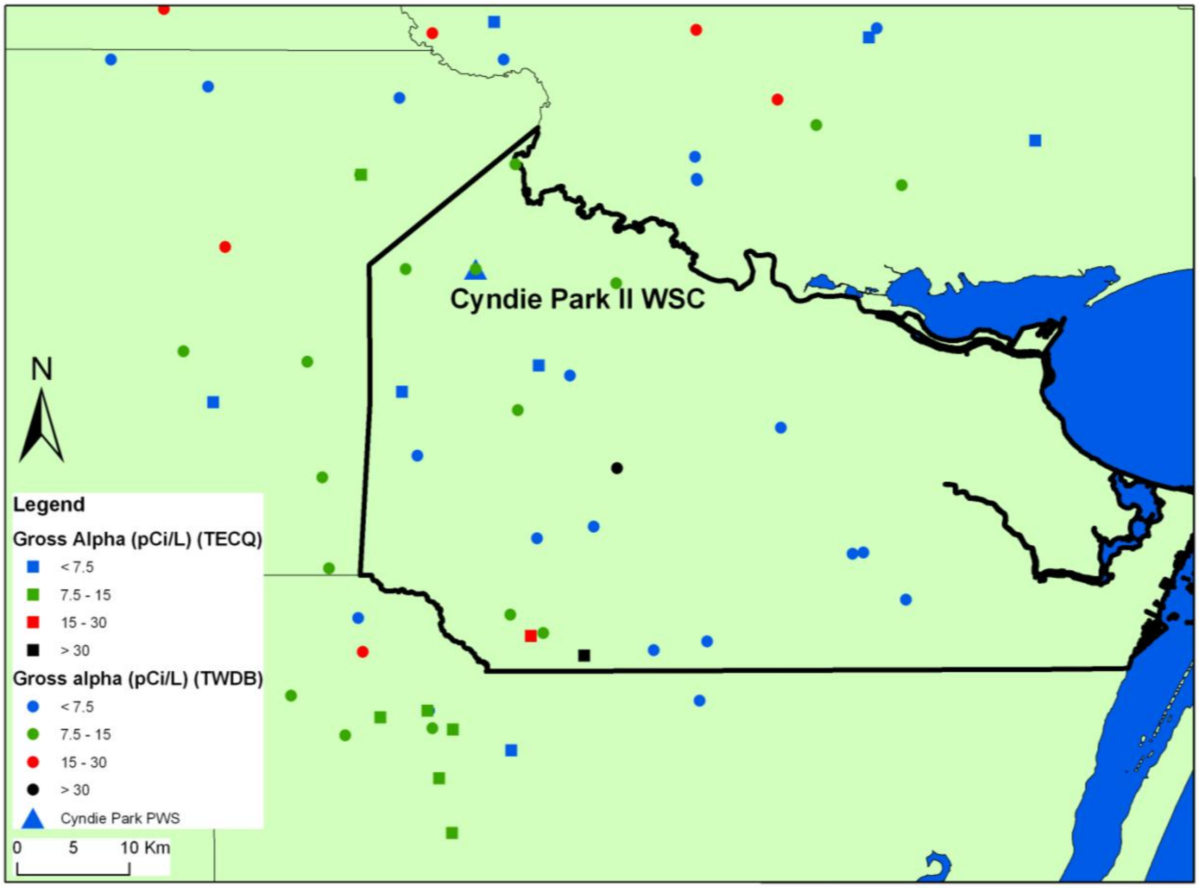


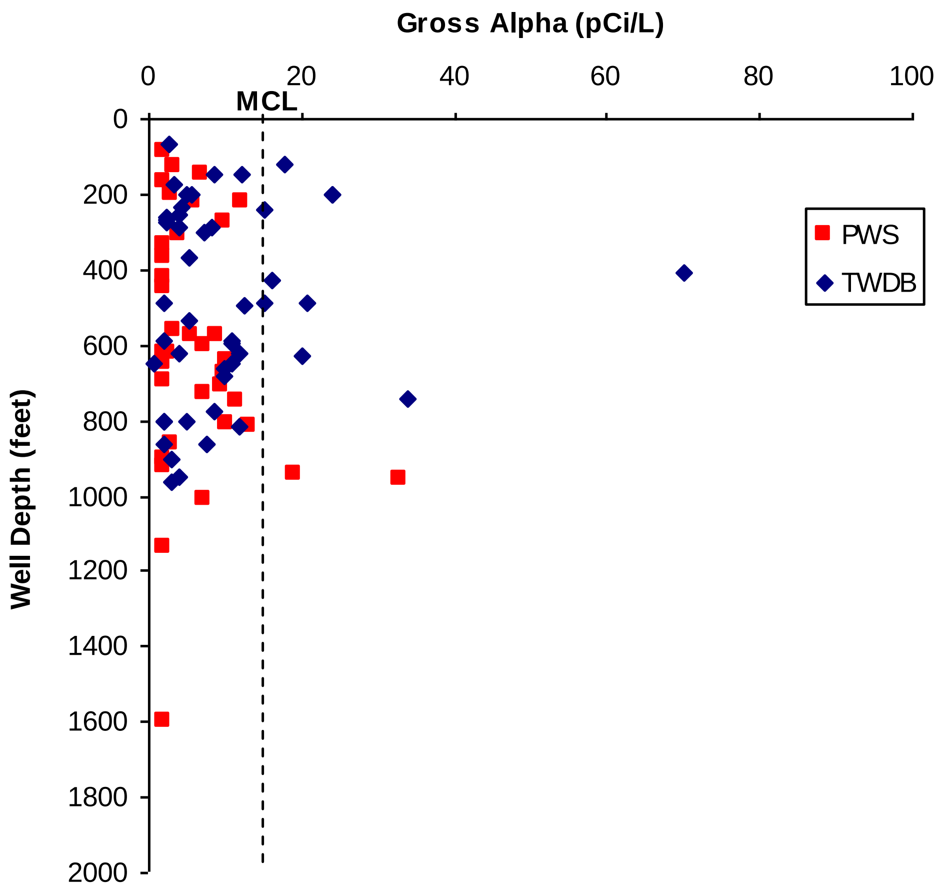
Table 3.4 Summary of Wells that Exceed the MCL for Gross Alpha Particle Activity, by Aquifer

Aquifer	Wells with measurements	Wells that exceed 30 pCi/L	Percentage of wells that exceed 30 pCi/L
Chicot	18	4	22%
Evangeline	60	5	8%

Data from the TWDB and TECQ databases

Gross alpha concentrations could not be associated with well depths (Figure 3.9), but a higher percentage of wells that exceed the MCL can be found in the Chicot aquifer (Table 3.4).

Figure 3.9 Gross Alpha Concentrations and Well Depths



3.1.3 Regional Hydrogeology

The Gulf Coast aquifer system is the primary source of groundwater along the coastal plains of Texas, extending about 100 km 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 gravel, sand, silt, and clay. 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 that the geologic units at the surface are youngest at the coast and oldest inland (Ashworth and Hopkins 1995). The units also generally thicken toward to 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, the 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).

3.2 DETAILED ASSESSMENTS FOR CYNDIE PARK II PWS

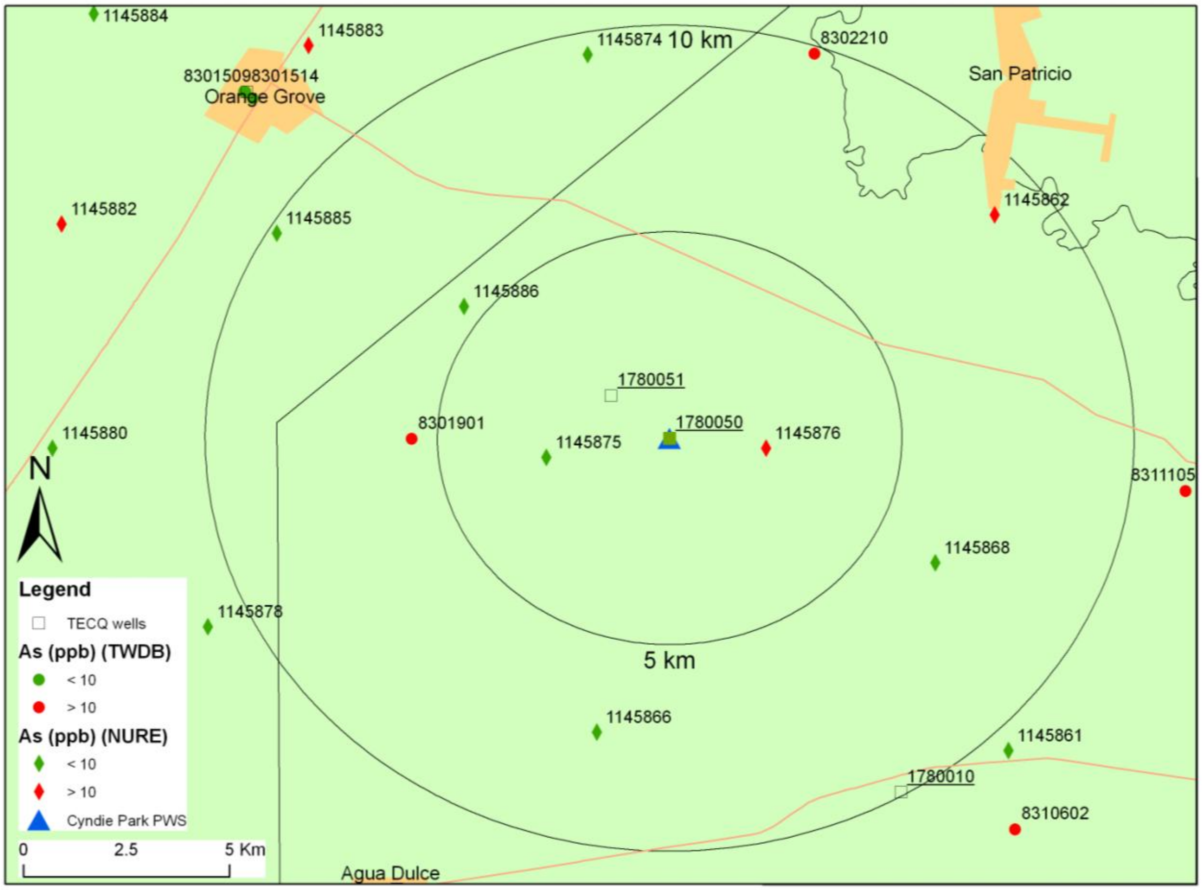
The Cyndie Park II WSC has one well (G1780050A) 398 feet deep, tapping into the Evangeline aquifer.

Table 3.5 Arsenic, Fluoride, and Gross Alpha Particle Activity concentrations in the Cyndie Park II WSC

Collection Date	As (µg/L)	F (mg/L)	Alpha (pCi/L)
27-Jan-98	11.4	1.9	-
17-Oct-01	11.3	2.5	14.4
30-Oct-03	-	-	13.7
02-Feb-05	12.5	-	-
28-Apr-05	10.7	-	-
25-Jul-05	12.5	-	-
24-Jan-06	10.2	2.3	-
05-Mar-07	9.82	-	-
09-Apr-07	9.54	2.5	-
13-Feb-08	-	1.97	-
28-Jan-09	14.6	-	-

Seven out of nine measurements of arsenic concentrations in this well, from samples taken between 1998 and 2009, exceed the MCL (10 µg/L). Three out of five measurements of fluoride exceed the SMCL (2 mg/L). Although gross alpha particle activity values do not exceed the MCL (15 pCi/L), the two measured values come very close to it. Distribution of arsenic, fluoride and gross alpha particle activity values measured in nearby wells are shown in Figures 3.10, 3.11, and 3.12, respectively.

Figure 3.10 Arsenic Concentrations within 5- and 10-km Buffers around the Cyndie Park II WSC

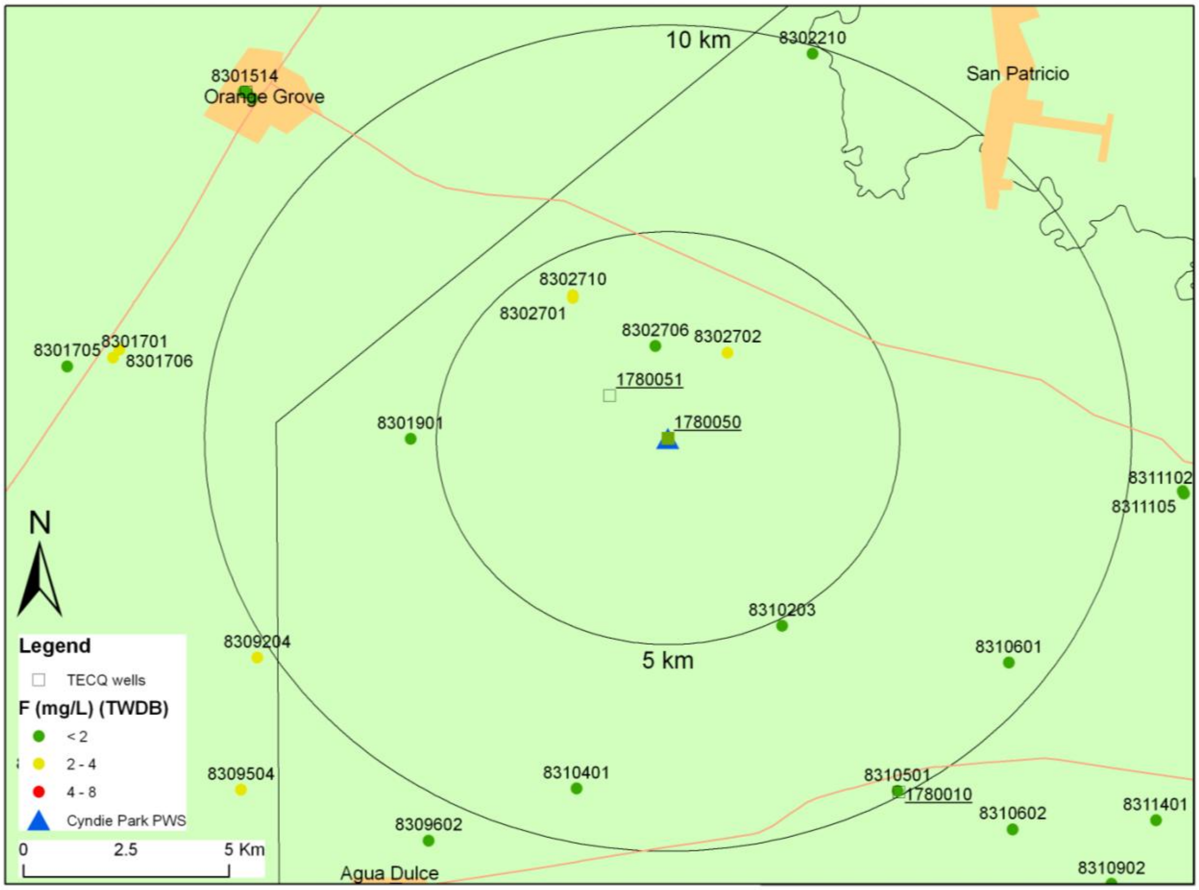


Data are from the TCEQ, TWDB, and NURE databases. Two types of samples were included in the analysis. Samples from the TWDB database (shown as circles in the map) and from the NURE database (shown as diamonds in the map) are taken from single wells. Where more than one measurement has been made from a source, the most recent concentration is shown. The two TECQ wells were not monitored for arsenic.

One NURE well within 5 km, and five NURE wells within 10 km of the Cyndie Park II WSC have arsenic values that comply with the MCL. Additional information about these wells is listed in Table 3.6.

Regional analyses suggest that arsenic concentrations can change with well depth. Acceptable values are found below 400 feet. Deepening the well (which is 398 feet deep) and casing higher parts might decrease arsenic levels.

Figure 3.11 Fluoride Concentrations within 5- and 10-km Buffers around the Cyndie Park II WSC

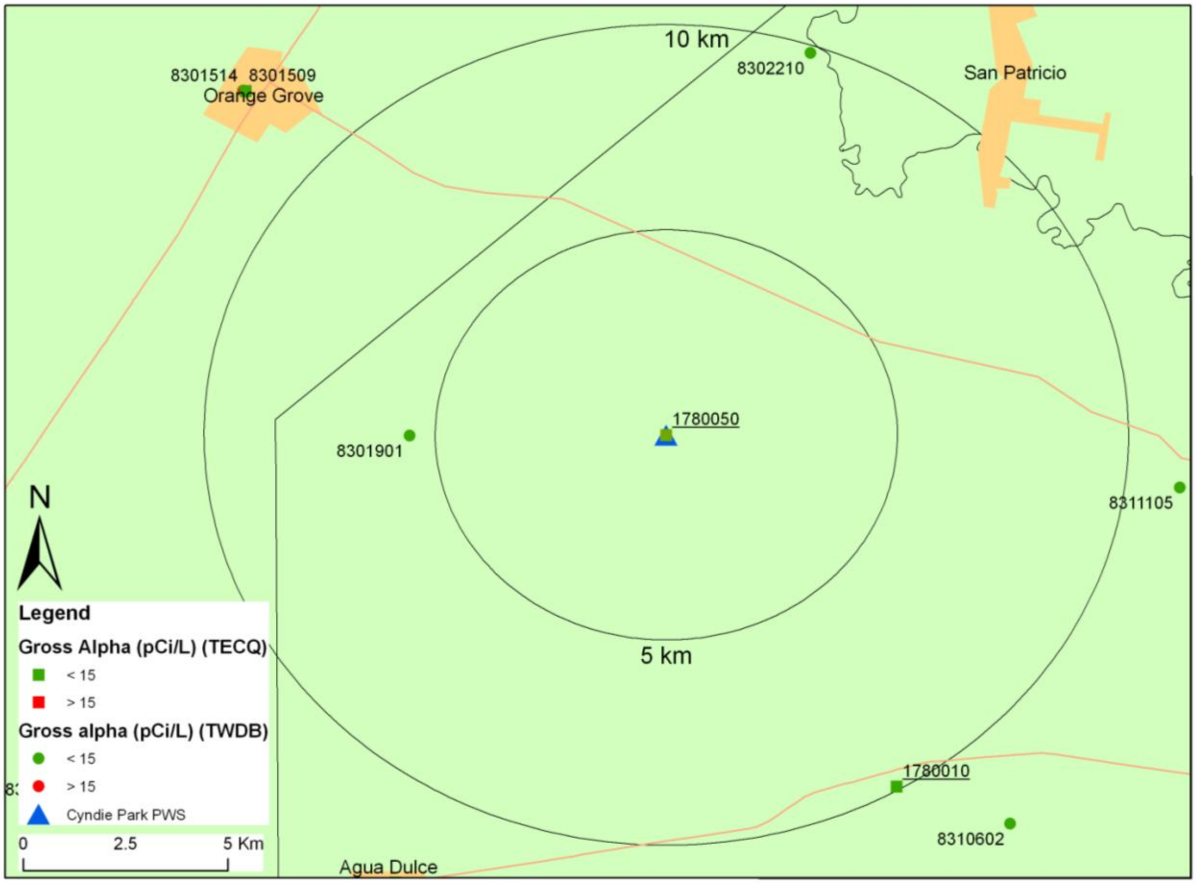


Data are from the TWDB database. Samples from the TWDB database are taken from single wells (shown as circles in the map). Where more than one measurement has been made from a source, the most recent concentration is shown. The two TECQ wells were not monitored for arsenic.

All values are below the MCL for fluoride, but many sites have values higher than the SMCL. One TWDB well within 5 km and six TWDB wells within 10 km of the Cyndie Park II WSC have fluoride values that comply with the SMCL. Additional information about these wells is listed in Table 3.6.

Regional analyses suggest that fluoride concentrations below 580 feet, and above 820 feet are more likely to have acceptable values that comply with the SMCL.

Figure 3.12 Gross Alpha Concentrations within 5- and 10-km Buffers around the Cyndie Park II WSC



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 values are below the MCL for gross alpha particle activity. The Cyndie Park II WSC is below the MCL but is very close to it. Two TWDB sites within a distance of 10 km have much lower values than Cyndie Park II WSC. Additional information about these wells is listed in Table 3.6.

Regional analyses could not correlate suggest gross alpha values with depth, but it does point to higher concentrations in the Chicot aquifer.

Table 3.6 Most Recent Concentrations of Select Constituents in Potential Alternative Water Sources

Source	Well	Owner	Depth (ft)	Aquifer	Use	Arsenic (µg/l)	Fluoride (mg/L)	Gross alpha (pCi/L)	Total dissolved solids (mg/L)
TECQ	1780051		300		Deleted PWS				
NURE	1145875		249		household	8.70			
TWDB	8302706	Arthur Merritt, Jr	320	Evangeline	Irrigation & stock		1.70		1062
TECQ	1780010		623		Plugged			2.7	
NURE	1145866		164		household	3.00			
NURE	1145868		164		household	2.50			
NURE	1145874		98		household	8.90			
NURE	1145885		400		household	5.50			
NURE	1145886		197		household & stock	8.80			
TWDB	8310203	Page Gabriel	350	Evangeline	household & stock				2338
TWDB	8310401	Fred Quebe	384	Chicot	unused		0.80		1493
TWDB	8310501	Nueces County Water	610	Evangeline	Public supply		0.9		1703
TWDB	8310601	Hale Dusting Service	309	Chicot	household				2248

Different databases collect different data, leaving many gaps in the table.

3.2.1 Summary of Alternative Groundwater Sources for the Cyndie Park II WSC

There are several options for meeting quality standards for arsenic and fluoride within the Cyndie Park II WSC. Local and regional analyses indicate that deepening the well below 400 feet might decrease arsenic concentrations. Deepening further below 580 feet might decrease fluoride concentrations. Furthermore, several nearby wells that contain acceptable levels of arsenic, fluoride, and gross alpha might be available as an alternative supply. However, the lack of complete information from these nearby wells does not allow for this finding to be assessed properly. These wells should be tested for other constituents of concern before being further considered for an alternative source of supply.

SECTION 4
ANALYSIS OF THE CYNDIE PARK II PWS

4.1 DESCRIPTION OF EXISTING SYSTEM

4.1.1 Existing System

The location of the Cyndie Park II PWS is shown in Figure 4.1. The Cyndie Park II PWS is located at approximately 7.5 miles northwest of Banquete, TX off FM 1833 and Cindy Lane in Nueces County. The water supply system serves a population of 50 and has 18 connections. Several homes within the subdivision are serviced with separate drinking water wells. The water source for this small community water system is one well (G1780050A), completed in the Evangeline aquifer (Code 121EVGL). The average daily water demand is approximately 0.003 million gallons per day (mgd). The well discharges to the distribution system through three pressure tanks. The well is approximately 398 feet deep and has a total production of 0.051 mgd. Hypochlorination is applied prior to the pressure tanks.

Well #1 is located directly across the street from 4722 Cindy Lane. The well is equipped with a 36-gallon per minute submersible pump. The three pressure tanks (two 525 gallon and one 315 gallon) are constructed of galvanized steel. There are no other storage tanks used at the facility.

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 contaminant concentrations. It may be possible to identify contaminant-producing strata through comparison of well logs or through sampling of water produced by various strata intercepted by the well screen.

Between the period of October 2001 to January 2009, arsenic concentrations have ranged from 0.0098 mg/L to 0.0146 mg/L and an overall average of 0.0113 mg/L, which is greater than the MCL of 10 mg/L (USEPA 2009a; TCEQ 2008); therefore, the Cyndie Park II PWS faces compliance issues under the water quality standards for arsenic.

Basic system information is as follows:

- Population served: 50
- Connections: 18
- Average daily flow: 0.003 mgd
- Total production capacity: 0.051 mgd
- Typical arsenic range: 0.0098 – 0.0146 mg/L
- Typical total alkalinity (as CaCO3): 378 mg/L - 382 mg/L
- Typical phenolphthalein alkalinity as CaCO3: <2.0 mg/L

- Typical bicarbonate (as $CaCO_3$): 378 - 382 mg/L
- Typical chloride range: 332 – 386 mg/L
- Typical fluoride range: 1.97 - 2.52 mg/L
- Typical gross alpha activity: 12.1 - 14.4 picoCuries per liter (pCi/L)
- Typical hardness range: 174 - 196 mg/L
- Typical iron range: 0.13 - 0.178 mg/L
- Typical magnesium range: 21.3 – 22.6 mg/L
- Typical manganese range: 0.0032 - 0.0058 mg/L
- Typical nitrate range: 2.43 - 2.64 mg/L
- Typical total radium 226 range: 0.2 - 0.6 pCi/L
- Typical total radium 228 range: 1.0 pCi/L
- Typical TDS range: 1140 - 1220 mg/L
- Typical pH range: 7.64 – 7.81
- Typical selenium range: 0.0104 - 0.0132 mg/L
- Typical sodium range: 339 – 387 mg/L
- Typical sulfate range: 140 - 147 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 2009.

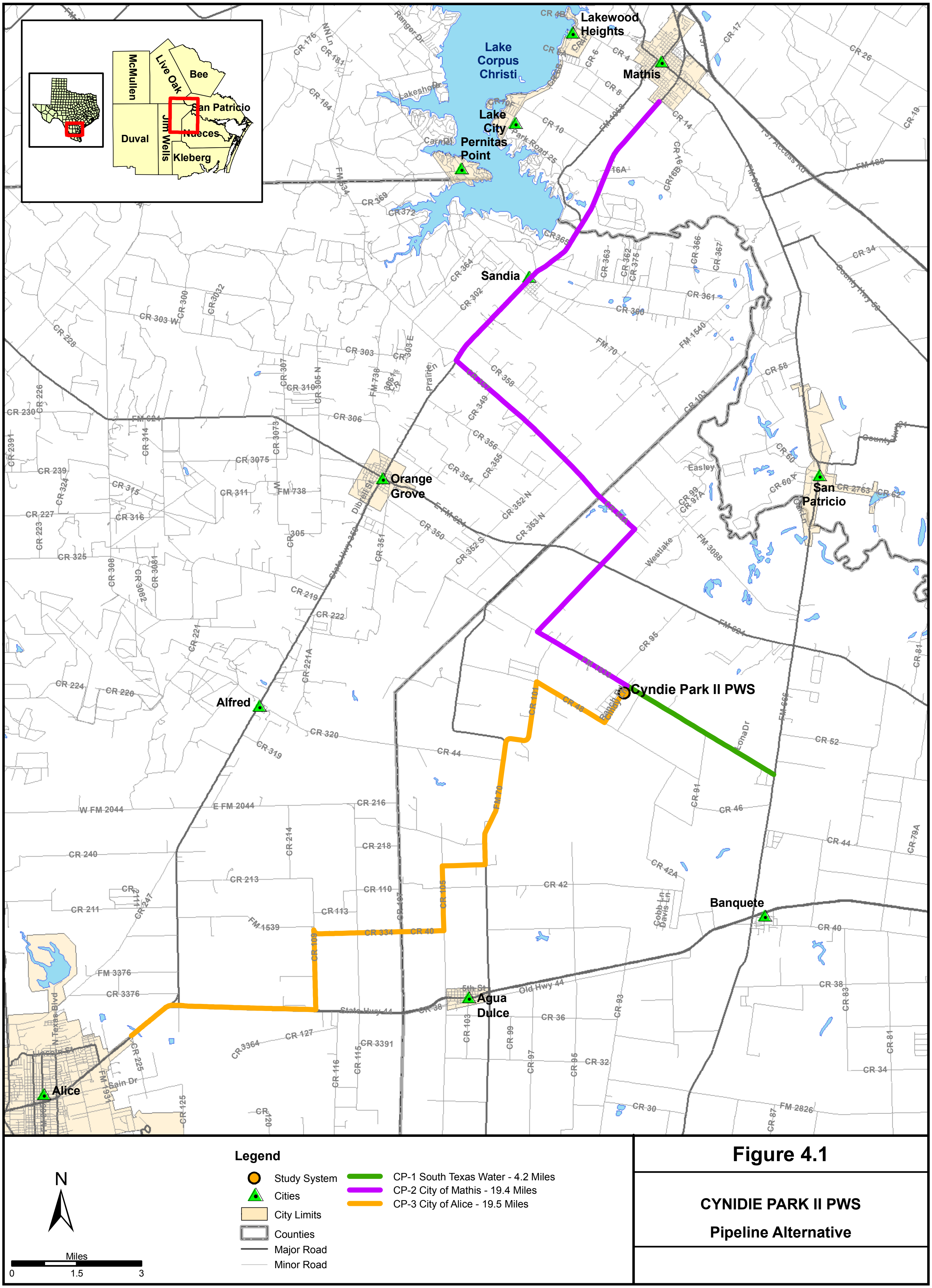


Figure 4.1

CYNIDIE PARK II PWS

Pipeline Alternative

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4.1.2 Capacity Assessment for Cyndie Park II PWS

The project team conducted a capacity assessment of the Cyndie Park II water system by telephone on July 27, 2009. The team interviewed David Pippin, Assistant Manager of the Cyndie Park II Water Supply Corporation. The team was unable to schedule an on-site interview.

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 trainings. Providing safe drinking water is the responsibility of every public water system, including those very small water systems that face increased challenges with compliance.

4.1.2.1 General Information about the Water System

Cyndie Park II is a water supply corporation. There have been very few distribution line breaks, and the system has a small number of valves so repairs are made quickly. Originally the homes were on private wells and the homes in the surrounding area are still on private wells. There is no certified water operator at this time. There was a board of directors in the past, but currently no one is willing to serve on the board. Chauncy Pippin, who was an original board member, manages and operates the water system with the help of his family. His wife takes care of the correspondence, recordkeeping, and financial matters and his son operates and maintains the system. Because there is no one to read meters, the amount that each household should pay was calculated based on the number of people in the household. Rates are between \$25 and \$35 a month. Customers are sent a coupon book once a year for payment and generally drop their payments off at the Pippin house. Revenues cover basic expenses such as utilities, chlorine, and sampling. There are no paid employees. A very small amount of revenue is set aside for emergencies. The system has exceeded the arsenic standard.

4.1.2.2 General Assessment of Capacity

This water system is not sustainable under its present operating conditions, even though Mr. Pippin and his family have worked hard to keep the water system running despite family health issues. The following serious issues prevent the system from being sustainable in the future.

- No Board of Directors: Water supply corporations are required to have a board of directors to oversee the water system. It appears that none of the community members are willing to serve on a board of directors.
- Water System Operation and Management: The Pippin family has been operating and maintaining the system but within the next year or so, they intend to stop. They have no obligation to operate the water system but have been doing so because they

were involved initially with the system, feel a commitment to provide safe drinking water, and there wasn't anyone else willing to do so.

- No Certified Operator: At the time of this assessment, the system did not have a certified water operator. There is a draft agreement with De-Go-La RC&D, Inc. that indicates that the company will provide a certified operator. However it also states that the company will not be responsible for meeting compliance. There is also a requirement for considerable involvement by the WSC, including collecting fees from residents and assisting with onsite maintenance and operations. When the Pippin family is no longer involved with the water system, it is unclear if others in the community will become involved in the management of the water system to ensure compliance.
- Lack of Sufficient Revenues from Rate Structure for Long-Term Sustainability: The current rate structure is not based on a review of current and future expense and does not provide sufficient revenue to cover unanticipated emergency expenses.
- No Long Term Plan for Compliance: There is no plan to meet compliance with the arsenic regulation. Because of the lack of leadership in the WSC, no one has investigated any treatment options or set-aside any funds to address the arsenic compliance issue.

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 Cyndie Park II 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. 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 15 miles of the study system. A distance of 15 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 PWSs within 15 miles of the Cyndie Park II PWS. 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 15 Miles of the Cyndie Park II PWS

PWS ID	PWS Name	Distance from Cyndie Park II PWS (miles)	Comments/Other Issues
1370035	SOUTH TEXAS WATER AUTHORITY	3	Larger SW system. WQ issues: None. **Evaluate Further**
1780010	NUECES COUNTY WCID 5	6	Smaller GW system. WQ issues: None.
1250002	CITY OF ORANGE GROVE	8	Larger GW system. WQ issues: Gross Alpha Particle Activity, TDS
1780001	CITY OF AGUA DULCE	8	Smaller GW system. WQ issues: None.
1250017	PAISANO MOBILE HOME PARK	11	Larger GW system. WQ issues: Gross Alpha Particle Activity, Sulfate, TDS
1250032	CAMP SHAWONDASSE	11	Larger GW system. WQ issues: TDS
1250029	ORANGE GROVE NAVY AUX LANDING FIELD	12	Larger GW system. WQ issues: Secondary water contaminants
1780005	NUECES COUNTY WCID 3	12	Larger SW system. WQ issues: TDS.
2050070	SAN PATRICIO COUNTY MUD 1	12	Larger GW system. WQ issues: Arsenic
1250037	QUICK STOP	13	Larger GW system. WQ issues: TDS
1490006	LAKE CORPUS CHRISTI RV PARK & MARINA	13	Larger GW system. WQ issues: TDS
2050016	TPWD LAKE CORPUS CHRISTI SP	13	Larger GW system. WQ issues: Arsenic
2050022	CAMP KARANKAWA	13	Larger GW system. WQ issues: Arsenic, TDS
1250019	ALICE COUNTRY CLUB	14	Larger GW system. WQ issues: TDS
2050003	CITY OF MATHIS	14	Larger GW/SW system. WQ issues: None. **Evaluate Further**
1250001	CITY OF ALICE	15	Larger GW/SW system. WQ issues: None. **Evaluate Further**
1780012	CITY OF DRISCOLL	15	Smaller GW system. Unable to confirm water quality
2050076	ADVENTURE TEXAS RESORTS	15	Smaller GW system. Unable to confirm water quality

WQ = water quality
GW = groundwater
SW= surface water

After the PWSs in Table 4.1 with water quality problems were eliminated from further consideration, the remaining PWSs were screened by proximity to Cyndie Park II PWS and sufficient total production capacity for selling or sharing water. Based on the initial screening summarized in Table 4.1, three alternatives were selected for further evaluation. These alternatives are summarized in Table 4.2. Descriptions of the water systems that could potentially supply water follow Table 4.2.

Table 4.2 Public Water Systems Within the Vicinity of the Cyndie Park II PWS Selected for Further Evaluation

PWS ID	PWS Name	Pop	Connections	Total Production (mgd)	Avg Daily Usage (mgd)	Approx. Dist. from Cyndie Park II PWS	Comments/ Other Issues
1370035	SOUTH TEXAS WATER AUTHORITY	33,500	13,895	6.227	1.37	3	Larger SW system. Wholesaler of treated water. No WQ issues
2050003	CITY OF MATHIS	5,730	1,790	2.037	0.531	14	Larger GW/SW system. No WQ issues
1250001	CITY OF ALICE	21,490	8,925	9.216	3.34	15	Larger GW/SW system. No WQ issues

4.2.1.1 South Texas Water Authority

The South Texas Water Authority (STWA) is a governmental, taxing entity established by the State Legislature as a conservation and reclamation district for wholesaling water. Cyndie Park II is not within STWA's district boundaries, but it is within five miles of a 6-inch treated water line extending north from Banquete along FM 666 toward Indian Trails Subdivision. STWA could wholesale water to Cyndie Park II through a pipeline (the nearest connection point to the 6-inch Banquete line would be at the southwest corner of the intersection of FM 666 and FM 1833) and metering station. It would require a wholesale water supply contract. Since Cyndie Park II is outside of STWA's taxing jurisdiction, the contract would include a "fee in lieu of taxes" provision.

South Texas Water Authority provides management services on a contract basis for the non-profit, member-owned Nueces WSC (NWSC), which also operates in the area to provide water to PWSs. However, two separate boards govern the two entities. Most of its customers are on a retail basis; however, NWSC currently has one wholesale customer. It has a CCN and does not have taxing authority.

Cyndie Park II is not within the service area of NWSC. However, two options are available for the NWSC to provide water to Cyndie Park II. First, NWSC could retail water service to the Cyndie Park II residents. This would require an extension of a transmission line to Cyndie Park II. If the water is retailed and the area becomes part of NWSC's service area, it will require an amendment to the NWSC CCN. It would also require that customers being served petition STWA for annexation into STWA's taxing jurisdiction. The second option is that NWSC could wholesale water to Cyndie Park II, although NWSC has not provided wholesale water previously.

4.2.1.2 City of Mathis

The City of Mathis obtains raw water via a pipeline from Lake Corpus Christi. The average daily consumption rate is 0.53 mgd and the total production capacity is 2.04 mgd, which means the city has some excess capacity. The City of Mathis is currently treating water to meet the demand of the approximate 5,700 residents and does not serve any public water systems outside of their city limits. To get approval for providing water to an entity outside the city limits, the Public Works Director would notify the City Manager who would present the application to the Mathis City Council.

4.2.1.3 City of Alice

The City of Alice obtains raw water via a pipeline from Lake Corpus Christi. The pipeline runs south along Hwy 359 for 23 miles to Lake Finley, a reservoir located southeast of Alice with a capacity to store 229-acre-feet of water. The water is then pumped to a 7 million gallon holding pond near Texas Boulevard and North 281. The nearby Alice Water Treatment Plant treats the before it is pumped into the distribution system. The average daily consumption rate for the approximately 20,000 people living in Alice is 3.34 mgd and the total production capacity is 9.216 mgd, which means the city has excess capacity. As a precautionary measure during the current drought conditions, the city is looking for alternative water sources to handle peak demand conditions. The City of Alice is currently not providing water to any neighboring water system beyond its city limits. If a neighboring PWS is interested in obtaining water from the city, the request would have to be approved by the Alice City Council.

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 Nueces County, as well as surrounding counties. One of five hydrogeological units that comprise the Gulf Coast Aquifer, the Evangeline Aquifer, is the water source for a single 398-foot deep well operated by the Cyndie Park II PWS.

A search of registered wells was conducted using TCEQ's Public Water Supply database to assess groundwater sources utilized within a 15-mile radius of the PWS. The search indicated that all public water supply and domestic wells in the search area are completed in either, the Goliad Sand Formation of the Evangeline Aquifer, or in the Chicot Aquifer. These two aquifers are also the groundwater source for irrigation, stock watering, and industrial supply wells located within the search area.

Groundwater Supply

The Gulf Coast Aquifer 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 TWBD, 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. A very large increase in water needs is anticipated for Nueces County due to an additional demand for manufacturing water use that would reach 37,897 AFY by the year 2060. In contrast, municipal water would have a moderate increase, from 399 AFY projected for 2010 to 590 in the year 2060.

A GAM was developed by TWDB for the southern section of the Gulf Coast Aquifer, including Nueces 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

The Cyndie Park II PWS is located within the Nueces-Rio Grande Coastal Basin where the demand for surface water is expected to increase over the next 50 years as a result of increased population and a decline in the groundwater supply by over pumping and salinization. The Texas State Water Plan, updated by the TWDB in 2007, estimates that the basin's surface water availability in the year 2010 will be approximately 8,900 AFY.

The 2007 State Water Plan estimated that, without implementation of additional water management strategies, the increasing water demand in Nueces County will exceed projected water supply estimates, largely due to an additional demand for manufacturing water. The increase in municipal water use is expected to be moderate, from 399 AFY projected for 2010 to 590 in the year 2060.

There is a minimum potential for development of new surface water sources for the Cyndie Park II PWS as indicated by results of the surface water availability model developed by the TWDB for the Nueces-Rio Grande Coastal Basin. The model is a tool to determine the maximum amount of water available during the drought of record over a given simulation period. The availability model determines the percent of months of flow per year, regardless of whether the supply is physically or legally available. Modeling results indicated that unappropriated flows for new applications would be typically available less than 50 percent of the time over all of Nueces County. 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:

1. South Texas Water Authority. Treated water would be purchased from the STWA to be used by the Cyndie Park II WSC. A pipeline would be constructed to convey water from the STWA water line extending north from the City of Banquete toward Indian Trails Subdivision (Alternative CP-1).

2. City of Mathis. Treated water would be purchased from the City of Mathis to be used by Cyndie Park II. A pipeline would be constructed to convey water from the City of Mathis water treatment plant to the Cyndie Park II PWS (Alternative CP-2).

3. City of Alice. Treated water would be purchased from the City of Alice to be used by Cyndie Park II. A pipeline would be constructed to convey water from the City of Alice water treatment plant to the Cyndie Park II PWS (Alternative CP-3).

4. New Wells at 10, 5, and 1 mile. Installing a new well within 10, 5, or 1 mile of the Cyndie Park II 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 Cyndie Park II PWS (Alternatives CP-4, CP-5, and CP-6).

4.3 TREATMENT OPTIONS

4.3.1 Centralized Treatment Systems

Centralized treatment of the well water is identified as a potential option. Reverse osmosis, iron-base adsorption treatment, and coagulation/filtration could be potential applicable processes. The central RO treatment alternative is Alternative CP-7, the adsorption treatment is Alternative CP-8, and the coagulation/filtration treatment alternative is Alternative CP-9.

4.3.2 Point-of-Use Systems

POU treatment using RO technology is valid for arsenic removal. The POU treatment alternative is CP-10.

4.3.3 Point-of-Entry Systems

POE treatment using RO technology is valid for arsenic removal. The POE treatment alternative is CP-11.

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 CP-12, CP-13, and CP-14.

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 CP-1: Purchase Treated Water from the South Texas Water Authority

This alternative involves purchasing potable water from the STWA, which will be used to supply the Cyndie Park II PWS. The STWA currently has sufficient excess capacity for this alternative to be feasible, although current policy only allows drinking water to be provided to areas within the STWA's district boundaries; however, Cyndie Park II is within several miles of a treated water line extending north from the City of Banquete. For purposes of this report, to allow direct and straightforward comparison with other alternatives, this alternative assumes that water would be purchased from the STWA. Also, it is assumed that Cyndie Park II PWS would obtain all its water from the STWA.

This alternative would require construction of a pump station and a 5,000-gallon feed tank at a point adjacent to the STWA's water line at the southwest corner of the intersection of FM 666 and FM 1833, and a pipe from the feed tank to a new 5,000-gallon ground storage tank for the Cyndie Park II PWS. The pump station is required to overcome pipe friction and the elevation differences between the feed tank and Cyndie Park II PWS. The required pipeline would be 4-inches in diameter, approximately 4.2 miles long, and follow FM 1833 west and then south along Cindy Lane and then discharge into the new ground storage tank at Cyndie Park II PWS. Service pumps would also be required at the new tank to pump water into the distribution system.

By definition this alternative involves regionalization, since Cyndie Park II would be obtaining drinking water from an existing larger supplier. Also, other PWSs near Cyndie Park II PWS are in need of compliant drinking water and could share in implementation of this alternative.

The estimated capital cost for this alternative includes constructing the pipeline, pump station, storage tank, building, and distribution pumps. The estimated O&M cost for this alternative includes the purchase price for the treated water minus the cost related to current operation of the Cyndie Park II well, plus maintenance cost for the pipeline, and power and O&M labor and materials for the pump station. The estimated capital cost for this alternative is $777,400, with an estimated annual O&M cost of $44,200. If the purchased water was used for blending rather than for the full water supply, the annual O&M cost for this alternative could be reduced because of reduced pumping costs and reduced water purchase costs. However, additional costs would be incurred for equipment to ensure proper blending, and additional monitoring to ensure the finished water is compliant.

The reliability of adequate amounts of compliant water under this alternative should be good. The STWA purchases treated water on a large scale from Corpus Christi, facilitating adequate O&M resources. From the perspective of the Cyndie Park II PWS, this alternative would be characterized as easy to operate and repair, since O&M and repair of pipelines and pumps are well understood. If the decision were made to perform blending then the operational complexity would increase.

The feasibility of this alternative is dependent on an agreement being reached with the both the STWA and the NWSC to purchase treated drinking water.

4.5.2 Alternative CP-2: Purchase Treated Water from the Mathis

This alternative involves purchasing potable water from the City of Mathis, which will be used to supply the Cyndie Park II PWS. The City of Mathis currently has sufficient excess capacity for this alternative to be feasible, although current City policy only allows drinking water to be provided to areas within the City limits. For purposes of this report, to allow direct and straightforward comparison with other alternatives, this alternative assumes that water would be purchased from the City. Also, it is assumed that Cyndie Park II would obtain all its water from the City of Mathis.

This alternative would require construction of a pump station and a 5,000-gallon feed tank at a point adjacent to a City of Mathis water main. A pipeline would be constructed to a new 5,000-gallon ground storage tank and booster pump set located at the Cyndie Park II PWS. The pump station is required to overcome pipe friction and the elevation differences between the feed tank and Cyndie Park II PWS. The required pipeline would be 4-inches in diameter, approximately 19.4 miles long, and follow State Highway (SH) 359 from Mathis west to Sandia, turning south on County Road (CR) 357 and crossing CR 70 to CR 54A, then west on CR 101 continuing on to FM 1833, and then tap into the new 5,000 gallon storage tank for Cyndie Park PWS.

The pump station would include two pumps, including one standby, and would be housed in a building. A tank would also be constructed for the pumps to draw from. It is assumed the pumps and piping would be installed with capacity to meet all water demand for the Cyndie Park II PWS, since the incremental cost would be relatively small, and would provide operational flexibility.

By definition this alternative involves regionalization, since Cyndie Park II would be obtaining drinking water from an existing larger supplier. Also, other PWSs near Cyndie Park II are in need of compliant drinking water and could share in implementation of this alternative.

The estimated capital cost for this alternative includes constructing the pipeline, feed tank, building, and distribution pumps. The estimated O&M cost for this alternative includes the purchase price for the treated water minus the cost related to current operation of the Cyndie Park II's well, plus maintenance cost for the pipeline, and power and O&M labor and materials for the pump station. The estimated capital cost for this alternative is $3.27 million, with an estimated annual O&M cost of $50,700. If the purchased water was used for blending rather than for the full water supply, the annual O&M cost for this alternative could be reduced because of reduced pumping costs and reduced water purchase costs. However, additional costs would be incurred for equipment to ensure proper blending, and additional monitoring to ensure the finished water is compliant.

The reliability of adequate amounts of compliant water under this alternative should be good. The City of Mathis provides treated surface water on a large scale, facilitating adequate

O&M resources. From Cyndie Park II's perspective, this alternative would be characterized as easy to operate and repair, since O&M and repair of pipelines and pump stations is well understood. If the decision was made to perform blending then the operational complexity would increase.

The feasibility of this alternative is dependent on an agreement being reached with the City of Mathis to purchase treated drinking water.

There are several small PWSs relatively close to the Cyndie Park II PWS that have water quality problems that would be good candidates for sharing the cost for obtaining water from the City of Mathis. The cost to the Cyndie Park II PWS for this alternative could be reduced if the other PWSs would be willing to share the costs. The analysis for a shared solution is presented in Appendix E. Based on these estimates, the range of pipeline capital cost savings to the Cyndie Park II PWS would be $740,000 to $3.2 million if they were to implement a shared solution like this, which would be savings of 23 to 98 percent. These estimates are hypothetical and are only provided to approximate the magnitude of potential savings if this shared solution is implemented as described.

4.5.3 Alternative CP-3: Purchase Treated Water from the Alice

This alternative involves purchasing treated water from the City of Alice, which will be used to supply the Cyndie Park II PWS. The City of Alice currently has sufficient excess capacity for this alternative to be feasible, although current City policy only allows drinking water to be provided to areas within the City limits. For purposes of this report, to allow direct and straightforward comparison with other alternatives, this alternative assumes that water would be purchased from the City. Also, it is assumed that Cyndie Park II would obtain all its water from the City of Alice.

This alternative would require construction of a pump station and 5,000-gallon feed tank at a point adjacent to a City of Alice water main. A pipeline would be constructed to a new 5,000-gallon ground storage tank and booster pump set located at the Cyndie Park II PWS. A pump station is required to overcome pipe friction and the elevation differences between the feed tank and Cyndie Park II PWS. The required pipeline would be 4-inches in diameter, approximately 19.5 miles long, and follow SH 359 from Alice toward Agua Dulce, turning north on CR 109 to CR 334/CR 40 to CR 105 North onto FM 70 to CR 101, and then east on CR 48 turning north on Cindy Lane to Cyndie Park II PWS.

The pump station would include two pumps, including one standby, and would be housed in a building. A tank would also be constructed for the pumps to draw from. It is assumed the pumps and piping would be installed with capacity to meet all water demand for Cyndie Park II, since the incremental cost would be relatively small, and would provide operational flexibility.

By definition this alternative involves regionalization, since Cyndie Park II would be obtaining drinking water from an existing larger supplier. Also, other PWSs near Cyndie Park II are in need of compliant drinking water and could share in implementation of this alternative.

The estimated capital cost for this alternative includes constructing the pipeline, feed tanks, building, and distribution pumps. The estimated O&M cost for this alternative includes the purchase price for the treated water minus the cost related to current operation of the Cyndie Park II's well, plus maintenance cost for the pipeline, and power and O&M labor and materials for the pump station. The estimated capital cost for this alternative is $2.91 million, with an estimated annual O&M cost of $52,200. If the purchased water was used for blending rather than for the full water supply, the annual O&M cost for this alternative could be reduced because of reduced pumping costs and reduced water purchase costs. However, additional costs would be incurred for equipment to ensure proper blending, and additional monitoring to ensure the finished water is compliant.

The reliability of adequate amounts of compliant water under this alternative should be good. The City of Alice provides treated surface water on a large scale, facilitating adequate O&M resources. From Cyndie Park II's perspective, this alternative would be characterized as easy to operate and repair, since O&M and repair of pipelines and pump stations is well understood. If the decision was made to perform blending then the operational complexity would increase.

The feasibility of this alternative is dependent on an agreement being reached with the City of Alice to purchase treated drinking water.

4.5.4 Alternative CP-4: New Well at 10 miles

This alternative consists of installing one new well within 10 miles of the Cyndie Park II PWS that would produce compliant water in place of the water produced by the existing well. At this level of study, it is not possible to positively identify an existing well or the location where a new well could be installed.

This alternative would require constructing one new 630-foot well, 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 a new 5,000-gallon storage tank with two service pumps installed within a pump house near the existing intake point for the Cyndie Park II PWS. The pump stations and feed tanks would be necessary to overcome pipe friction and changes in land elevation. For this alternative, the pipeline is assumed to be approximately 10 miles long, and would be a 4-inches in diameter and discharge to the new 5,000-gallon storage tank at the Cyndie Park II PWS. The pump station would include a feed tank, two transfer pumps, including one standby, and would be housed in a building. The new storage tank would include two service 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 well, constructing the pipeline, the pump station, the storage tank, service pumps and pump house. 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 $1.85 million, and the estimated annual O&M cost for this alternative is $56,800.

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 Cyndie Park II PWS, this alternative would be similar to operate as the existing system. Cyndie Park II PWS personnel have experience with O&M of wells, pipelines, and pump stations.

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

4.5.5 Alternative CP-5: New Well at 5 miles

This alternative consists of installing one new well within 5 miles of the Cyndie Park II PWS that would produce compliant water in place of the water produced by the existing well. At this level of study, it is not possible to positively identify an existing well or the location where new well could be installed.

This alternative would require constructing one new 630-foot well, a new pump station with 5,000-gallon feed tank near the new well, and a pipeline from the new well/feed tank to a new 5,000-gallon storage tank with two service pumps installed within a pump house near the existing intake point for the Cyndie Park II PWS 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, approximately 5 miles long, and would discharge to a new storage tank at the Cyndie Park II PWS. The pump station near the well would include two transfer pumps, including one standby, and would be housed in a building. The new storage tank would include two service 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 well, 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 $1.11 million, and the estimated annual O&M cost for this alternative is $55,400.

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 Cyndie Park II PWS, this alternative would be similar to operate as the existing system. Cyndie Park II PWS personnel have experience with O&M of wells, pipelines and pump stations.

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

4.5.6 Alternative CP-6: New Well at 1 mile

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

This alternative would require constructing one new 630-foot well and a pipeline from the new well to a new 5,000-gallon storage tank with two service pumps installed within a pump house near the existing intake point for the Cyndie Park II PWS. Since the new well is relatively close, a pump station would not be necessary. For this alternative, the pipeline is assumed to be 4 inches in diameter, approximately 1 mile long, and would discharge to a new storage tank at the Cyndie Park II PWS. The new storage tank would include two service 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 well, 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 $386,000, and the estimated annual O&M cost for this alternative is $26,900.

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 Cyndie Park II PWS, this alternative would be similar to operate as the existing system. Cyndie Park II PWS personnel have experience with O&M of wells, pipelines and pump stations.

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

4.5.7 Alternative CP-7: Central RO Treatment

The system would continue to pump water from the existing well, and would treat the water through an RO system prior to distribution. For this option, 57 percent of the raw water would be treated to obtain compliant water. It is estimated the RO reject generation would be approximately 500 gallons per day (gpd) when the system is operated at the average daily consumption (0.003 mgd).

This alternative consists of installing the RO treatment plants near the existing well. The plant is composed of a 500 ft^2 building with a paved driveway; a skid with the pre-constructed RO plant; three transfer pumps, a 5,000-gallon tank for storing the treated water. The reject water discharge would be stored in a 15,000-gallon tank and periodically hauled away by tanker truck for disposal at a nearby WWTP over an estimated 18 mile round trip distance. 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 would be fenced.

The estimated capital cost for this alternative is $437,800, and the estimated annual O&M cost is $49,900.

The reliability of adequate amounts of compliant water under this alternative is good, since RO treatment is a common and well-understood 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.

4.5.8 Alternative CP-8: Central Iron Adsorption Treatment

The system would treat groundwater from the existing well using an iron-based adsorption system prior to distribution. This alternative consists of constructing the adsorption treatment plant near the existing well. The plant is composed of a 500 ft^{2-}building with a paved driveway, the pre-constructed adsorption system on a skid (*e.g.,* one AdEdge APU-100 package unit), and a 1,400-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 distribution system. Backwash would be required every 14 days with raw well water supplied directly by the well pump. The backwash would be equalized in the 1,400-gallon tank, and disposed of by a tanker truck. The adsorption media are expected to last up to 1.5 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 $250,600, and the estimated annual O&M cost is $25,000, which includes the annual media replacement cost of $800. 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.

4.5.9 Alternative CP-9: Central Coagulation/Filtration Treatment

The system would treat groundwater from the well 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 require a 500 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 1,800-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 14 days by well water directly from the well pump. The backwash wastewater would be disposed of by tanker truck. The Macrolite media do not need replacement.

The estimated capital cost for this alternative is $296,200, and the estimated annual O&M cost is $39,300. 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.

4.5.10 Alternative CP-10: Point-of-Use Treatment

This alternative consists of the continued operation of the Cyndie Park II PWS well, 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. Cyndie Park II PWS 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 Cyndie Park II PWS 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 (Title 30, Part I, Chapter 290, Subchapter F, Rule 290.106). The estimated capital cost for this alternative is $10,700, and the estimated annual O&M cost for this alternative is $10,000. For the cost estimate, it is assumed that one POU treatment unit will be required for each of the 18 connections in the Cyndie Park II PWS. It should be noted that 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. 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 Cyndie Park II 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.

4.5.11 Alternative CP-11: Point-of-Entry Treatment

This alternative consists of the continued operation of the Cyndie Park II PWS well, 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).

Cyndie Park II PWS 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 $282,000, and the estimated annual O&M cost for this alternative is $39,900. For the cost estimate, it is assumed that one POE treatment unit will be required for each of the 18 existing connections to the Cyndie Park II PWS.

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 Cyndie Park II 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.

4.5.12 Alternative CP-12: Public Dispenser for Treated Drinking Water

This alternative consists of the continued operation of the Cyndie Park II PWS well, plus dispensing treated water for drinking and cooking at a publicly accessible location. Implementing this alternative would require purchasing and installing a treatment unit 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.

Cyndie Park II PWS 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 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 $18,400, and the estimated annual O&M cost for this alternative is $35,700.

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. Cyndie Park II PWS has not provided this type of service in the past. From Cyndie Park II PWS' perspective, this alternative would be characterized as relatively easy to operate, since these types of treatment units are highly automated, and there is only one unit.

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

4.5.13 Alternative CP-13: 100 Percent Bottled Water Delivery

This alternative consists of the continued operation of the Cyndie Park II PWS well, 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 Cyndie Park II PWS 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 Cyndie Park II 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 $27,600, and the estimated annual O&M cost for this alternative is $56,000. 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 Cyndie Park II PWS.

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

4.5.14 Alternative CP-14: Public Dispenser for Trucked Drinking Water

This alternative consists of continued operation of the Cyndie Park II PWS well, plus dispensing compliant water for drinking and cooking at a publicly accessible location. The compliant water would be purchased from the City of Corpus Christi, 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.

Cyndie Park II PWS 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 $131,100, and the estimated annual O&M cost for this alternative is $36,900.

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 Cyndie Park II PWS, 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.

4.5.15 Summary of Alternatives

Table 4.3 provides a summary of the key features of each alternative for Cyndie Park II PWS.

1 **Table 4.3 Summary of Compliance Alternatives for Cyndie Park II PWS**

Alt No.	Alternative Description	Major Components	Capital Cost[1]	Annual O&M Cost	Total Annualized Cost	Reliability	System Impact	Remarks
CP-1	Purchase water from STWA	- Pump station/feed tank - Storage tank - 4.2-mile pipeline	$ 777,400	$ 44,200	$ 112,000	Good	N	Agreement must be successfully negotiated with the STWA,. Blending may be possible. Costs could possibly be shared with small systems along pipeline route.
CP-2	Purchase water from City of Mathis	- Pump station/feed tank - Storage tank - 19.4-mile pipeline	$3,272,600	$ 50,700	$ 336,000	Good	N	Agreement must be successfully negotiated with City of Mathis. Blending may be possible. Costs could possibly be shared with small systems along pipeline route.
CP-3	Purchase water from City of Alice	- Pump station/feed tank - Storage tank - 19.5-mile pipeline	$2,907,000	$ 52,200	$ 305,600	Good	N	Agreement must be successfully negotiated with City of Alice. Blending may be possible. Costs could possibly be shared with small systems along pipeline route.
CP-4	Install new compliant well within 10 miles	- New well - Storage tank - Pump station/feed tank - 10-mile pipeline	$1,845,200	$ 56,800	$ 217,700	Good	N	May be difficult to find well with good water quality. Costs could possibly be shared with small systems along pipeline route.
CP-5	Install new compliant well within 5 miles	- New well - Storage tank - Pump station/feed tank - 5-mile pipeline	$1,105,500	$ 55,400	$ 151,800	Good	N	May be difficult to find well with good water quality. Costs could possibly be shared with small systems along pipeline route.
CP-6	Install new compliant well within 1 mile	- New well - Storage tank - 1-mile pipeline	$ 386,000	$ 26,900	$ 60,500	Good	N	May be difficult to find well with good water quality.
CP-7	Continue operation of Cyndie Park II well with central RO treatment	- Central RO treatment plant	$ 437,800	$ 49,900	$ 88,100	Good	T	No nearby system to possibly share treatment plant cost.
CP-8	Continue operation of Cyndie Park II well with central iron adsorption treatment	- Central adsorption treatment plant	$ 250,600	$ 25,000	$ 46,900	Good	T	No nearby system to possibly share treatment plant cost.
CP-9	Continue operation of Cyndie Park II well with central coagulation/filtration treatment	- Central coagulation/filtration treatment plant	$ 296,200	$ 39,300	$ 65,200	Good	T	No nearby system to possibly share treatment plant cost.

Alt No.	Alternative Description	Major Components	Capital Cost[1]	Annual O&M Cost	Total Annualized Cost	Reliability	System Impact	Remarks
CP-10	Continue operation of Cyndie Park II well, and POU treatment	- POU treatment units.	$ 10,700	$ 10,000	$ 10,900	Fair	T, M	Only one compliant tap in home. Cooperation of residents required for installation, maintenance, and testing.
CP-11	Continue operation of Cyndie Park II well, and POE treatment	- POE treatment units.	$ 282,000	$ 39,900	$ 64,500	Fair (*better than POU*)	T, M	All home taps compliant and less resident cooperation required.
CP-12	Continue operation of Cyndie Park II well, but furnish public dispenser for treated drinking water	- Water treatment and dispenser unit	$ 18,400	$ 35,700	$ 37,300	Fair/interim measure	T	Does not provide compliant water to all taps, and requires a lot of effort by customers.
CP-13	Continue operation of Cyndie Park II well, but furnish bottled drinking water for all customers	- Set up bottled water system	$ 27,600	$ 56,000	$ 58,400	Fair/interim measure	M	Does not provide compliant water to all taps, and requires customers to order and use. Management of program may be significant.
CP-14	Continue operation of Cyndie Park II well, but furnish public dispenser for trucked drinking water	- Construct storage tank and dispenser - Purchase potable water truck	$ 131,100	$ 36,900	$ 48,300	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. Cyndie Park II PWS serves a population of 50 and has 18 connections (none of the connections are metered). Information that was used to complete the financial analysis was based on annual maintenance fees for revenues and estimated expenses. The water usage rate for Cyndie Park II PWS was estimated to be 52 gpd per capita based on average daily use and current population.

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

Financial records and statements for Cyndie Park II PWS were used to determine annual revenues. According to the available financial data, approximately 1.1 million gallons of water was used in fiscal year 2008, generating an annual income of $6,480 base on a rate of $30 per month per connection. The actual usage rate was $5.92 per 1,000 gallons or approximately 1.25 percent of the annual household income of $28,777. The Cyndie Park II PWS MHI is below 75% of the median state household income, which may make it eligible for grants and low interest rate loans.

4.6.2 Current Financial Condition

4.6.2.1 Cash Flow Needs

Since all the necessary financial records for Cyndie Park II PWS were not available, expenses were estimated for this PWS based on expenses for similar size systems. Based on estimated expenses of $9,766, it appears that revenues are not sufficient to maintain operations.

4.6.2.2 Ratio Analysis

Current Ratio

The Current Ratio for the Cyndie Park II PWS could not be determined due to lack of necessary financial data to determine this ratio.

Debt to Net Worth Ratio

A Debt-to-Net-Worth Ratio also could not be determined owing to lack of the necessary financial data to determine this ratio.

Operating Ratio

Because of the lack of complete separate financial data on expenses specifically related to the Cyndie Park II PWS, the Operating Ratio could not be accurately determined.

4.6.3 Financial Plan Results

Each of the compliance alternatives for the Cyndie Park II PWS 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 4.4 and Figure 4.2. Table 4.4 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, 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).

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. Cyndie Park II 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, 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 no longer than 20 years. 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. The DWSRF program can provide funds from State sources or Federal capitalization grants. State loans provide a net long-term interest rate of 0.7 percentage points below the rate the borrower would receive on the open market at the time of loan closing and Federal Capitalization Grants provide a lower net long-term interest rate of 1.2 percentage points. "Disadvantaged communities" may obtain loans at even greater subsidies and up to a 30-year loan term.

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 notifies 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 qualify for a sales tax exemption. Rural Political Subdivisions are eligible (non-profit 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 non-profit 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 is set in accordance with the TWDB rules in 31 Texas Administrative Code (TAC) 384.5 and the scale varies according to the length of the loan and several factors. The TWDB seeks to provide reasonable rates for its customers with minimal risk to the state. The TWDB posts rates for comparison for applicants, and in August 2009 the TWDB showed its rates for a 22-year, taxable loan at 7.07 percent, where the market was at 8.47 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 Cyndie Park II PWS. The maximum financing life is 50 years. The average financing period is 20 to 23 years. The interest rate is set in accordance with the TWDB rules in 31 TAC 363.33(a). The TWDB seeks to provide reasonable rates with minimal risk to the state. The TWDB post rates for comparison for applicants and in August 2009, the TWDB showed their rates for a 22-year, taxable loan at 7.07 percent where the market was at 8.47 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 board considers applications monthly.

ECONOMICALLY DISTRESSED AREAS PROGRAM

The EDAP 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 minimal residential needs. Eligible communities are those that have median household income less than 75 percent of the state household income. The applicant 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 planning, design, construction, and acquisition. Up to 75 percent funding is available for facility plans with certain hardship cases 100 percent funding may be available. Projects must complete the planning, acquisition, and design phase before applying for second phase construction funds. The TWDB works with the applicant to find ways to leverage other state and federal financial resources. For grant fund above 50 percent, the Texas Department of State Health Services must determine if there is a health and safety nuisance.

The loan requires that the applicant pledge revenue or taxes, as well as some collateral for Cyndie Park II 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 in accordance with the TWDB rules in 31 TAC 363.33(a). The TWDB seeks to provide reasonable rates with minimal loss to the state. The TWDB posts rates for comparison for applicants and in August 2009 the TWDB showed its rates for a 22-year, tax exempt loan at 5.05 percent where the market was at 6.05 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 and the Texas

Small Towns Environment Program. 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 WSC. All program requirements would have to be met by the benefiting community receiving services by the WSC.

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 in each region by local elected officials, appointed by the Governor 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. 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. 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, community meetings are held, and after CDBG staff determine eligibility with a written invitation to apply, 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's agency of Rural Development established Water and Waste Disposal Program for public entities administered by the staff of the Water and Environment Program 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.

The Water and Waste Disposal Program 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 people and rural areas with no population limits. Recipients must be public entities such as municipalities, counties, special purpose districts, Indian tribes, and non-profit corporations. RUS has set aside direct loans and grants for several areas (e.g., empowerment zones). Projects include all forms of infrastructure improvement, acquisition of land and water rights, and design fees. 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.

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:

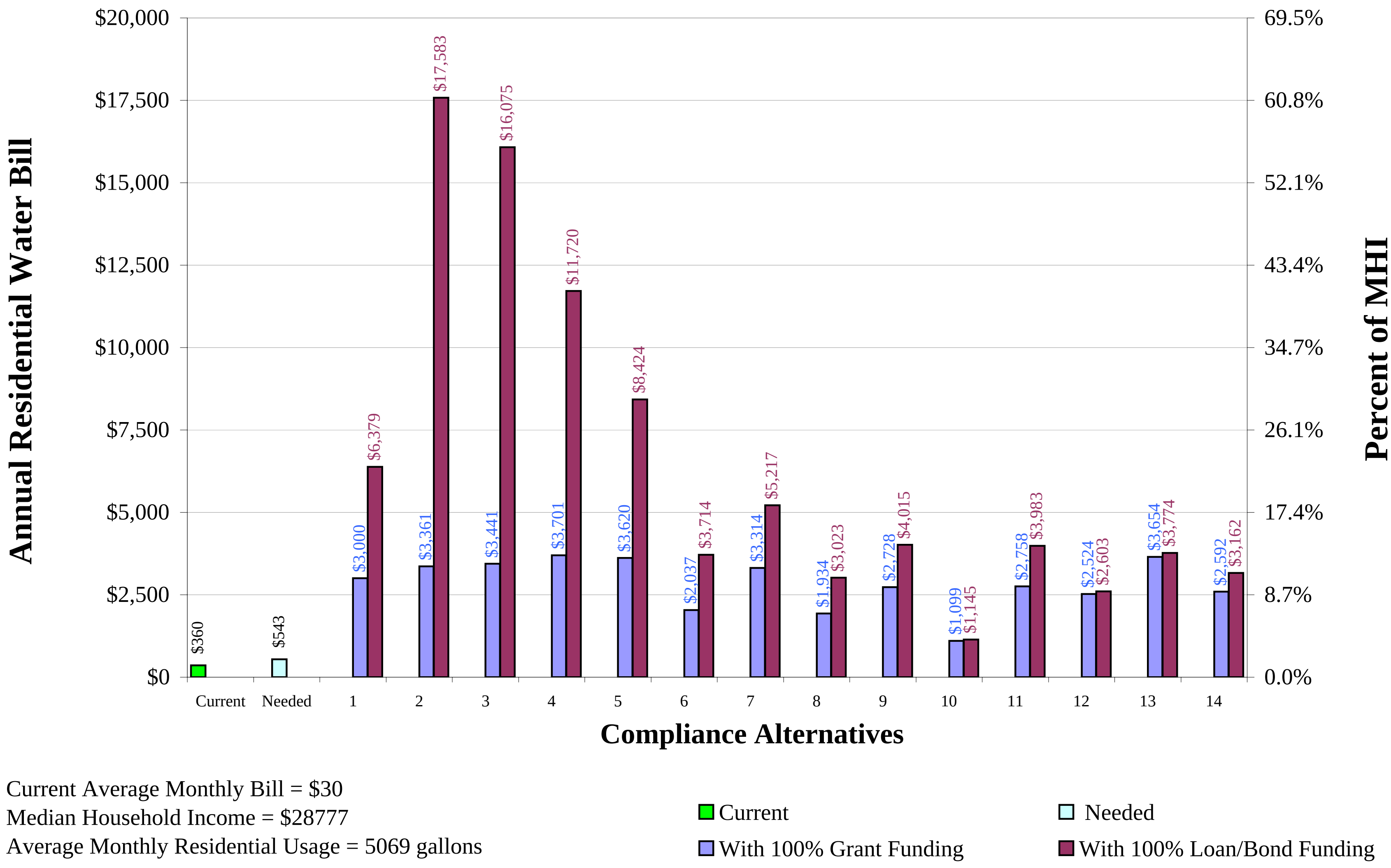
- Poverty Rate - The lowest rate is the poverty interest rate of 4.5 percent. Loans must be used to upgrade or construct new facilities to meet health standards, and the MHI in the service area must be below the poverty line for a family of four or below 80 percent of the statewide MHI for non-metropolitan 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.

Table 4.4 Financial Impact on Households for Cyndie Park II PWS

#		Funding Source #	0	1	2	3	4	5
	ALTERNATIVES		All Revenue	100% Grant	75% Grant	50% Grant	State Revolving Fund	Loan/Bond
CP-1	Purchase Water from STWA	Average Annual Water Bill	$43,733	$3,000	$3,845	$4,690	$5,394	$6,379
		Maximum % of HH Income	152.0%	10.4%	13.4%	16.3%	18.7%	22.2%
		Percentage Rate Increase Compared to Current	12,049%	733%	968%	1,203%	1,398%	1,672%
CP-2	Purchase Water from Mathis	Average Annual Water Bill	$182,351	$3,361	$6,916	$10,472	$13,436	$17,583
		Maximum % of HH Income	633.7%	11.7%	24.0%	36.4%	46.7%	61.1%
		Percentage Rate Increase Compared to Current	50,558%	834%	1,821%	2,809%	3,633%	4,785%
CP-3	Purchase Water from Alice	Average Annual Water Bill	$162,044	$3,441	$6,599	$9,758	$12,391	$16,075
		Maximum % of HH Income	563.1%	12.0%	22.9%	33.9%	43.1%	55.9%
		Percentage Rate Increase Compared to Current	44,916%	856%	1,733%	2,611%	3,342%	4,366%
CP-4	New Well at 10 Miles	Average Annual Water Bill	$103,054	$3,701	$5,706	$7,710	$9,382	$11,720
		Maximum % of HH Income	358.1%	12.9%	19.8%	26.8%	32.6%	40.7%
		Percentage Rate Increase Compared to Current	28,529%	928%	1,485%	2,042%	2,506%	3,156%
CP-5	New Well at 5 Miles	Average Annual Water Bill	$61,958	$3,620	$4,821	$6,022	$7,023	$8,424
		Maximum % of HH Income	215.3%	12.6%	16.8%	20.9%	24.4%	29.3%
		Percentage Rate Increase Compared to Current	17,112%	906%	1,239%	1,573%	1,851%	2,240%
CP-6	New Well at 1 Miles	Average Annual Water Bill	$21,985	$2,037	$2,456	$2,875	$3,225	$3,714
		Maximum % of HH Income	76.4%	7.1%	8.5%	10.0%	11.2%	12.9%
		Percentage Rate Increase Compared to Current	6,008%	466%	582%	699%	796%	932%
CP-7	Central Treatment - RO	Average Annual Water Bill	$24,864	$3,314	$3,790	$4,266	$4,662	$5,217
		Maximum % of HH Income	86.4%	11.5%	13.2%	14.8%	16.2%	18.1%
		Percentage Rate Increase Compared to Current	6,807%	821%	953%	1,085%	1,195%	1,349%
CP-8	Central Treatment – Iron Adsorption	Average Annual Water Bill	$14,467	$1,934	$2,206	$2,478	$2,705	$3,023
		Maximum % of HH Income	50.3%	6.7%	7.7%	8.6%	9.4%	10.5%
		Percentage Rate Increase Compared to Current	3,919%	437%	513%	588%	652%	740%
CP-9	Central Treatment – Coagulation/Filtration	Average Annual Water Bill	$16,997	$2,728	$3,050	$3,372	$3,640	$4,015
		Maximum % of HH Income	59.1%	9.5%	10.6%	11.7%	12.6%	14.0%
		Percentage Rate Increase Compared to Current	4,622%	658%	747%	837%	911%	1,015%
CP-10	Point-of-Use Treatment	Average Annual Water Bill	$1,137	$1,099	$1,110	$1,22	$1,131	$1,145
		Maximum % of HH Income	3.9%	3.8%	3.9%	3.9%	3.9%	4.0%

#		Funding Source #	0	1	2	3	4	5
	ALTERNATIVES		**All Revenue**	**100% Grant**	**75% Grant**	**50% Grant**	**State Revolving Fund**	**Loan/Bond**
		Percentage Rate Increase Compared to Current	216%	205%	208%	212%	214%	218%
CP-11	Point-of-Entry Treatment	Average Annual Water Bill	$16,209	$2,758	$3,064	$3,370	$3,626	$3,983
		Maximum % of HH Income	56.3%	9.6%	10.6%	11.7%	12.6%	13.8%
		Percentage Rate Increase Compared to Current	4,403%	666%	751%	836%	907%	1,007%
CP-12	Public Dispenser for Treated Drinking water	Average Annual Water Bill	$2,524	$2,524	$2,544	$2,564	$2,580	$2,603
		Maximum % of HH Income	8.8%	8.8%	8.8%	8.9%	9.0%	9.0%
		Percentage Rate Increase Compared to Current	601%	601%	607%	612%	617%	623%
CP-13	Supply Bottled Water to 100% of Population	Average Annual Water Bill	$3,654	$3,654	$3,684	$3,714	$3,739	$3,774
		Maximum % of HH Income	12.7%	12.7%	12.8%	12.9%	13.0%	13.1%
		Percentage Rate Increase Compared to Current	915%	915%	923%	932%	939%	948%
CP-14	Central Trucked Drinking Water	Average Annual Water Bill	$7,826	$2,592	$2,735	$2,877	$2,996	$3,162
		Maximum % of HH Income	27.2%	9.0%	9.5%	10.0%	10.4%	11.0%
		Percentage Rate Increase Compared to Current	2,074%	620%	660%	699%	732%	778%

Figure 4.2
Alternative Cost Summary: Cyndie Park II WSC



Current Average Monthly Bill = $30
Median Household Income = $28777
Average Monthly Residential Usage = 5069 gallons

SECTION 5
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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 $0.175 per kWH, as supplied by Nueces Electric Co-op. 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 2009 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 2009 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 2009 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, for both adsorption and coagulation/filtration, 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 quotations from drillers for installation of similar depth wells in the area. 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
Cyndie Park II PWS
1780050
General PWS Information

Service Population	50	**Number of Connections**	18
Total PWS Daily Water Usage	0.003 (mgd)	**Source**	2009 Official

Unit Cost Data

General Items	**Unit**	**Unit Cost**
Treated water purchase cost	*See alternative*	
Water purchase cost (trucked)	$/1,000 gals	$ 4.33
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, 04"	LF	$ 11
Bore and encasement, 10"	LF	$ 260
Open cut and encasement, 10"	LF	$ 140
Gate valve and box, 04"	EA	$ 727
Air valve	EA	$ 2,110
Flush valve	EA	$ 1,055
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	$ 8,230
Pump Station Piping, 04"	EA	$ 566
Gate valve, 04"	EA	$ 727
Check valve, 04"	EA	$ 774
Electrical/Instrumentation	EA	$ 10,550
Site work	EA	$ 2,635
Building pad	EA	$ 5,275
Pump Building	EA	$ 10,550
Fence	EA	$ 6,330
Tools	EA	$ 1,055
5,000 gal feed tank	EA	$ 10,250
Backflow preventer, 4"	EA	$ 2,359
Backflow Testing/Certification	EA	$ 110

Well Installation Unit Costs	**Unit**	**Unit Cost**
Well installation	*See alternative*	
Water quality testing	EA	$ 1,320
3HP Well Pump	EA	$ 4,824
Well electrical/instrumentation	EA	$ 5,800
Well cover and base	EA	$ 3,165
Piping	EA	$ 3,165
5,000 gal ground storage tank	EA	$ 10,250
Electrical Power	$/kWH	$ 0.175
Building Power	kWH	11,800
Labor	$/hr	$ 62
Materials	EA	$ 1,585
Transmission main O&M	$/mile	$ 285
Tank O&M	EA	$ 1,055

POU/POE Unit Costs		
POU treatment unit purchase	EA	$ 200
POU treatment unit installation	EA	$ 160
POE treatment unit purchase	EA	$ 5,275
POE - pad and shed, per unit	EA	$ 2,110
POE - piping connection, per unit	EA	$ 1,055
POE - electrical hook-up, per unit	EA	$ 1,055
POU Treatment O&M, per unit	$/year	$ 66
POE Treatment O&M, per unit	$/year	$ 1,585
Treatment analysis	$/year	$ 210
POU/POE labor support	$/hr	$ 42

Dispenser/Bottled Water Unit Costs		
POE-Treatment unit purchase	EA	$ 7,385
POE-Treatment unit installation	EA	$ 5,275
Treatment unit O&M	EA	$ 2,110
Administrative labor	hr	$ 46
Bottled water cost (inc. delivery)	gallon	$ 1.60
Water use, per capita per day	gpcd	1.0
Bottled water program materials	EA	$ 5,275
5,000 gal ground storage tank	EA	$ 10,250
Site improvements	EA	$ 3,165

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	$ 0.175
Equipment power	kwh/yr	$ 0.175
Labor, O&M	hr	$ 40
Analyses	test	$ 200
Adsorption		
Electrical	JOB	$ 30,000
Piping	JOB	$ 15,000
Adsorption package plant	UNIT	$ 50,000
Backwash tank	GAL	$ 2.00
Sewer connection fee	EA	$ 15,000
Spent media disposal	CY	$ 20
Adsorption materials replacement	CF	$ 200.00
Backwash discharge to sewer	MG/year	$ 5,000
Coagulation/filtration		
Electrical	JOB	$ 30,000
Piping	JOB	$ 15,000
Coagulation package plant	UNIT	$ 76,000
Backwash tank	GAL	$ 5.00
Coagulant tank	GAL	$ 3.00
Sewer connection fee	EA	$ 15,000
Coagulation/Filtration Materials	year	$ 4,000
Chemicals, Coagulation	year	$ 1,100
Backwash disposal/sewer discharge	MG/year	$ 5,000
Reverse Osmosis		
Electrical	JOB	$ 40,000
Piping	JOB	$ 20,000
RO package plant	UNIT	$ 24,000
Transfer pumps (3 hp)	EA	$ 3,000
Permeate tank	gal	$ 3
RO chemicals	kgal	$ 0.65

Reject/Backwash Disposal		
Backwash disposal mileage cost	miles	$ 1.50
Reject (brine) disposal fee	per 1,000 gal	$ 5.00
Truck - reject/backwash	per day	$ 250
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 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.14. 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 *Cyndie Park II PWS*
Alternative Name *Purchase Water from South Texas Water*
Alternative Number *Alt-1*

Distance from Alternative to PWS (along pipe)		4.2	miles
Total PWS annual water usage		1.106	MG
Treated water purchase cost	$	2.43	per 1,000 gals
Pump Stations needed w/ 1 feed tank each		1	
On site storage tanks / pump sets needed		1	

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	4	n/a	n/a		n/a	
PVC water line, Class 200, 04"	22,109	LF	$	11	$	244,599
Bore and encasement, 10"	200	LF	$	260	$	52,000
Open cut and encasement, 10"	200	LF	$	140	$	28,000
Gate valve and box, 04"	4	EA	$	727	$	3,214
Air valve	11	EA	$	2,110	$	23,210
Flush valve	4	EA	$	1,055	$	4,665
Metal detectable tape	22,109	LF	$	2	$	44,218
Subtotal					**$**	**399,906**
Pump Station(s) Installation						
Pump	4	EA	$	8,230	$	32,920
Pump Station Piping, 04"	2	EA	$	566	$	1,132
Gate valve, 04"	8	EA	$	727	$	5,814
Check valve, 04"	4	EA	$	774	$	3,094
Electrical/Instrumentation	2	EA	$	10,550	$	21,100
Site work	2	EA	$	2,635	$	5,270
Building pad	2	EA	$	5,275	$	10,550
Pump Building	2	EA	$	10,550	$	21,100
Fence	2	EA	$	6,330	$	12,660
Tools	2	EA	$	1,055	$	2,110
5,000 gal feed tank	1	EA	$	10,250	$	10,250
5,000 gal ground storage tank	1	EA	$	10,250	$	10,250
Backflow Preventor	-	EA	$	2,359	$	-
Subtotal					**$**	**136,250**
Subtotal of Component Costs					**$**	**536,156**
Contingency	20%				$	107,231
Design & Constr Management	25%				$	134,039
TOTAL CAPITAL COSTS					**$**	**777,427**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost		Total Cost	
Pipeline O&M						
Pipeline O&M	4.2	mile	$	285	$	1,193
Subtotal					**$**	**1,193**
Water Purchase Cost						
From PWS	1,106	1,000 gal	$	2.43	$	2,687
Subtotal					**$**	**2,687**
Pump Station(s) O&M						
Building Power	23,600	kWH	$	0.175	$	4,130
Pump Power	339	kWH	$	0.175	$	59
Materials	2	EA	$	1,585	$	3,170
Labor	730	Hrs	$	62.00	$	45,260
Tank O&M	1	EA	$	1,055	$	1,055
Backflow Test/Cert	-	EA	$	110	$	-
Subtotal					**$**	**53,674**
O&M Credit for Existing Well Closure						
Pump power	3,268	kWH	$	0.175	$	(572)
Well O&M matl	1	EA	$	1,585	$	(1,585)
Well O&M labor	180	Hrs	$	62.00	$	(11,160)
Subtotal					**$**	**(13,317)**
TOTAL ANNUAL O&M COSTS					**$**	**44,238**

Table C.2

PWS Name	***Cyndie Park II PWS***
Alternative Name	***Purchase Water from City of Mathis***
Alternative Number	***Alt-2***

Distance from Alternative to PWS (along pipe)		19.4	miles
Total PWS annual water usage		1.106	MG
Treated water purchase cost	$	4.33	per 1,000 gals
Pump Stations needed w/ 1 feed tank each		1	
On site storage tanks / pump sets needed		1	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	9	n/a	n/a	n/a
Number of Crossings, open cut	29	n/a	n/a	n/a
PVC water line, Class 200, 04"	102,209	LF	$ 11	$ 1,130,773
Bore and encasement, 10"	1,800	LF	$ 260	$ 468,000
Open cut and encasement, 10"	1,450	LF	$ 140	$ 203,000
Gate valve and box, 04"	20	EA	$ 727	$ 14,857
Air valve	37	EA	$ 2,110	$ 78,070
Flush valve	20	EA	$ 1,055	$ 21,566
Metal detectable tape	102,209	LF	$ 2	$ 204,418
Subtotal				**$ 2,120,684**
Pump Station(s) Installation				
Pump	4	EA	$ 8,230	$ 32,920
Pump Station Piping, 04"	2	EA	$ 566	$ 1,132
Gate valve, 04"	8	EA	$ 727	$ 5,814
Check valve, 04"	4	EA	$ 774	$ 3,094
Electrical/Instrumentation	2	EA	$ 10,550	$ 21,100
Site work	2	EA	$ 2,635	$ 5,270
Building pad	2	EA	$ 5,275	$ 10,550
Pump Building	2	EA	$ 10,550	$ 21,100
Fence	2	EA	$ 6,330	$ 12,660
Tools	2	EA	$ 1,055	$ 2,110
5,000 gal feed tank	1	EA	$ 10,250	$ 10,250
5,000 gal ground storage tank	1	EA	$ 10,250	$ 10,250
Backflow Preventor	-	EA	$ 2,359	$ -
Subtotal				**$ 136,250**
Subtotal of Component Costs				**$ 2,256,934**
Contingency	20%			$ 451,387
Design & Constr Management	25%			$ 564,234
TOTAL CAPITAL COSTS				**$ 3,272,554**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	19.4	mile	$ 285	$ 5,517
Subtotal				**$ 5,517**
Water Purchase Cost				
From PWS	1,106	1,000 gal	$ 4.33	$ 4,789
Subtotal				**$ 4,789**
Pump Station(s) O&M				
Building Power	23,600	kWH	$ 0.175	$ 4,130
Pump Power	722	kWH	$ 0.175	$ 126
Materials	2	EA	$ 1,585	$ 3,170
Labor	730	Hrs	$ 62.00	$ 45,260
Tank O&M	1	EA	$ 1,055	$ 1,055
Backflow Test/Cert	0	EA	$ 110	$ -
Subtotal				**$ 53,741**
O&M Credit for Existing Well Closure				
Pump power	3,268	kWH	$ 0.175	$ (572)
Well O&M matl	1	EA	$ 1,585	$ (1,585)
Well O&M labor	180	Hrs	$ 62	$ (11,160)
Subtotal				**$ (13,317)**
TOTAL ANNUAL O&M COSTS				**$ 50,730**

Table C.3

PWS Name ***Cyndie Park II PWS***
Alternative Name ***Purchase Water from City of Alice***
Alternative Number ***Alt-3***

Distance from Alternative to PWS (along pipe)	19.5	miles
Total PWS annual water usage	1.106	MG
Treated water purchase cost	$ 5.67	per 1,000 gals
Pump Stations needed w/ 1 feed tank each	1	
On site storage tanks / pump sets needed	1	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	7	n/a	n/a	n/a
Number of Crossings, open cut	12	n/a	n/a	n/a
PVC water line, Class 200, 04"	102,714	LF	$ 11	$ 1,136,360
Bore and encasement, 10"	1,400	LF	$ 260	$ 364,000
Open cut and encasement, 10"	600	LF	$ 140	$ 84,000
Gate valve and box, 04"	21	EA	$ 727	$ 14,930
Air valve	20	EA	$ 2,110	$ 42,200
Flush valve	21	EA	$ 1,055	$ 21,673
Metal detectable tape	102,714	LF	$ 2	$ 205,428
Subtotal				**$ 1,868,591**
Pump Station(s) Installation				
Pump	4	EA	$ 8,230	$ 32,920
Pump Station Piping, 04"	2	EA	$ 566	$ 1,132
Gate valve, 04"	8	EA	$ 727	$ 5,814
Check valve, 04"	4	EA	$ 774	$ 3,094
Electrical/Instrumentation	2	EA	$ 10,550	$ 21,100
Site work	2	EA	$ 2,635	$ 5,270
Building pad	2	EA	$ 5,275	$ 10,550
Pump Building	2	EA	$ 10,550	$ 21,100
Fence	2	EA	$ 6,330	$ 12,660
Tools	2	EA	$ 1,055	$ 2,110
5,000 gal feed tank	1	EA	$ 10,250	$ 10,250
5,000 gal ground storage tank	1	EA	$ 10,250	$ 10,250
Backflow Preventor	0	EA	$ 2,359	$ -
Subtotal				**$ 136,250**
Subtotal of Component Costs				**$ 2,004,841**
Contingency	20%			$ 400,968
Design & Constr Management	25%			$ 501,210
TOTAL CAPITAL COSTS				**$ 2,907,019**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	19.5	mile	$ 285	$ 5,544
Subtotal				**$ 5,544**
Water Purchase Cost				
From PWS	1,106	1,000 gal	$ 5.67	$ 6,276
Subtotal				**$ 6,276**
Pump Station(s) O&M				
Building Power	23,600	kWH	$ 0.175	$ 4,130
Pump Power	302	kWH	$ 0.175	$ 53
Materials	2	EA	$ 1,585	$ 3,170
Labor	730	Hrs	$ 62.00	$ 45,260
Tank O&M	1	EA	$ 1,055	$ 1,055
Backflow Test/Cert	0	EA	$ 110	$ -
Subtotal				**$ 53,668**
O&M Credit for Existing Well Closure				
Pump power	3,268	kWH	$ 0.175	$ (572)
Well O&M matl	1	EA	$ 1,585	$ (1,585)
Well O&M labor	180	Hrs	$ 62	$ (11,160)
Subtotal				**$ (13,317)**
TOTAL ANNUAL O&M COSTS				**$ 52,171**

Table C.4

PWS Name *Cyndie Park II PWS*
Alternative Name *New Well at 10 Miles*
Alternative Number *Alt-4*

Distance from PWS to new well location	10.0	miles
Estimated well depth	630	feet
Number of wells required	1	
Well installation cost (location specific)	$153	per foot
Pump Stations needed w/ 1 feed tank each	1	
On site storage tanks / pump sets needed	1	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	4	n/a	n/a	n/a
Number of Crossings, open cut	10	n/a	n/a	n/a
PVC water line, Class 200, 04"	52,800	LF	$ 11	$ 584,144
Bore and encasement, 10"	800	LF	$ 260	$ 208,000
Open cut and encasement, 10"	500	LF	$ 140	$ 70,000
Gate valve and box, 04"	11	EA	$ 727	$ 7,675
Air valve	16	EA	$ 2,110	$ 33,760
Flush valve	11	EA	$ 1,055	$ 11,141
Metal detectable tape	52,800	LF	$ 2	$ 105,600
Subtotal				**$ 1,020,320**
Pump Station(s) Installation				
Pump	4	EA	$ 8,230	$ 32,920
Pump Station Piping, 04"	2	EA	$ 566	$ 1,132
Gate valve, 04"	8	EA	$ 727	$ 5,814
Check valve, 04"	4	EA	$ 774	$ 3,094
Electrical/Instrumentation	2	EA	$ 10,550	$ 21,100
Site work	2	EA	$ 2,635	$ 5,270
Building pad	2	EA	$ 5,275	$ 10,550
Pump Building	2	EA	$ 10,550	$ 21,100
Fence	2	EA	$ 6,330	$ 12,660
Tools	2	EA	$ 1,055	$ 2,110
5,000 gal feed tank	1	EA	$ 10,250	$ 10,250
5,000 gal ground storage tank	1	EA	$ 10,250	$ 10,250
Subtotal				**$ 136,250**
Well Installation				
Well installation	630	LF	$ 153	$ 96,390
Water quality testing	2	EA	$ 1,320	$ 2,640
Well pump	1	EA	$ 4,824	$ 4,824
Well electrical/instrumentation	1	EA	$ 5,800	$ 5,800
Well cover and base	1	EA	$ 3,165	$ 3,165
Piping	1	EA	$ 3,165	$ 3,165
Subtotal				**$ 115,984**
Subtotal of Component Costs				**$ 1,272,554**
Contingency	20%			$ 254,511
Design & Constr Management	25%			$ 318,139
TOTAL CAPITAL COSTS				**$ 1,845,204**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	10.0	mile	$ 285	$ 2,850
Subtotal				**$ 2,850**
Pump Station(s) O&M				
Building Power	23,600	kWH	$ 0.175	$ 4,130
Pump Power	317	kWH	$ 0.175	$ 55
Materials	2	EA	$ 1,585	$ 3,170
Labor	730	Hrs	$ 62.00	$ 45,260
Tank O&M	1	EA	$ 1,055	$ 1,055
Subtotal				**$ 53,670**
Well O&M				
Pump power	5,147	kWH	$ 0.175	$ 901
Well O&M matl	1	EA	$ 1,585	$ 1,585
Well O&M labor	180	Hrs	$ 62	$ 11,160
Subtotal				**$ 13,646**
O&M Credit for Existing Well Closure				
Pump power	3,268	kWH	$ 0.175	$ (572)
Well O&M matl	1	EA	$ 1,585	$ (1,585)
Well O&M labor	180	Hrs	$ 62	$ (11,160)
Subtotal				**$ (13,317)**
TOTAL ANNUAL O&M COSTS				**$ 56,849**

Table C.5

PWS Name *Cyndie Park II PWS*
Alternative Name *New Well at 5 Miles*
Alternative Number *Alt-5*

Distance from PWS to new well location	5.0	miles
Estimated well depth	630	feet
Number of wells required	1	
Well installation cost (location specific)	$153	per foot
Pump Stations needed w/ 1 feed tank each	1	
On site storage tanks / pump sets needed	1	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	2	n/a	n/a	n/a
Number of Crossings, open cut	5	n/a	n/a	n/a
PVC water line, Class 200, 04"	26,400	LF	$ 11	$ 292,072
Bore and encasement, 10"	400	LF	$ 260	$ 104,000
Open cut and encasement, 10"	250	LF	$ 140	$ 35,000
Gate valve and box, 04"	5	EA	$ 727	$ 3,837
Air valve	8	EA	$ 2,110	$ 16,880
Flush valve	5	EA	$ 1,055	$ 5,570
Metal detectable tape	26,400	LF	$ 2	$ 52,800
Subtotal				**$ 510,160**
Pump Station(s) Installation				
Pump	4	EA	$ 8,230	$ 32,920
Pump Station Piping, 04"	2	EA	$ 566	$ 1,132
Gate valve, 04"	8	EA	$ 727	$ 5,814
Check valve, 04"	4	EA	$ 774	$ 3,094
Electrical/Instrumentation	2	EA	$ 10,550	$ 21,100
Site work	2	EA	$ 2,635	$ 5,270
Building pad	2	EA	$ 5,275	$ 10,550
Pump Building	2	EA	$ 10,550	$ 21,100
Fence	2	EA	$ 6,330	$ 12,660
Tools	2	EA	$ 1,055	$ 2,110
5,000 gal feed tank	1	EA	$ 10,250	$ 10,250
5,000 gal ground storage tank	1	EA	$ 10,250	$ 10,250
Subtotal				**$ 136,250**
Well Installation				
Well installation	630	LF	$ 153	$ 96,390
Water quality testing	2	EA	$ 1,320	$ 2,640
Well pump	1	EA	$ 4,824	$ 4,824
Well electrical/instrumentation	1	EA	$ 5,800	$ 5,800
Well cover and base	1	EA	$ 3,165	$ 3,165
Piping	1	EA	$ 3,165	$ 3,165
Subtotal				**$ 115,984**
Subtotal of Component Costs				**$ 762,394**
Contingency	20%			$ 152,479
Design & Constr Management	25%			$ 190,599
TOTAL CAPITAL COSTS				**$ 1,105,472**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	5.0	mile	$ 285	$ 1,425
Subtotal				**$ 1,425**
Pump Station(s) O&M				
Building Power	23,600	kWH	$ 0.175	$ 4,130
Pump Power	158	kWH	$ 0.175	$ 28
Materials	2	EA	$ 1,585	$ 3,170
Labor	730	Hrs	$ 62.00	$ 45,260
Tank O&M	1	EA	$ 1,055	$ 1,055
Subtotal				**$ 53,643**
Well O&M				
Pump power	5,147	kWH	$ 0.175	$ 901
Well O&M matl	1	EA	$ 1,585	$ 1,585
Well O&M labor	180	Hrs	$ 62	$ 11,160
Subtotal				**$ 13,646**
O&M Credit for Existing Well Closure				
Pump power	3,268	kWH	$ 0.175	$ (572)
Well O&M matl	1	EA	$ 1,585	$ (1,585)
Well O&M labor	180	Hrs	$ 62	$ (11,160)
Subtotal				**$ (13,317)**
TOTAL ANNUAL O&M COSTS				**$ 55,397**

Table C.6

PWS Name *Cyndie Park II PWS*
Alternative Name *New Well at 1 Mile*
Alternative Number *Alt-6*

Distance from PWS to new well location	1.0	miles
Estimated well depth	630	feet
Number of wells required	1	
Well installation cost (location specific)	$153	per foot
Pump Stations needed w/ 1 feed tank each	0	
On site storage tanks / pump sets needed	1	

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, 04"	5,280	LF	$ 11	$ 58,414
Bore and encasement, 10"	-	LF	$ 260	$ -
Open cut and encasement, 10"	50	LF	$ 140	$ 7,000
Gate valve and box, 04"	1	EA	$ 727	$ 767
Air valve	2	EA	$ 2,110	$ 4,220
Flush valve	1	EA	$ 1,055	$ 1,114
Metal detectable tape	5,280	LF	$ 2	$ 10,560
Subtotal				**$ 82,076**
Pump Station(s) Installation				
Pump	2	EA	$ 8,230	$ 16,460
Pump Station Piping, 04"	1	EA	$ 566	$ 566
Gate valve, 04"	4	EA	$ 727	$ 2,907
Check valve, 04"	2	EA	$ 774	$ 1,547
Electrical/Instrumentation	1	EA	$ 10,550	$ 10,550
Site work	1	EA	$ 2,635	$ 2,635
Building pad	1	EA	$ 5,275	$ 5,275
Pump Building	1	EA	$ 10,550	$ 10,550
Fence	1	EA	$ 6,330	$ 6,330
Tools	1	EA	$ 1,055	$ 1,055
5,000 gal feed tank	-	EA	$ 10,250	$ -
5,000 gal ground storage tank	1	EA	$ 10,250	$ 10,250
Subtotal				**$ 68,125**
Well Installation				
Well installation	630	LF	$ 153	$ 96,390
Water quality testing	2	EA	$ 1,320	$ 2,640
Well pump	1	EA	$ 4,824	$ 4,824
Well electrical/instrumentation	1	EA	$ 5,800	$ 5,800
Well cover and base	1	EA	$ 3,165	$ 3,165
Piping	1	EA	$ 3,165	$ 3,165
Subtotal				**$ 115,984**
Subtotal of Component Costs				**$ 266,185**
Contingency	20%			$ 53,237
Design & Constr Management	25%			$ 66,546
TOTAL CAPITAL COSTS				**$ 385,968**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	1.0	mile	$ 285	$ 285
Subtotal				**$ 285**
Pump Station(s) O&M				
Building Power	11,800	kWH	$ 0.175	$ 2,065
Pump Power	-	kWH	$ 0.175	$ -
Materials	1	EA	$ 1,585	$ 1,585
Labor	365	Hrs	$ 62.00	$ 22,630
Tank O&M	-	EA	$ 1,055	$ -
Subtotal				**$ 26,280**
Well O&M				
Pump power	5,147	kWH	$ 0.175	$ 901
Well O&M matl	1	EA	$ 1,585	$ 1,585
Well O&M labor	180	Hrs	$ 62	$ 11,160
Subtotal				**$ 13,646**
O&M Credit for Existing Well Closure				
Pump power	3,268	kWH	$ 0.175	$ (572)
Well O&M matl	1	EA	$ 1,585	$ (1,585)
Well O&M labor	180	Hrs	$ 62	$ (11,160)
Subtotal				**$ (13,317)**
TOTAL ANNUAL O&M COSTS				**$ 26,894**

Table C.7

PWS Name *Cyndie Park II PWS*
Alternative Name *Central Treatment - RO*
Alternative Number *Alt-7*

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Reverse Osmosis Unit Purchase/Installation				
Site preparation	0.20	acre	$ 4,000	$ 800
Slab	19	CY	$ 1,000	$ 18,750
Building	500	SF	$ 60	$ 30,000
Building electrical	500	SF	$ 8	$ 4,000
Building plumbing	500	SF	$ 8	$ 4,000
Heating and ventilation	500	SF	$ 7	$ 3,500
Fence	400	LF	$ 15	$ 6,000
Paving	1,500	SF	$ 2	$ 3,000
Electrical	1	JOB	$ 40,000	$ 40,000
Piping	1	JOB	$ 20,000	$ 20,000
Reverse osmosis package including:				
High pressure pumps - 15hp				
Cartridge filters and vessels				
RO membranes and vessels				
Control system				
Chemical feed systems				
Freight cost				
Vendor start-up services	1	UNIT	$ 24,000	$ 24,000
Transfer pumps	3	EA	$ 3,000	$ 9,000
Permeate tank	5,000	gal	$ 3	$ 15,000
Reject Tank	15,100	gal	$ 3	$ 45,300
Reject pond:				
Excavation	-	CYD	$ 3.00	$ -
Compacted fill	-	CYD	$ 7.00	$ -
Lining	-	SF	$ 1.50	$ -
Vegetation	-	SY	$ 1.50	$ -
Access road	320	LF	$ 30.00	$ 9,600
Subtotal of Design/Construction Costs				**$ 232,950**
Contingency	20%			$ 46,590
Design & Constr Management	25%			$ 58,238
Reject water haulage truck	1	EA	$ 100,000	$ 100,000
TOTAL CAPITAL COSTS				**$ 437,778**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Reverse Osmosis Unit O&M				
Building Power	4,500	kwh/yr	$ 0.175	$ 788
Equipment power	3,000	kwh/yr	$ 0.175	$ 525
Labor	1,000	hrs/yr	$ 40.000	$ 40,000
RO Chemicals	1,100	year	$ 0.65	$ 715
RO materials and membranes	1	year	$ 3,500	$ 3,500
Analyses	12	test	$ 200	$ 2,400
Subtotal				**$ 47,928**
Backwash Disposal				
Disposal truck mileage	700	miles	$ 1.50	$ 1,050
Backwash disposal fee	183	kgal/yr	$ 5.00	$ 915
Subtotal				**$ 1,965**
TOTAL ANNUAL O&M COSTS				**$ 49,893**

Table C.8

PWS Name *Cyndie Park II PWS*
Alternative Name *Central Treatment - Iron Based Adsorption*
Alternative Number *Alt-8*

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Adsorption Unit Purchase/Installation				
Site preparation	0.20	acre	$ 4,000	$ 800
Slab	19	CY	$ 1,000	$ 18,750
Building	500	SF	$ 60	$ 30,000
Building electrical	500	SF	$ 8	$ 4,000
Building plumbing	500	SF	$ 8	$ 4,000
Heating and ventilation	500	SF	$ 7	$ 3,500
Fence	400	LF	$ 15	$ 6,000
Paving	2,000	SF	$ 2	$ 4,000
Electrical	1	JOB	$ 30,000	$ 30,000
Piping	1	JOB	$ 15,000	$ 15,000
Adsorption package including:				
3 Adsorption vessels				
E33 Iron oxide media				
Controls & instruments	1	UNIT	$ 50,000	$ 50,000
Spent Backwash Tank	1,400	GAL	$ 2	$ 2,800
Chlorination Point	1	EA	$ 4,000	$ 4,000
Transfer/backwash pumps	2	EA	$ 3,000	$ 6,000
Product water	-	gal	$ 5	$ -
Feed Tank	-	gal	$ 5	$ -
Subtotal of Component Costs				**$ 172,850**
Contingency	20%			$ 34,570
Design & Constr Management	25%			$ 43,213
TOTAL CAPITAL COSTS				**$ 250,633**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Adsorption Unit O&M				
Building Power	4,500	kwh/yr	$ 0.175	$ 788
Equipment power	319	kwh/yr	$ 0.175	$ 56
Labor	500	hrs/yr	$ 40.00	$ 20,000
Media replacement	4	CF	$ 200	$ 800
Analyses	12	CY	$ 200	$ 2,400
Backwash discharge to sewer	-	test	$ 5,000	$ -
Spent Media Disposal	4.00	CF	$ 20	$ 80
Subtotal				**$ 24,123**
Haul Regenerant Waste and Brine				
Disposal Truck Rental	3	days	$ 250	$ 785
Disposal truck mileage	57	miles	$ 1.50	$ 86
Reject (brine) disposal fee	9	kgal/yr	$ 5.00	$ 45
Subtotal				**$ 915**
TOTAL ANNUAL O&M COSTS				**$ 25,039**

Table C.9

PWS Name ***Cyndie Park II PWS***
Alternative Name ***Central Treatment - Coagulation/Filtration***
Alternative Number ***Alt-9***

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Coagulation/Filtration Unit Purchase/Installation				
Site preparation	0.20	acre	$ 4,000	$ 800
Slab	19	CY	$ 1,000	$ 18,750
Building	500	SF	$ 60	$ 30,000
Building electrical	500	SF	$ 8	$ 4,000
Building plumbing	500	SF	$ 8	$ 4,000
Heating and ventilation	500	SF	$ 7	$ 3,500
Fence	400	LF	$ 15	$ 6,000
Paving	1,500	SF	$ 2	$ 3,000
Electrical	1	JOB	$ 30,000	$ 30,000
Piping	1	JOB	$ 15,000	$ 15,000
Coagulant/filter package including:				
Chemical feed system				
Pressure ceramic filters				
Controls & Instruments	1	UNIT	$ 76,000	$ 76,000
Spent Backwash Tank	1,800	GAL	$ 5	$ 9,000
Coagulant Tank	70	GAL	$ 3	$ 210
Sewer Connection Fee	-	EA	$ 15,000	$ -
Chlorination Point	1	EA	$ 4,000	$ 4,000
Subtotal of Component Costs				**$ 204,260**
Contingency	20%			$ 40,852
Design & Constr Management	25%			$ 51,065
TOTAL CAPITAL COSTS				**$ 296,177**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Adsorption Unit O&M				
Building Power	4,500	kwh/yr	$ 0.175	$ 788
Equipment power	798	kwh/yr	$ 0.175	$ 140
Labor	750	hrs/yr	$ 40	$ 30,000
Materials	1	year	$ 4,000	$ 4,000
Chemicals	1	year	$ 1,100	$ 1,100
Analyses	12	test	$ 200	$ 2,400
Backwash discharge to sewer		kgal/yr	$ 5,000	$ -
Subtotal				**$ 38,427**
Haul Regenerant Waste and Brine				
Waste haulage truck rental	3	days	$ 250	$ 785
Mileage charge	57	miles	$ 1.50	$ 86
Waste disposal	9	kgal/yr	$ 5.00	$ 45
Subtotal				**$ 915**
TOTAL ANNUAL O&M COSTS				**$ 39,342**

Table C.10

PWS Name ***Cyndie Park II PWS***
Alternative Name ***Point-of-Use Treatment***
Alternative Number ***Alt-10***

Number of Connections for POU Unit Installation 18 connections

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
POU-Treatment - Purchase/Installation				
POU treatment unit purchase	18	EA	$ 200	$ 3,600
POU treatment unit installation	18	EA	$ 160	$ 2,880
Subtotal				**$ 6,480**
Subtotal of Component Costs				**$ 6,480**
Contingency	20%			$ 1,296
Design & Constr Management	25%			$ 1,620
Procurement & Administration	20%			$ 1,296
TOTAL CAPITAL COSTS				**$ 10,692**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
O&M				
POU materials, per unit	18	EA	$ 66	$ 1,188
Contaminant analysis, 1/3 units/yr	6	EA	$ 210	$ 1,260
Program labor, 10 hrs/unit	180	hrs	$ 42	$ 7,560
Subtotal				**$ 10,008**
TOTAL ANNUAL O&M COSTS				**$ 10,008**

Table C.11

PWS Name ***Cyndie Park II PWS***
Alternative Name ***Point-of-Entry Treatment***
Alternative Number ***Alt-11***

Number of Connections for POE Unit Installation 18 connections

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
POE-Treatment - Purchase/Installat				
POE treatment unit purchase	18	EA	$ 5,275	$ 94,950
Pad and shed, per unit	18	EA	$ 2,110	$ 37,980
Piping connection, per unit	18	EA	$ 1,055	$ 18,990
Electrical hook-up, per unit	18	EA	$ 1,055	$ 18,990
Subtotal				**$ 170,910**
Subtotal of Component Costs				**$ 170,910**
Contingency	20%			$ 34,182
Design & Constr Management	25%			$ 42,728
Procurement & Administration	20%			$ 34,182
TOTAL CAPITAL COSTS				**$ 282,002**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
O&M				
POE materials, per unit	18	EA	$ 1,585	$ 28,530
Contaminant analysis, 1/yr per uni	18	EA	$ 210	$ 3,780
Program labor, 10 hrs/unit	180	hrs	$ 42	$ 7,560
Subtotal				**$ 39,870**
TOTAL ANNUAL O&M COSTS				**$ 39,870**

Table C.12

PWS Name *Cyndie Park II PWS*
Alternative Name *Public Dispenser for Treated Drinking Water*
Alternative Number *Alt-12*

Number of Treatment Units Recommended 1

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Public Dispenser Unit Installation				
POE-Treatment unit(s)	1	EA	$ 7,385	$ 7,385
Unit installation costs	1	EA	$ 5,275	$ 5,275
Subtotal				**$ 12,660**
Subtotal of Component Costs				**$ 12,660**
Contingency	20%			$ 2,532
Design & Constr Management	25%			$ 3,165
TOTAL CAPITAL COSTS				**18,357**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Program Operation				
Treatment unit O&M, 1 per unit	1	EA	$ 2,110	$ 2,110
Contaminant analysis, 1/wk per u	52	EA	$ 210	$ 10,920
Sampling/reporting, 1 hr/day	365	HRS	$ 62	$ 22,630
Subtotal				**$ 35,660**
TOTAL ANNUAL O&M COSTS				**$ 35,660**

Table C.13

PWS Name ***Cyndie Park II PWS***
Alternative Name ***Supply Bottled Water to 100% of Population***
Alternative Number ***Alt-13***

Service Population	50	
Percentage of population requiring supply	100%	
Water consumption per person	1.00	gpcd
Calculated annual potable water needs	18,250	gallons

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Program Implementation				
Initial program set-up	500	hours	$ 46	$ 23,000
Subtotal				**$ 23,000**
Subtotal of Component Costs				**$ 23,000**
Contingency	20%			$ 4,600
TOTAL CAPITAL COSTS				**$ 27,600**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Program Operation				
Water purchase costs	18,250	gals	$ 1.60	$ 29,200
Program admin, 9 hrs/wk	468	hours	$ 46	$ 21,528
Program materials	1	EA	$ 5,275	$ 5,275
Subtotal				**$ 56,003**
TOTAL ANNUAL O&M COSTS				**$ 56,003**

Table C.14

PWS Name *Cyndie Park II PWS*
Alternative Name *Central Trucked Drinking Water*
Alternative Number *Alt-14*

Service Population	50	
Percentage of population requiring supply	100%	
Water consumption per person	1.00	gpcd
Calculated annual potable water needs	18,250	gallons
Travel distance to compliant water source	21	miles

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Storage Tank Installation				
5,000 gal ground storage tank	1	EA	$ 10,250	$ 10,250
Site improvements	1	EA	$ 3,165	$ 3,165
Potable water truck	1	EA	$ 77,000	$ 77,000
Subtotal				**$ 90,415**
Subtotal of Component Costs				**$ 90,415**
Contingency	20%			$ 18,083
Design & Constr Management	25%			$ 22,604
TOTAL CAPITAL COSTS				**$ 131,102**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Program Operation				
Water delivery labor, 4 hrs/wk	208	hrs	$ 62	$ 12,896
Truck operation, 1 round trip/wk	2,184	miles	$ 3.00	$ 6,552
Water purchase	18	1,000 gals	$ 4.33	$ 79
Water testing, 1 test/wk	52	EA	$ 210	$ 10,920
Sampling/reporting, 2 hrs/wk	104	hrs	$ 62	$ 6,448
Subtotal				**$ 36,895**
TOTAL ANNUAL O&M COSTS				**$ 36,895**

APPENDIX D
EXAMPLE FINANCIAL MODEL

Cyndie Park II WSC

Number of Alternatives 14 Selected from Results Sheet

Input Fields are Indicated by:

General Inputs		
Implementation Year	2010	
Months of Working Capital	0	
Depreciation	$ -	
Percent of Depreciation for Replacement Fund	0%	
Allow Negative Cash Balance (yes or no)	No	
Median Household Income	$ 28,777	Cyndie Park II WSC
Median HH Income -- Texas	$ 39,927	
Grant Funded Percentage	0%	Selected from Results
Capital Funded from Revenues	$ -	

	Base Year Growth/Escalation	2008
Accounts & Consumption		
Metered Residential Accounts		
Number of Accounts	0.0%	18
Number of Bills Per Year		12
Annual Billed Consumption		1,095,000
Consumption per Account Per Pay Period	0.0%	5,069
Consumption Allowance in Rates		-
Total Allowance		-
Net Consumption Billed		1,095,000
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%	1,095,000
Unaccounted for Water		-
Percentage Unaccounted for Water		0.0%

Appendix D
General Inputs

Cyndie Park II WSC

Number of Alternatives 14 Selected from Results Sheet

Input Fields are Indicated by:

Residential Rate Structure	Allowance within Tier	
	-	
Estimated Average Water Rate ($/1000gallons)		$ 5.92
Non-Residential Rate Structure		
	-	
Estimated Average Water Rate ($/1000gallons)		

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%	9,766
Other 4	0.0%	-
Incremental O&M for Alternative	0.0%	-
Total Operating Expenses		9,766
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 Cyndie Park II WSC
Alternative Number = 14
Funding Source = Loan/Bond

		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	2038
		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		-	-	131,102	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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		-	-	131,102	128,712	126,179	123,494	120,648	117,632	114,434	111,044	107,451	103,643	99,606	95,326	90,790	85,982	80,885	75,483	69,756	63,686	57,251	50,430	43,201	35,537	27,414	18,803	9,675	0	0	0	0
Principal		-	-	2,390	2,533	2,685	2,846	3,017	3,198	3,390	3,593	3,809	4,037	4,279	4,536	4,808	5,097	5,403	5,727	6,070	6,435	6,821	7,230	7,664	8,123	8,611	9,128	9,675	-	-	-	-
Interest	6.00%	-	-	7,866	7,723	7,571	7,410	7,239	7,058	6,866	6,663	6,447	6,219	5,976	5,720	5,447	5,159	4,853	4,529	4,185	3,821	3,435	3,026	2,592	2,132	1,645	1,128	0	0	0	0	0
Total Debt Service		-	-	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	10,256	9,675	0	0	0	0
New Balance		-	-	128,712	126,179	123,494	120,648	117,632	114,434	111,044	107,451	103,643	99,606	95,326	90,790	85,982	80,885	75,483	69,756	63,686	57,251	50,430	43,201	35,537	27,414	18,803	9,675	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	1.00%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

APPENDIX E
ANALYSIS OF SHARED SOLUTION FOR OBTAINING WATER FROM THE CITY OF MATHIS

E.1 OVERVIEW OF METHOD USED

There are several small PWSs with water quality problems located in the vicinity of the Cyndie Park II that could benefit from joining together and cooperating to share the cost for obtaining compliant drinking water. This cooperation could involve creating a formal organization of individual PWSs to address obtaining compliant drinking water, consolidating to form a single PWS, or having the individual PWSs taken over or bought out by a larger regional entity.

This analysis focuses on compliance alternatives related to obtaining water from large water providers interested in providing water outside their current area, either by wholesaling to PWSs, or by expanding their service areas. This type of solution is most likely to have the best prospects for sustainability, and a reliable provision of compliant drinking water.

The purpose of this analysis is to approximate the level of capital cost savings that could be expected from pursuing a shared solution versus a solution where the study PWS obtains compliant drinking water on its own. Regardless of the form a group solution would take, water consumers would have to pay for the infrastructure needed for obtaining compliant water. To keep this analysis as straightforward and realistic as possible, it is assumed the individual PWSs would remain independent, and would share the capital cost for the infrastructure required. Also, to maintain simplicity, this analysis is limited to estimating capital cost savings related to pipeline construction, which is likely to be by far the largest component of the overall capital cost. A shared solution could also produce savings in O&M expenses as a result of reduction in redundant facilities and the potential for shared O&M resources, and these savings would have to be evaluated if the PWSs are interested in implementing a shared solution.

There are many ways pipeline capital costs could be divided between participating PWSs, and the final apportioning of costs would likely be based on negotiation between the participating entities. At this preliminary stage of analysis, it is not possible to project results from negotiations regarding cost sharing. For this reason, three methods are used to allocate cost between PWSs in an effort to give an approximation of the range of savings that might be attainable for an individual PWS.

Method A is based on allocating capital cost of the shared pipeline solution proportionate to the amount of water used by each PWS. In this case, the capital cost for the shared pipeline and the necessary pump stations is estimated, and then this total capital cost is allocated based on the fraction of the total water used by each PWS. For example, PWS #1 has an average daily water use of 0.1 mgd and PWS #2 has an average daily use of 0.3 mgd. Using this method, PWS #1 would be allocated 25 percent of the capital cost of the shared solution. This method is a reasonable method for allocating cost when all the PWSs are different in size but are relatively equidistant from the shared water source.

Method B is also based on allocating capital cost of the shared pipeline solution proportionate to the amount of water used by the PWSs. However, rather than allocating the *total* capital cost of the shared solution between each participating PWS, this approach splits the shared pipeline into segments and allocates flow-proportional costs to the PWSs using each segment. Costs for a pipeline segment are not shared by a PWS if the PWS does not use that particular segment. For example, PWS #1 has an average daily water use of 0.3 mgd and PWS #2 has an average daily use of 0.2 mgd. A 3-mile long pipeline segment is common to both PWSs, while PWS #2 requires an additional 4-mile segment. Using this method, PWS #2 would be allocated 40 percent of the cost of the 3-mile segment and 100 percent of the cost of the 4-mile segment. This method is a reasonable method for allocating cost when all the PWSs are different in size and are located at different distances from the shared water source.

Method C is based on allocating capital cost of the shared pipeline solution proportionate to the cost each PWS would have to pay to obtain compliant water if it were to implement an individual solution. In this case, the total capital cost for the shared pipeline and the necessary pump stations is estimated as well as the capital cost each PWS would have for obtaining its own pipeline. The total capital cost for the shared solution is then allocated between the participating PWSs based on what each PWS would have to pay to construct its own pipeline. For example, the individual solution cost for PWS #1 is $4 million and the individual solution cost for PWS #2 is $1 million. Using this method, PWS #1 would be allocated 80 percent of the cost of the shared solution. This method is a reasonable method for allocating cost when the PWS are located at different distances from the water source.

For any given PWS, all three of these methods should generate costs for the shared solution that produce savings for the PWS over an individual solution. However, for different PWSs participating in a shared solution, each of these three methods can produce savings of varying magnitudes: for one PWS, Method A might show the best cost savings while for another Method C might provide the best savings. For this reason, this range is considered to be representative of possible savings that could result from an agreement that should be fair and equitable to all parties involved.

E.2 SHARED SOLUTION FOR OBTAINING WATER FROM THE CITY OF MATHIS

The small PWSs with water quality problems near Cyndie Park II that could obtain water from the City of Mathis are listed in Table E.1, along with their average water consumption and estimates of the capital cost for each PWS to construct an individual pipeline. It is assumed for this analysis that all the systems would participate in a shared solution.

This alternative would consist of constructing a 12.3 mile joint pipeline (4-inch, 6-inch, and 8-inch in size) from the City of Mathis water system by rerouting the line to go south along FM 1068 and extending south on State Hwy 359 to Orange Grove, then going east along FM 624 to CR 103 and following FM 1833 to Cyndie Park II PWS. Each PWS would connect to this joint line with a spur line. Spur lines would convey the water from the main line to the storage tanks of each PWS. All spur pipelines would be 4 inches in diameter. It is assumed seven pump stations would be required to transfer the water from Mathis main distribution line to the end of the pipeline. The pipeline routing is shown in Figure E.1 at the end of this section.

The capital costs for each pipe segment and the total capital cost for the shared pipeline are summarized in Table E.2. Table E.3 shows the capital costs allocated to each PWS using Method A. Table E.4 shows the capital costs allocated to each PWS using Method B. Table E.5 shows the allocation of pipeline capital costs to each of the PWSs using Method C, as described above. Table E.6 provides a summary of the pipeline capital costs estimated for each PWS, and the savings that could be realized compared to developing individual pipelines. More detailed cost estimates for the pipe segments are shown at the end of this section in Tables E.7 through E.13.

Based on these estimates, the range of pipeline capital cost savings to the Cyndie Park II PWS would be $740,000 to $3.2 million if they were to implement a shared solution like this, which would be savings of 23 to 98 percent. These estimates are hypothetical and are only provided to approximate the magnitude of potential savings if this shared solution is implemented as described.

Table E.1
Summary Information for PWSs Participating in Shared Solution

PWS	PWS #	Average Water Demand (mgd)	Water Demand as Percent of Total	Pipeline Capital Cost for Individual Solutions from Mathis	Percent of Sum of Capital Costs for Individual Solutions from Mathis
TPWD Lake Corpus Christi SP	2050016	0.012	3.5%	$ 594,490	7.6%
Camp Karankawa	2050022	0.025	7.2%	$ 665,778	8.5%
City of Orange Grove	1250002	0.306	88.4%	$ 3,291,456	42.1%
Cyndie Park 2 PWS	1780050	0.00303	0.9%	$ 3,272,554	41.8%
	Totals	**0.34603**	**100%**	**$ 7,824,278**	**100%**

Table E.2
Capital cost for Shared Pipeline from Mathis

Pipe Segment	Capital Cost
Pipe 1	$ 747,465
Pipe 2	$ 239,949
Pipe 3	$ 2,429,003
Pipe A	$ 124,630
Pipe B	$ 194,295
Pipe C	$ 812,823
Pipe D	$ 1,506,173
Totals	**$ 6,054,336**

Table E.3
Pipeline Capital Cost Allocation by Method A
Shared Pipeline Assesment for Cyndie Park 2 PWS

PWS	PWS #	Percentage Based On Flow	Total Costs
TPWD Lake Corpus Christi SP	2050016	3.5%	$ 209,959
Camp Karankawa	2050022	7.2%	$ 437,414
City of Orange Grove	1250002	88.4%	$ 5,353,949
Cyndie Park 2 PWS	1780050	0.9%	$ 53,015
	Totals	**100%**	**$ 6,054,336**

Table E.4
Pipeline Capital Cost Allocation by Method B
Shared Pipeline Assesment for Cyndie Park 2 PWS

Pipeline Segment	Pipe Segment Capital Cost	TPWD Lake Corpus Christi SP		Camp Karankawa		City of Orange Grove		Cyndie Park 2 PWS	
		Percent Allocation Based on Water Use	Allocated Cost	Percent Allocation Based on Water Use	Allocated Cost	Percent Allocation Based on Water Use	Allocated Cost	Percent Allocation Based on Water Use	Allocated Cost
Pipe 1	$ 747,465	3.5%	$ 25,921	7.2%	$ 54,003	88.4%	$ 660,995	0.9%	$ 6,545
Pipe 2	$ 239,949	32.4%	$ 77,821	67.6%	$ 162,128	0.0%	$ -	0.0%	$ -
Pipe 3	$ 2,429,003	0.0%	$ -	0.0%	$ -	99.0%	$ 2,405,186	1.0%	$ 23,816
Pipe A	$ 124,630	100.0%	$ 124,630	0.0%	$ -	0.0%	$ -	0.0%	$ -
Pipe B	$ 194,295	0.0%	$ -	100.0%	$ 194,295	0.0%	$ -	0.0%	$ -
Pipe C	$ 812,823	0.0%	$ -	0.0%	$ -	100.0%	$ 812,823	0.0%	$ -
Pipe D	$ 1,506,173	0.0%	$ -	0.0%	$ -	0.0%	$ -	100.0%	$ 1,506,173
Totals	**$ 6,054,336**		**$ 228,372**		**$ 410,426**		**$ 3,879,004**		**$ 1,536,534**

Table E.5
Pipeline Capital Cost Allocation by Method C
Shared Pipeline Assesment for Cyndie Park 2 PWS

PWS	PWS #	Cost for Individual Pipelines	Percentage based on Individual Solutions	Allocated Capital Cost
TPWD Lake Corpus Christi SP	2050016	$ 594,490	8%	$ 460,010
Camp Karankawa	2050022	$ 665,778	9%	$ 515,171
City of Orange Grove	1250002	$ 3,291,456	42%	$ 2,546,891
Cyndie Park 2 PWS	1780050	$ 3,272,554	42%	$ 2,532,265
	Totals	**$ 7,824,278**	**100%**	**$ 6,054,336**

Table E.6
Pipeline Capital Cost Summary
Shared Pipelilne Assessment for Cyndie Park 2 PWS

PWS	Individual Pipeline Capital Costs	Shared Solution Capital Cost Allocation			Shared Solution Cost Savings			Shared Solution Percentage Savings		
		Method A	**Method B**	**Method C**	**Method A**	**Method B**	**Method C**	**Method A**	**Method B**	**Method C**
TPWD Lake Corpus Christi SP	$ 594,490	$ 209,959	$ 228,372	$ 460,010	$ 384,531	$ 366,118	$ 134,480	65%	62%	23%
Camp Karankawa	$ 665,778	$ 437,414	$ 410,426	$ 515,171	$ 228,364	$ 255,352	$ 150,607	34%	38%	23%
City of Orange Grove	$ 3,291,456	$ 5,353,949	$ 3,879,004	$ 2,546,891	$ (2,062,493)	$ (587,548)	$ 744,565	-63%	-18%	23%
Cyndie Park 2 PWS	$ 3,272,554	$ 53,015	$ 1,536,534	$ 2,532,265	$ 3,219,539	$ 1,736,020	$ 740,289	98%	53%	23%
Totals	**$ 7,824,278**	**$ 6,054,336**	**$ 6,054,336**	**$ 6,054,336**	**$ 1,769,942**	**$ 1,769,942**	**$ 1,769,942**			

Table E.7

Main Link # 1
Total Pipe Length 2.94 miles
Number of Pump Stations Needed 1
Pipe Size 08" inches

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, 08"	15,525	LF	$ 25	$ 391,625
Bore and encasement, 12"	-	LF	$ 260	$ -
Open cut and encasement, 12"	50	LF	$ 140	$ 7,000
Gate valve and box, 08"	4	EA	$ 808	$ 3,230
Air valve	3	EA	$ 2,110	$ 6,330
Flush valve	4	EA	$ 1,055	$ 4,220
Metal detectable tape	15,525	LF	$ 2.00	$ 31,050
Subtotal				**$ 443,455**
Pump Station(s) Installation				
Pump	2	EA	$ 8,230	$ 16,460
Pump Station Piping, 08"	2	EA	$ 1,342	$ 2,685
Gate valve, 08"	4	EA	$ 808	$ 3,230
Check valve, 08"	2	EA	$ 1,509	$ 3,018
Electrical/Instrumentation	1	EA	$ 10,550	$ 10,550
Site work	1	EA	$ 2,635	$ 2,635
Building pad	1	EA	$ 5,275	$ 5,275
Pump Building	1	EA	$ 10,550	$ 10,550
Fence	1	EA	$ 6,330	$ 6,330
Tools	1	EA	$ 1,055	$ 1,055
5,000 gal ground storage tank	1	EA	$ 10,250	$ 10,250
Subtotal				**$ 72,038**
Subtotal of Component Costs				**$ 515,493**
Contingency	20%			$ 103,099
Design & Constr Management	25%			$ 128,873
TOTAL CAPITAL COSTS				**$ 747,465**

Table E.8

Main Link # 2
Total Pipe Length 0.49 miles
Number of Pump Stations Needed 1
Pipe Size 04" inches

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	1	n/a	n/a	n/a
PVC water line, Class 200, 04"	2,595	LF	$ 11	$ 28,709
Bore and encasement, 10"	200	LF	$ 260	$ 52,000
Open cut and encasement, 10"	50	LF	$ 140	$ 7,000
Gate valve and box, 04"	1	EA	$ 727	$ 727
Air valve	1	EA	$ 2,110	$ 2,110
Flush valve	1	EA	$ 1,055	$ 1,055
Metal detectable tape	2,595	LF	$ 2.00	$ 5,190
Subtotal				**$ 96,791**
Pump Station(s) Installation				
Pump	2	EA	$ 8,230	$ 16,460
Pump Station Piping, 04"	2	EA	$ 566	$ 1,132
Gate valve, 04"	4	EA	$ 727	$ 2,907
Check valve, 04"	2	EA	$ 774	$ 1,547
Electrical/Instrumentation	1	EA	$ 10,550	$ 10,550
Site work	1	EA	$ 2,635	$ 2,635
Building pad	1	EA	$ 5,275	$ 5,275
Pump Building	1	EA	$ 10,550	$ 10,550
Fence	1	EA	$ 6,330	$ 6,330
Tools	1	EA	$ 1,055	$ 1,055
5,000 gal ground storage tank	1	EA	$ 10,250	$ 10,250
Subtotal				**$ 68,691**
Subtotal of Component Costs				**$ 165,482**
Contingency	20%			$ 33,096
Design & Constr Management	25%			$ 41,371
TOTAL CAPITAL COSTS				**$ 239,949**

Table E.9

Main Link # 3
Total Pipe Length 8.87 miles
Number of Pump Stations Needed 5
Pipe Size 06" inches

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	4	n/a	n/a	n/a
Number of Crossings, open cut	22	n/a	n/a	n/a
PVC water line, Class 200, 06"	46,852	LF	$ 18	$ 829,389
Bore and encasement, 10"	800	LF	$ 260	$ 208,000
Open cut and encasement, 10"	1,100	LF	$ 140	$ 154,000
Gate valve and box, 06"	10	EA	$ 825	$ 8,245
Air valve	9	EA	$ 2,110	$ 18,990
Flush valve	10	EA	$ 1,055	$ 10,550
Metal detectable tape	46,852	LF	$ 2.00	$ 93,704
Subtotal				**$ 1,322,878**
Pump Station(s) Installation				
Pump	10	EA	$ 8,230	$ 82,300
Pump Station Piping, 06"	10	EA	$ 859	$ 8,593
Gate valve, 06"	20	EA	$ 825	$ 16,491
Check valve, 06"	10	EA	$ 1,169	$ 11,688
Electrical/Instrumentation	5	EA	$ 10,550	$ 52,750
Site work	5	EA	$ 2,635	$ 13,175
Building pad	5	EA	$ 5,275	$ 26,375
Pump Building	5	EA	$ 10,550	$ 52,750
Fence	5	EA	$ 6,330	$ 31,650
Tools	5	EA	$ 1,055	$ 5,275
5,000 gal ground storage tank	5	EA	$ 10,250	$ 51,250
Subtotal				**$ 352,296**
Subtotal of Component Costs				**$ 1,675,174**
Contingency	20%			$ 335,035
Design & Constr Management	25%			$ 418,794
TOTAL CAPITAL COSTS				**$ 2,429,003**

Table E.10

Segment A

TPWD Lake Corpus Christi SP

Private Pipe Size	04"	
Total Pipe Length	0.34	miles
Total PWS annual water usage	4.4	MG
Number of Pump Stations Needed	1	

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	-	n/a	n/a		n/a	
PVC water line, Class 200, 04"	1,808	LF	$	11	$	20,003
Bore and encasement, 10"	-	LF	$	260	$	-
Open cut and encasement, 10"	-	LF	$	140	$	-
Gate valve and box, 04"	1	EA	$	727	$	727
Air valve	1	EA	$	2,110	$	2,110
Flush valve	1	EA	$	1,055	$	1,055
Metal detectable tape	1,808	LF	$	2.00	$	3,616
Subtotal					**$**	**27,510**
Pump Station(s) Installation						
Pump	2	EA	$	8,230	$	16,460
Pump Station Piping, 04"	2	EA	$	566	$	1,132
Gate valve, 04"	4	EA	$	727	$	2,907
Check valve, 04"	2	EA	$	774	$	1,547
Electrical/Instrumentation	1	EA	$	10,550	$	10,550
Site work	1	EA	$	2,635	$	2,635
Building pad	1	EA	$	5,275	$	5,275
Pump Building	1	EA	$	10,550	$	10,550
Fence	1	EA	$	6,330	$	6,330
Tools	1	EA	$	1,055	$	1,055
Subtotal					**$**	**58,441**
Subtotal of Component Costs					**$**	**85,951**
Contingency	20%				$	17,190
Design & Constr Management	25%				$	21,488
TOTAL CAPITAL COSTS					**$**	**124,630**

Table E.11

Segment B

Camp Karankawa

Private Pipe Size	04"	
Total Pipe Length	0.94	miles
Total PWS annual water usage	9.1	MG
Number of Pump Stations Needed	1	

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, 04"	4,950	LF	$ 11	$ 54,764
Bore and encasement, 10"	-	LF	$ 260	$ -
Open cut and encasement, 10"	50	LF	$ 140	$ 7,000
Gate valve and box, 04"	1	EA	$ 727	$ 727
Air valve	1	EA	$ 2,110	$ 2,110
Flush valve	1	EA	$ 1,055	$ 1,055
Metal detectable tape	4,950	LF	$ 2.00	$ 9,900
Subtotal				**$ 75,555**
Pump Station(s) Installation				
Pump	2	EA	$ 8,230	$ 16,460
Pump Station Piping, 04"	2	EA	$ 566	$ 1,132
Gate valve, 04"	4	EA	$ 727	$ 2,907
Check valve, 04"	2	EA	$ 774	$ 1,547
Electrical/Instrumentation	1	EA	$ 10,550	$ 10,550
Site work	1	EA	$ 2,635	$ 2,635
Building pad	1	EA	$ 5,275	$ 5,275
Pump Building	1	EA	$ 10,550	$ 10,550
Fence	1	EA	$ 6,330	$ 6,330
Tools	1	EA	$ 1,055	$ 1,055
Subtotal				**$ 58,441**
Subtotal of Component Costs				**$ 133,996**
Contingency	20%			$ 26,799
Design & Constr Management	25%			$ 33,499
TOTAL CAPITAL COSTS				**$ 194,295**

Table E.12

Segment C

City of Orange Grove

Private Pipe Size	06"	
Total Pipe Length	0.46	miles
Total PWS annual water usage	111.7	MG
Number of Pump Stations Needed	7	

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	5	n/a	n/a		n/a	
PVC water line, Class 200, 06"	2,442	LF	$	18	$	43,229
Bore and encasement, 10"	200	LF	$	260	$	52,000
Open cut and encasement, 10"	250	LF	$	140	$	35,000
Gate valve and box, 06"	1	EA	$	825	$	825
Air valve	1	EA	$	2,110	$	2,110
Flush valve	1	EA	$	1,055	$	1,055
Metal detectable tape	2,442	LF	$	2.00	$	4,884
Subtotal					**$**	**139,103**
Pump Station(s) Installation						
Pump	14	EA	$	8,230	$	115,220
Pump Station Piping, 06"	14	EA	$	859	$	12,030
Gate valve, 06"	28	EA	$	825	$	23,087
Check valve, 06"	14	EA	$	1,169	$	16,363
Electrical/Instrumentation	7	EA	$	10,550	$	73,850
Site work	7	EA	$	2,635	$	18,445
Building pad	7	EA	$	5,275	$	36,925
Pump Building	7	EA	$	10,550	$	73,850
Fence	7	EA	$	6,330	$	44,310
Tools	7	EA	$	1,055	$	7,385
Subtotal					**$**	**421,465**
Subtotal of Component Costs					**$**	**560,567**
Contingency	20%				$	112,113
Design & Constr Management	25%				$	140,142
TOTAL CAPITAL COSTS					**$**	**812,823**

Table E.13

Segment D

Cyndie Park 2 PWS

Private Pipe Size	04"	
Total Pipe Length	8.85	miles
Total PWS annual water usage	1.1	MG
Number of Pump Stations Needed	1	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	5	n/a	n/a	n/a
Number of Crossings, open cut	9	n/a	n/a	n/a
PVC water line, Class 200, 04"	46,714	LF	$ 11	$ 516,813
Bore and encasement, 10"	1,000	LF	$ 260	$ 260,000
Open cut and encasement, 10"	450	LF	$ 140	$ 63,000
Gate valve and box, 04"	10	EA	$ 727	$ 7,268
Air valve	9	EA	$ 2,110	$ 18,990
Flush valve	10	EA	$ 1,055	$ 10,550
Metal detectable tape	46,714	LF	$ 2.00	$ 93,428
Subtotal				**$ 970,049**
Pump Station(s) Installation				
Pump	2	EA	$ 8,230	$ 16,460
Pump Station Piping, 04"	2	EA	$ 566	$ 1,132
Gate valve, 04"	4	EA	$ 727	$ 2,907
Check valve, 04"	2	EA	$ 774	$ 1,547
Electrical/Instrumentation	1	EA	$ 10,550	$ 10,550
Site work	1	EA	$ 2,635	$ 2,635
Building pad	1	EA	$ 5,275	$ 5,275
Pump Building	1	EA	$ 10,550	$ 10,550
Fence	1	EA	$ 6,330	$ 6,330
Tools	1	EA	$ 1,055	$ 1,055
5,000 gal ground storage tank	1	EA	$ 10,250	$ 10,250
Subtotal				**$ 68,691**
Subtotal of Component Costs				**$ 1,038,740**
Contingency	20%			$ 207,748
Design & Constr Management	25%			$ 259,685
TOTAL CAPITAL COSTS				**$ 1,506,173**

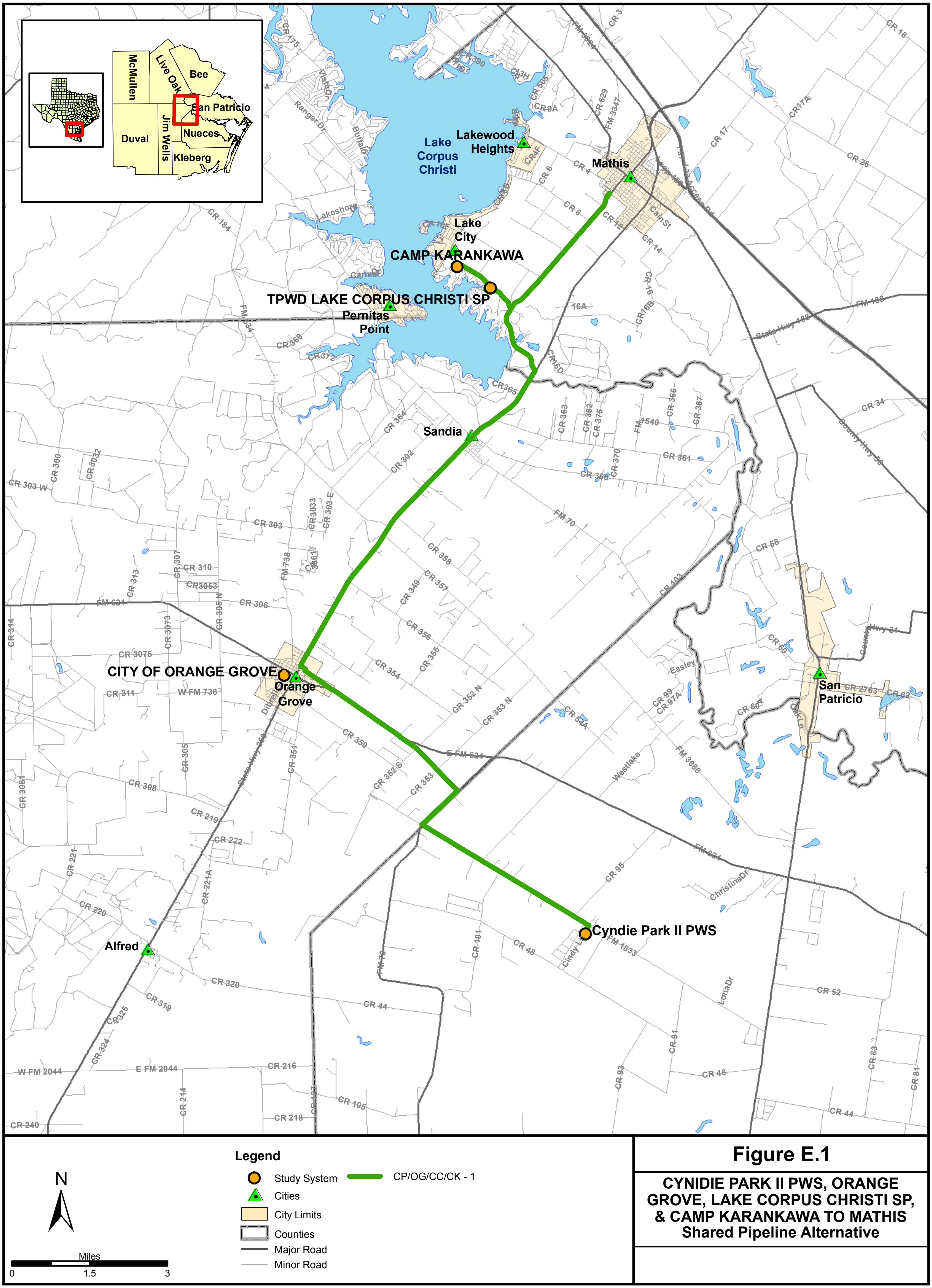

Figure E.1

CYNIDIE PARK II PWS, ORANGE GROVE, LAKE CORPUS CHRISTI SP, & CAMP KARANKAWA TO MATHIS
Shared Pipeline Alternative