

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

VALLEY ESTATES

PWS ID# 1520198, CCN# 12490

Prepared for:

THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY



Prepared by:

**THE UNIVERSITY OF TEXAS BUREAU OF ECONOMIC GEOLOGY
AND**

PARSONS

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

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AUGUST 2008

EXECUTIVE SUMMARY

INTRODUCTION

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

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

This feasibility report provides an evaluation of water supply alternatives for the Valley Estates PWS, PWS ID# 1520198, Certificate of Convenience and Necessity (CCN) #12490, located in Lubbock County. The Valley Estates Mobile Home Park PWS is located at 7400 North Venita Avenue, Shallowater, Texas. The water supply system serves a population of 70 and has 36 connections. The water source comes from one groundwater well completed to a depth of 115 feet in the Ogallala Aquifer, and is rated at 70 gallons per minute. Valley Estates also has two other inactive wells; one is capped and one is non-potable water.

The Valley Estates PWS recorded fluoride concentrations ranging from 4.0 milligrams per liter (mg/L) to 4.6 mg/L between May 1995 and June 2004, exceeding the fluoride MCL of 4.0 mg/L. Arsenic concentrations of 0.0121 mg/L to 0.0138 mg/L were recorded between June 1998 and April 2004, which exceed the 0.010 mg/L MCL for arsenic that went into effect on January 23, 2006 (USEPA 2008a; TCEQ 2004). Selenium was detected between 0.05 mg/L and 0.10 mg/L between January 2003 and December 2005, exceeding the MCL of 0.05 mg/L. Between January 2005 and December 2006, a combined uranium concentration of 0.051 mg/L was recorded on two separate occasions, which exceeded the uranium MCL of 0.030 mg/L. Therefore, Valley Estates PWS potentially faces compliance issues for water quality standards for these contaminants.

Basic system information for the Valley Estates PWS is shown in Table ES.1.

**Table ES.1 Valley Estates PWS
Basic System Information**

Population served	70
Connections	36
Average daily flow rate	0.010 million gallons per day (mgd)
Peak demand flow rate	28.1 gallons per minute
Water system peak capacity	0.101 mgd
Typical arsenic range	0.0121 mg/L – 0.0138 mg/L
Typical fluoride range	4.0 mg/L to 4.6 mg/L
Typical selenium range	0.05 mg/L to 0.10 mg/L
Typical combined uranium	0.051 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 which, 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.

HYDROGEOLOGICAL ANALYSIS

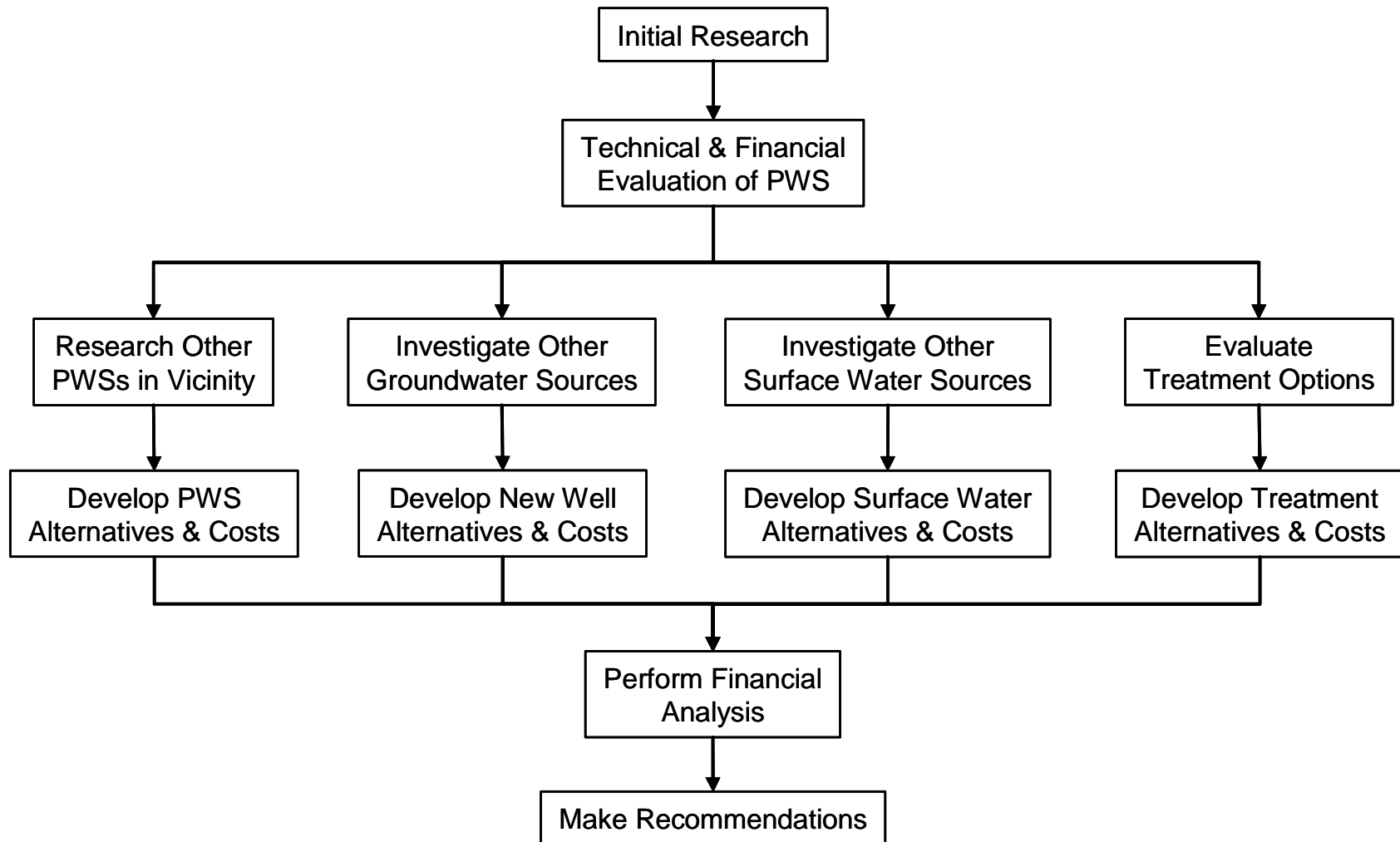
The Valley Estates PWS obtains groundwater from the Ogallala Aquifer. Arsenic, fluoride, selenium, and uranium are commonly found in area wells at concentrations greater than the MCL. There are many wells within 6.2 miles of the Valley Estates PWS wells that show acceptable levels of fluoride and nitrate. Only two of these have been sampled for arsenic and selenium, and none have been sampled for uranium. Any of these wells would need to be resampled before being considered for an alternative water supply.

Regional analyses show that concentrations of fluoride, selenium, and uranium are usually below the MCLs in wells drilled greater than about 250 feet. The Valley Estates PWS wells are all shallower than this (less than 120 feet deep), and so deepening the existing wells might also help to improve water quality, provided the aquifer is thick enough.

It may be possible to do 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.

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Figure ES.1 Summary of Project Methods



COMPLIANCE ALTERNATIVES

The Valley Estates PWS is managed by Mr. Richard Sullivan. It was not possible to schedule the site visit and interview, so it was not possible to complete FMT capacity assessment of this PWS.

There are several PWSs within 10 miles of Valley Estates. Many of these nearby systems also have water quality problems, but the CRMWA provides good quality water in the area. 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, and obtaining a new surface water source is considered through two alternatives where treated surface water is obtained from the City of Lubbock and the CRMWA water line that connects Lubbock to Levelland. In addition, the City of New Deal is an additional potable water source.

Centralized treatment alternatives for arsenic, fluoride, selenium, and uranium removal have been developed and were considered for this report; for example, reverse osmosis and electrodialysis reversal. 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 Valley Estates is likely to be the best solution if compliant groundwater can be found. Having a new well close to Valley Estates 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 Valley Estates PWS was performed using estimated system revenues and expenses. Estimated values were used since complete

financial data for the water system were not available. The estimated annual water bill of \$180 per connection (\$15 per month) represents 0.5 percent of the median household income (MHI). Even though some values were assumed, the alternative comparison generated by the financial data still provides the PWS valuable information regarding the viability and affordability of implementing a solution. 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 or regional 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	\$180	0.5
To meet current expenses	NA	\$360	0.9
Purchase water from Lubbock	100% Grant	\$809	2.1
	Loan/Bond	\$1,292	3.4
Central EDR treatment	100% Grant	\$1,974	5.1
	Loan/Bond	\$3,169	8.2
Point-of-use	100% Grant	\$1,195	3.1
	Loan/Bond	\$1,294	3.4
Public dispenser	100% Grant	\$1,321	3.4
	Loan/Bond	\$1,360	3.5

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ACRONYMS AND ABBREVIATIONS

µg/L	Micrograms per liter
°F	Degrees Fahrenheit
ANSI	American National Standards Institute
AFY	acre-foot per year
BAT	Best available technology
BEG	Bureau of Economic Geology
CA	cellulose acetate
CCN	Certificate of Convenience and Necessity
CDBG	Community Development Block Grants
CFR	Code of Federal Regulations
CR	County Road
CRMWA	Canadian River Municipal Water Authority
DWSRF	Drinking Water State Revolving Fund
ED	Electrodialysis
EDR	Electrodialysis reversal
FMT	Financial, managerial, and technical
GAM	Groundwater Availability Model
gpd	gallons per day
HUD	U.S. Department of Housing and Urban Development
IX	Ion exchange
LARS	Lubbock Area Regional Solution
MCL	Maximum contaminant level
mg/L	Milligram per liter
mgd	Million gallons per day
MHI	Median household income
NF	nanofiltration
NMEFC	New Mexico Environmental Financial Center
NURE	National Uranium Resource Evaluation
NPDWR	National Primary Drinking Water Regulations
O&M	Operation and Maintenance
ORCA	Office of Rural Community Affairs
Parsons	Parsons Transportation Group, Inc.
pCi/L	picoCuries per liter
POE	Point-of-entry
POU	Point-of-use
psi	pounds per square inch
PWS	Public water system

RO	Reverse osmosis
SDWA	Safe Drinking Water Act
SSCT	Small System Compliance Technology
STEP	Small Towns Environment Program
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TCF	Texas Capital Fund
TDA	Texas Department of Agriculture
TDS	Total dissolved solids
TFC	thin film composite
TWDB	Texas Water Development Board
USC	United States Code
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WAM	Water Availability Model

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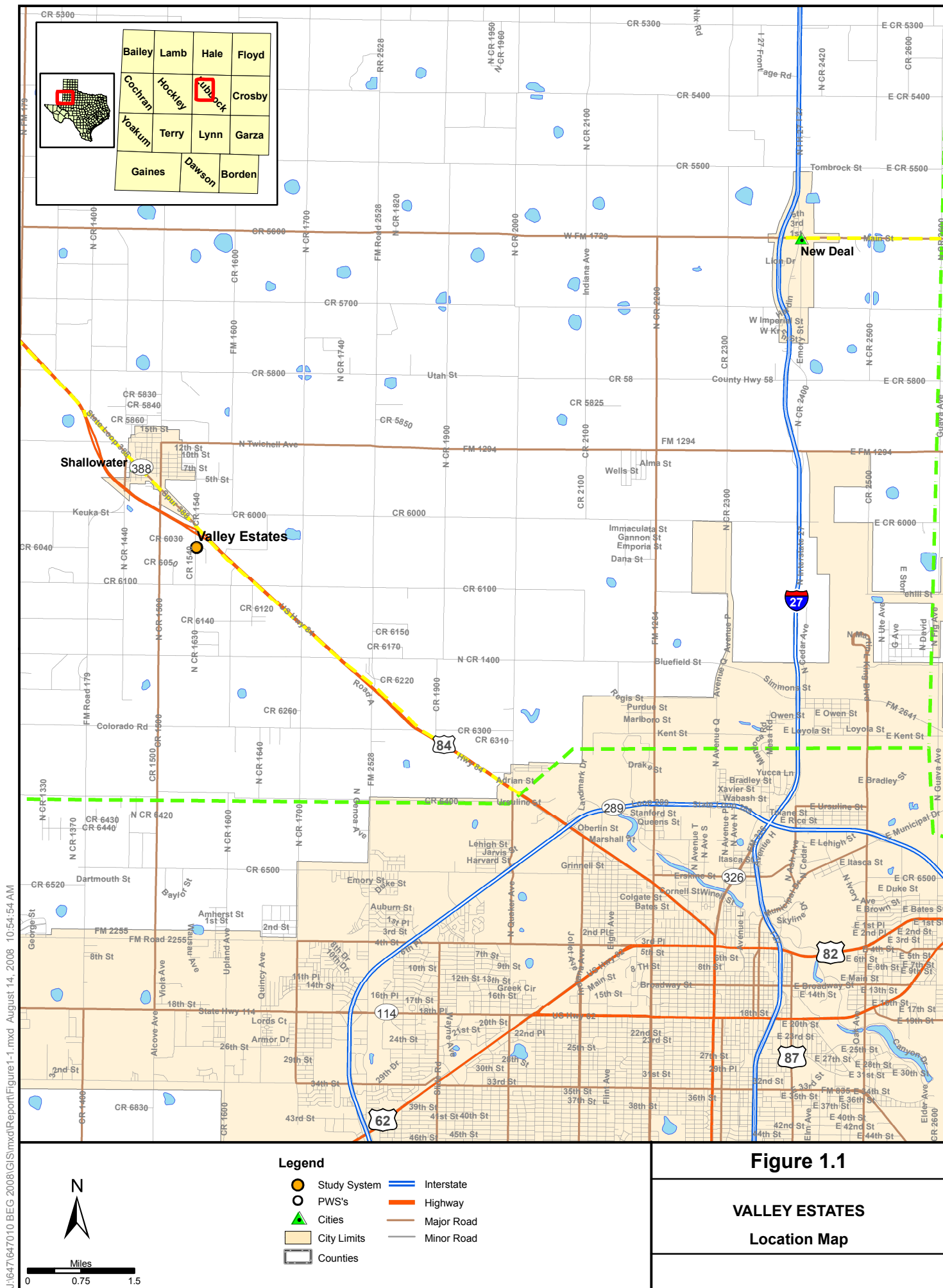
SECTION 1 INTRODUCTION

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 Valley Estates, PWS ID# 1520198, Certificate of Convenience and Necessity (CCN) #12490, located in Lubbock County, hereinafter referred to in this document as the “Valley Estates PWS.” Recent sample results from the Valley Estates PWS exceeded the MCL for combined uranium of 0.030 milligrams per liter (mg/L). Recent sample results also exceeded the MCL for arsenic of 0.010 mg/L, selenium of 0.050 mg/L, and fluoride of 4.0 mg/L (USEPA 2008a; TCEQ 2004). The location of the Valley Estates 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.





Groundwater Conservation Districts

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 Valley Estates water system had recent sample results exceeding the MCL for arsenic, fluoride, selenium, and combined uranium. In general, contaminant(s) in drinking water above the MCL(s) can have both short-term (acute) and long-term or lifetime (chronic) effects. Health concerns relating to drinking water above the MCLs for these chemicals are briefly described below.

Potential health effects from the ingestion of water with levels of fluoride above the MCL (4 mg/L) over many years include bone disease, including pain and tenderness of the bones. Additionally, the U.S. Environmental Protection Agency (USEPA) has set a secondary fluoride standard of 2 mg/L to protect against dental fluorosis, which in its moderate or severe forms, may result in a brown staining and/or pitting of the permanent teeth in children under 9 years of age (USEPA 2008c).

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 cardiovascular, pulmonary, immunological, neurological and endocrine effects, and cancerous effects, including skin, bladder, lung, kidney, nasal passage, liver and prostate cancer (USEPA 2008b).

Potential health effects from ingestion of water with levels of uranium above the MCL (0.030 mg/L) are increased risk of cancer and kidney toxicity.

Potential short-term health effects from the ingestion of water with levels of selenium above the MCL (0.050 mg/L) include hair and fingernail changes, damage to the peripheral nervous system, fatigue, and irritability. Long-term exposure of selenium has the potential to cause the following effects from a lifetime exposure at levels above the MCL; hair and fingernail loss; damage to kidney and liver tissue, and the nervous and circulatory systems (USEPA 2008d).

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 USEPA and Texas drinking water standards. Three PWSs were evaluated in the pilot project to develop the method (*i.e.*, decision tree approach) for analyzing options for provision of compliant drinking water. This project is performed using the decision tree approach that was developed for the pilot project, and which was also used for subsequent projects.

Other tasks of the feasibility study are as follows:

- Identifying available data sources;
- Gathering and compiling data;

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

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

1.3 REGULATORY PERSPECTIVE

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

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

This project was conducted to assist in achieving these responsibilities.

1.4 ABATEMENT OPTIONS

When a PWS exceeds a regulatory MCL, the PWS must take action to correct the violation. The MCL exceedances at the Valley Estates PWS involve arsenic, fluoride, selenium, and combined uranium. The following subsections explore alternatives considered as potential options for obtaining/providing compliant drinking water.

1.4.1 Existing Public Water Supply Systems

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

1.4.1.1 Quantity

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

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

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

In addition to the necessary improvements, a transmission pipeline would need to be constructed to tie the two PWSs together. The pipeline must tie-in at a point in the supplier PWS where all the upstream pipes and appurtenances are of sufficient capacity to handle the new demand. In the non-compliant PWS, the pipeline must tie in at a point where no downstream 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 Valley Estates PWS, the following standards could be used in a rough screening to identify compliant groundwater in surrounding systems:
 - Nitrate (measured as nitrogen) concentrations less than 8 mg/L (below the MCL of 10 mg/L);
 - Fluoride concentration less than 2.0 mg/L (below the Secondary MCL of 2 mg/L);
 - Arsenic concentration less than 0.008 mg/L (below the MCL of 0.01 mg/L);
 - Uranium concentration less than 0.024 mg/L (below the MCL of 0.030 mg/L); and
 - Selenium concentration less than 0.04 mg/L (below the MCL of 0.05 mg/L).
- The recorded well information will be reviewed to eliminate those wells that appear to be unsuitable for the application. Often, the “Remarks” column in the Texas Water Development Board (TWDB) hard-copy database provides helpful information. Wells eliminated from consideration generally include domestic and stock wells, dug wells, test holes, observation wells, seeps and springs, destroyed wells, wells used by other communities, etc.

- Wells of sufficient size are identified. Some may be used for industrial or irrigation purposes. Often the TWDB database will include well yields, which may indicate the likelihood that a particular well is a satisfactory source.
- At this point in the process, the local groundwater control district (if one exists) should be contacted to obtain information about pumping restrictions. Also, preliminary cost estimates should be made to establish the feasibility of pursuing further well development options.
- If particular wells appear to be acceptable, the owner(s) should be contacted to ascertain their willingness to work with the PWS. Once the owner agrees to participate in the program, questions should be asked about the wells. Many owners have more than one well, and would probably be the best source of information regarding the latest test dates, who tested the water, flowrates, and other well characteristics.
- After collecting as much information as possible from cooperative owners, the PWS would then narrow the selection of wells and sample and analyze them for quality. Wells with good quality water would then be potential candidates for test pumping. In some cases, a particular well may need to be refurbished before test pumping. Information obtained from test pumping would then be used in combination with information about the general characteristics of the aquifer to determine whether a well at that location would be suitable as a supply source.
- It is recommended that new wells be installed instead of using existing wells to ensure the well characteristics are known and the well meets construction standards.
- Permit(s) would then be obtained from the groundwater control district or other regulatory authority, and an agreement with the owner (purchase or lease, access easements, etc.) would then be negotiated.

1.4.2.2 Develop New Wells

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

1.4.3 Potential for Surface Water Sources

Water rights law dominates the acquisition of water from surface water sources. For a PWS, 100 percent availability of water is required, except where a back-up source is available. For PWSs with an existing water source, although it may be non-compliant because of elevated

concentrations of one or more parameters, water rights may not need to be 100 percent available.

1.4.3.1 Existing Surface Water Sources

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

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

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

1.4.3.2 New Surface Water Sources

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

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

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

1.4.4 Identification of Treatment Technologies

Various treatment technologies were also investigated as compliance alternatives for treatment of fluoride, selenium, arsenic, and uranium to regulatory levels (*i.e.*, MCLs). Numerous options have been identified by the USEPA as best available technologies (BAT) for non-compliant constituents. Identification and descriptions of the various BATs are provided in the following sections.

1.4.4.1 Treatment Technologies for Fluoride

Fluoride is a soluble anion and is not removed by particle filtration. The secondary MCL for fluoride is 2 mg/L and the primary MCL is 4 mg/L. The USEPA BATs for fluoride removal include activated alumina adsorption and reverse osmosis. Other treatment technologies that can potentially remove fluoride from water include lime softening (modified), alum coagulation, electrodialysis (ED or EDR) and anion exchange.

1.4.4.2 Treatment Technologies for Selenium

In natural waters, selenium exists in four different oxidation states (-II, 0, +IV, and +VI). Among these, Se(IV), selenite and Se(VI), selenate, are the most common species in ground water and surface water (Levander 1985). The MCL for selenium in drinking water is 50 µg/L. The USEPA BATs for selenium include activated alumina adsorption, reverse osmosis, ED or EDR, lime softening and coagulation/filtration. Lime softening is not recommended for water systems with less than 500 connections due to process complexities and the use of large amounts of chemicals. Coagulation/filtration is only effective for removing Se(IV), selenite. Other potential treatment technologies include adsorption by different specialty media such as granular iron oxide, granular ferric hydroxide, and the newly commercialized granular titanium oxide media (*e.g.*, Dow ADSORSIA™ GTO™). These adsorption media are effective for removing arsenic (III and V) and selenium (IV).

1.4.4.3 Treatment Technologies for Arsenic

In January 2001, the USEPA published a final rule in the Federal Register that established an MCL for arsenic of 0.010 mg/L (USEPA 2008b). 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 need to complete initial monitoring or have a state-approved waiver by December 31, 2007.

Various treatment technologies were 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.

1.4.4.4 Treatment Technologies for Uranium

The uranium isotopes U-234, U-235, and U-238 combine with carbonate to form complex anions (*e.g.*, $\text{UO}_2(\text{CO}_3)_2^{2-}$ and $\text{UO}_2(\text{CO}_3)_3^{4-}$), which are dissolved in water at pH between 6.0 and 8.2, and are not easily removed by particle filtration. The MCL for total uranium is 0.030 mg/L, which is equivalent to 20.1 picoCuries per liter (pCi/L) as radioactivity.

The following BATs were identified in the Radionuclides Final Rule for achieving compliance with the uranium MCL:

- Ion exchange;
- Reverse osmosis;
- Lime softening; and
- Coagulation/filtration.

In addition, the following technologies are included in the Radionuclides Final Rule as small system compliance technologies (SSCT):

- IX (Centralized and POU);
- RO (Centralized and POU);
- Lime softening;
- Activated Alumina; and
- Coagulation/filtration.

Other technologies that can remove uranium include electrodialysis or electrodialysis reversal and WRT Z-92™ adsorption.

1.4.5 Treatment Technologies Description

Reverse Osmosis, EDR, and adsorption are identified by USEPA as BATs for removal of fluoride, selenium, and arsenic. In this case, adsorption is not a feasible technology because of the high alkalinity of the groundwater. RO is also a viable option for POE and POU systems. A description of these technologies follows.

In addition to the BAT and SSCTs identified in the Radionuclides Final Rule, EDR and a relatively new process using WRT Z-92 media that is specific for uranium adsorption has been demonstrated to be effective uranium removal technologies. However, because of the presence of relatively high fluoride and total dissolved solids (TDS) concentrations in the well water, only RO and EDR are considered applicable processes that can remove uranium as well as the other contaminants. These two technologies are described as follows.

1.4.5.1 Reverse Osmosis

Process. RO is a physical process in which contaminants are removed by applying pressure on the feed water to force it through a semi-permeable membrane. RO membranes reject ions based on 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 (CA) or polyamide thin film composite (TFC). The TFC membrane operates at much lower pressure and can achieve higher salt rejection than the CA membranes but is less chlorine resistant. Each material has specific benefits and limitations depending on the raw water characteristics and pre-treatment. Spiral wound has been the dominant media type in typical RO systems. A newer, lower pressure type membrane which is similar in operation to spiral wound type RO, is nanofiltration (NF) which has higher rejection for divalent ions than mono-valent ions. NF is sometimes used instead of spiral wound type RO for treating water with high hardness and sulfate concentrations.

A typical RO installation includes a high pressure feed pump; 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 pre-treatment. Factors influencing performance are raw water characteristics, pressure, temperature, and regular monitoring and maintenance. Depending on the membrane type and operating pressure, RO is capable of removing 85-95 percent of fluoride, and over 95 percent of nitrate, selenium, arsenic, and uranium. The treatment process is relatively insensitive to pH. Water recovery is 60-80 percent, depending on raw water characteristics. The concentrate volume for disposal can be significant. The conventional RO treatment train for well water uses anti-scalant addition, cartridge filtration, RO membranes, chlorine disinfection, and clearwell storage.

Pre-treatment. RO requires careful review of raw water characteristics, and pre-treatment needs to prevent membranes from fouling, scaling, or other membrane degradation. Removal or sequestering of suspended solids is necessary to prevent colloidal and bio-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 to remove

suspended particles; IX softening to remove hardness; antiscalant feed; temperature and pH adjustment to maintain efficiency; acid to prevent scaling and membrane damage; activated carbon or bisulfite to remove chlorine (post-disinfection may be required); and cartridge filters to remove any remaining suspended particles to protect membranes from upsets.

Maintenance. Rejection percentages must be monitored to ensure contaminant removal below MCLs. Regular monitoring of membrane performance is necessary to determine fouling, scaling, or other membrane degradation. Use of monitoring equipment to track membrane performance is recommended. Acidic or caustic solutions are regularly flushed through the system at high volume/low pressure with a cleaning agent to remove fouling and scaling. The system is flushed and returned to service. RO stages are cleaned sequentially. Frequency of membrane replacement is dependent on raw water characteristics, pre-treatment, and maintenance.

Waste Disposal. Pre-treatment waste streams, concentrate flows, and spent filters and membrane elements all require approved disposal methods. Disposal of the significant volume of the concentrate stream is a problem for many utilities.

Advantages (RO)

- Produces the highest water quality.
- Can effectively treat a wide range of dissolved salts and minerals, turbidity, health and aesthetic contaminants, and certain organics. Some highly maintained units are capable of treating biological contaminants.
- Low pressure - less than 100 pounds per square inch (psi), compact, self-contained, single membrane units are available for small installations.

Disadvantages (RO)

- Relatively expensive to install and operate.
- Frequent membrane monitoring and maintenance; pressure, temperature, and pH requirements to meet membrane tolerances. Membranes can be chemically sensitive.
- Additional water usage depending on rejection rate.
- Concentrate disposal required.

A concern with RO for treatment of inorganics is that if the full stream is treated, then most of the alkalinity and hardness would also be removed. In that event, post-treatment may be necessary to avoid corrosion problems. If feasible, a way to avoid this issue is to treat a slip stream of raw water and blend the slip stream back with the raw water rather than treat the full stream. The amount of water rejected is also an issue with RO. Discharge concentrate can be between 10 and 50 percent of the influent flow.

1.4.5.2 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 spacers, 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 fluoride, nitrate, selenium, arsenic, uranium, and TDS. Additional stages are required to achieve higher removal efficiency (85-95% for fluoride). 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 pre-treatment steps such as raw water pumps, debris screens, rapid mix with addition of an anti-scalant, slow mix flocculator, sedimentation basin or clarifier, and gravity filters. Microfiltration could be used in place of flocculation, sedimentation, and filtration. Additional treatment or management of the concentrate and the removed solids would be necessary prior to disposal.

Pre-treatment. 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 (°F) for cleaning. They can be removed from the unit and scrubbed. Solids can be washed off by turning the power 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. EDR requires reversing the polarity. Flushing at high volume/low pressure continuously is required to clean electrodes. If used, pre-treatment 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. Pre-treatment 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.

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 part-time operation, it may be an appropriate technology for small systems. It can be used to simultaneously reduce fluoride, selenium, nitrate, arsenic and TDS.

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*,” EPA 815-R-06-010, April 2006 (USEPA 2006).

Point-of-entry and POU treatment systems can be used to provide compliant drinking water. These systems typically use small adsorption or reverse osmosis treatment units installed “under the sink” in the case of POU, and where water enters a house or building in the case of POE. It should be noted that the POU treatment units would need to be more complex than units typically found in commercial retail outlets to meet regulatory requirements, making

1 purchase and installation more expensive. Point-of-entry and POU treatment units would be
2 purchased and owned by the PWS. These solutions are decentralized in nature, and require
3 utility personnel entry into houses or at least onto private property for installation,
4 maintenance, and testing. Due to the large number of treatment units that would be employed
5 and would be largely out of the control of the PWS, it is very difficult to ensure 100 percent
6 compliance. Prior to selection of a POE or POU program for implementation, consultation
7 with TCEQ would be required to address measurement and determination of level of
8 compliance.

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

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

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

- 41 • POU and POE treatment units must be owned, controlled, and maintained by the
42 water system, although the utility may hire a contractor to ensure proper operation

and maintenance (O&M) and MCL compliance. The water system must retain unit ownership and oversight of unit installation, maintenance and sampling; the utility ultimately is the responsible party for regulatory compliance. The water system staff need not perform all installation, maintenance, or management functions, as these tasks may be contracted to a third party-but the final responsibility for the quality and quantity of the water supplied to the community resides with the water system, and the utility must monitor all contractors closely. Responsibility for O&M of POU or POE devices installed for SDWA compliance may not be delegated to homeowners.

- POU and POE units must have mechanical warning systems to automatically notify customers of operational problems. Each POU or POE treatment device must be equipped with a warning device (e.g., alarm, light) that would alert users when their unit is no longer adequately treating their water. As an alternative, units may be equipped with an automatic shut-off mechanism to meet this requirement.
- If the American National Standards Institute (ANSI) issued product standards for a specific type of POU or POE treatment unit, only those units that have been independently certified according to those standards may be used as part of a compliance strategy.

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

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

1.4.7 Water Delivery or Central Drinking Water Dispensers

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

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

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

- 9 • Water delivery programs require consumer participation to a varying degree.
10 Ideally, consumers would have to do no more than they currently do for a piped-
11 water delivery system. Least desirable are those systems that require maximum
12 effort on the part of the customer (*e.g.*, customer has to travel to get the water,
13 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

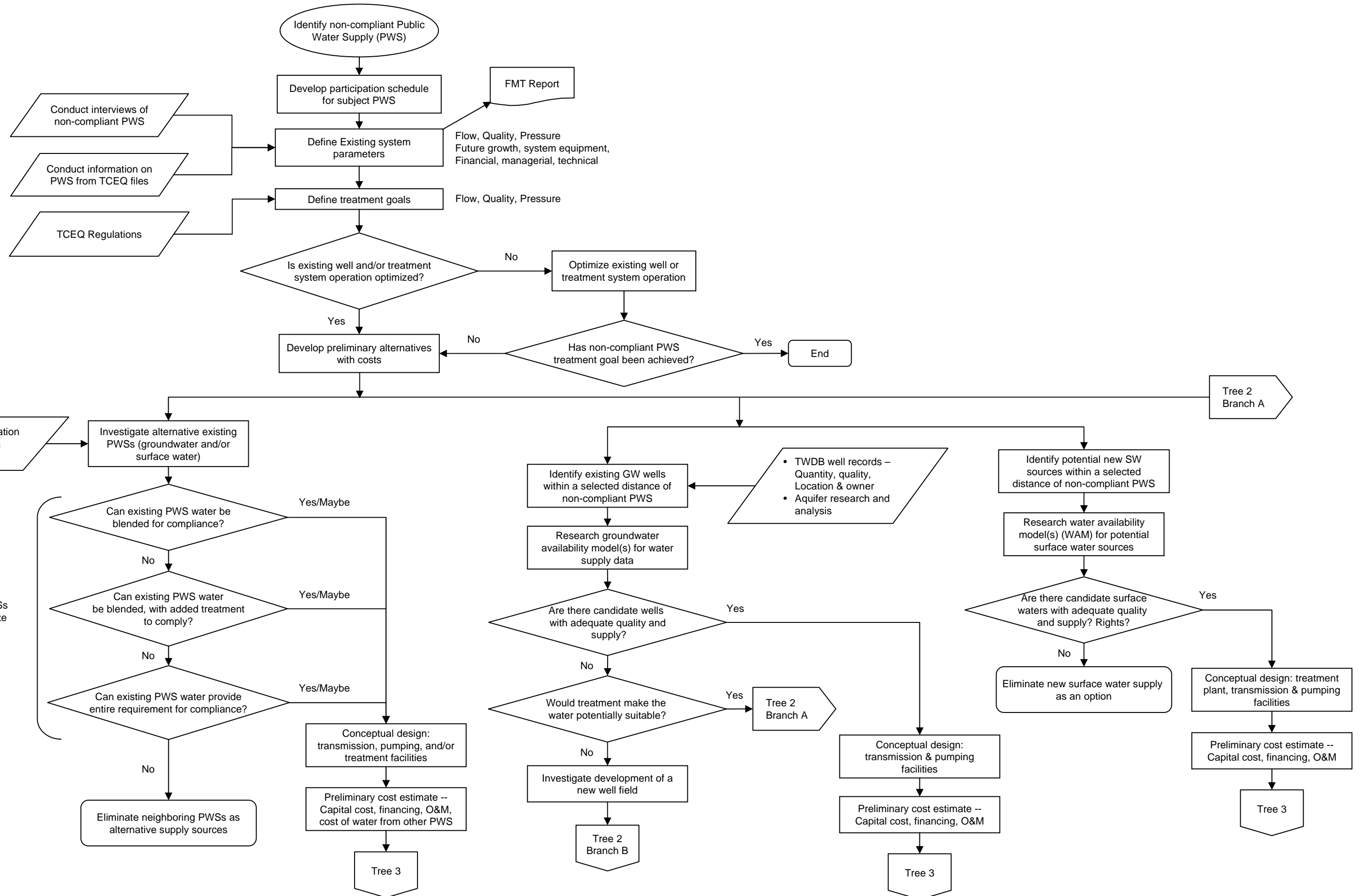


Figure 2.2
TREE 2 – DEVELOP TREATMENT ALTERNATIVES

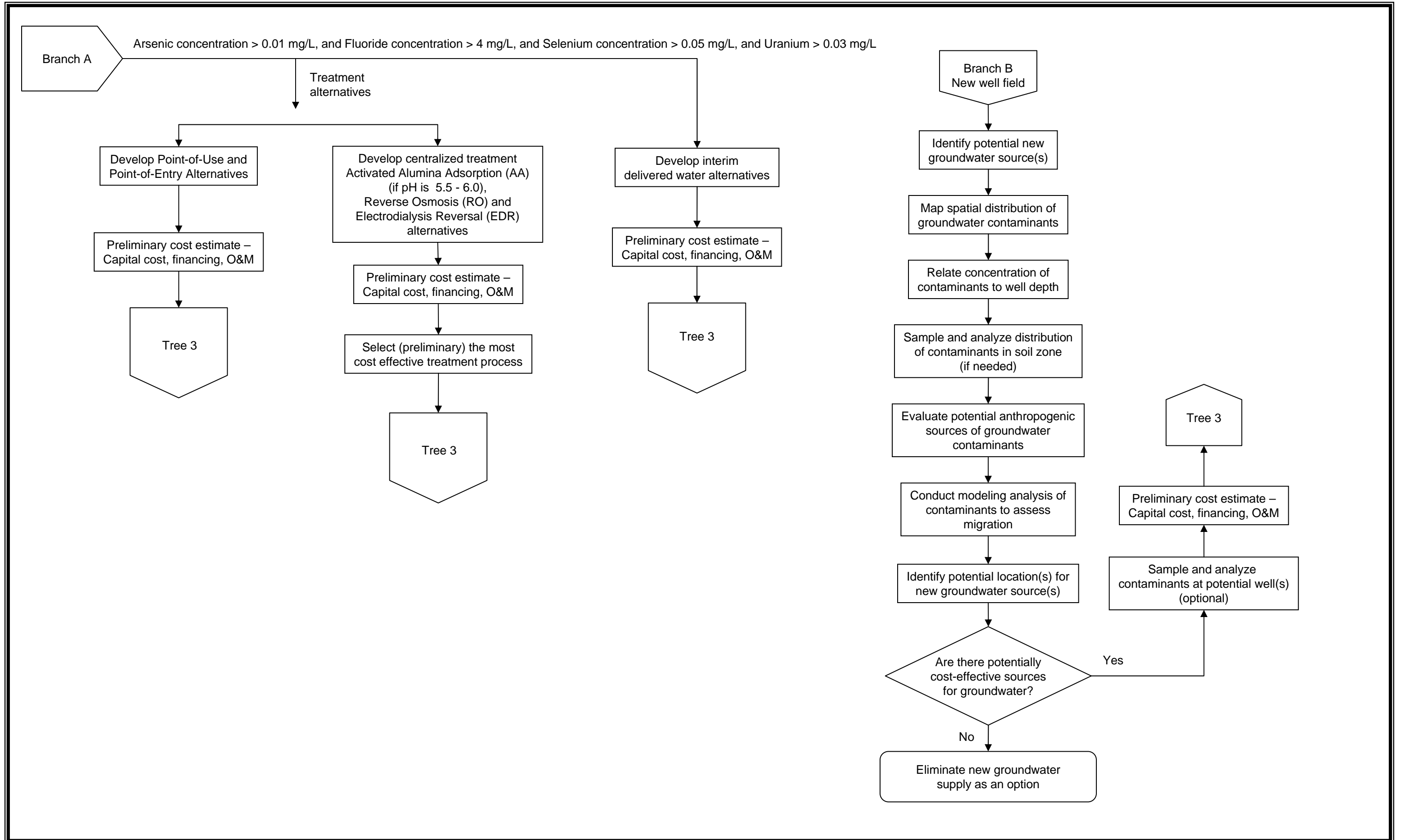


Figure 2.3

Tree 3 – PRELIMINARY ANALYSIS

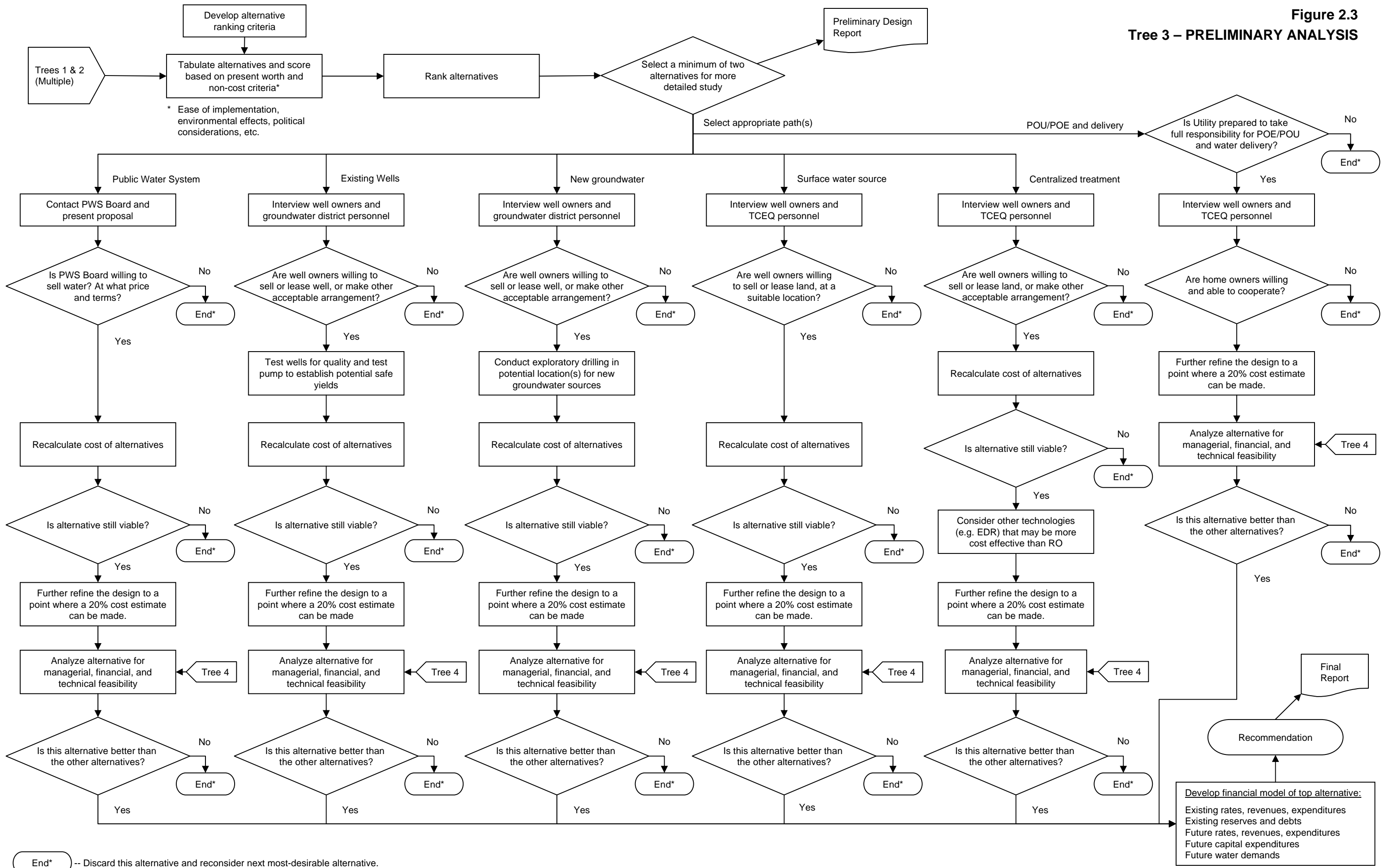
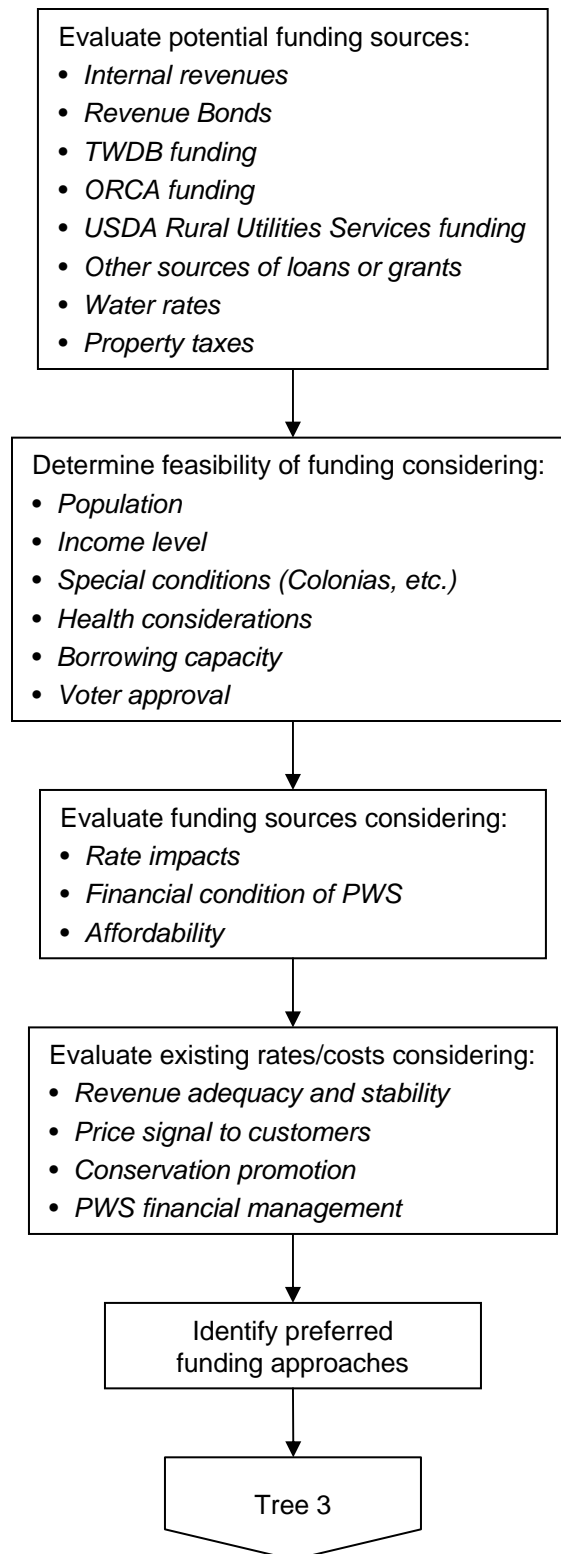


Figure 2.4
TREE 4 – FINANCIAL



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 Ogallala Aquifer was investigated as a potential tool for identifying available and suitable groundwater resources.

2.2.1.5 Water Availability Model

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

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

2.2.1.6 Financial Data

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

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

2.2.1.7 Demographic Data

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

2.2.2 PWS Interviews

2.2.2.1 PWS Capacity Assessment Process

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

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

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

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

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

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

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

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

investigated or the assessor could decide that the preventative maintenance program was inadequate.

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

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

The only common treatment technologies considered potentially applicable for removal of fluoride, selenium, arsenic, and uranium are RO and EDR. Adsorption is not economically feasible because of the high alkalinity of the water, which would result in high acid consumption for pH adjustment. RO and EDR can remove fluoride as well as arsenic, selenium, uranium, nitrate, TDS, and other dissolved constituents. RO treatment is considered for central treatment alternatives, as well as POU and POE alternatives. EDR is considered for central treatment 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 RO treatment and blending treated and untreated water to meet the fluoride MCL would reduce the amount of raw water used. The EDR operation can be tailored to provide a desired fluoride effluent concentration by controlling the electrical energy applied. 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 and the average water consumption rate, respectively. 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 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.

2.4 COST OF SERVICE AND FUNDING ANALYSIS

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

2.4.1 Financial Feasibility

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

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

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

2.4.2 Median Household Income

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

chosen. The MHI for each PWS was estimated by selecting the most appropriate value based on block group or ZIP code based on results of the site interview and a comparison with the surrounding area.

2.4.3 Annual Average Water Bill

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

2.4.4 Financial Plan Development

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

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

- Restricted or desired cash balances:

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

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

2.4.5 Financial Plan Results

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

2.4.5.1 Funding Options

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

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

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

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

- If local MHI = 50-60 percent of state MHI, 0 percent interest and 15 percent forgiveness of principal.
- If local MHI less than 50 percent of state MHI, 0 percent interest and 35 percent forgiveness of principal.
- Terms of revenue bonds assumed to be 25-year term at 6.0 percent interest rate.

2.4.5.2 General Assumptions Embodied in Financial Plan Results

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

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

2.4.5.3 Interpretation of Financial Plan Results

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

2.4.5.4 Potential Funding Sources

A number of potential funding sources exist for rural utilities, 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 and lower interest rates 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 provider to obtain water or wastewater service supplied by a larger utility or to finance the consolidation or regionalization of neighboring utilities. Of the three Texas agencies that offer financial assistance for water infrastructure the TWDB is the primary agencies that offers financing for privately owned water systems.

TWDB has several programs that offer loans at interest rates lower than the market offers to finance projects for 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 and Water Supply Corporations with projects, but Drinking Water State Revolving Fund (DWSRF) is available to privately owned systems. Other programs with agencies such as Office of Rural Community Affairs (ORCA) and the 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. Although, the programs with these agencies are for public systems special cases have been addressed where in need communities can receive funds by way of public entities (e.g., county). A public entity can apply for state funds and private water system be the recipient of the services (all agency criteria would still have to be met by the benefiting community).

The application process, eligibility requirements, and funding structure vary for each of these programs. There are many conditions that must be considered by each agency to determine eligibility and ranking of projects. The principal factors that affect this choice are population, percent of the population under the state MHI, health concerns, compliance with standards, Colonia status, and compatibility with regional and state plans.

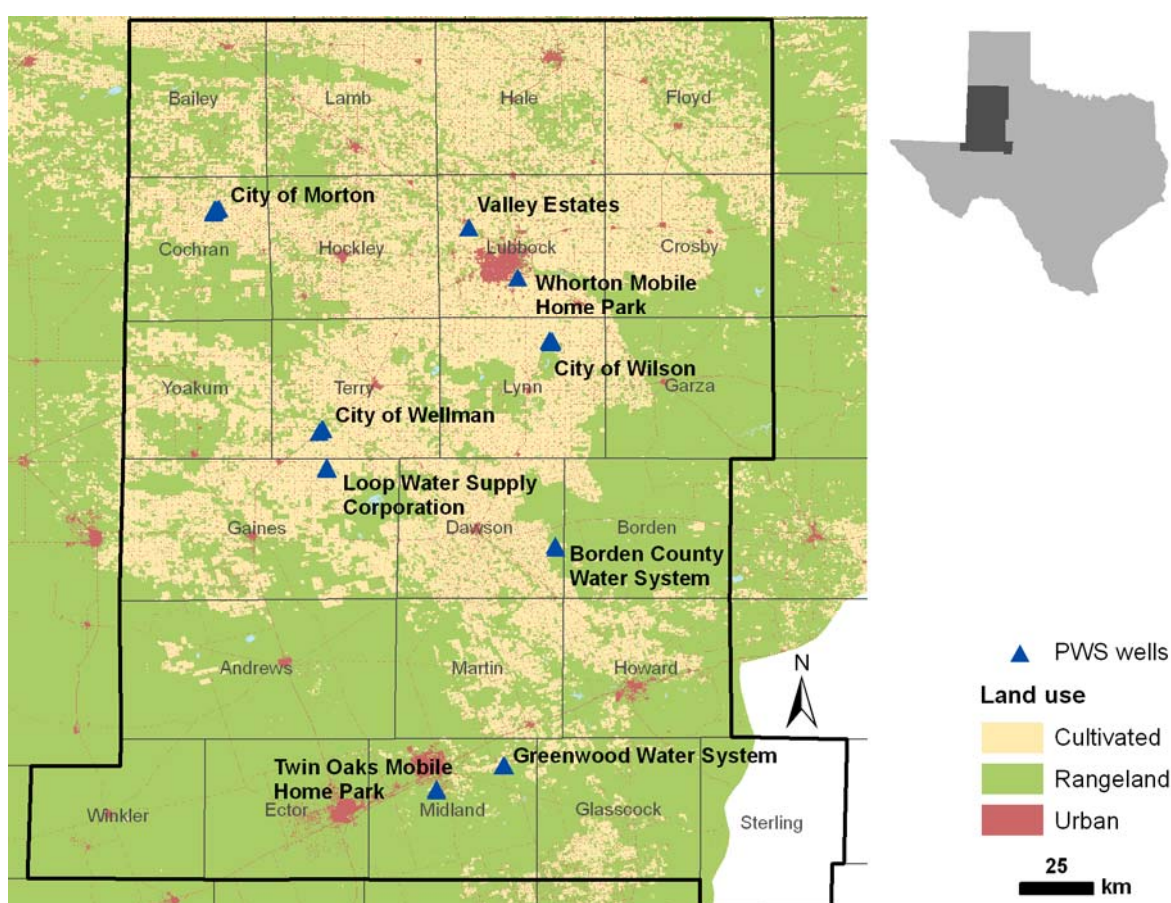
SECTION 3 UNDERSTANDING SOURCES OF CONTAMINANTS

3.1 REGIONAL ANALYSIS

3.1.1 Overview of the Study Area

The regional analysis described below includes data from 23 counties in the High Plains within Texas: Andrews, Bailey, Borden, Cochran, Crosby, Dawson, Ector, Floyd, Gaines, Garza, Glasscock, Hale, Hockley, Howard, Lamb, Lubbock, Lynn, Martin, Midland, Sterling, Terry, Winkler, and Yoakum (Figure 3.1).

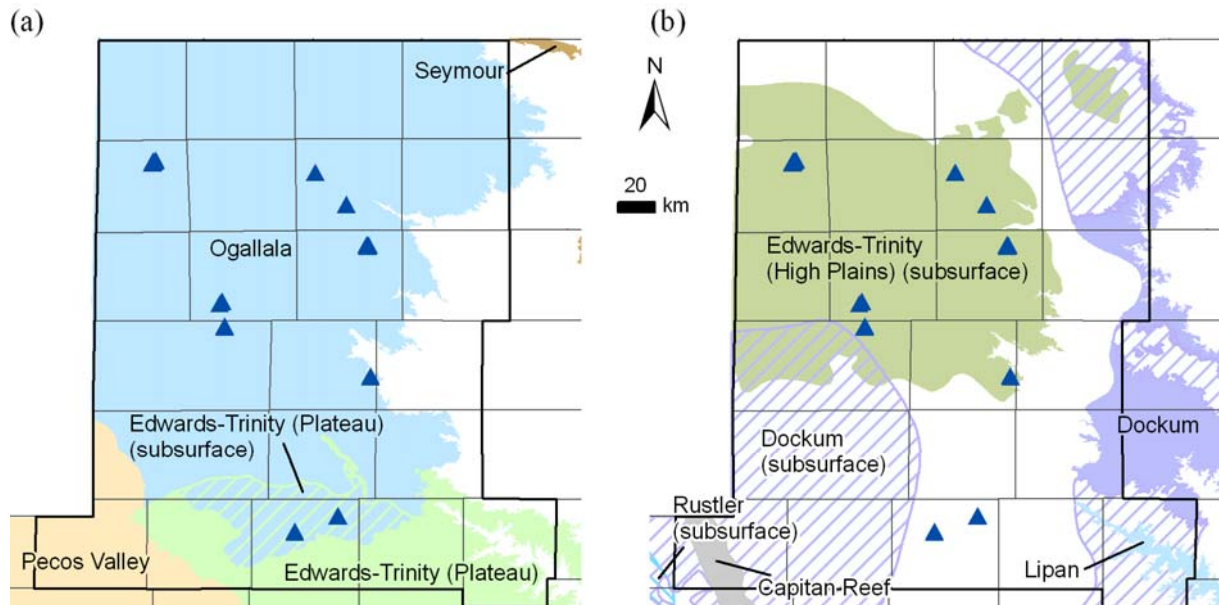
Figure 3.1 Regional Study Area and Locations of the PWS Wells Assessed



The major and minor aquifers within the region are shown in Figure 3.2. Most of the PWS wells of concern are drilled within the Tertiary sediments of the Ogallala aquifer. Other aquifers in the region that may locally be hydraulically connected to the Ogallala aquifer include younger alluvial and fluvial deposits of Quaternary age (Blackwater Draw Formation, not shown) and underlying older aquifers, including the Cretaceous-age Edwards-Trinity (Plateau) aquifer, the Edwards-Trinity (High Plains) aquifer of Cretaceous age, the Dockum

1 aquifer of Triassic age, and undifferentiated Permian aquifers (not shown). Other aquifers in
2 the area, including the Capitan Reef, Lipan, Pecos Valley, Rustler, and Seymour aquifers, are
3 not located near any of the wells in this analysis.

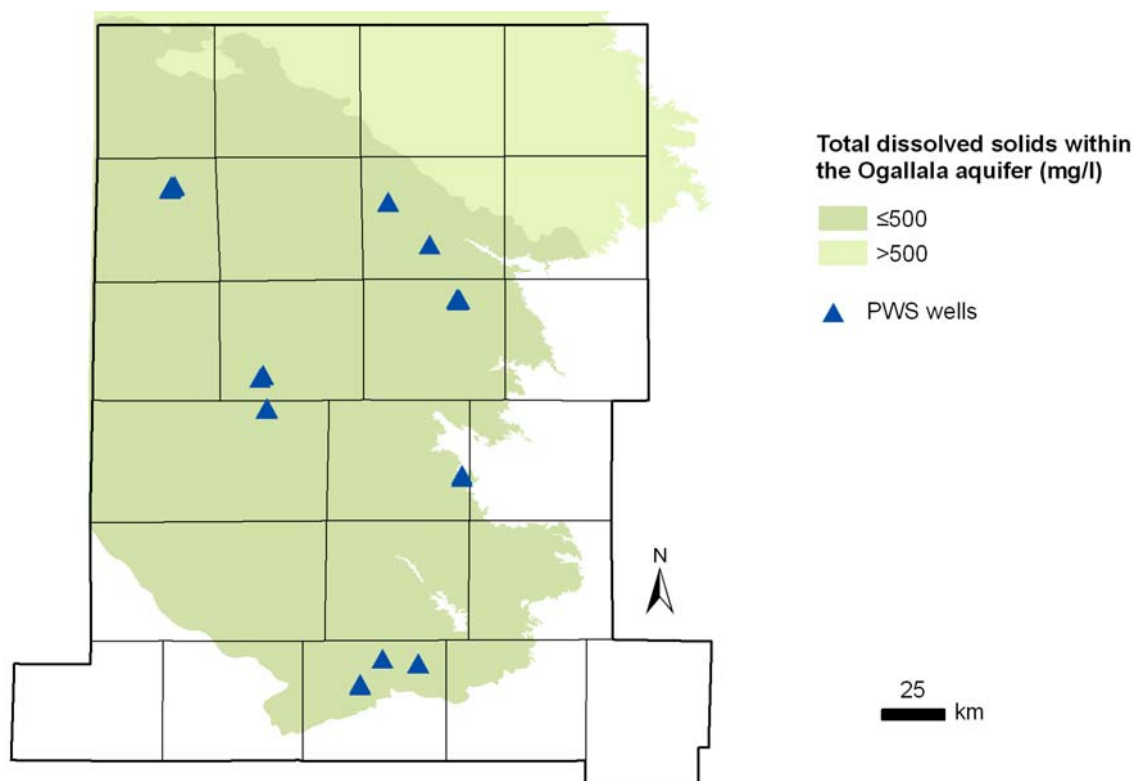
Figure 3.2 Major (a) and Minor (b) Aquifers in the Study Area



"Subsurface" indicates a portion of an aquifer that underlies other formations. All other labels indicate a portion of an aquifer that lies at the land surface.

6 Water quality in the Ogallala aquifer is distinctively different in the northern portion of the
7 study area. Thus, this study analyzes the Ogallala aquifer in two parts: Ogallala-North (TDS \leq
8 500 mg/L) and Ogallala-South (TDS $>$ 500 mg/L) (Figure 3.3).

Figure 3.3 Water Quality Zones in the Study Area



Data used for this study include information from three sources:

- Texas Water Development Board groundwater database available at www.twdb.state.tx.us. The database includes information on the location and construction of wells throughout the state as well as historical measurements of water chemistry and levels in the wells.
- Texas Commission on Environmental Quality Public Water Supply database (not publicly available). The database includes information on the location, type, and construction of water sources used by PWS 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. The NURE dataset covers only the eastern part of the study area.

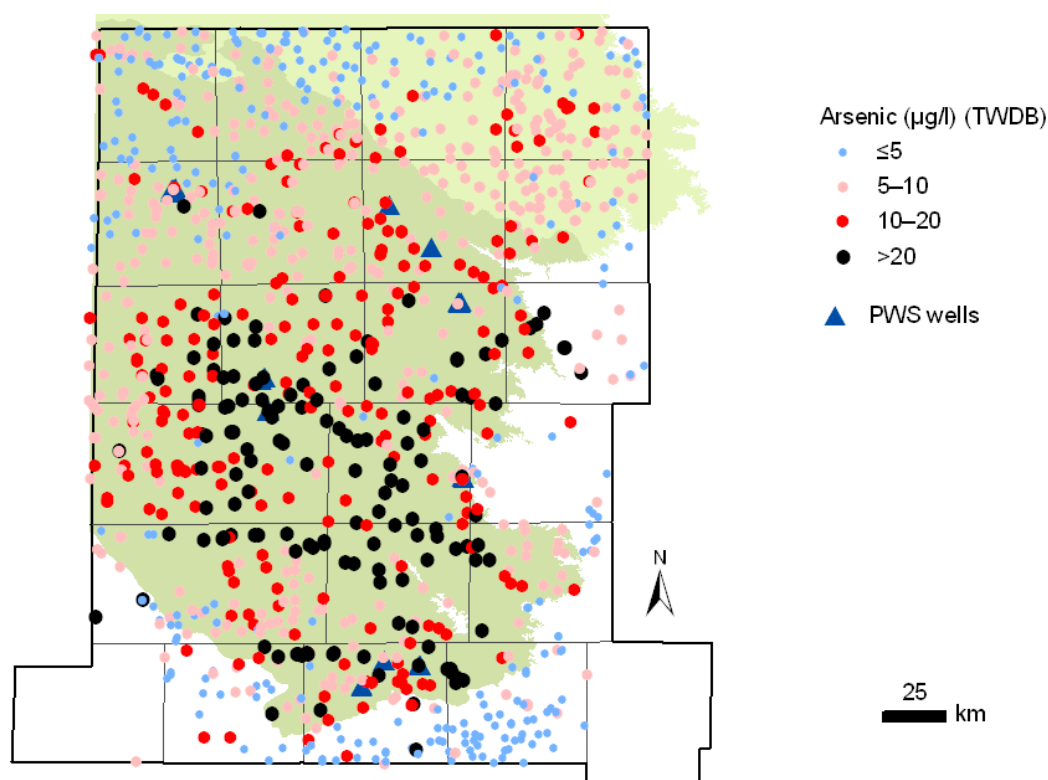
3.1.2 Contaminants of Concern in the Study Area

Contaminants addressed include arsenic, fluoride, nitrate, selenium, and uranium. In PWSs in the area, water sampling shows that one or more of these solutes exceeds the USEPA's MCL.

Arsenic

Arsenic concentrations exceed the USEPA's MCL (10 µg/L) throughout the study area, especially in the Ogallala-South area (Figure 3.4). Half of the wells in the Ogallala-South aquifer and one-fifth of wells in the Edwards-Trinity (High Plains) aquifer contain arsenic levels above the MCL. In contrast, only 10 percent or less of wells in the Ogallala-North, Edwards-Trinity (Plateau), and Dockum aquifers exceed the MCL for arsenic.

Figure 3.4 Spatial Distribution of Arsenic Concentrations



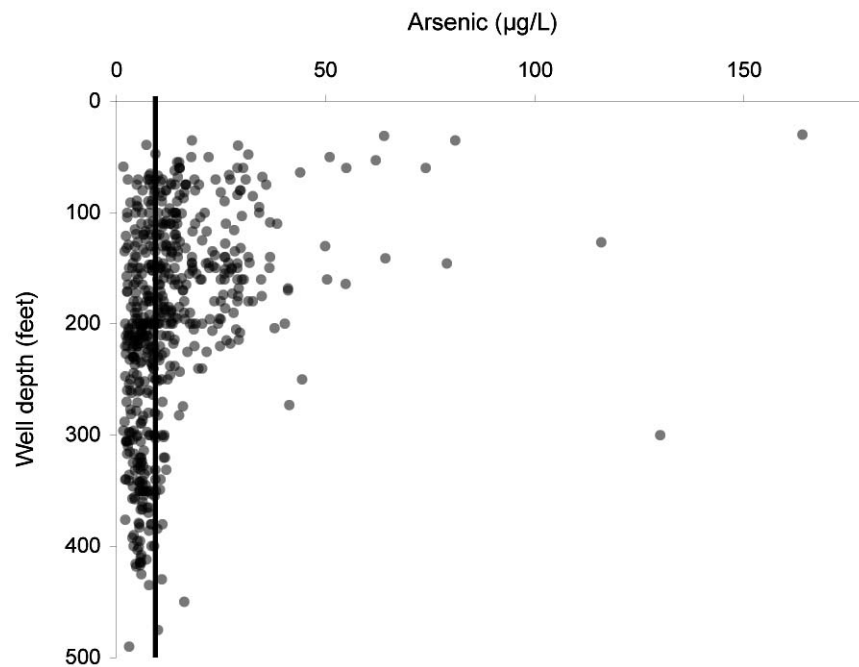
Data presented here are from the TWDB database. The most recent sample for each well is shown. Table 3.1 gives the percentage of wells with arsenic exceeding the MCL (10 µg/L) in each of the major aquifers in the study area.

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
Ogallala-North	228	15	7%
Ogallala-South	642	323	50%
Edwards-Trinity (Plateau)	127	13	10%
Edwards-Trinity (High Plains)	16	3	19%
Dockum	70	4	6%
Other	5	0	0%

There is a clear stratification of arsenic concentrations with depth in the study area (Figure 3.5), with arsenic concentrations decreasing with depth. This suggests that tapping deeper water by deepening shallow wells or casing off shallower parts of wells might decrease arsenic concentrations.

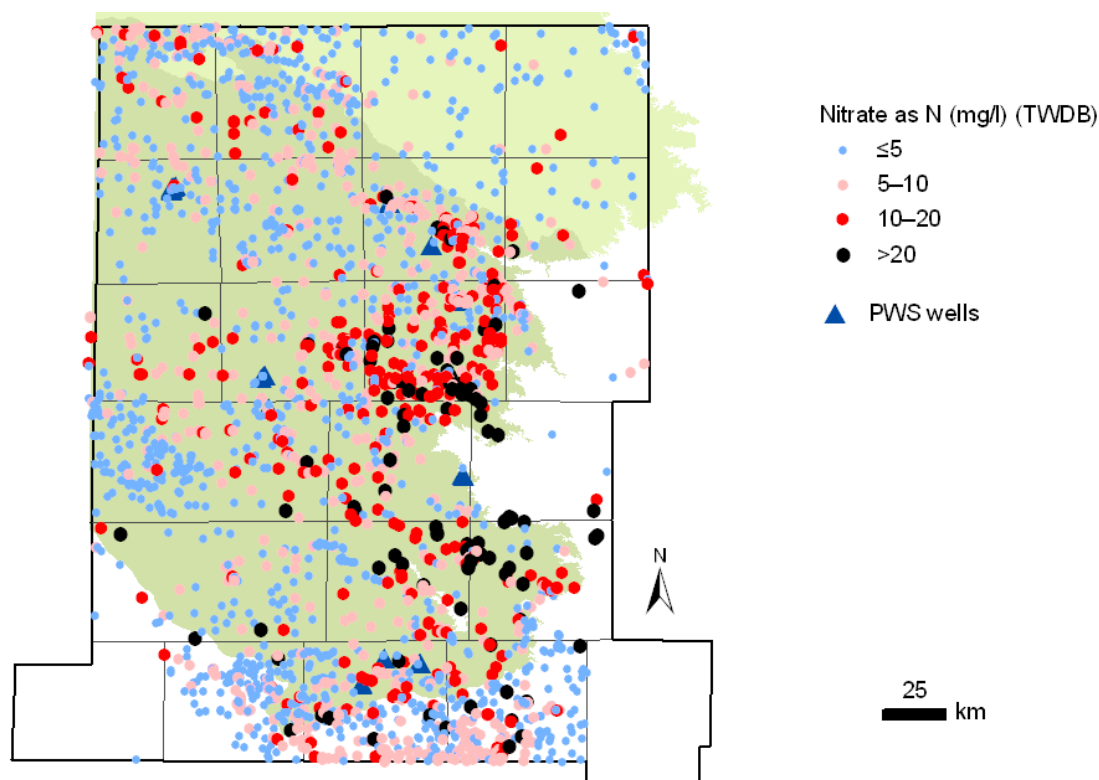
Figure 3.5 Arsenic Concentrations and Well Depths in the Ogallala Aquifer



Nitrate

Nitrate concentrations exceed the MCL (10 mg/L) throughout the study area, especially in the eastern part of the Ogallala-South aquifer (Figure 3.6). In the Ogallala-North, only one percent of wells have nitrate concentrations above the MCL.

Figure 3.6 Spatial Distribution of Nitrate Concentrations



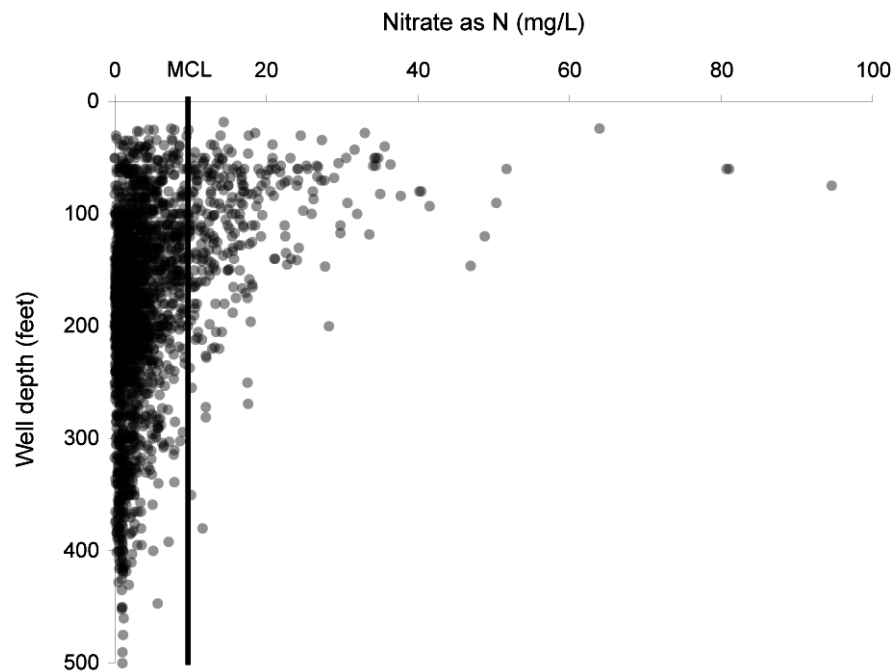
Data presented here are from the TWDB database. The most recent measurement from each well is shown. Table 3.2 shows the percentage of wells with nitrate as N exceeding the MCL (10 mg/L).

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

Aquifer	Wells with measurements	Wells that exceed 10 mg/L	Percentage of wells that exceed 10 mg/L
Ogallala-North	590	6	1%
Ogallala-South	2826	370	13%
Edwards-Trinity (Plateau)	642	39	6%
Edwards-Trinity (High Plains)	76	3	4%
Dockum	149	9	6%
Seymour	1	1	100%
other	40	5	13%

Within the study area, the concentration of nitrate as N tends to decrease with well depth (Figure 3.7). Nearly all wells in the Ogallala aquifer deeper than 250 feet have acceptable nitrate levels. Therefore, deepening shallow wells or casing the upper portions of problematic wells might decrease nitrate concentrations.

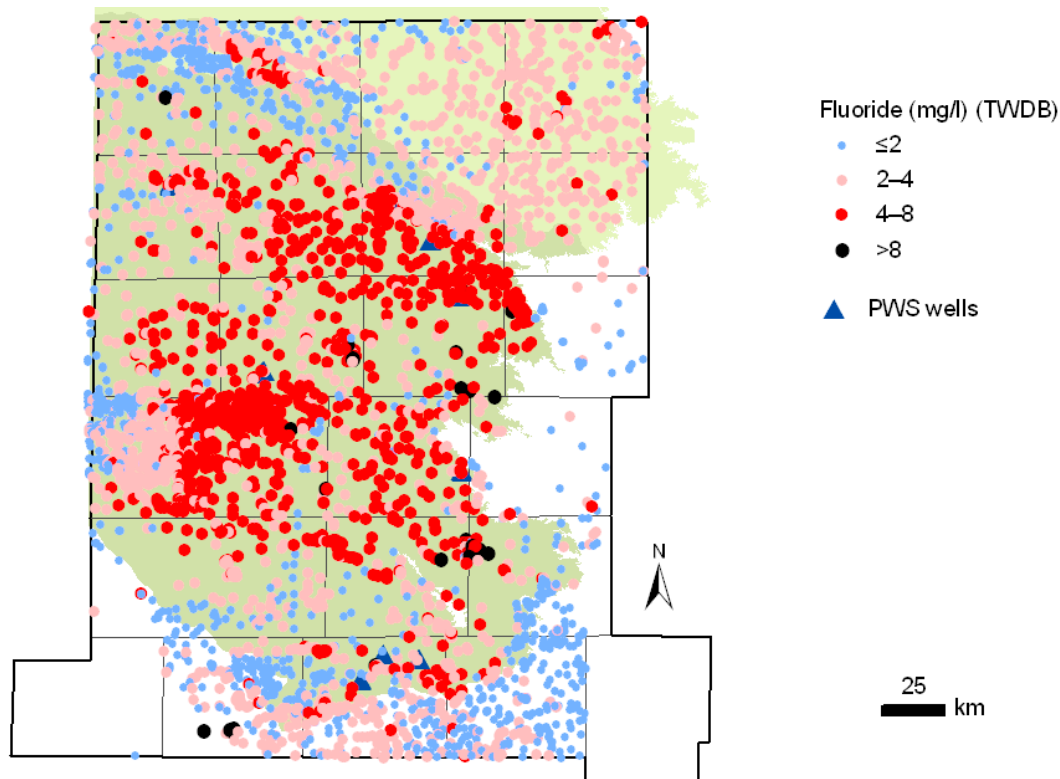
Figure 3.7 Nitrate as N Concentrations and Well Depths in the Ogallala Aquifer within the Study Area



Fluoride

Fluoride concentrations above the MCL (4 mg/L) are widespread in the Ogallala-South area (42% of wells) and relatively rare in the Ogallala-North area (2% of wells) (Figure 3.8, Table 3.3). Fluoride levels are also high in the Edwards-Trinity (High Plains) aquifer, with over half of wells in the aquifer containing fluoride in excess of the MCL.

Figure 3.8 Spatial Distribution of Fluoride Concentrations



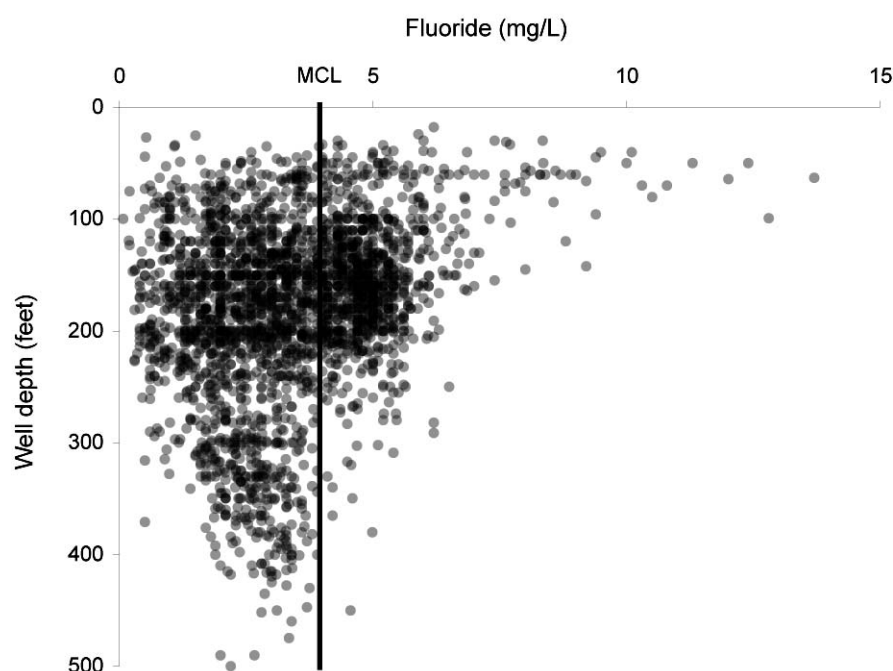
Data presented here are from the TWDB database. The most recent measurement from each well is shown. Table 3.3 shows the percentage of wells with fluoride exceeding the MCL (4 mg/L).

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

Aquifer	Wells with measurements	Wells that exceed 4 mg/L	Percentage of wells that exceed 4 mg/L
Ogallala-North	588	13	2%
Ogallala-South	2622	1098	42%
Edwards-Trinity (Plateau)	626	5	1%
Edwards-Trinity (High Plains)	76	40	53%
Dockum	144	10	7%
other	29	5	17%

Comparing fluoride levels with well depth, it is clear that the highest fluoride concentrations occur in wells shallower than about 100 feet and that concentrations tend to decrease with well depth (Figure 3.9). However, fluoride levels above the MCL are common in wells 100–200 feet deep. Based on this trend, deepening shallow wells or casing the shallower portions of wells could lead to decreased fluoride concentrations in produced groundwater.

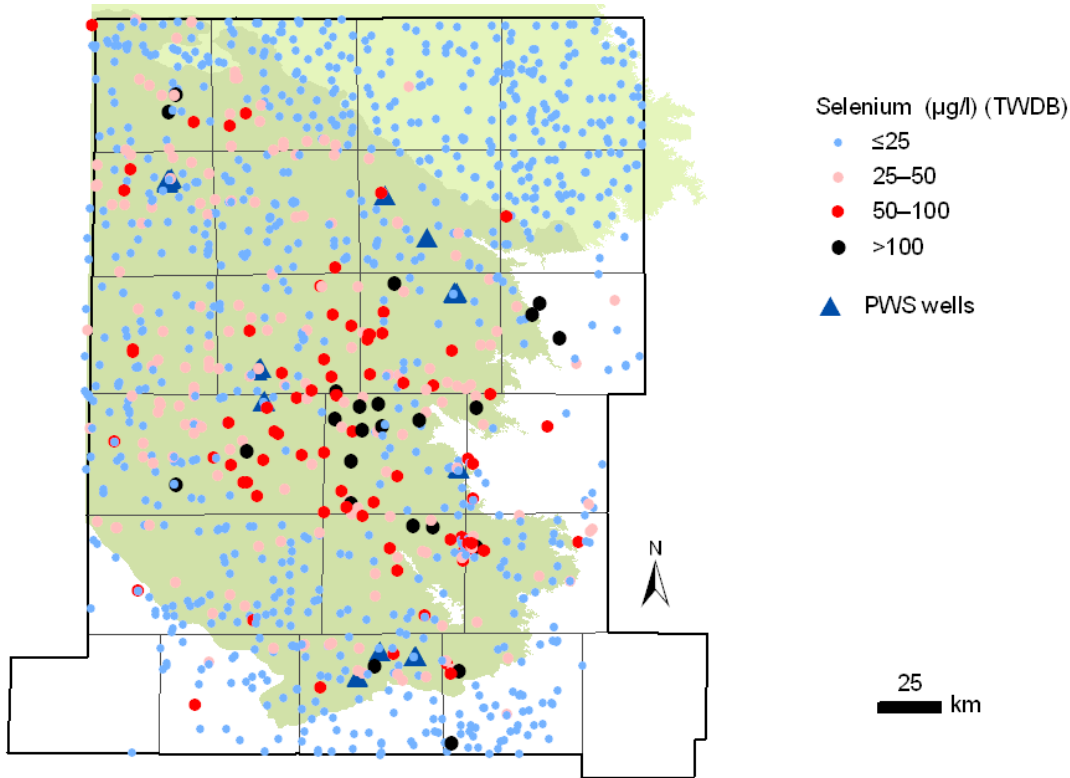
Figure 3.9 Fluoride Concentrations and Well Depths in the Ogallala Aquifer within the Study Area



Selenium

Selenium concentrations in the study area are generally below the MCL (50 µg/L). However, some wells with excess selenium occur in the Dockum and Ogallala-South aquifers, particularly in the eastern part of the study area (Figure 3.10, Table 3.4).

Figure 3.10 Spatial Distribution of Selenium Concentrations



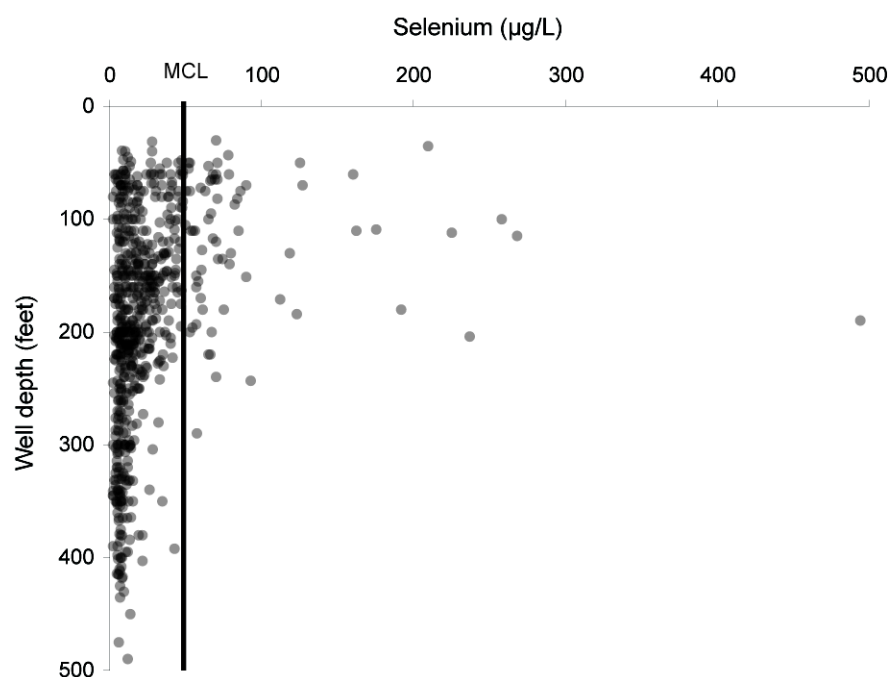
Data presented here are from the TWDB database. The most recent sample for each well is shown. Table 3.4 shows the percentage of wells with selenium concentrations exceeding the selenium MCL (50 µg/L).

Table 3.4 Summary of Wells that Exceed the MCL for Selenium, by Aquifer

Aquifer	Wells with measurements	Wells that exceed 50 µg/L	Percentage of wells that exceed 50 µg/L
Ogallala-North	233	0	0%
Ogallala-South	693	84	12%
Edwards-Trinity (Plateau)	104	1	1%
Edwards-Trinity (High Plains)	16	1	6%
Dockum	74	10	14%
Other	5	1	20%

Selenium shows a trend with well depth similar to that of the other constituents discussed (Figure 3.11). Most wells with selenium concentrations above the MCL are shallower than 200 feet. Thus, deepening a well to more than 200 feet or casing the shallower portion of deeper wells could lead to reduced selenium concentrations.

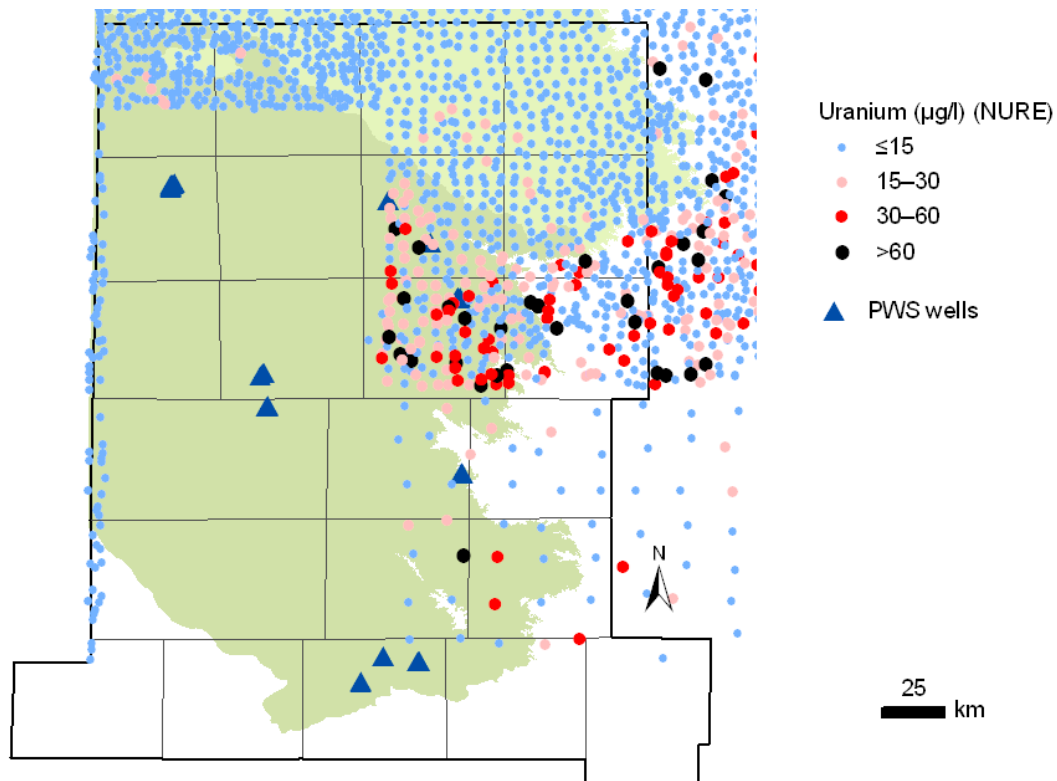
Figure 3.11 Selenium Concentrations and Well Depths in the Ogallala Aquifer within the Study Area



Uranium

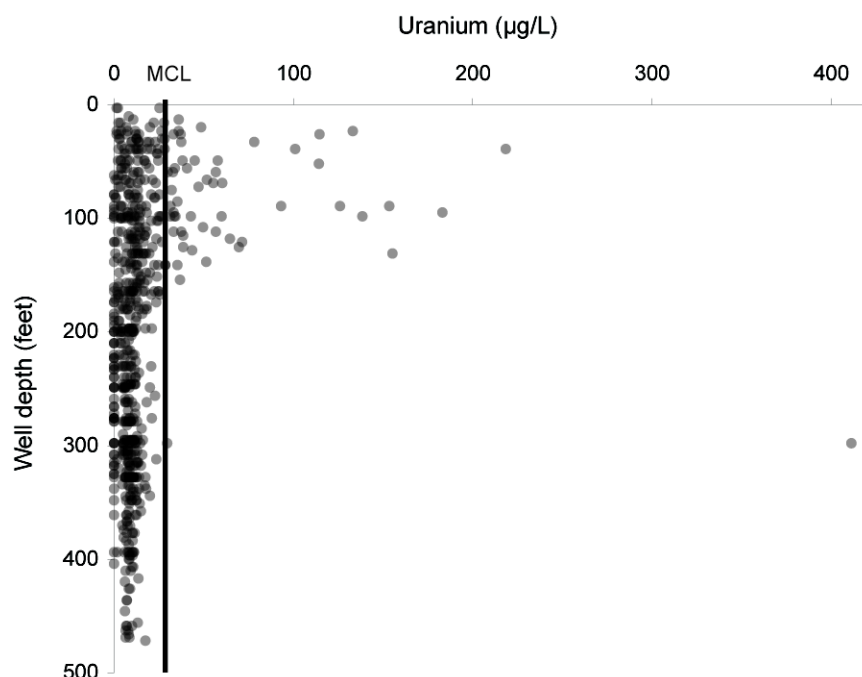
The TWDB rarely tests wells for uranium content in water samples, but the NURE database provides a large dataset of uranium levels in the area. This database only includes wells from part of the study area, as shown in Figure 3.12. Even with this limited distribution of measurements, it is clear that uranium concentrations are much higher in the Ogallala-South aquifer than the Ogallala-North aquifer. However, the NURE database does not include information about which aquifer the sampled wells are from, so a quantitative comparison of uranium levels by aquifer is not available.

Figure 3.12 Spatial Distribution of Uranium Concentrations in the Study Area



A comparison of uranium concentrations and well depths shows that nearly all wells with uranium levels above the MCL are less than about 150 feet deep (Figure 3.13). Therefore, deepening or casing wells to access water from greater depths might reduce uranium levels.

Figure 3.13 Uranium Concentrations and Well Depths in the Study Area



3.1.3 Regional Geology

The major aquifer in the study area is the Ogallala aquifer, which is equivalent to the Ogallala Formation, the predominant geologic unit that makes up the High Plains aquifer. The Ogallala Formation is late Tertiary (Miocene–Pliocene, or about 2–12 million years ago) (Nativ 1988). It consists of coarse fluvial sandstone and conglomerates that were deposited in the paleovalleys of a mid-Tertiary erosional surface and eolian sand deposited in intervening upland areas (Gustavson and Holliday 1985). In the Ogallala-North area, the Ogallala Formation consists largely of sediments within a paleovalley. In this region, the saturated thickness of the aquifer is greater and the water table is deeper. In contrast, the formation is composed of deposition on top of a paleoup-land in the Ogallala-South area. Here the formation is thinner, resulting in a smaller saturated thickness and shallower water table. The top of the Ogallala Formation is marked in many places by a resistant calcite layer known as the “caprock caliche.”

Within much of the study area, the Ogallala Formation is overlain by Quarternary-age (Pleistocene–Holocene) eolian, fluvial, and lacustrine sediments, collectively called the Blackwater Draw Formation (Holliday 1989). The texture of the formation ranges from sands and gravels along riverbeds to clay-rich sediments in playa floors.

In much of the southern High Plains, the Ogallala Formation lies on top of Lower Cretaceous (Comanchean) strata. The top of the Cretaceous sediments is marked by an uneven erosional surface that represents the end of the Laramide orogeny. Cretaceous strata are absent beneath the thick Ogallala paleovalley fill deposits because they were removed by prior

erosion. The Cretaceous sediments were deposited in a subsiding shelf environment and consist of the Trinity Group (including the basal sandy, permeable Antlers Formation); the Fredericksburg Group (limey to shaley formations, including the Walnut, Comanche Peak, and Edwards Formations, as well as the Kiamichi Formation); and the Washita Group (low-permeability, shaley sediments of Duck Creek Formation) (Nativ 1988). The sequence results in two main aquifer units: the Antlers Sandstone (also termed the Trinity or Paluxy sandstone, about 49 feet thick) and the Edwards Limestone (about 98 feet thick). These aquifer units constitute the Edwards-Trinity (High Plains) aquifer (Ashworth and Flores 1991). The limestone decreases in thickness to the northwest and transitions into the Kiamichi and Duck Creek formations.

The Ogallala Formation also overlies the Triassic Dockum Group in much of the southern High Plains. The Dockum Group is generally about 492 feet thick and is exposed along the margins of the High Plains. The uppermost sediments consist of red mudstones that generally form an aquitard. Underlying units (Trujillo Sandstone [Upper Dockum] and Santa Rosa Sandstone [lower Dockum]) form the Dockum aquifer. Water quality in the Dockum is generally poor (Dutton and Simpkins 1986). The sediments of the Dockum were deposited in a continental fluvio-lacustrine environment that included streams, deltas, lakes, and mud flats (McGowen et al. 1977) and included alternating arid and humid climatic conditions. The Triassic rocks reach up to 1,956 feet thick in the Midland Basin.

3.2 DETAILED ASSESSMENT FOR VALLEY ESTATES PWS

The Valley Estates PWS has three wells: G1520198A, G1520198B, and G1520198C. The wells are drilled to depths of 112, 115, and 119 feet, respectively, and are all designated as drawing water from the Ogallala aquifer. Water in this water supply system is sampled from a single sample tap that combines water from all these wells. Therefore, available water quality data cannot be associated with a single well. Table 3.5 summarizes fluoride, selenium, and uranium concentrations measured in water sampled from the Valley Estates PWS.

Table 3.5 Fluoride, Selenium, and Uranium Concentrations from the Valley Estates PWS

Date	Fluoride (mg/L)	Selenium (µg/L)	Uranium (µg/L)	Wells sampled
6/22/98	4.3	98.5	-	G1520198A-C
5/15/01	4.4	66.9	47.5	G1520198A-C
3/20/03	4.6	-	-	G1520198A-C
9/22/03	4.5	-	-	G1520198A-C
11/25/03	4.4	-	51.5	G1520198A-C
3/18/04	4.5	87.9	52.4	G1520198A-C
4/15/04	4.8	97.1	-	G1520198A-C
12/17/04	4.4	92.7	-	G1520198A-C
1/5/06	-	-	54.9	G1520198A-C

Data from the TCEQ PWS Database

All historical samples, taken between 1998 and 2006, exceed the MCLs for fluoride (4 mg/L), selenium (50 µg/L), and uranium (30 µg/L). There are 10 existing measurements of fluoride, five of selenium, and four of uranium. Concentrations of fluoride, selenium, and uranium in nearby wells are mapped in Figures 3.14, 3.15, and 3.16, respectively.

Figure 3.14 Fluoride Concentrations within 5- and 10-km Buffers around the Valley Estates PWS Wells

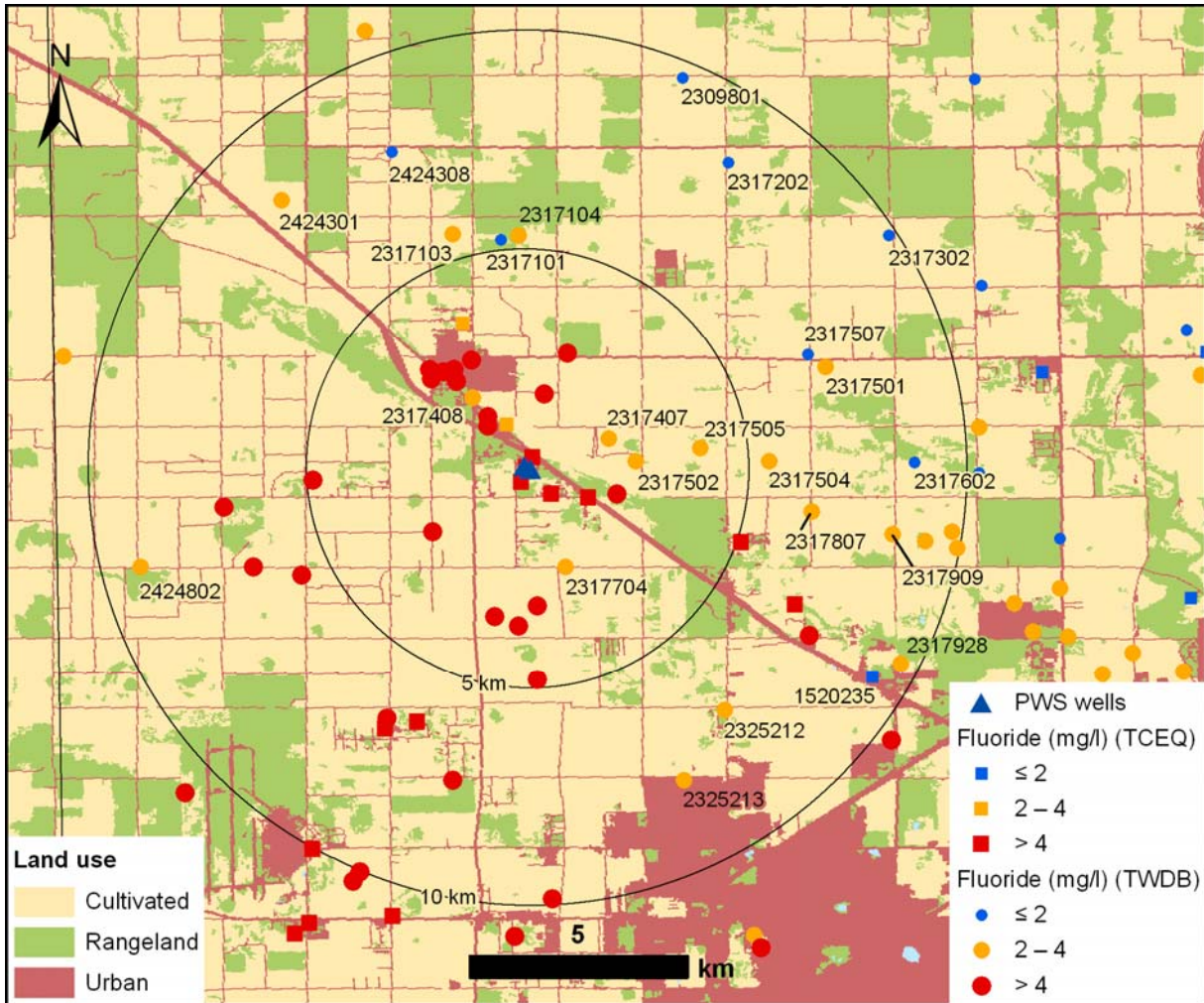


Figure 3.15 Selenium Concentrations within 5- and 10-km Buffers around the Valley Estates PWS Wells

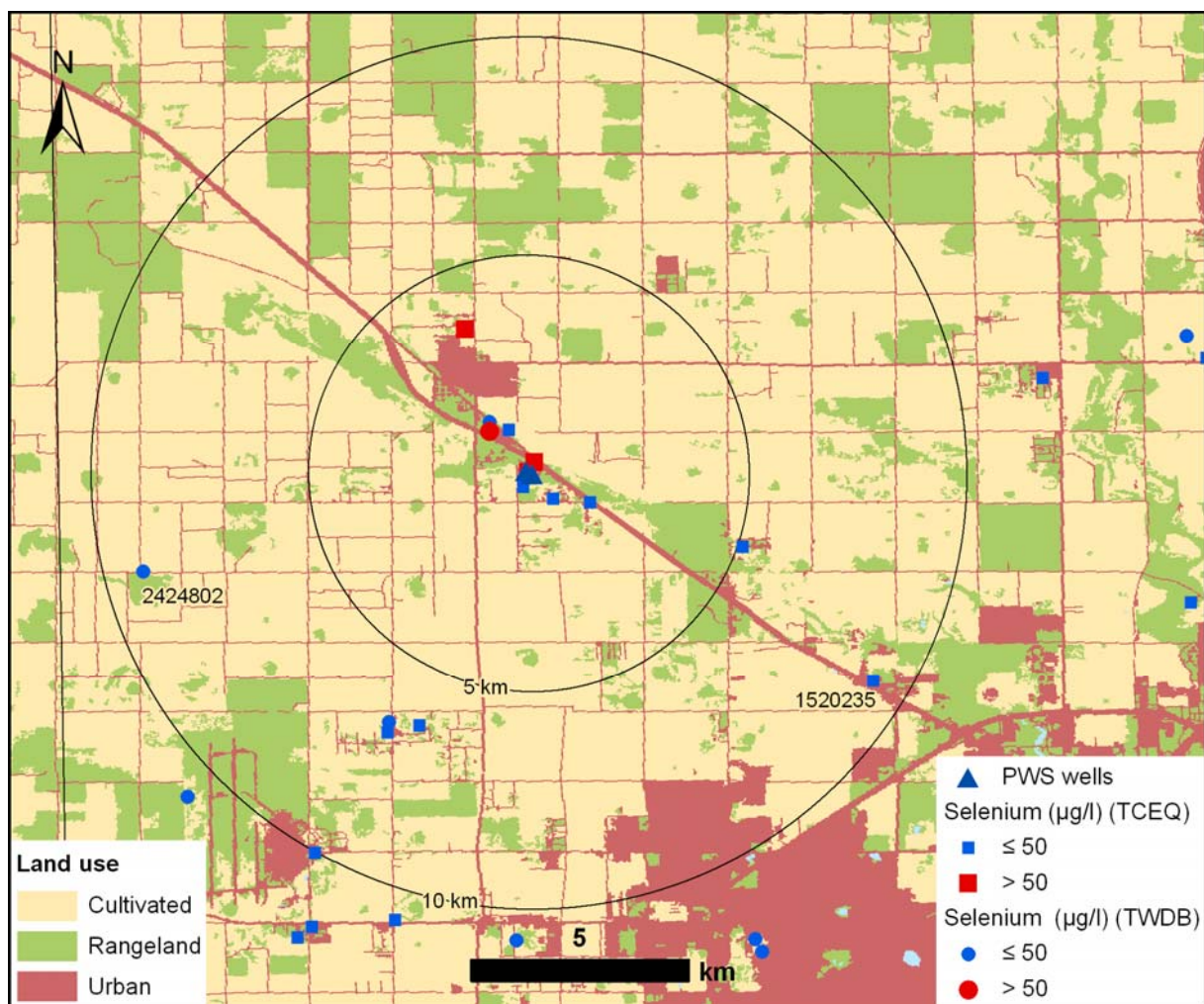
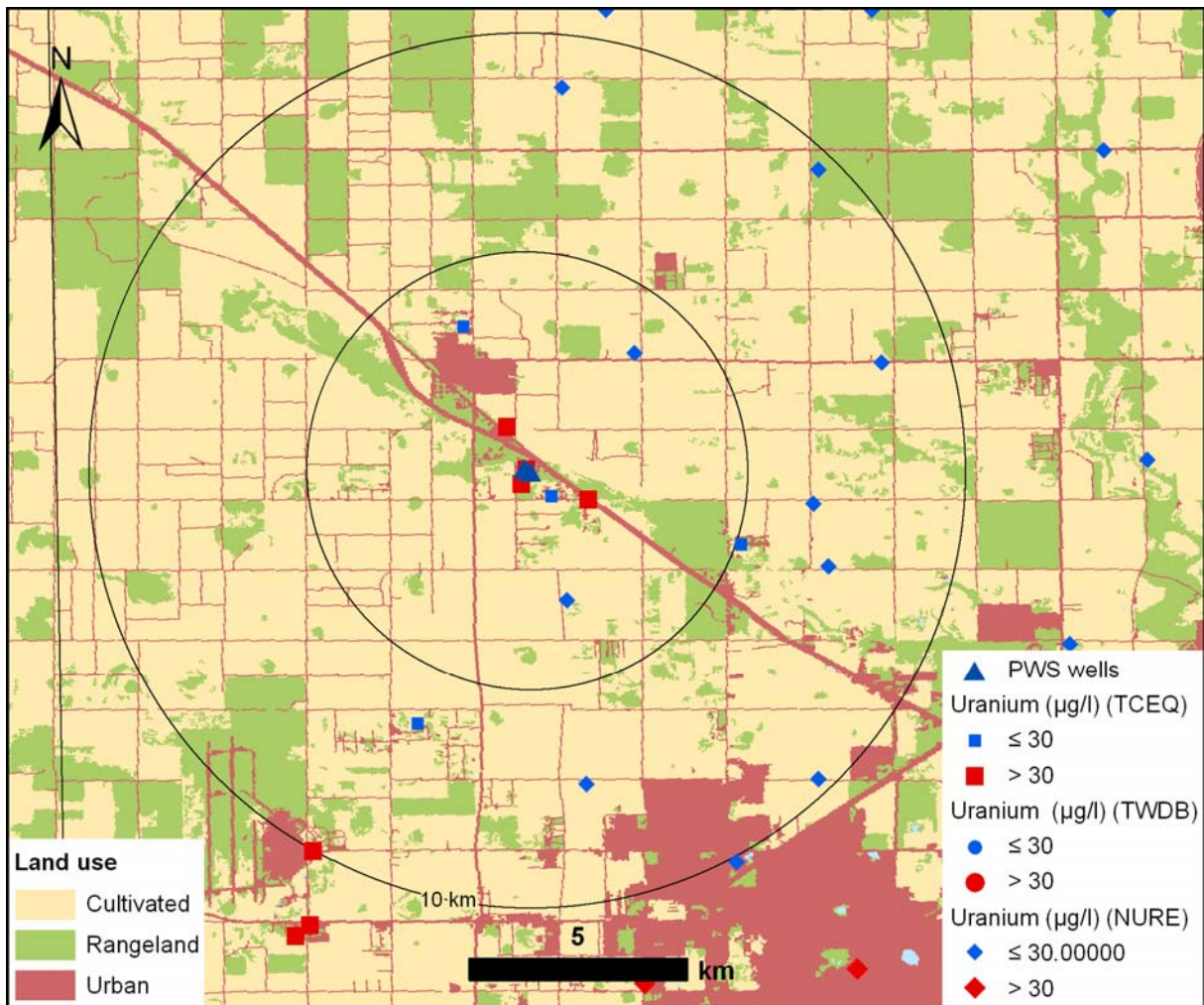


Figure 3.16 Uranium Concentrations within 5- and 10-km Buffers around the Valley Estates PWS Wells



Data are from the TCEQ, TWDB, and NURE 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 (shown as circles in the map) and the NURE database (shown as diamonds on the map) are taken from single wells. Where more than one measurement was made in a well, the most recent concentration is shown.

There are many wells within 6.2 miles of the Valley Estates PWS wells that show acceptable levels of fluoride and nitrate (Figure 3.14, Table 3.6). Only two of these, G1520235A and 2424802, have been sampled for arsenic and selenium, and none have been sampled for uranium. However, samples from the NURE database show that uranium levels are generally below the MCL (30 µg/L) throughout the area. Wells G1520235 and 2424802 have been sampled more thoroughly and more recently than the other wells, but both are

located about 5-1/2 miles from the Valley Estates PWS wells. Well 2317408 is located about 1 mile from the PWS wells and is currently unused. However, it was last sampled in 1990 and a new chemical analysis would be needed before it could be considered for a possible alternative supply.

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

Well	Owner	Depth (ft)	Aquifer	Use	Date	Arsenic (µg/L)	Fluoride (mg/L)	Nitrate as N (mg/L)	Selenium (µg/L)
G1520235A	Goulds Pumps, Inc.	145	Ogallala	public supply	5/20/2004 2/9/2005	<0.002	0.1	0.57	<0.003
2309801	R.L. Hood	106	Ogallala	domestic	11/4/1944	-	1.9	0.632	-
2317101	T.A. McClure	170	Ogallala	irrigation	8/14/1956	-	1.6	0.18	-
2317103	John Hunter	190	Ogallala	irrigation	8/11/1978	-	2.2	2.71	-
2317104	Perser & Dean William R. Butcher, Jr.	171	Ogallala	irrigation	8/10/1987	-	2.2	5.242	-
2317202	C.W. & Mildred Teal	220	Ogallala	irrigation	8/22/1988	-	1.8	7.264	-
2317302	T.H. Sears	108	Ogallala	domestic stock	11/4/1944	-	1.9	0.948	-
2317407	T.J. Stanton	137	Ogallala	irrigation	8/18/1983	-	3.6	4.623	-
2317408	City of Shallowater	145	Ogallala	unused	4/17/1990	-	3.35	6.349	-
2317501	L.E. McMenamy	170	Ogallala	unused	7/11/1980	-	2.2	3.343	-
2317502	E.E. Ireland Estate	107	Ogallala	irrigation	8/10/1983	-	3.5	0.368	-
2317504	F.B. Arnold	unknown	Ogallala	irrigation	7/28/1983	-	2.5	7.856	-
2317505	Doyce Middlebrook	unknown	Ogallala	irrigation	8/10/1983	-	3.6	6.835	-
2317507	Grovesville School	82	Ogallala	unused	9/30/1937	-	2	0.022	-
2317602	Macon James	131	Ogallala	irrigation	8/10/1983	-	1.9	7.433	-
2317704	Harold Hardesty Jay Stanton	unknown	Ogallala	irrigation	8/10/1987	-	2.2	9.385	-
2317807	MacMillan Farms	155	Ogallala	irrigation	8/10/1983	-	2.6	7.564	-
2317909	MacMillan Farms	unknown	Ogallala	irrigation	8/18/1983	-	2.3	8.095	-
2317928	C.L. Quillen	55	Ogallala	domestic stock	10/4/1944	-	4	1.468	-
2325212	H.V. Feazel	49	Ogallala	domestic stock	10/5/1944	-	3.3	4.291	-
2325213	W.D. Gregory	179	Ogallala	irrigation	9/26/1944	-	4	0.722	-
2424301	J.J. Chauncey	176	Ogallala	irrigation	7/11/1980	-	2.4	2.936	-
2424308	C. Tatum	285	Ogallala	irrigation domestic stock	10/5/1944	-	1.6	0.18	-
2424802	Mrs. Heinen	200	Ogallala	domestic	4/27/2004	8.08	3.64	7.009	13.3

**3.2.1 Summary of Alternative Groundwater Sources for the Valley Estates
PWS**

A number of wells in the area show acceptable levels of nitrate and fluoride, and wells G1520235A and 2424802 also show acceptable levels of arsenic and selenium. Well 2317408 is listed as unused and is located about 1.2 miles from the Valley Estates PWS wells. Any of these wells would need to be resampled before being considered for an alternative water supply.

Regional analyses show that concentrations of fluoride, selenium, and uranium are usually below the MCLs in wells drilled greater than about 250 feet. The Valley Estates PWS wells are all shallower than this (less than 120 feet deep), and so deepening the existing wells might also help to improve water quality.

SECTION 4 ANALYSIS OF THE VALLEY ESTATES PWS

4.1 DESCRIPTION OF EXISTING SYSTEM

4.1.1 Existing System

The location of the Valley Estates PWS is shown in Figure 4.1. The Valley Estates PWS is located in Lubbock County at 7400 North Venita Avenue, Shallowater, Texas. The water source for this community water system is one well, completed in the Ogallala Aquifer. The well is approximately 115 feet deep and has a total production capacity of 0.10 mgd. The water is chlorinated downstream of the well, before it enters three pressure tanks prior to the distribution system. The water system has three wells; however, Well #2 (G1520198B), rated at 70 gallons per minute, is the only one active. Well #2 is located just north of the Valley Estates mobile home park.

The treatment employed for disinfection is not appropriate or effective for removal of arsenic and fluoride, so optimization is not expected to be effective for increasing removal of these contaminants. However, there is a potential opportunity for system optimization to reduce arsenic, selenium, uranium, and fluoride 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.

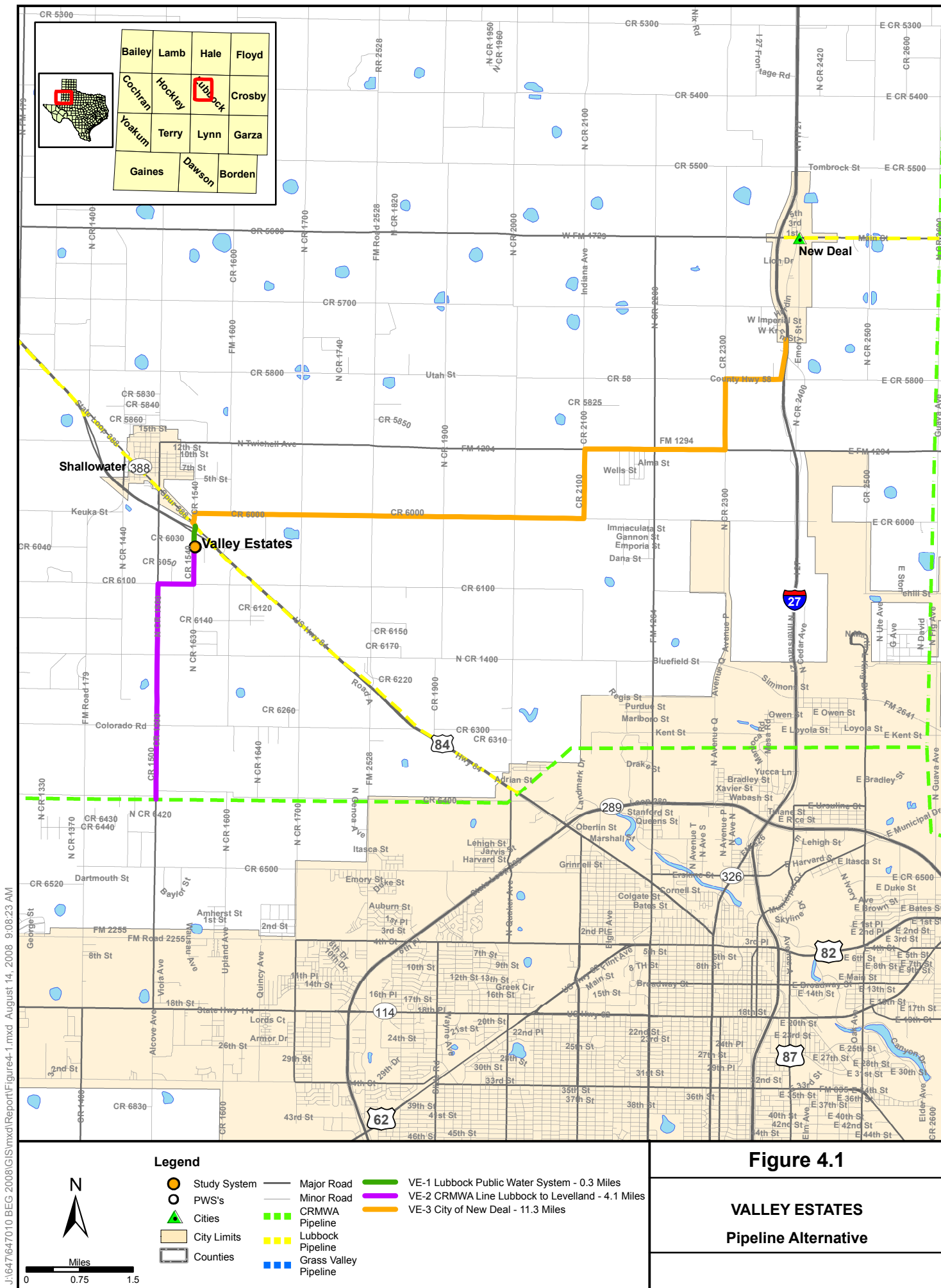
The Valley Estates PWS recorded fluoride concentrations ranging from 4.0 mg/L to 4.6 mg/L between May 1995 and June 2004, exceeding the fluoride MCL of 4.0 mg/L. Arsenic concentrations of 0.0121 mg/L to 0.0138 mg/L were recorded between June 1998 and April 2004, which exceed the 0.010 mg/L MCL for arsenic that went into effect on January 23, 2006 (USEPA 2008; TCEQ 2004). Selenium was detected between 0.05 mg/L and 0.10 mg/L between January 2003 and December 2005, exceeding the MCL of 0.05 mg/L. Between January 2005 and December 2006, a combined uranium concentration of 0.051 mg/L was recorded on two separate occasions, which exceeded the uranium MCL of 0.030 mg/L. Therefore, Valley Estates PWS potentially faces compliance issues for water quality standards for these contaminants.

Basic system information is as follows:

- Population served: 70
- Connections: 36
- Average daily flow: 0.01 mgd
- Total production capacity: 0.101 mgd

Basic system raw water quality data are as follows:

- Typical arsenic range: 0.0121 - 0.0138 mg/L
- Typical fluoride range: 4.0 – 4.6 mg/L



- Typical fluoride range: 4.0 – 4.6 mg/L
- Typical selenium range: 0.05 – 0.1 mg/L
- Typical combined uranium: 0.051 mg/L
- Typical calcium range: 44.3 – 75 mg/L
- Typical chloride range: 60 – 70 mg/L
- Typical iron: <0.01 mg/L
- Typical magnesium range: 44 – 65.6 mg/L
- Typical manganese: <0.008 mg/L
- Typical nitrate range: <0.01 – 4.65 mg/L
- Typical sodium range: 97.3 – 105 mg/L
- Typical sulfate range: 162 – 176 mg/L
- Total hardness as CaCO₃ range: 361 – 377 mg/L
- Typical pH range: 7.2 – 7.5
- Total alkalinity as CaCO₃ range: 311 – 339 mg/L
- Typical bicarbonate range: 379 – 414 mg/L
- Typical total dissolved solids range: 661 to 723 mg/L

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

4.1.2 Capacity Assessment for the Valley Estates PWS

It was not possible to schedule the site visit and interview, so it was not possible to complete capacity assessment portion of the evaluation.

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 Valley Estates PWS were reviewed with regard to their reported drinking water quality and production capacity. PWSs that appeared to have water supplies with water quality issues were ruled out from evaluation as alternative sources, while those without identified water quality issues were investigated further. Small systems were only considered if they were within 5 miles of the Valley Estates PWS. Large systems or systems capable of producing greater than four times the daily volume produced by the study system were considered if they were within 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 selected PWSs based on these criteria for large and small PWSs within 15 miles of the Valley Estates. 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 Valley Estates PWS

PWS ID	PWS Name	Distance from Valley Estates (miles)	Comments/Other Issues
1520212	SHALLOWATER TRUCK STOP	0.18	Small GW system. WQ issue: arsenic, fluoride, selenium and sulfate
1520002	LUBBOCK PUBLIC WATER SYSTEM	0.3	Larger GW/SW system. No WQ issues. Evaluate Further
1520225	FAY BEN MOBILE HOME PARK	0.63	Small GW system. WQ issues: fluoride, gross alpha and nitrate
1520003	SHALLOWATER CITY OF	0.7	Larger GW system. WQ issues: Combined uranium and gross alpha
1520152	TOWN NORTH ESTATES	0.95	Larger GW system. WQ issues: arsenic, fluoride, combined uranium and gross alpha
1520094	TOWN NORTH VILLAGE WATER SYSTEM	2.06	Small GW system. WQ issue: arsenic, fluoride, and selenium
1520106	COX ADDITION WATER SYSTEM	2.8	Larger GW system. WQ issues: arsenic, fluoride, gross alpha and selenium
1520244	MCLAIN OIL 38	3.22	Small non-residential GW system. WQ issues: arsenic
1520104	LUBBOCK KOA CAMPGROUND	3.83	Small non- residential GW system. WQ issues: arsenic and fluoride
1970003	CRMWA Line Lubbock to Levelland	4.1	Larger GW/SW system. No WQ issues. Evaluate Further
1520062	PLOTT ACRES	4.12	Larger GW system. WQ issues: arsenic, fluoride, and gross alpha
1520241	MANAGED CARE CENTER	4.13	Larger GW system. WQ issues: arsenic and fluoride
1520235	GOULDS PUMPS INC	5.2	Small GW system. WQ issues: arsenic, nitrate, and sulfate
1520159	NORTH UNIVERSITY ESTATES	6.18	Larger GW system. WQ issue: nitrate
1520177	FOUR CORNERS GROCERY	6.67	Small non- residential GW system. WQ issues: arsenic and fluoride
1520020	REESE CENTER	6.79	Larger purchased water system. Don't consider further.
1520118	WESTGATE VILLAGE MHP	7.03	Larger GW system. WQ issues: arsenic and fluoride
1520156	ELM GROVE MOBILE HOME PARK	7.06	Larger GW system. WQ issues: arsenic, fluoride, gross alpha and selenium
1520039	PECAN GROVE MOBILE HOME PARK	7.21	Small non- residential GW system. WQ issues: arsenic and combined uranium
1520221	LUBBOCK COUNTRY HERITAGE	8.15	Small GW system. WQ issue: Marginal nitrate
1520185	LUBBOCK RV PARK	8.54	Small GW system. WQ issue: nitrate
1520157	TEXAS WATER RAMPAGE INC	8.61	Small GW system. WQ issue: fluoride
1520223	PAUL COBB WATER SYSTEM	9.79	Small GW system. WQ issue: arsenic, fluoride, and selenium
1520026	FAMILY COMMUNITY CENTER MHP	10.12	Small GW system. WQ issues: gross alpha and nitrate
1520227	SOUTHWEST SPORTS PLEX	10.51	Larger GW system. WQ issue: fluoride
1520005	CITY OF WOLFFORTH	11.22	Larger GW system. WQ issues: arsenic, fluoride and sulfate
1520199	WOLFFORTH PLACE	11.3	Larger GW system. WQ issues: arsenic, fluoride and selenium
1520182	HORKEY LP GAS CO INC	11.49	Small non residential. GW system. WQ issue: fluoride
1520015	CITY OF NEW DEAL	11.7	Larger SW system. No WQ issue. Evaluate further.
1100010	CITY OF SMYER	11.91	Larger GW system. WQ issues: arsenic, fluoride and gross alpha

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 Valley Estates 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. The first alternative is a connection to the City of Lubbock distribution system that is within a mile of the study system. The second alternative is a connection to the CRMWA pipeline running between Lubbock and Levelland. The third option is connecting to the City of New Deal, which is located within 12 miles of the study system. Descriptions of possible supplier PWSs follow Table 4.2.

Table 4.2 Public Water Systems Within the Vicinity of the Valley Estates PWS Selected for Further Evaluation

PWS ID	PWS Name	Pop	Connections	Total Production (mgd)	Avg Daily Usage (mgd)	Approx. Dist. from Valley Estates	Comments/Other Issues
1520002	LUBBOCK PUBLIC WATER SYSTEM	222,473	81,059	156.34	37.979	0.3	Larger SW/GW system. No WQ issues
1970003	CRMWA Line Lubbock to Levelland	199,144	72,750	57.938	35.666	4.1	Large SW/GW system that has limited excess capacity and would require CRMWA approval before proceeding.
1520015	CITY OF NEW DEAL	800	309	0.626	0.24	11.7	Larger SW system. No WQ issue

WQ = water quality
GW = groundwater
SW = storm water

4.2.1.1 City of Lubbock Water System

The City of Lubbock PWS produces an average of 38 to 40 mgd for the City of Lubbock and five surrounding small municipalities with a total production capacity of 156 mgd. The service pump capacity can meet a peak demand of over 291 mgd. In addition to treating water for the City of Lubbock distribution system, the Lubbock water treatment plant treats about 6 mgd on average for the six Canadian River Municipal Water Authority (CRMWA) member cities receiving treated water from the City of Lubbock.

The City of Lubbock receives water from two sources, the CRMWA and the Bailey County well field. Additional details on the CRMWA are provided in a separate description. As a member of the 11-City agreement with the CRMWA, the City of Lubbock is responsible for receiving raw water from the Lake Meredith/Roberts County well field located 160 miles north of Lubbock and treating the water. In 2008, Lake Meredith was at 8 percent of capacity.

A CRMWA aqueduct distributes the treated water to six other PWSs: Levelland, Brownfield, Slaton, Tahoka, O'Donnell, and Lamesa. The majority of City of Lubbock water supply comes from the CRMWA with the secondary supply being the Bailey County well field located 60 miles northwest of Lubbock. The city has water rights to 82,000 surface acres at the

Bailey County well field. The water received from Bailey County is treated at the central station in Bailey County before it enters the pipeline leading to Lubbock. As the water reaches Lubbock, it enters directly into the distribution system predominantly in the northwest section of Lubbock. It should be noted that the City of Lubbock normally utilizes its total annual water allocation from CRMWA. If Lubbock needs additional water, its supply is supplemented with water from the Bailey County well field. The well field consists of 150 wells capable of producing 50 mgd total (pipeline is limited to 40 mgd). In 2006, the City of Lubbock pumped an average of 9.3 mgd from the Bailey County well field. However, most of this water was pumped during the summer months. At peak flows, the pipeline is at near capacity.

In addition to the population of Lubbock, five cities are connected to the City of Lubbock distribution system. Shallowater and Reese Redevelopment Authority, located northwest and west of Lubbock, have had contracts with the city for more than 30 years to receive water predominantly originating in Bailey County. The contract allows up to the equivalent of 5 percent of what the city consumes each year. After determining that city wastewater disposal practices had contaminated Buffalo Springs and Ransom Canyon groundwater supplies, the City of Lubbock dedicated another half billion gallons of water per year to each of those communities. Buffalo Springs and Ransom Canyon are located east of Lubbock and receive water mostly originating from Lake Meredith and the Roberts County well field. A fifth city, Littlefield, located northwest of the city has a water line connected to the Bailey County pipeline for an emergency supply of water over a 72-hour period. Additionally, Lubbock-Cooper Independent School District can buy up to 18.3 million gallons a year, and the City Council just approved certain supplies for residents around Lake Alan Henry. The decision to add these five cities to the City of Lubbock water supply was a decision made by the Lubbock City Council.

Future plans for the City of Lubbock water supply system call for construction of the necessary infrastructure to supply water to Lubbock from Lake Alan Henry located 65 miles southeast of Lubbock and construction of a new reservoir through the permit held by the White River Water Supply Corporation. Lake Alan Henry is the largest project undertaken by the city at \$230 million. Both projects are still in the preliminary engineering phase. The amount of water available from this system will be staged into the existing Lubbock system over several years to match Lubbock's needs. The system is estimated to be operating in 2012.

Only government entities that choose to be incorporated under the strictest guidelines or for which Lubbock is responsible for their adverse water conditions will be considered at this time. Although Lubbock currently does not have water to share, it may be part of a regional solution where it may play the largest role.

4.2.1.2 Canadian River Municipal Water Authority

The CRMWA was formed over 50 years ago by a group of Panhandle communities to provide drinking water from Lake Meredith. The CRMWA currently has contracts to provide water to 11 member cities in west Texas, including Amarillo, Borger, Brownfield, Lamesa, Levelland, Lubbock, O'Donnell, Pampa, Plainview, Slaton, and Tahoka. A pipeline ranging in size from 8 feet to 1.5 feet is used to convey raw water approximately 160 miles from Lake

Meredith and a well field in Roberts County (40 miles northeast of Lake Meredith) to the Lubbock water treatment plant. Along the pipeline route, four cities (Amarillo, Borger, Pampa, and Plainview) receive their allocated water supply and each of these four cities treats their own water. The rest of the untreated water for the other seven member cities goes to the City of Lubbock water treatment plant. The treated water is pumped into the City of Lubbock distribution system and to the other six member cities. The raw water line flows by gravity from Amarillo to the Lubbock treatment plant. The treated water leaving the City of Lubbock water treatment plant flows by gravity in the east leg pipeline to Lamesa; however, the water in the west leg to Levelland and Brownfield is pumped.

The current volume of water delivered annually by the CRMWA to the member cities is 85,000 acre-feet (35,000 acre-feet from Lake Meredith and 50,000 acre-feet from the well field in Roberts County). The available water volume is set by the CRMWA and may fluctuate during the year, but the volume is based on water levels in the well field and in the lake. The provision for each member city is based on a contracted percentage of the available acre-feet. The City of Lubbock is under contract to receive 41.6 mgd from the CRMWA, and the City of Lubbock water treatment plant treats an additional 5.4 mgd for the other six member cities receiving treated water from the City of Lubbock water treatment plant. When the CRMWA program was established in the 1960s, the system was designed to accommodate the 11 member cities at the time and there were no plans to add additional member cities.

If a member city has excess water, that particular city can decide through its city council how much water it would like to allocate to a non-member PWS. If the non-member city is to receive water directly from a member city's distribution system, then the CRMWA would not be involved. However, if a non-member is requesting to receive the water (essentially a portion of a member city's allocation) via a direct line from the CRMWA line, then the non-member city must get approval from the CRMWA and the 11 member cities for distribution of water to the non-member PWS. The non-member PWS would be responsible for financing the installation of the pipeline to the CRMWA treated water line from Lubbock. The CRMWA would be involved throughout the process of a non-member PWS applying for, securing access to, and eventually receiving water through the CRMWA system.

4.2.1.3 City of New Deal

The City of New Deal is located approximately 12 miles northeast from the Valley Estates PWS. Its production is 0.626 mgd for a population of about 800 people or 309 connections with an average demand of 125,000 gallons per day. The City of New Deal is one of 11 member cities that receive 0.136 mgd of water through an agreement with the CRMWA. The city also has a well field 3 miles east of the city. The city at this time does not provide water to any other customers. According to available information on this PWS, there are no reported exceedances for constituents of concern above the associated MCLs. The water demand of the city is approaching its maximum capacity and additional water supply will be needed. The city does have property with water rights but the quality and quantity of water has not been tested. If water could be secured, wholesale of this water would require approval of the city council. Growth is occurring and the city is working on a bringing in a new industry.

The city is growing, its peak demand is approaching maximum capacity, and future water supply is uncertain. As a result, some investigation and investment will be needed to determine if the City of New Deal can provide additional water to nearby communities.

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

In Lubbock County, groundwater is available from two sources, the relatively shallow Ogallala aquifer, and the underlying Edwards-Trinity (High Plains) aquifer. The Ogallala provides drinking water to most of the communities in the Texas panhandle, as well as irrigation water. The Edwards-Trinity (High Plains) is a lower yield aquifer used almost exclusively as an irrigation water source.

Three wells operated by PWS are completed in the southern Ogallala Aquifer, at depths ranging from 112 to 119 feet. A search of registered wells was conducted using TCEQ's Public Water Supply database to assess groundwater sources utilized within a 10-mile radius of the PWS. The search indicated that all domestic and public supply wells located within a 10 miles from the Valley States PWS also withdraw groundwater from the Ogallala; this aquifer is also extensively used in the PWS vicinity as a source of irrigation water and industrial use. A

few active irrigation and industrial wells are also completed in the Edwards-Trinity (High Plains) aquifer. No domestic or public supply wells pump water from this aquifer.

Groundwater Supply

The Ogallala is the largest aquifer in the United States. The aquifer outcrop underlies eastern New Mexico and much of the Texas High Plains region, extending eastward over the entire Lubbock County. The Ogallala provides significantly more water for users than any other aquifer in the state, and is used primarily for irrigation. The aquifer saturated thickness ranges up to an approximate depth of 600 feet. Supply wells have an average yield of approximately 500 gal/min, but higher yields, up to 2,000 gal/min, are found in previously eroded drainage channels filled with coarse-grained sediments (TWDB 2007).

Water level declines in excess of 300 feet have occurred in several aquifer areas over the last decades. Over a 50-year planning period, the 2007 Texas Water Plan anticipates a water supply depletion of more than 40 percent, from 5,968,260 acre-foot per year (AFY) projected for the year 2010, to 3,534,124 AFY by the year 2060. Nearly 95 percent of the groundwater pumped from the Ogallala Aquifer is used for irrigated agriculture.

Groundwater Availability

Regional groundwater withdrawal in the Texas High Plains region is extensive and likely to remain near current levels over the next decades. The 2007 State Water Plan indicates that in Lubbock County, without implementation of additional water management strategies, the increasing water demand will exceed projected water supply estimates. For the 50-year planning period ending in 2060, the additional water need will be 112,370 AFY. Most additional water needs would be for irrigation, but a substantial component, 16,063 AFY by the year 2060, would be associated with municipal supplies and other uses.

A GAM developed for the Ogallala aquifer simulated historical conditions and provided long-term groundwater projections (Blandford et al., 2003). Predictive simulations using the GAM model indicated that, if estimated future withdrawals are realized, aquifer water levels could decline to a point at which significant regions currently practicing irrigated agriculture could be essentially dewatered by 2050. The 2007 State Water Plan, however, indicates that the rate of decline has slowed relative to previous decades, and water levels have risen in a few areas.

The GAM model predicted the most critical conditions for Cochran, Hockley, Lubbock, Yoakum, Terry, and Gaines Counties where the simulated drawdown could exceed 100 feet. For Lubbock County, the simulated drawdown by the year 2050 would be within a typical 50 to 100 feet range (Blandford et al., 2003). The Ogallala aquifer GAM was not run for the PWS because anticipated use would represent a minor addition to regional withdrawal conditions, beyond the spatial resolution of the GAM model.

4.2.3 Potential for New Surface Water Sources

There is a minimum potential for development of new surface water sources for the PWS because water availability is very limited at the county level, and within the site vicinity.

The PWS is located in the upper reach of the Brazos Basin, which has the largest average annual flow of any river in the State. The Texas State Water Plan, updated in 2007 by the TWDB, estimates that the average yield over the entire basin is 3.2 inches per year. Water rights are assigned primarily to municipal and industrial uses (49% and 31%, respectively). In the upper basin, a significant increase demand for surface water use is anticipated due to the decline in groundwater supply from the Ogallala Aquifer. Despite the increasing demand, the 2007 State Water Plan anticipates a steadily increase of basin water supply (1,595,000 AFY in the year 2010) over the next 50 years, as several proposed long-term management strategies are implemented along the Brazos Basin.

In Lubbock County, where the PWS is located, over 90 percent of the water supply is used for irrigation, largely supported by groundwater from the Ogallala Aquifer, and to a lesser extent municipal water use. The 2007 State Water Plan indicates that in Lubbock County, without implementation of additional water management strategies, the increasing water demand will exceed projected water supply estimates. For the 50-year planning period ending in 2060, the additional water need will be 112,370 AFY. Most additional water needs would be for irrigation, but a substantial component, 16,063 AFY by the year 2060, would be associated with municipal supplies and other uses.

The TWDB developed a surface water availability model for the Brazos Basin as a tool to determine, at a regional level, the maximum amount of water available during the drought of record over the simulation period (regardless of whether the supply is physically or legally available). For the PWS vicinity, simulation data indicate that there is a low availability of surface water for new uses. Surface water availability maps were developed by TCEQ for the Brazos Basin, illustrating percent of months of flow per year. Availability maps indicate that in the site vicinity, and over all of Lubbock County, unappropriated flows for new applications are typically available between 25 and 50 percent of the time. This availability is inadequate for development of new municipal water supplies as a 100 percent year-round availability is required by TCEQ for new surface water source permit applications.

4.2.4 Options for Detailed Consideration

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

1. Lubbock Public Water System. A pipeline would be constructed from the City of Lubbock to Valley Estates (Alternative VE-1).
2. CRMWA Water Line from Lubbock to Levelland. A pipeline would be constructed from the CRMWA main pipeline that conveys treated water from the Lubbock treatment plant to the City of Levelland (Alternative VE-2).

3. City of New Deal. A new groundwater well would be completed in the vicinity of the well at the City of New Deal (Alternative VE-3).

4. New Wells at 10, 5, and 1 mile. Installing a new well within 10, 5, or 1 mile of the Valley Estates PWS that may produce compliant water in place of the water produced by the existing active well (Alternatives VE-4, VE-5, and VE-6).

4.3 TREATMENT OPTIONS

4.3.1 Centralized Treatment Systems

Centralized treatment of the well water is identified as a potential option. Both RO and EDR could be potentially applicable. The central RO treatment alternative is Alternative VE-7, and the central EDR treatment alternative is Alternative VE-8.

4.3.2 Point-of-Use Systems

POU treatment using RO technology is valid for fluoride, arsenic, selenium, and uranium removal. The POU treatment alternative is VE-9.

4.3.3 Point-of-Entry Systems

POE treatment using RO technology is valid for fluoride, arsenic, selenium, and uranium removal. The POE treatment alternative is VE-10.

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 VE-11, VE-12, and VE-13.

4.5 ALTERNATIVE DEVELOPMENT AND ANALYSIS

A number of potential alternatives for compliance with the MCL for fluoride, radium, selenium, and uranium 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 VE-1: Purchase Treated Water from the City of Lubbock

This alternative involves purchasing potable water from the City of Lubbock, which will be used to supply the Valley Estates. The City of Lubbock currently has sufficient excess capacity for this alternative to be feasible, although current City policy only allows drinking water to be provided to areas annexed by the City. It is assumed that Valley Estates would obtain all its water from the City of Lubbock.

This alternative would require constructing a pipeline from the City of Lubbock's Bailey County well field pipeline to a new 10,000-gallon storage tank and service pumps located at the Valley Estates. The required pipeline would be 4-inches in diameter, approximately 0.3 miles long, and follows County Road (CR) 1540 south from the intersection of the City's pipeline at State Highway 84 and CR 1540 and terminate at the new storage tank

By definition this alternative involves regionalization, since Valley Estates would be obtaining drinking water from an existing larger supplier. Also, other PWSs near Valley Estates 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, storage tank, building, and service 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 Valley Estates 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 \$222,100, with an estimated annual O&M cost of \$16,200. 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 Lubbock provides treated surface water on a large scale, facilitating adequate O&M resources. From the perspective of the Valley Estates, 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 City of Lubbock to purchase treated drinking water.

4.5.2 Alternative VE-2: Purchase Treated Water from the CRMWA via the Water Line from Lubbock to Levelland

This alternative involves purchasing compliant water from the CRMWA, which would be used to supply Valley Estates. As previously stated, Valley Estates must get approval from the

1 CRMWA and 11 member cities to construct a direct water line from the CRMWA main
2 distribution line to the city's water supply.

3 This alternative would require construction of a pump station and a 5,000-gallon feed tank
4 at a point adjacent to CRMWA's main distribution line running from Lubbock to Levelland,
5 and a pipeline to the existing intake point for Valley Estates, where a new 10,000-gallon
6 storage tank and service pumps would be installed within a pump house.

7 The required pipeline would be 4 inches in diameter and would follow CR 1500 north from
8 the CRMWA pipeline crossing, turning east on CR 6100, then north on CR 1540 continuing to
9 Valley Estates. Using this route, the length of pipe required would be approximately 4.1 miles.
10 The pipeline would terminate at the new storage tank at the Valley Estates.

11 The pump station would include two pumps, including one standby, and would be housed
12 in a building. It is assumed the pumps and piping would be installed with capacity to meet all
13 water demand for the Valley Estates, since the incremental cost would be relatively small, and
14 would provide operational flexibility.

15 By definition this alternative involves regionalization, since Valley Estates would be
16 obtaining drinking water from an existing larger supplier. Also, other PWSs near Valley
17 Estates are in need of compliant drinking water and could share in implementation of this
18 alternative.

19 The estimated capital cost for this alternative includes constructing the pipeline, storage
20 and feed tank, pump houses, and pump station. The estimated O&M cost for this alternative
21 includes the purchase price for the treated water minus the cost the Valley Estates currently
22 pays to operate its well field, plus maintenance cost for the pipeline, and power and O&M labor
23 and materials for the pump stations. The estimated capital cost for this alternative is \$856,700
24 with an estimated annual O&M cost of \$44,300. If the purchased water was used for blending
25 rather than for the full water supply, the annual O&M cost for this alternative could be reduced
26 because of reduced pumping costs and reduced water purchase costs. However, additional
27 costs would be incurred for equipment to ensure proper blending, and additional monitoring to
28 ensure the finished water is compliant.

29 The reliability of adequate amounts of compliant water under this alternative should be
30 good. The CRMWA has adequate O&M resources. From the perspective of the Valley Estates
31 PWS, this alternative would be characterized as easy to operate and repair, since O&M and
32 repair of pipelines and pump stations is well understood, and Valley Estates personnel currently
33 operate pipelines and pump stations. If the decision were made to perform blending then the
34 operational complexity would increase.

35 The feasibility of this alternative is dependent on an agreement being reached between
36 Valley Estates, the CRMWA, and 11 member cities to purchase compliant drinking water.
37 There are several small PWSs relatively close to the Valley Estates PWS that have water
38 quality problems that would be good candidates for sharing the cost for obtaining water from
39 CRMWA. The cost to Valley Estates 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 F. This analysis shows that Valley Estates could expect to save between \$412,500 to \$572,900 if they were to implement a shared solution like this, which would be a savings between 48 to 67 percent.

4.5.3 Alternative VE-3: New Well in the Vicinity of New Deal

This alternative involves completing a new well in the vicinity of New Deal, and constructing a pump station and pipeline to transfer the pumped groundwater to a new ground storage tank and service pumps at Valley Estates. Based on the water quality data in the TCEQ database, it is expected that groundwater from this well would be compliant with drinking water MCLs. An agreement would need to be negotiated with New Deal to expand its well field.

This alternative would require completing a new 300-foot well and a pump station and a 5,000 gallon feed tank at New Deal, and constructing a pipeline from that well/feed tank to a new 10,000 gallon storage tank and service pumps at the Valley Estates PWS. The pump station would be required to overcome pipe friction and the elevation differences between New Deal and Valley Estates. The required pipeline would be constructed of 4-inch pipe and would follow several minor roads from the City of New Deal to Valley Estates. Using this route, the pipeline required would be approximately 11.3 miles long. The pipeline would terminate at the new ground storage tank at the Valley Estates PWS.

The pump station would include two pumps, including one standby, and would be housed in a building. It is assumed the pumps and piping would be installed with capacity to meet all water demand for the Valley Estates, since the incremental cost would be relatively small, and it would provide operational flexibility.

This alternative has the potential to provide a regional solution, as there are several PWSs in the vicinity that have a need for compliant water. PWSs located close to the proposed pipeline route could share the cost of drilling the new well and pipeline construction.

The estimated capital cost for this alternative includes completing the new well, and constructing the pipeline, storage and feed tank, pump houses, and pump station. The estimated O&M cost for this alternative includes the 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 \$1.76 million, with an estimated annual O&M cost of \$53,900. 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. From the Valley Estates' 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,

1 and Valley Estates personnel currently operate pipelines and a pump station. If the decision
2 was made to perform blending then the operational complexity would increase.

3 The feasibility of this alternative would be dependent on Valley Estates being able to reach
4 an agreement with New Deal to install a new groundwater well.

5 **4.5.4 Alternative VE-4: New Well at 10 miles**

6 This alternative consists of installing one new well within 10 miles of Valley Estates that
7 would produce compliant water in place of the water produced by the existing wells. At this
8 level of study, it is not possible to positively identify an existing well or the location where a
9 new well could be installed.

10 This alternative would require constructing one new 300-foot well, a new pump station
11 with a 5,000-gallon feed tank near the new well, an additional pump station and feed tank along
12 the pipeline, and a pipeline from the new well/feed tank to a new 10,000 gallon storage tank
13 and service pumps for the Valley Estates system. The pump stations and feed tanks would be
14 necessary to overcome pipe friction and changes in land elevation. For this alternative, the
15 pipeline is assumed to be approximately 10 miles long, and would be a 4-inches in diameter
16 and discharge to the new storage tank at the Valley Estates. Each pump station would include a
17 feed tank, two transfer pumps, including one standby, and would be housed in a building. The
18 new storage tank would include two service pumps, including one standby, and would be
19 housed in a building.

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

23 The estimated capital cost for this alternative includes installing the well, constructing the
24 pipeline, the pump stations, the storage and feed tanks, service pumps and pump house. The
25 estimated O&M cost for this alternative includes O&M for the pipeline and pump stations. The
26 estimated capital cost for this alternative is \$1.84 million, and the estimated annual O&M cost
27 for this alternative is \$78,100.

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

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

4.5.5 Alternative VE-5: New Well at 5 miles

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

This alternative would require constructing one new 300-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 10,000-gallon storage and service pumps tank near the existing intake point for the Valley Estates 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 Valley Estates PWS. The pump station 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 \$985,800, and the estimated annual O&M cost for this alternative is \$52,100.

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 Valley Estates PWS, this alternative would be similar to operate as the existing system. Valley Estates 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 Valley Estates, so landowner cooperation would likely be required.

4.5.6 Alternative VE-6: New Well at 1 mile

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

This alternative would require constructing one new 300-foot well and a pipeline from the new well to a new 10,000-gallon storage tank and service pumps near the existing intake point

for the Valley Estates system. 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 the new storage tank at the Valley Estates 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 \$315,800, and the estimated annual O&M cost for this alternative is \$26,400.

The reliability of adequate amounts of compliant water under this alternative should be good, since water wells and pipelines are commonly employed. From the perspective of the Valley Estates PWS, this alternative would be similar to operate as the existing system. Valley Estates 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 Valley Estates, so landowner cooperation may be required.

4.5.7 Alternative VE-7: Central RO Treatment

This 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, 100 percent of the raw water would be treated to obtain compliant water. The RO process concentrates impurities in the reject stream that would require disposal. It is estimated the RO reject generation would be approximately 3,400 gallons per day (gpd) when the system is operated at the average daily consumption (0.01 mgd).

This alternative consists of constructing the RO treatment plant near the existing well. The plant is composed of a 500 square foot building with a paved driveway; a skid with the pre-constructed RO plant; two transfer pumps, a 12,000-gallon tank for storing the treated water, and a 100,000-gallon pond for storing reject water. The treated water would be chlorinated and stored in the new treated water tank prior to being pumped into the distribution system. The existing pressure tanks would continue to be used to accumulate feed water from the well field. The entire facility is fenced.

The estimated capital cost for this alternative is \$526,400, and the estimated annual O&M cost is \$60,700.

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

4.5.8 Alternative VE-8: Central EDR Treatment

The system would continue to pump water from the existing well, and would treat the water through an EDR system prior to distribution. For this option the EDR would treat the full flow without bypass as the EDR operation can be tailored for desired removal efficiency. It is estimated the EDR reject generation would be approximately 2,500 gpd when the system is operated at the average daily consumption (0.01 mgd).

This alternative consists of constructing the EDR treatment plant near the existing well. The plant is composed of a 450 square foot building with a paved driveway; a skid with the pre-constructed EDR system; two transfer pumps; a 12,000-gallon tank for storing the treated water, and a 76,000-gallon pond for storing reject water. The treated water would be chlorinated and stored in the new treated water tank prior to being pumped into the distribution system. The existing pressure tanks would continue to be used to accumulate feed water from the wells. The entire facility is fenced.

The estimated capital cost for this alternative is \$550,200 and the estimated annual O&M cost is \$58,100.

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

4.5.9 Alternative VE-9: Point-of-Use Treatment

This alternative consists of the continued operation of the Valley Estates well field, plus treatment of water to be used for drinking or food preparation at the point of use to remove Fluoride, selenium, combined uranium, and 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. Valley Estates 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 Valley Estates or contract personnel into the houses of customers. As a result, cooperation of

customers would be important for success implementing this alternative. The treatment units could be installed for access without house entry, but that would complicate the installation and increase costs.

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

This alternative does not present options for a regional solution.

The estimated capital cost for this alternative includes purchasing and installing the POU treatment systems. The estimated O&M cost for this alternative includes the purchase and replacement of filters and membranes, as well as periodic sampling and record keeping as required by the Texas Administrative Code (TAC) (Title 30, Part I, Chapter 290, Subchapter F, Rule 290.106). The estimated capital cost for this alternative is \$45,700, and the estimated annual O&M cost for this alternative is \$30,100. For the cost estimate, it is assumed that one POU treatment unit will be required for each of the 36 connections in the Valley Estates system. It should be noted that the POU treatment units would need to be more complex than units typically found in commercial retail outlets in order to meet regulatory requirements, making purchase and installation more expensive. Additionally, capital cost would increase if POU treatment units are placed at other taps within a home, such as refrigerator water dispensers, ice makers, and bathroom sinks. In school settings, all taps where children and faculty receive water may need POU treatment units or clearly mark those taps suitable for human consumption. Additional considerations may be necessary for preschools or other establishments where individuals cannot read.

The reliability of adequate amounts of compliant water under this alternative is fair, since it relies on the active cooperation of the customers for system installation, use, and maintenance, and only provides compliant water to single tap within a house. Additionally, the O&M efforts (including monitoring of the devices to ensure adequate performance) required for the POU systems will be significant, and the current personnel are inexperienced in this type of work. From the perspective of the Valley Estates 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.

4.5.10 Alternative VE-10: Point-of-Entry Treatment

This alternative consists of the continued operation of the Valley Estates well field, plus treatment of water as it enters residences to remove fluoride, arsenic, selenium, and combined

uranium. 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).

Valley Estates 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 fluoride, arsenic, selenium, and combined uranium 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 \$548,000, and the estimated annual O&M cost for this alternative is \$77,200. For the cost estimate, it is assumed that one POE treatment unit will be required for each of the 36 existing connections to the Valley Estates system.

The reliability of adequate amounts of compliant water under this alternative are fair, but better than POU systems since it relies less on the active cooperation of the customers for system installation, use, and maintenance, and compliant water is supplied to all taps within a house. Additionally, the O&M efforts required for the POE systems will be significant, and the current personnel are inexperienced in this type of work. From the perspective of the Valley Estates 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.

4.5.11 Alternative VE-11: Public Dispenser for Treated Drinking Water

This alternative consists of the continued operation of the Valley Estates 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.

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

This alternative does not present options for a regional solution.

The estimated capital cost for this alternative includes purchasing and installing the treatment system to be used for the drinking water dispenser. The estimated O&M cost for this alternative includes purchasing and replacing filters and media or membranes, as well as periodic sampling and record keeping. The estimated capital cost for this alternative is \$17,800, and the estimated annual O&M cost for this alternative is \$34,600.

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. Valley Estates PWS has not provided this type of service in the past. From Valley Estates' 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.

4.5.12 Alternative VE-12: 100 Percent Bottled Water Delivery

This alternative consists of the continued operation of the Valley Estates wells, but compliant drinking water will be delivered to customers in containers. This alternative involves setting up and operating a bottled water delivery program to serve all customers in the system. It is expected that Valley Estates 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

1 this alternative would be considered an interim measure until a compliance alternative is
2 implemented.

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

7 This alternative does not present options for a regional solution.

8 The estimated initial capital cost is for setting up the program. The estimated O&M cost
9 for this alternative includes program administration and purchase of the bottled water. The
10 estimated capital cost for this alternative is \$27,000, and the estimated annual O&M cost for
11 this alternative is \$58,100. For the cost estimate, it is assumed that each person requires one
12 gallon of bottled water per day.

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

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

18 **4.5.13 Alternative VE-13: Public Dispenser for Trucked Drinking Water**

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

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

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

35 The estimated capital cost for this alternative includes purchasing a water truck and
36 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 \$127,700, and the estimated annual O&M cost for this alternative is \$29,500.

The reliability of adequate amounts of compliant water under this alternative is fair because of the large amount of effort required from the customers and the associated inconvenience. Current personnel have not provided this type of service in the past. From the perspective of Valley Estates, 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.

4.5.14 Summary of Alternatives

Table 4.3 provides a summary of the key features of each alternative for Valley Estates PWS.

1 **Table 4.3 Summary of Compliance Alternatives for Valley Estates PWS**

Alt No.	Alternative Description	Major Components	Capital Cost ¹	Annual O&M Cost	Total Annualized Cost	Reliability	System Impact	Remarks
VE-1	Purchase Water from Lubbock	- New storage tank - 0.3-mile pipeline	\$222,100	\$16,200	\$35,600	Good	N	Agreement must be successfully negotiated with City of Lubbock. Blending may be possible. Costs could possibly be shared with small systems along pipeline route.
VE-2	Purchase Water from CRMWA	- New pump station / feed tank - New storage tank - 4.1-mile pipeline	\$856,700	\$44,300	\$119,000	Good	N	Agreement must be successfully negotiated with CRMWA. Blending may be possible. Costs could possibly be shared with small systems along pipeline route.
VE-3	New Well at City of New Deal	- New well - New pump station / feed tank - New storage tank - 11.3-mile pipeline	\$1,761,500	\$53,900	\$207,500	Good	N	Agreement must be successfully negotiated with City of New Deal, or land must be purchased. Blending may be possible. Costs could possibly be shared with small systems along pipeline route.
VE-4	Install new compliant well at 10 Miles	- New well - Two new pump stations / feed tanks - New storage tank - 10-mile pipeline	\$1,844,700	\$78,100	\$239,000	Good	N	May be difficult to find well with good water quality. Costs could possibly be shared with small systems along pipeline route.
VE-5	Install new compliant well at 5 Miles	- New well - New pump station / feed tank - New storage tank - 5-mile pipeline	\$985,800	\$52,100	\$138,100	Good	N	May be difficult to find well with good water quality. Costs could possibly be shared with small systems along pipeline route.
VE-6	Install new compliant well at 1 Miles	- New well - New storage tank - 1-mile pipeline	\$315,800	\$26,400	\$53,900	Good	N	May be difficult to find well with good water quality.
VE-7	Continue operation of Valley Estates well field with central RO treatment	- Central RO treatment plant	\$526,400	\$60,700	\$106,600	Good	T	Costs could possibly be shared with nearby small systems.
VE-8	Continue operation of Valley Estates well field with central EDR Treatment	- Central EDR treatment plant	\$550,200	\$58,100	\$106,100	Good	T	Costs could possibly be shared with nearby small systems.
VE-9	Continue operation of Valley Estates well field, and POU treatment	- POU treatment units	\$45,700	\$30,100	\$34,000	Fair	T, M	Only one compliant tap in home. Cooperation of residents required for installation, maintenance, and testing.
VE-10	Continue operation of Valley Estates well field, and POE treatment	- POE treatment units	\$548,000	\$77,200	\$125,000	Fair (better than POU)	T, M	All home taps compliant and less resident cooperation required.

Alt No.	Alternative Description	Major Components	Capital Cost ¹	Annual O&M Cost	Total Annualized Cost	Reliability	System Impact	Remarks
VE-11	Continue operation of Valley Estates well field, but furnish public dispenser for treated drinking water	- Water treatment and dispenser unit	\$17,800	\$34,600	\$36,200	Fair/interim measure	T	Does not provide compliant water to all taps, and requires a lot of effort by customers.
VE-12	Continue operation of Valley Estates well field, but furnish bottled drinking water for all customers	- Set up bottled water system	\$27,000	\$58,100	\$60,500	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.
VE-13	Continue operation of Valley Estates well field, but furnish public dispenser for trucked drinking water.	- Construct storage tank and dispenser - Purchase potable water truck	\$127,700	\$29,500	\$40,700	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 DEVELOPMENT AND EVALUATION OF A REGIONAL SOLUTION

A concept for a regional solution to provide compliant drinking water to PWSs near Lubbock and surrounding counties was developed and evaluated to investigate whether a large-scale regional approach might be more cost-effective than each PWS seeking its own solution. The development and evaluation of the Lubbock Area Regional Solutions is described in Appendix E. It was found that a regional solution to serving non-compliant PWSs in the Lubbock area presents a potentially viable solution to an existing problem. A regional system could be implemented within a cost-per-connection range of \$61/month (\$738/year) to \$173/month (\$2,079/year), with the actual cost depending on the source and costs of capital funds needed to build a regional system.

4.7 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. Valley Estates is a mobile home park with 36 connections, serving a population of approximately 70. Information that was used to complete the financial analysis was based on estimated revenues and expenses.

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.

4.7.1 Valley Estates Financial Data

Financial records and statements for Valley Estates were unavailable. Financial data for system expenditures were based on estimates of expenses of similar size PWS.

4.7.2 Current Financial Condition

4.7.2.1 Cash Flow Needs

The average annual water bill was estimated to be \$180, or approximately 0.5 per cent of the annual household income of \$38,423. Because of the lack of separate financial data exclusively for the water system, it is difficult to determine exact cash flow needs.

4.7.2.2 Ratio Analysis

Current Ratio

The Current Ratio for the Valley Estates water system 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 Valley Estates, the Operating Ratio could not be accurately determined.

4.7.3 Financial Plan Results

Each compliance alternative for the Valley Estates PWS was evaluated, with emphasis on the impact on affordability (expressed as a percentage of household income), and the overall increase in water rates 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, shows the following:

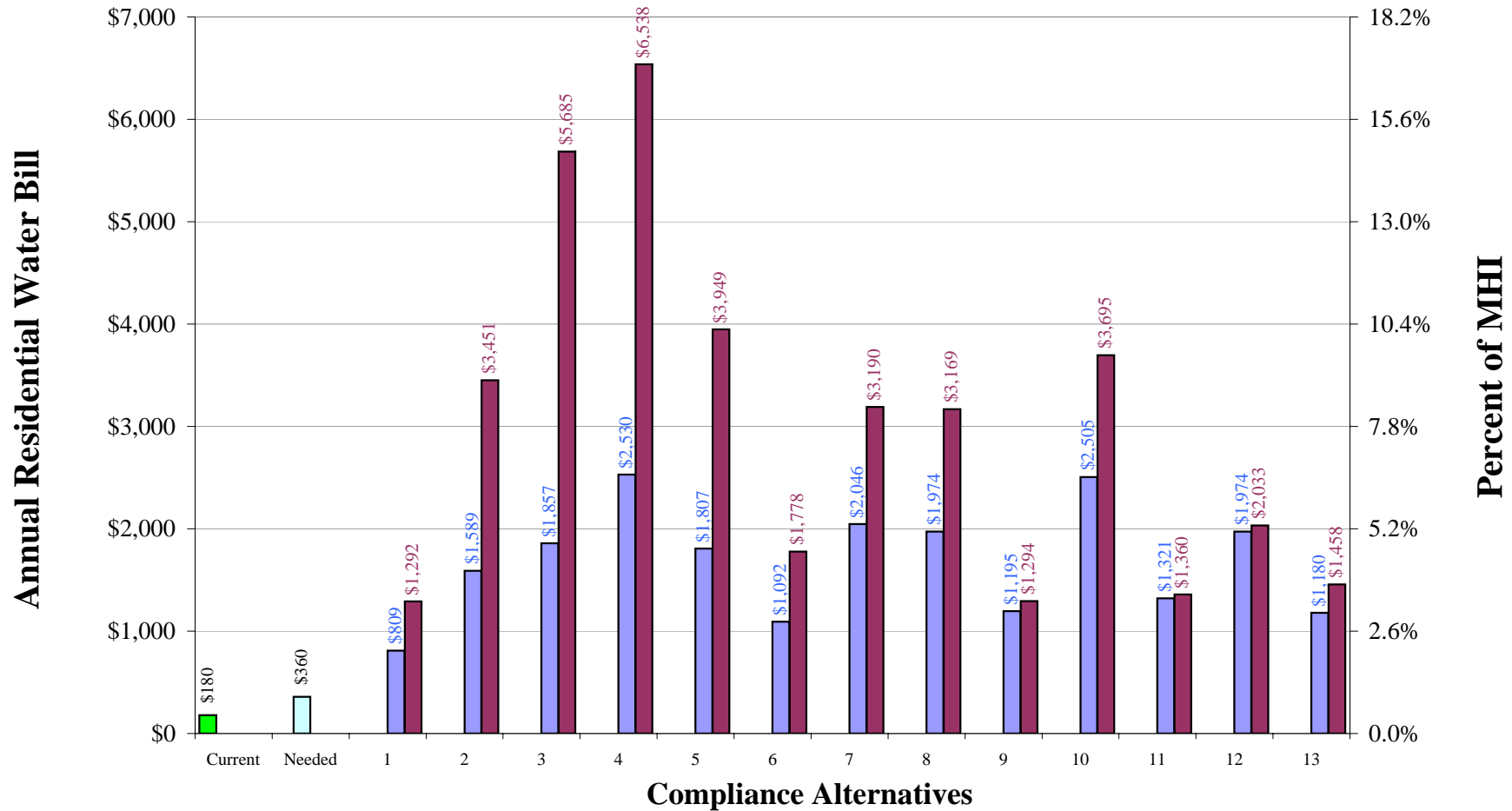
- Current annual average bill,
- Projected annual average bill including rate increase, if needed, to match existing expenditures, and
- Projected annual bill including rate increases needed to fund implementation of a compliance alternative (this does not include funding for reserve accounts).

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.

Valley Estates
Table 4.4 Financial Impact on Households

Alternative	Description		All Revenue	100% Grant	75% Grant	50% Grant	SRF	Bond
1	Purchase Water from Lubbock	Maximum % of MHI	17.0%	2.1%	2.4%	2.7%	3.2%	3.4%
		Percentage Rate Increase Compared to Current	3528%	350%	417%	484%	578%	618%
		Average Annual Water Bil	\$6,530	\$809	\$930	\$1,051	\$1,220	\$1,292
2	Purchase Water from CRMWA	Maximum % of MHI	62.9%	4.1%	5.3%	6.6%	8.3%	9.0%
		Percentage Rate Increase Compared to Current	13321%	783%	1042%	1300%	1663%	1817%
		Average Annual Water Bil	\$24,157	\$1,589	\$2,055	\$2,520	\$3,174	\$3,451
3	New Well at City of New Deal	Maximum % of MHI	128.3%	4.8%	7.3%	9.8%	13.3%	14.8%
		Percentage Rate Increase Compared to Current	27283%	932%	1464%	1995%	2742%	3058%
		Average Annual Water Bil	\$49,290	\$1,857	\$2,814	\$3,771	\$5,116	\$5,685
4	New Well at 10 Miles	Maximum % of MHI	134.3%	6.6%	9.2%	11.8%	15.5%	17.0%
		Percentage Rate Increase Compared to Current	28567%	1305%	1862%	2419%	3201%	3532%
		Average Annual Water Bil	\$51,601	\$2,530	\$3,532	\$4,534	\$5,942	\$6,538
5	New Well at 5 Miles	Maximum % of MHI	72.2%	4.7%	6.1%	7.5%	9.4%	10.3%
		Percentage Rate Increase Compared to Current	15313%	904%	1201%	1499%	1917%	2094%
		Average Annual Water Bil	\$27,743	\$1,807	\$2,343	\$2,878	\$3,631	\$3,949
6	New Well at 1 Mile	Maximum % of MHI	23.8%	2.8%	3.3%	3.7%	4.4%	4.6%
		Percentage Rate Increase Compared to Current	4974%	507%	602%	697%	831%	888%
		Average Annual Water Bil	\$9,132	\$1,092	\$1,264	\$1,435	\$1,676	\$1,778
7	Central Treatment - RO	Maximum % of MHI	39.0%	5.3%	6.1%	6.8%	7.9%	8.3%
		Percentage Rate Increase Compared to Current	8223%	1037%	1195%	1354%	1578%	1672%
		Average Annual Water Bil	\$14,982	\$2,046	\$2,332	\$2,618	\$3,020	\$3,190
8	Central Treatment - EDR	Maximum % of MHI	40.7%	5.1%	5.9%	6.7%	7.8%	8.2%
		Percentage Rate Increase Compared to Current	8590%	997%	1163%	1329%	1562%	1661%
		Average Annual Water Bil	\$15,642	\$1,974	\$2,273	\$2,572	\$2,992	\$3,169
9	Point-of-Use Treatment	Maximum % of MHI	4.2%	3.1%	3.2%	3.2%	3.3%	3.4%
		Percentage Rate Increase Compared to Current	806%	564%	577%	591%	611%	619%
		Average Annual Water Bil	\$1,630	\$1,195	\$1,219	\$1,244	\$1,279	\$1,294
10	Point-of-Entry Treatment	Maximum % of MHI	40.6%	6.5%	7.3%	8.1%	9.2%	9.6%
		Percentage Rate Increase Compared to Current	8556%	1291%	1457%	1622%	1855%	1953%
		Average Annual Water Bil	\$15,581	\$2,505	\$2,802	\$3,100	\$3,518	\$3,695
11	Public Dispenser for Treated Drinking Water	Maximum % of MHI	3.4%	3.4%	3.5%	3.5%	3.5%	3.5%
		Percentage Rate Increase Compared to Current	634%	634%	639%	645%	652%	655%
		Average Annual Water Bil	\$1,321	\$1,321	\$1,331	\$1,340	\$1,354	\$1,360
12	Supply Bottled Water to 100% of Population	Maximum % of MHI	5.1%	5.1%	5.2%	5.2%	5.3%	5.3%
		Percentage Rate Increase Compared to Current	997%	997%	1005%	1013%	1024%	1029%
		Average Annual Water Bil	\$1,974	\$1,974	\$1,989	\$2,003	\$2,024	\$2,033
13	Central Trucked Drinking Water	Maximum % of MHI	10.2%	3.1%	3.3%	3.4%	3.7%	3.8%
		Percentage Rate Increase Compared to Current	2071%	556%	594%	633%	687%	710%
		Average Annual Water Bil	\$3,907	\$1,180	\$1,250	\$1,319	\$1,416	\$1,458

Figure 4.2
Alternative Cost Summary: Valley Estates



Current Average Monthly Bill = \$15
 Median Household Income = \$38,423
 Average Monthly Residential Usage = 8,534 gallons

■ Current ■ With 100% Grant Funding ■ Needed
■ With 100% Loan/Bond Funding

4.7.4 Evaluation of Potential Funding Options

There are limited funding programs available to entities as described in Section 2.4. Valley Estates PWS is most likely to obtain funding from programs administered by the TWDB. 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 with the TWDB. 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.

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

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

Additional information can be found online at the TWDB website under the Assistance tab, Financial Assistance section, Public Works Infrastructure Construction subsection, and under the link "Clean Water State Revolving Fund Loan Program."

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2

**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 | <input type="checkbox"/> | NO | <input type="checkbox"/> |
| A source water protection plan? | | | |
| YES | <input type="checkbox"/> | NO | <input type="checkbox"/> |
| | | N/A | <input type="checkbox"/> |
| An emergency plan? | | | |
| YES | <input type="checkbox"/> | NO | <input type="checkbox"/> |
| A cross-connection control program? | | | |
| YES | <input type="checkbox"/> | NO | <input type="checkbox"/> |
| An emergency source? | | | |
| YES | <input type="checkbox"/> | NO | <input type="checkbox"/> |
| System security measures? | | | |
| YES | <input type="checkbox"/> | NO | <input type="checkbox"/> |
21. Does the system report and maintain records in accordance with the drinking water regulations concerning:
- | | | | |
|--------------------------|--------------------------|----|--------------------------|
| Water quality violations | | | |
| YES | <input type="checkbox"/> | NO | <input type="checkbox"/> |
| Public notification | | | |
| YES | <input type="checkbox"/> | NO | <input type="checkbox"/> |
| Sampling exemptions | | | |
| YES | <input type="checkbox"/> | NO | <input type="checkbox"/> |
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 Lubbock County region.

Electrical power cost is estimated to be \$0.097 per kWh, as supplied by South Plains Electric. The annual cost for power to a pump station is calculated based on the pumping head and volume, and includes 11,800 kWh for pump building heating, cooling, and lighting, as recommended in USEPA publication, *Standardized Costs for Water Supply Distribution Systems* (1992).

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

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

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

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

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

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

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

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

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

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

13

Table B.1
Summary of General Data
Valley Estates
1520198
General PWS Information

Service Population	70	Number of Connections	36
Total PWS Daily Water Usage	0.01 (mgd)	Source	Site visit list

Unit Cost Data

General Items	Unit	Unit Cost	Central Treatment Unit Costs	Unit	Unit Cost
Treated water purchase cost	<i>See alternative</i>		General		
Water purchase cost (trucked)	\$/1,000 gals	\$ 2.61	Site preparation	acre	\$ 4,000
			Slab	CY	\$ 1,000
Contingency	20%	n/a	Building	SF	\$ 60
Engineering & Constr. Management	25%	n/a	Building electrical	SF	\$ 8.00
Procurement/admin (POU/POE)	20%	n/a	Building plumbing	SF	\$ 8.00
			Heating and ventilation	SF	\$ 7.00
Pipeline Unit Costs	Unit	Unit Cost	Fence	LF	\$ 15
PVC water line, Class 200, 04"	LF	\$ 12	Paving	SF	\$ 2.00
Bore and encasement, 10"	LF	\$ 240	General O&M		
Open cut and encasement, 10"	LF	\$ 130	Building power	kwh/yr	\$ 0.097
Gate valve and box, 04"	EA	\$ 710	Equipment power	kwh/yr	\$ 0.097
Air valve	EA	\$ 2,050	Labor, O&M	hr	\$ 40
Flush valve	EA	\$ 1,025	Analyses	test	\$ 200
Metal detectable tape	LF	\$ 2.00			
			Reject Pond		
Bore and encasement, length	Feet	200	Reject pond, excavation	CYD	\$ 3
Open cut and encasement, length	Feet	50	Reject pond, compacted fill	CYD	\$ 7
			Reject pond, lining	SF	\$ 1.50
Pump Station Unit Costs	Unit	Unit Cost	Reject pond, vegetation	SY	\$ 1.50
Pump	EA	\$ 8,000	Reject pond, access road	LF	\$ 30
Pump Station Piping, 04"	EA	\$ 550	Reject water haulage truck	EA	\$ 100,000
Gate valve, 04"	EA	\$ 710			
Check valve, 04"	EA	\$ 755	Reverse Osmosis		
Electrical/Instrumentation	EA	\$ 10,250	Electrical	JOB	\$ 40,000
Site work	EA	\$ 2,560	Piping	JOB	\$ 20,000
Building pad	EA	\$ 5,125	RO package plant	UNIT	\$ 72,000
Pump Building	EA	\$ 10,250	Transfer pumps (5 hp)	EA	\$ 5,000
Fence	EA	\$ 6,150	Permeate tank	gal	\$ 3
Tools	EA	\$ 1,025	RO materials and chemicals	kgal	\$ 0.75
5,000 gal feed tank	EA	\$ 10,000	RO chemicals	year	\$ 2,000
Backflow preventer, 4"	EA	\$ 2,295	Backwash disposal mileage cost	miles	\$ 1.50
Backflow Testing/Certification	EA	\$ 105	Backwash disposal fee	1,000 gal/yr	\$ 5.00
Well Installation Unit Costs	Unit	Unit Cost	EDR		
Well installation	<i>See alternative</i>		Electrical	JOB	\$ 50,000
Water quality testing	EA	\$ 1,280	Piping	JOB	\$ 20,000
5HP Well Pump	EA	\$ 2,750	Product storage tank	gal	\$ 3.00
Well electrical/instrumentation	EA	\$ 5,635	EDR package plant	UNIT	\$ 90,000
Well cover and base	EA	\$ 3,075	EDR materials	kgal	\$ 0.48
Piping	EA	\$ 3,075	EDR chemicals	kgal	\$ 0.40
10,000 gal ground storage tank	EA	\$ 15,000	Backwash disposal mileage cost	miles	\$ 1.50
			Backwash disposal fee	1,000 gal/yr	\$ 5.00
Electrical Power	\$/kWH	\$ 0.097	Transfer pumps (5 hp)	EA	\$ 5,000
Building Power	kWH	11,800			
Labor	\$/hr	\$ 60			
Materials	EA	\$ 1,540			
Transmission main O&M	\$/mile	\$ 275			
Tank O&M	EA	\$ 1,025			
POU/POE Unit Costs					
POU treatment unit purchase	EA	\$ 615			
POU treatment unit installation	EA	\$ 155			
POE treatment unit purchase	EA	\$ 5,125			
POE - pad and shed, per unit	EA	\$ 2,050			
POE - piping connection, per unit	EA	\$ 1,025			
POE - electrical hook-up, per unit	EA	\$ 1,025			
POU Treatment O&M, per unit	\$/year	\$ 230			
POE Treatment O&M, per unit	\$/year	\$ 1,540			
Treatment analysis	\$/year	\$ 205			
POU/POE labor support	\$/hr	\$ 40			
Dispenser/Bottled Water Unit Costs					
POE-Treatment unit purchase	EA	\$ 7,175			
POE-Treatment unit installation	EA	\$ 5,125			
Treatment unit O&M	EA	\$ 2,050			
Administrative labor	hr	\$ 45			
Bottled water cost (inc. delivery)	gallon	\$ 1.25			
Water use, per capita per day	gpcd	1.0			
Bottled water program materials	EA	\$ 5,125			
5,000 gal ground storage tank	EA	\$ 10,000			
Site improvements	EA	\$ 3,075			
Potable water truck	EA	\$ 75,000			
Water analysis, per sample	EA	\$ 205			
Potable water truck O&M costs	\$/mile	\$ 3.00			

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.13. 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 *Valley Estates*
Alternative Name *Purchase Water from Lubbock*
Alternative Number *VE-1*

Distance from Alternative to PWS (along pipe) 0.3 miles
Total PWS annual water usage 3.650 MG
Treated water purchase cost \$ 0.83 per 1,000 gals
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
<i>Pipeline Construction</i>				
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"	1,610	LF	\$ 12	\$ 19,320
Bore and encasement, 10"	200	LF	\$ 240	\$ 48,000
Open cut and encasement, 10"	50	LF	\$ 130	\$ 6,500
Gate valve and box, 04"	0	EA	\$ 710	\$ 229
Air valve	1	EA	\$ 2,050	\$ 2,050
Flush valve	0	EA	\$ 1,025	\$ 330
Metal detectable tape	1,610	LF	\$ 2	\$ 3,220
Subtotal				\$ 79,649

Pump Station(s) Installation

Pump	2	EA	\$ 8,000	\$ 16,000
Pump Station Piping, 04"	1	EA	\$ 550	\$ 550
Gate valve, 04"	4	EA	\$ 710	\$ 2,840
Check valve, 04"	2	EA	\$ 755	\$ 1,510
Electrical/Instrumentation	1	EA	\$ 10,250	\$ 10,250
Site work	1	EA	\$ 2,560	\$ 2,560
Building pad	1	EA	\$ 5,125	\$ 5,125
Pump Building	1	EA	\$ 10,250	\$ 10,250
Fence	1	EA	\$ 6,150	\$ 6,150
Tools	1	EA	\$ 1,025	\$ 1,025
5,000 gal feed tank	-	EA	\$ 10,000	\$ -
10,000 gal ground storage tank	1	EA	\$ 15,000	\$ 15,000
Backflow Preventor	1	EA	\$ 2,295	\$ 2,295
Subtotal				\$ 73,555

Subtotal of Component Costs **\$ 153,204**

Contingency 20% \$ 30,641
 Design & Constr Management 25% \$ 38,301

TOTAL CAPITAL COSTS **\$ 222,145**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Pipeline O&M</i>				
Pipeline O&M	0.3	mile	\$ 275	\$ 84
Subtotal				\$ 84
<i>Water Purchase Cost</i>				
From PWS	3,650	1,000 gal	\$ 0.83	\$ 3,030
Subtotal				\$ 3,030

Pump Station(s) O&M

Building Power	11,800	kWH	\$ 0.097	\$ 1,145
Pump Power	53	kWH	\$ 0.097	\$ 5
Materials	1	EA	\$ 1,540	\$ 1,540
Labor	365	Hrs	\$ 60.00	\$ 21,900
Tank O&M	1	EA	\$ 1,025	\$ 1,025
Backflow Test/Cert	1	EA	\$ 105	\$ 105
Subtotal				\$ 25,720

O&M Credit for Existing Well Closure

Pump power	3,100	kWH	\$ 0.097	\$ (301)
Well O&M matl	1	EA	\$ 1,540	\$ (1,540)
Well O&M labor	180	Hrs	\$ 60	\$ (10,800)
Subtotal				\$ (12,641)

TOTAL ANNUAL O&M COSTS **\$ 16,192**

Table C.2

PWS Name *Valley Estates*
Alternative Name *Purchase Water from CRMWA*
Alternative Number *VE-2*

Distance from Alternative to PWS (along pipe) 4.1 miles
Total PWS annual water usage 3.650 MG
Treated water purchase cost \$ 1.52 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
<i>Pipeline Construction</i>				
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"	21,640	LF	\$ 12	\$ 259,680
Bore and encasement, 10"	400	LF	\$ 240	\$ 96,000
Open cut and encasement, 10"	250	LF	\$ 130	\$ 32,500
Gate valve and box, 04"	4	EA	\$ 710	\$ 3,073
Air valve	7	EA	\$ 2,050	\$ 14,350
Flush valve	4	EA	\$ 1,025	\$ 4,436
Metal detectable tape	21,640	LF	\$ 2	\$ 43,280
Subtotal				\$ 453,319

Pump Station(s) Installation

Pump	4	EA	\$ 8,000	\$ 32,000
Pump Station Piping, 04"	2	EA	\$ 550	\$ 1,100
Gate valve, 04"	8	EA	\$ 710	\$ 5,680
Check valve, 04"	4	EA	\$ 755	\$ 3,020
Electrical/Instrumentation	2	EA	\$ 10,250	\$ 20,500
Site work	2	EA	\$ 2,560	\$ 5,120
Building pad	2	EA	\$ 5,125	\$ 10,250
Pump Building	2	EA	\$ 10,250	\$ 20,500
Fence	2	EA	\$ 6,150	\$ 12,300
Tools	2	EA	\$ 1,025	\$ 2,050
5,000 gal feed tank	1	EA	\$ 10,000	\$ 10,000
10,000 gal ground storage tank	1	EA	\$ 15,000	\$ 15,000
Backflow Preventor	-	EA	\$ 2,295	\$ -
Subtotal				\$ 137,520

Subtotal of Component Costs **\$ 590,839**

Contingency 20% \$ 118,168
Design & Constr Management 25% \$ 147,710

TOTAL CAPITAL COSTS **\$ 856,717**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Pipeline O&M</i>				
Pipeline O&M	4.1	mile	\$ 275	\$ 1,127
Subtotal				\$ 1,127
<i>Water Purchase Cost</i>				
From PWS	3,650	1,000 gal	\$ 1.52	\$ 5,548
Subtotal				\$ 5,548

Pump Station(s) O&M

Building Power	23,600	kWH	\$ 0.097	\$ 2,289
Pump Power	456	kWH	\$ 0.097	\$ 44
Materials	2	EA	\$ 1,540	\$ 3,080
Labor	730	Hrs	\$ 60.00	\$ 43,800
Tank O&M	1	EA	\$ 1,025	\$ 1,025
Backflow Test/Cert	-	EA	\$ 105	\$ -
Subtotal				\$ 50,238

O&M Credit for Existing Well Closure

Pump power	3,100	kWH	\$ 0.097	\$ (301)
Well O&M matl	1	EA	\$ 1,540	\$ (1,540)
Well O&M labor	180	Hrs	\$ 60	\$ (10,800)
Subtotal				\$ (12,641)

TOTAL ANNUAL O&M COSTS **\$ 44,273**

Table C.3

PWS Name Valley Estates
Alternative Name New Well at City of New Deal
Alternative Number VE-3

Distance from PWS to new well location 11.3 miles
 Estimated well depth 300 feet
 Number of wells required 1
 Well installation cost (location specific) \$150.5 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
<i>Pipeline Construction</i>				
Number of Crossings, bore	1	n/a	n/a	n/a
Number of Crossings, open cut	13	n/a	n/a	n/a
PVC water line, Class 200, 04"	59,658	LF	\$ 12	\$ 715,896
Bore and encasement, 10"	200	LF	\$ 240	\$ 48,000
Open cut and encasement, 10"	650	LF	\$ 130	\$ 84,500
Gate valve and box, 04"	12	EA	\$ 710	\$ 8,471
Air valve	13	EA	\$ 2,050	\$ 26,650
Flush valve	12	EA	\$ 1,025	\$ 12,230
Metal detectable tape	59,658	LF	\$ 2	\$ 119,316
Subtotal				\$ 1,015,063

Pump Station(s) Installation

Pump	4	EA	\$ 8,000	\$ 32,000
Pump Station Piping, 04"	2	EA	\$ 550	\$ 1,100
Gate valve, 04"	8	EA	\$ 710	\$ 5,680
Check valve, 04"	4	EA	\$ 755	\$ 3,020
Electrical/Instrumentation	2	EA	\$ 10,250	\$ 20,500
Site work	2	EA	\$ 2,560	\$ 5,120
Building pad	2	EA	\$ 5,125	\$ 10,250
Pump Building	2	EA	\$ 10,250	\$ 20,500
Fence	2	EA	\$ 6,150	\$ 12,300
Tools	2	EA	\$ 1,025	\$ 2,050
5,000 gal feed tank	1	EA	\$ 10,000	\$ 10,000
10,000 gal ground storage tank	1	EA	\$ 15,000	\$ 15,000
Backflow Preventor	0	EA	\$ 2,295	\$ -
Subtotal				\$ 137,520

Well Installation

Well installation	300	LF	\$ 150.5	\$ 45,150
Water quality testing	2	EA	\$ 1,280	\$ 2,560
Well pump	1	EA	\$ 2,750	\$ 2,750
Well electrical/instrumentation	1	EA	\$ 5,635	\$ 5,635
Well cover and base	1	EA	\$ 3,075	\$ 3,075
Piping	1	EA	\$ 3,075	\$ 3,075
Subtotal				\$ 62,245

Subtotal of Component Costs \$ 1,214,828

Contingency 20% \$ 242,966
 Design & Constr Management 25% \$ 303,707

TOTAL CAPITAL COSTS \$ 1,761,501

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Pipeline O&M</i>				
Pipeline O&M	11.3	mile	\$ 275	\$ 3,107
Subtotal				\$ 3,107

Pump Station(s) O&M

Building Power	23,600	kWH	\$ 0.097	\$ 2,289
Pump Power	1,410	kWH	\$ 0.097	\$ 137
Materials	2	EA	\$ 1,540	\$ 3,080
Labor	730	Hrs	\$ 60.00	\$ 43,800
Tank O&M	1	EA	\$ 1,025	\$ 1,025
Backflow Cert/Test	0	EA	\$ 105	\$ -
Subtotal				\$ 50,331

Well O&M

Pump power	8,089	kWH	\$ 0.097	\$ 785
Well O&M matl	1	EA	\$ 1,540	\$ 1,540
Well O&M labor	180	Hrs	\$ 60	\$ 10,800
Subtotal				\$ 13,125

O&M Credit for Existing Well Closure

Pump power	3,100	kWH	\$ 0.097	\$ (301)
Well O&M matl	1	EA	\$ 1,540	\$ (1,540)
Well O&M labor	180	Hrs	\$ 60	\$ (10,800)
Subtotal				\$ (12,641)

TOTAL ANNUAL O&M COSTS \$ 53,922

Table C.4

PWS Name *Valley Estates*
Alternative Name *New Well at 10 Miles*
Alternative Number *VE-4*

Distance from PWS to new well location 10.0 miles
Estimated well depth 300 feet
Number of wells required 1
Well installation cost (location specific) \$150.5 per foot
Pump Stations needed w/ 1 feed tank each 2
On site storage tanks / pump sets needed 1

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Pipeline Construction</i>				
Number of Crossings, bore	3	n/a	n/a	n/a
Number of Crossings, open cut	12	n/a	n/a	n/a
PVC water line, Class 200, 04"	52,800	LF	\$ 12	\$ 633,600
Bore and encasement, 10"	600	LF	\$ 240	\$ 144,000
Open cut and encasement, 10"	600	LF	\$ 130	\$ 78,000
Gate valve and box, 04"	11	EA	\$ 710	\$ 7,498
Air valve	13	EA	\$ 2,050	\$ 26,650
Flush valve	11	EA	\$ 1,025	\$ 10,824
Metal detectable tape	52,800	LF	\$ 2	\$ 105,600
Subtotal				\$ 1,006,172

Pump Station(s) Installation

Pump	6	EA	\$ 8,000	\$ 48,000
Pump Station Piping, 04"	3	EA	\$ 550	\$ 1,650
Gate valve, 04"	12	EA	\$ 710	\$ 8,520
Check valve, 04"	6	EA	\$ 755	\$ 4,530
Electrical/Instrumentation	3	EA	\$ 10,250	\$ 30,750
Site work	3	EA	\$ 2,560	\$ 7,680
Building pad	3	EA	\$ 5,125	\$ 15,375
Pump Building	3	EA	\$ 10,250	\$ 30,750
Fence	3	EA	\$ 6,150	\$ 18,450
Tools	3	EA	\$ 1,025	\$ 3,075
5,000 gal feed tank	2	EA	\$ 10,000	\$ 20,000
10,000 gal ground storage tank	1	EA	\$ 15,000	\$ 15,000
Subtotal				\$ 203,780

Well Installation

Well installation	300	LF	\$ 150.5	\$ 45,150
Water quality testing	2	EA	\$ 1,280	\$ 2,560
Well pump	1	EA	\$ 2,750	\$ 2,750
Well electrical/instrumentation	1	EA	\$ 5,635	\$ 5,635
Well cover and base	1	EA	\$ 3,075	\$ 3,075
Piping	1	EA	\$ 3,075	\$ 3,075
Subtotal				\$ 62,245

Subtotal of Component Costs **\$ 1,272,197**

Contingency 20% \$ 254,439
Design & Constr Management 25% \$ 318,049

TOTAL CAPITAL COSTS **\$ 1,844,685**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Pipeline O&M</i>				
Pipeline O&M	10.0	mile	\$ 275	\$ 2,750
Subtotal				\$ 2,750

Pump Station(s) O&M

Building Power	35,400	kWH	\$ 0.097	\$ 3,434
Pump Power	1,222	kWH	\$ 0.097	\$ 119
Materials	3	EA	\$ 1,540	\$ 4,620
Labor	1,095	Hrs	\$ 60.00	\$ 65,700
Tank O&M	1	EA	\$ 1,025	\$ 1,025
Subtotal				\$ 74,897

Well O&M

Pump power	8,089	kWH	\$ 0.097	\$ 785
Well O&M matl	1	EA	\$ 1,540	\$ 1,540
Well O&M labor	180	Hrs	\$ 60	\$ 10,800
Subtotal				\$ 13,125

O&M Credit for Existing Well Closure

Pump power	3,100	kWH	\$ 0.097	\$ (301)
Well O&M matl	1	EA	\$ 1,540	\$ (1,540)
Well O&M labor	180	Hrs	\$ 60	\$ (10,800)
Subtotal				\$ (12,641)

TOTAL ANNUAL O&M COSTS **\$ 78,131**

Table C.5

PWS Name *Valley Estates*
Alternative Name *New Well at 5 Miles*
Alternative Number *VE-5*

Distance from PWS to new well location 5.0 miles
Estimated well depth 300 feet
Number of wells required 1
Well installation cost (location specific) \$150.5 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
<i>Pipeline Construction</i>				
Number of Crossings, bore	1	n/a	n/a	n/a
Number of Crossings, open cut	6	n/a	n/a	n/a
PVC water line, Class 200, 04"	26,400	LF	\$ 12	\$ 316,800
Bore and encasement, 10"	200	LF	\$ 240	\$ 48,000
Open cut and encasement, 10"	300	LF	\$ 130	\$ 39,000
Gate valve and box, 04"	5	EA	\$ 710	\$ 3,749
Air valve	7	EA	\$ 2,050	\$ 14,350
Flush valve	5	EA	\$ 1,025	\$ 5,412
Metal detectable tape	26,400	LF	\$ 2	\$ 52,800
Subtotal				\$ 480,111
<i>Pump Station(s) Installation</i>				
Pump	4	EA	\$ 8,000	\$ 32,000
Pump Station Piping, 04"	2	EA	\$ 550	\$ 1,100
Gate valve, 04"	8	EA	\$ 710	\$ 5,680
Check valve, 04"	4	EA	\$ 755	\$ 3,020
Electrical/Instrumentation	2	EA	\$ 10,250	\$ 20,500
Site work	2	EA	\$ 2,560	\$ 5,120
Building pad	2	EA	\$ 5,125	\$ 10,250
Pump Building	2	EA	\$ 10,250	\$ 20,500
Fence	2	EA	\$ 6,150	\$ 12,300
Tools	2	EA	\$ 1,025	\$ 2,050
5,000 gal feed tank	1	EA	\$ 10,000	\$ 10,000
10,000 gal ground storage tank	1	EA	\$ 15,000	\$ 15,000
Subtotal				\$ 137,520
<i>Well Installation</i>				
Well installation	300	LF	\$ 150.5	\$ 45,150
Water quality testing	2	EA	\$ 1,280	\$ 2,560
Well pump	1	EA	\$ 2,750	\$ 2,750
Well electrical/instrumentation	1	EA	\$ 5,635	\$ 5,635
Well cover and base	1	EA	\$ 3,075	\$ 3,075
Piping	1	EA	\$ 3,075	\$ 3,075
Subtotal				\$ 62,245

Subtotal of Component Costs **\$ 679,876**

Contingency 20% \$ 135,975
Design & Constr Management 25% \$ 169,969

TOTAL CAPITAL COSTS **\$ 985,820**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Pipeline O&M</i>				
Pipeline O&M	5.0	mile	\$ 275	\$ 1,375
Subtotal				\$ 1,375
<i>Pump Station(s) O&M</i>				
Building Power	23,600	kWH	\$ 0.097	\$ 2,289
Pump Power	611	kWH	\$ 0.097	\$ 59
Materials	2	EA	\$ 1,540	\$ 3,080
Labor	730	Hrs	\$ 60.00	\$ 43,800
Tank O&M	1	EA	\$ 1,025	\$ 1,025
Subtotal				\$ 50,253
<i>Well O&M</i>				
Pump power	8,089	kWH	\$ 0.097	\$ 785
Well O&M matl	1	EA	\$ 1,540	\$ 1,540
Well O&M labor	180	Hrs	\$ 60	\$ 10,800
Subtotal				\$ 13,125
<i>O&M Credit for Existing Well Closure</i>				
Pump power	3,100	kWH	\$ 0.097	\$ (301)
Well O&M matl	1	EA	\$ 1,540	\$ (1,540)
Well O&M labor	180	Hrs	\$ 60	\$ (10,800)
Subtotal				\$ (12,641)

TOTAL ANNUAL O&M COSTS **\$ 52,112**

Table C.6

PWS Name *Valley Estates*
Alternative Name *New Well at 1 Mile*
Alternative Number *VE-6*

Distance from PWS to new well location 1.0 miles
Estimated well depth 300 feet
Number of wells required 1
Well installation cost (location specific) \$150.5 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
<i>Pipeline Construction</i>				
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	\$ 12	\$ 63,360
Bore and encasement, 10"	-	LF	\$ 240	-
Open cut and encasement, 10"	50	LF	\$ 130	\$ 6,500
Gate valve and box, 04"	1	EA	\$ 710	\$ 750
Air valve	1	EA	\$ 2,050	\$ 2,050
Flush valve	1	EA	\$ 1,025	\$ 1,082
Metal detectable tape	5,280	LF	\$ 2	\$ 10,560
Subtotal				\$ 84,302
<i>Pump Station(s) Installation</i>				
Pump	2	EA	\$ 8,000	\$ 16,000
Pump Station Piping, 04"	1	EA	\$ 550	\$ 550
Gate valve, 04"	4	EA	\$ 710	\$ 2,840
Check valve, 04"	2	EA	\$ 755	\$ 1,510
Electrical/Instrumentation	1	EA	\$ 10,250	\$ 10,250
Site work	1	EA	\$ 2,560	\$ 2,560
Building pad	1	EA	\$ 5,125	\$ 5,125
Pump Building	1	EA	\$ 10,250	\$ 10,250
Fence	1	EA	\$ 6,150	\$ 6,150
Tools	1	EA	\$ 1,025	\$ 1,025
5,000 gal feed tank	-	EA	\$ 10,000	-
10,000 gal ground storage tank	1	EA	\$ 15,000	\$ 15,000
Subtotal				\$ 71,260
<i>Well Installation</i>				
Well installation	300	LF	\$ 150.5	\$ 45,150
Water quality testing	2	EA	\$ 1,280	\$ 2,560
Well pump	1	EA	\$ 2,750	\$ 2,750
Well electrical/instrumentation	1	EA	\$ 5,635	\$ 5,635
Well cover and base	1	EA	\$ 3,075	\$ 3,075
Piping	1	EA	\$ 3,075	\$ 3,075
Subtotal				\$ 62,245

Subtotal of Component Costs **\$ 217,807**

Contingency 20% \$ 43,561
Design & Constr Management 25% \$ 54,452

TOTAL CAPITAL COSTS **\$ 315,820**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Pipeline O&M</i>				
Pipeline O&M	1.0	mile	\$ 275	\$ 275
Subtotal				\$ 275
<i>Pump Station(s) O&M</i>				
Building Power	11,800	kWH	\$ 0.097	\$ 1,145
Pump Power	-	kWH	\$ 0.097	-
Materials	1	EA	\$ 1,540	\$ 1,540
Labor	365	Hrs	\$ 60.00	\$ 21,900
Tank O&M	1	EA	\$ 1,025	\$ 1,025
Subtotal				\$ 25,610
<i>Well O&M</i>				
Pump power	8,089	kWH	\$ 0.097	\$ 785
Well O&M matl	1	EA	\$ 1,540	\$ 1,540
Well O&M labor	180	Hrs	\$ 60	\$ 10,800
Subtotal				\$ 13,125
<i>O&M Credit for Existing Well Closure</i>				
Pump power	3,100	kWH	\$ 0.097	\$ (301)
Well O&M matl	1	EA	\$ 1,540	\$ (1,540)
Well O&M labor	180	Hrs	\$ 60	\$ (10,800)
Subtotal				\$ (12,641)

TOTAL ANNUAL O&M COSTS **\$ 26,369**

Table C.7

PWS Name *Valley Estates*
Alternative Name *Central Treatment - Reverse Osmosis*
Alternative Number *VE-7*

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Reverse Osmosis Unit Purchase/Installation</i>				
Site preparation	0.40	acre	\$ 4,000	\$ 1,600
Slab	25	CY	\$ 1,000	\$ 25,000
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	2,500	SF	\$ 2	\$ 5,000
Electrical	1	JOB	\$ 40,000	\$ 40,000
Piping	1	JOB	\$ 20,000	\$ 20,000
Reverse osmosis package including:				
High pressure pumps - 20 hp				
Cartridge filters and vessels				
RO membranes and vessels				
Control system				
Chemical feed systems				
Freight cost				
Vendor start-up services	1	UNIT	\$ 72,000	\$ 72,000
Transfer pumps	4	EA	\$ 5,000	\$ 20,000
Permeate tank	1,500	gal	\$ 3	\$ 4,500
Feed Tank	12,000	gal	\$ 3	\$ 36,000
Reject pond:				
Excavation	800	CYD	\$ 3.00	\$ 2,400
Compacted fill	640	CYD	\$ 7.00	\$ 4,480
Lining	1,600	SF	\$ 1.50	\$ 2,400
Vegetation	800	SY	\$ 1.50	\$ 1,200
Access road	400	LF	\$ 30.00	\$ 12,000
Subtotal of Design/Construction Costs				\$ 294,080
Contingency	20%		\$	58,816
Design & Constr Management	25%		\$	73,520
Reject water haulage truck	1	EA	\$ 100,000	\$ 100,000

TOTAL CAPITAL COSTS **\$ 526,416**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Reverse Osmosis Unit O&M</i>				
Building Power	4,500	kwh/yr	\$ 0.097	\$ 437
Equipment power	24,000	kwh/yr	\$ 0.097	\$ 2,328
Labor	800	hrs/yr	\$ 40.00	\$ 32,000
RO materials and Chemicals	3,700	kgal	\$ 0.75	\$ 2,775
Analyses	12	test	\$ 200	\$ 2,400
Subtotal				\$ 39,940
<i>Backwash Disposal</i>				
Disposal truck mileage	9,400	miles	\$ 1.50	\$ 14,100
Backwash disposal fee	1,332	kgal/yr	\$ 5.00	\$ 6,660
Subtotal				\$ 20,760

TOTAL ANNUAL O&M COSTS **\$ 60,700**

Table C.8

PWS Name *Valley Estates*
Alternative Name *Central Treatment - Electro-dialysis Reversal*
Alternative Number *VE-8*

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Reverse Osmosis Unit Purchase/Installation</i>				
Site preparation	0.40	acre	\$ 4,000	\$ 1,600
Slab	23	CY	\$ 1,000	\$ 22,500
Building	450	SF	\$ 60	\$ 27,000
Building electrical	450	SF	\$ 8	\$ 3,600
Building plumbing	450	SF	\$ 8	\$ 3,600
Heating and ventilation	450	SF	\$ 7	\$ 3,150
Fence	400	LF	\$ 15	\$ 6,000
Paving	2,000	SF	\$ 2	\$ 4,000
Electrical	1	JOB	\$ 50,000	\$ 50,000
Piping	1	JOB	\$ 20,000	\$ 20,000
EDR package including:				
Feed and concentrate pumps				
Cartridge filters and vessels				
EDR membrane stacks				
Electrical module				
Chemical feed systems				
Freight cost				
Vendor start-up services	1	UNIT	\$ 90,000	\$ 90,000
Transfer pumps	4	EA	\$ 5,000	\$ 20,000
Product water tank	1,500	gal	\$ 3.00	\$ 4,500
Feed Tank	12,000	gal	\$ 3.00	\$ 36,000
Reject pond:				
Excavation	600	CYD	\$ 3.00	\$ 1,800
Compacted fill	480	CYD	\$ 7.00	\$ 3,360
Lining	1,200	SF	\$ 1.50	\$ 1,800
Vegetation	700	SY	\$ 1.50	\$ 1,050
Access road	350	LF	\$ 30.00	\$ 10,500
Subtotal of Design/Construction Costs				\$ 310,460
Contingency	20%		\$	62,092
Design & Constr Management	25%		\$	77,615
Reject water haulage truck	1	EA	\$ 100,000	\$ 100,000

TOTAL CAPITAL COSTS **\$ 550,167**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>EDR Unit O&M</i>				
Building Power	4,000	kwh/yr	\$ 0.097	\$ 388
Equipment power	30,000	kwh/yr	\$ 0.097	\$ 2,910
Labor	800	hrs/yr	\$ 40.00	\$ 32,000
Materials	3,700	kgal	\$ 0.48	\$ 1,776
Chemicals	3,700	kgal	\$ 0.40	\$ 1,480
Analyses	12	test	\$ 200	\$ 2,400
Subtotal				\$ 40,954
<i>Backwash Disposal</i>				
Disposal truck mileage	7,000	miles	\$ 1.50	\$ 10,500
Backwash disposal fee	1,332	kgal/yr	\$ 5.00	\$ 6,660
Subtotal				\$ 17,160

TOTAL ANNUAL O&M COSTS **\$ 58,114**

Table C.9

PWS Name *Valley Estates*
Alternative Name *Point-of-Use Treatment*
Alternative Number *VE-9*

Number of Connections for POU Unit Installation 36 connections

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>POU-Treatment - Purchase/Installation</i>				
POU treatment unit purchase	36	EA	\$ 615	\$ 22,140
POU treatment unit installation	36	EA	\$ 155	\$ 5,580
Subtotal				\$ 27,720
Subtotal of Component Costs				\$ 27,720
Contingency	20%		\$	5,544
Design & Constr Management	25%		\$	6,930
Procurement & Administration	20%		\$	5,544
TOTAL CAPITAL COSTS				\$ 45,738

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>O&M</i>				
POU materials, per unit	36	EA	\$ 230	\$ 8,280
Contaminant analysis, 1/yr per unit	36	EA	\$ 205	\$ 7,380
Program labor, 10 hrs/unit	360	hrs	\$ 40	\$ 14,400
Subtotal				\$ 30,060
TOTAL ANNUAL O&M COSTS				\$ 30,060

Table C.10

PWS Name *Valley Estates*
Alternative Name *Point-of-Entry Treatment*
Alternative Number *VE-10*

Number of Connections for POE Unit Installation 36 connections

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>POE-Treatment - Purchase/Installat</i>				
POE treatment unit purchase	36	EA	\$ 5,125	\$ 184,500
Pad and shed, per unit	36	EA	\$ 2,050	\$ 73,800
Piping connection, per unit	36	EA	\$ 1,025	\$ 36,900
Electrical hook-up, per unit	36	EA	\$ 1,025	\$ 36,900
Subtotal				\$ 332,100

Subtotal of Component Costs **\$ 332,100**

Contingency	20%	\$ 66,420
Design & Constr Management	25%	\$ 83,025
Procurement & Administration	20%	\$ 66,420

TOTAL CAPITAL COSTS **\$ 547,965**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>O&M</i>				
POE materials, per unit	36	EA	\$ 1,540	\$ 55,440
Contaminant analysis, 1/yr per unit	36	EA	\$ 205	\$ 7,380
Program labor, 10 hrs/unit	360	hrs	\$ 40	\$ 14,400
Subtotal				\$ 77,220

TOTAL ANNUAL O&M COSTS **\$ 77,220**

Table C.11

PWS Name *Valley Estates*
Alternative Name *Public Dispenser for Treated Drinking Water*
Alternative Number *VE-11*

Number of Treatment Units Recommended 1

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Public Dispenser Unit Installation</i>				
POE-Treatment unit(s)	1	EA	\$ 7,175	\$ 7,175
Unit installation costs	1	EA	\$ 5,125	\$ 5,125
Subtotal				\$ 12,300
Subtotal of Component Costs				\$ 12,300
Contingency	20%			\$ 2,460
Design & Constr Management	25%			\$ 3,075
TOTAL CAPITAL COSTS				17,835

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Program Operation</i>				
Treatment unit O&M, 1 per unit	1	EA	\$ 2,050	\$ 2,050
Contaminant analysis, 1/wk per u	52	EA	\$ 205	\$ 10,660
Sampling/reporting, 1 hr/day	365	HRS	\$ 60	\$ 21,900
Subtotal				\$ 34,610
TOTAL ANNUAL O&M COSTS				\$ 34,610

Table C.12

PWS Name *Valley Estates*
Alternative Name *Supply Bottled Water to 100% of Population*
Alternative Number *VE-12*

Service Population 70
Percentage of population requiring supply 100%
Water consumption per person 1.00 gpcd
Calculated annual potable water needs 25,550 gallons

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Program Implementation</i>				
Initial program set-up	500	hours	\$ 45	\$ 22,500
Subtotal				\$ 22,500
Subtotal of Component Costs				\$ 22,500
Contingency	20%			\$ 4,500

TOTAL CAPITAL COSTS **\$ 27,000**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Program Operation</i>				
Water purchase costs	25,550	gals	\$ 1.25	\$ 31,938
Program admin, 9 hrs/wk	468	hours	\$ 45	\$ 21,060
Program materials	1	EA	\$ 5,125	\$ 5,125
Subtotal				\$ 58,123

TOTAL ANNUAL O&M COSTS **\$ 58,123**

Table C.13

PWS Name *Valley Estates*
Alternative Name *Central Trucked Drinking Water*
Alternative Number *VE-13*

Service Population 70
Percentage of population requiring supply 100%
Water consumption per person 1.00 gpcd
Calculated annual potable water needs 25,550 gallons
Travel distance to compliant water source 0 miles

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Storage Tank Installation</i>				
5,000 gal ground storage tank	1	EA	\$ 10,000	\$ 10,000
Site improvements	1	EA	\$ 3,075	\$ 3,075
Potable water truck	1	EA	\$ 75,000	\$ 75,000
Subtotal				\$ 88,075
Subtotal of Component Costs				\$ 88,075
Contingency	20%		\$	17,615
Design & Constr Management	25%		\$	22,019
TOTAL CAPITAL COSTS			\$	127,709

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Program Operation</i>				
Water delivery labor, 4 hrs/wk	208	hrs	\$ 60	\$ 12,480
Truck operation, 1 round trip/wk	31	miles	\$ 3.00	\$ 94
Water purchase	26	1,000 gals	\$ 2.61	\$ 67
Water testing, 1 test/wk	52	EA	\$ 205	\$ 10,660
Sampling/reporting, 2 hrs/wk	104	hrs	\$ 60	\$ 6,240
Subtotal				\$ 29,540
TOTAL ANNUAL O&M COSTS				\$ 29,540

1
2
3

APPENDIX D EXAMPLE FINANCIAL MODEL

Appendix D
General Inputs

Valley Estates

Number of Alternatives

13

Selected from Results Sheet

Input Fields are Indicated by:

General Inputs		
Implementation Year	2009	
Months of Working Capital	0	
Depreciation	\$ -	
Percent of Depreciation for Replacement Fund	0%	
Allow Negative Cash Balance (yes or no)	No	
Median Household Income	\$ 38,423	Valley Estates
Median HH Income -- Texas	\$ 39,927	
Grant Funded Percentage	0%	Selected from Results
Capital Funded from Revenues	\$ -	
	Base Year	2007
	Growth/Escalation	
Accounts & Consumption		
Metered Residential Accounts		
Number of Accounts	0.0%	36
Number of Bills Per Year		12
Annual Billed Consumption		3,686,500
Consumption per Account Per Pay Period	0.0%	8,534
Consumption Allowance in Rates		100,000
Total Allowance		43,200,000
Net Consumption Billed		(39,513,500)
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%	3,686,500
Unaccounted for Water		-
Percentage Unaccounted for Water		0.0%

Appendix D
General Inputs

Valley Estates

Number of Alternatives

13

Selected from Results Sheet

Input Fields are Indicated by:

Residential Rate Structure	Allowance within Tier	
Base Monthly Payment	-	\$ 15.00
		\$ -
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%	12,945
Other 4	0.0%	-
Incremental O&M for Alternative	0.0%	-
Total Operating Expenses		12,945
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		\$ -

Funding Source = Loan/Bond

APPENDIX E CONCEPTUAL ANALYSIS OF INCREASING COMPLIANT DRINKING WATER

E.1 Introduction

E.1.1 Overview of Drinking Water Quality in Region

There are many PWSs in the Lubbock area that do not have compliant drinking water due to elevated concentrations of naturally occurring contaminants in the area groundwater. Largely, this is a result of the generally poor water quality associated with the Ogallala-South Formation that is the water source for most of these systems (see Chapter 3 of the report to which this is appended). The common groundwater contaminants in the Ogallala-South Formation include arsenic, selenium, fluoride, nitrate, and uranium.

According to the TCEQ Water Utility Database, there are nearly 24,000 people in the Lubbock area who are served by active residential PWSs that do not currently have compliant drinking water. The majority of this population can be found in the area just outside the City of Lubbock, and also to the south of the city. The total area population with noncompliant drinking water is likely greater than 24,000, since only populations served by active PWSs are included in this estimate. There is additional populations that currently obtain drinking water from private wells or are served by PWSs that have too few connections to be considered active PWSs in the TCEQ Water Utility Database. Additionally, while the issue of noncompliant drinking water affects these area residents directly, the lack of good quality drinking water may restrict growth in the entire Lubbock area.

This appendix presents a conceptual analysis of a possible regional solution to the drinking water compliance issue in the Lubbock area. The purpose of this analysis is to investigate whether a large-scale regional approach to provide compliant drinking water might be more cost-effective than each PWS seeking its own solution. The objective of the analysis is to provide an indication of whether there is sufficient potential benefit to a regional approach to warrant further study. The conceptual analysis presented here is based on a single scenario and does not attempt to evaluate or rank a range of different solutions. For purposes of this report, this single scenario is referred to as the Lubbock Area Regional Solution (LARS).

To improve readability, the tables and figures for this appendix appear in Section E.6.

E.1.2 Evaluation of PWS Drinking Water Quality

Drinking water quality for the PWSs in the eight counties included in and around Lubbock was evaluated using TCEQ PWS drinking water quality data to identify PWSs that had potential water quality compliance issues. There are a number of PWSs that do not serve residential populations, such as restaurants, businesses, *etc.* Since this analysis is focused on residential systems, these commercial systems were excluded from the analysis. Additionally, systems listed as “inactive” were also excluded because it was not easy to determine whether they were listed as inactive because of small size, or are truly inactive.

Once the active residential PWSs were identified, they were screened for the common contaminants in the area: arsenic, selenium, fluoride, nitrate, and uranium. Systems with concentrations of the identified contaminants greater than MCLs were deemed to have noncompliant water. It is important to note that this screening was not an official compliance determination, and a system's compliance status determined from the screening may not coincide with a system's actual compliance status. Discrepancies may result from the data available not being current, the use of simplified algorithms to give an indication of compliance, *etc.*

The PWSs identified with potential water quality compliance issues are shown in Table E.1, along with numbers of connections, the population served, and average daily consumption. For the LARS, the area has been divided into three separate subareas named LARS–Lubbock, LARS-Lamesa, and LARS-Brownfield. The PWSs, population, connections, and average daily consumptions for these subareas are shown in Tables E.2, E.3, and E.4. These systems are also shown in Figure E.1. As can be seen on the figure, these systems are generally located near Lubbock and south of Lubbock.

E.1.3 Existing Drinking Water Supplies and Infrastructure

PWSs in the area typically obtain drinking water from wells, purchase water from the City of Lubbock, or obtain water from the Canadian River Municipal Water Authority (CRMWA), either as one of the 11 member cities or as customers of a member city. The City of Lubbock is a member city of the CRMWA and has the largest water system in the area. As well as getting water from the CRMWA, Lubbock obtains water from its own well field in Bailey County. The CRMWA provides surface water and groundwater via a pipeline from the north to a water treatment plant located at and operated by Lubbock, from which point the treated water is distributed via transmission mains to the seven member cities west and south of Lubbock. There are existing CRMWA pipelines that extend to the southeast and west and southwest from Lubbock. The approximate location and extent of these lines are shown in Figure E.1.

The CRMWA production is fully committed to the 11 member cities. In addition, the transmission mains from Lubbock to the other seven member cities are at capacity during the summer months. Therefore, the LARS scenario proposed here uses new wells for the water source and if existing pipeline infrastructure is used for water transmission, allowances are made to account for any pipeline capacity used.

E.2 Description of the LARS

Since existing water supplies and infrastructure do not have sufficient capacity available, and the existing infrastructure does not cover the entire area projected to be served by the LARS, the LARS needs to provide both a water source and a means of conveyance. To accomplish this, the LARS includes several groundwater treatment plants located near clusters of PWSs with water quality problems. The locations of these treatment plants include one near the existing water treatment plant in Lubbock, one at Lamesa, and one at Brownfield (Figure E.2).

In addition to the groundwater treatment plants, new well fields would also be required to feed the groundwater treatment plants. The assumed water quality used to design each

groundwater treatment plant is based on water quality data for PWSs near the proposed plant location. Groundwater treatment will be achieved using RO technology because, of the two technologies best suited for treating contaminants generally found in the water of the Ogallala-South aquifer (RO and EDR), RO is typically the most economical option.

The plant at Lubbock would tie into the Lubbock distribution system. The water would be passed through the Lubbock distribution system, and pipelines would be run from the Lubbock distribution system to the noncompliant PWSs around Lubbock. The location of the treatment plant, required new pipelines, and potential customers for the Lubbock component of the LARS are shown on Figure E.3.

The plant at Lamesa could tie into the Lubbock distribution system at Lamesa or could be independent. If tied into the Lamesa system, it could supplement Lamesa's system to allow the non-compliant PWSs upstream of Lamesa to withdraw water without impacting existing customers between Lamesa and Lubbock. If not tied in, the system could serve PWSs outside the Lamesa area. The location of the treatment plant, required new pipelines, and potential customers for the Lamesa component of the LARS are shown on Figure E.4.

The plant at Brownfield could tie into the Brownfield distribution system at Brownfield or could be independent. If tied into the Brownfield system, it could supplement Lubbock's system to allow the non-compliant PWSs upstream of Brownfield to withdraw water without impacting existing customers between Brownfield and Lubbock. If not tied in, the system could serve PWSs outside the Brownfield area. The location of the treatment plant, required new pipelines, and potential customers for the Brownfield component of the LARS are shown on Figure E.5.

Pipelines could be built to connect the CRMWA lines to the other noncompliant PWSs. In this way, the Lamesa and Brownfield groundwater treatment plants could provide enough drinking water to meet the demands of the systems at the ends of the CRMWA lines to offset water that would be taken out by noncompliant PWSs along the existing CRMWA lines. Connecting pipelines for the groundwater treatment plants and noncompliant PWSs to the existing City of Lubbock and CRMWA pipe systems reduces the need for added infrastructure to implement the regional solution, and would provide operational flexibility.

E.3 Estimated Costs

Costs to implement the LARS were estimated. This includes costs for new wells, pipelines, pump stations, and treatment plants. A conceptual design was developed for the main infrastructure components, and was used as the basis for estimating capital and O&M costs. The estimated capital and O&M costs for the major infrastructure components are summarized in Table E.5. The annualized costs of these components are also shown in Table E.5, using a 6 percent discount rate and a 20-year period. Details of the capital costs for the three subareas are included in Tables E.6, E.7, and E.8.

Table E-9 presents an estimate of the cost of service to the LARS customers. If the customers were to bear the total capital and operating costs of the systems for their subarea or the system as a whole, the approximate monthly cost per connection would be as follows:

LARS-Lubbock:	\$97/month	\$1,163/year	3% of MHI
LARS-Lamesa:	\$233/month	\$2,794/year	7% of MHI
LARS-Brownfield:	\$190/month	\$2,281/year	6% of MHI
Combined:	\$173/month	\$2,079/year	5% of MHI

1 If the systems would be able to get 100 percent grant funding for the capital costs of
2 constructing the system, the approximate monthly cost per connection would be as follows:

LARS-Lubbock:	\$43/month	\$519/year	1% of MHI
LARS-Lamesa:	\$61/month	\$732/year	2% of MHI
LARS-Brownfield:	\$80/month	\$962/year	3% of MHI
Combined:	\$61/month	\$738/year	2% of MHI

3 This then forms the approximate range of the cost of service for the customers (per
4 connection) of a regional solution.

5 Increasing the coverage of the regional solution to include populations served by inactive
6 PWSs or those that have private wells could have the effect of reducing treatment costs on a per
7 gallon basis, but increasing the cost for distribution piping. Likewise, other sources of water
8 with associated quality aspects would affect the cost, including surface water sources, better
9 groundwater sources, and the use of reclaimed water, either for supplemental potable or non-
10 potable uses. A more detailed assessment would be required to determine whether the overall
11 effect would be an increase or decrease on the cost to the customers.

12 **E.4 Conclusion**

13 A regional solution to serving non-compliant PWSs in the Lubbock area presents a
14 potentially viable solution to an existing problem. If suitable groundwater can be found, a
15 regional system could be implemented within a cost per connection range of \$61/month to
16 \$173/month, with the actual cost depending on the source and costs of capital funds needed to
17 build a regional system.

18 A Community Development Block Grant is one possible source of funding the capital
19 costs for the regional solution. Community Development Block Grants are discussed further in
20 Attachment E1.

21 **E.5 Tables and Figures**

Table E.1
Active Residential Public Water Systems with Potential Water Quality Problems
Lubbock Area Regional Solution

PWS ID #	PWS Name	Population	Connections	Avg. Daily Consumption (mgd)	County
0170010	BORDEN COUNTY WATER SYSTEM	150	98	0.012	BORDEN
0580011	CITY OF ACKERLY	230	126	0.004	DAWSON
0580013	WELCH WATER SUPPLY CORP	354	115	0.035	DAWSON
0580025	KLONDIKE ISD	207	11	0.025	DAWSON
0830001	SEAGRAVES CITY OF	2396	931	0.344	GAINES
0830011	LOOP WATER SUPPLY CORP	300	113	0.040	GAINES
0830012	SEMINOLE CITY OF	5916	2540	1.410	GAINES
0850002	SOUTHLAND ISD	190	4	0.019	GARZA
1100004	ROPESVILLE CITY OF	517	196	0.094	HOCKLEY
1100010	SMYER CITY OF	480	180	0.051	HOCKLEY
1100011	WHITHARRAL WATER SUPPLY CORP	275	82	0.043	HOCKLEY
1100030	OPDYKE WEST WATER SUPPLY	140	63	0.018	HOCKLEY
1520005	WOLFFORTH CITY OF	3000	1150	0.439	LUBBOCK
1520009	BIG Q MOBILE HOME ESTATES	200	70	0.013	LUBBOCK
1520025	BUSTERS MOBILE HOME PARK	20	8	0.002	LUBBOCK
1520026	FAMILY COMMUNITY CENTER MHP	88	40	0.011	LUBBOCK
1520027	WAGON WHEEL MOBILE VILLAGE HOME PR	30	21	0.003	LUBBOCK
1520036	GREEN MOBILE HOME PARK	50	28	0.004	LUBBOCK
1520039	PECAN GROVE MOBILE HOME PARK	100	50	0.008	LUBBOCK
1520062	PLOTT ACRES	201	63	0.019	LUBBOCK
1520067	114TH STREET MOBILE HOME PARK	96	43	0.009	LUBBOCK
1520080	FRANKLIN WATER SERVICE COMPANY	152	64	0.011	LUBBOCK
1520094	TOWN NORTH VILLAGE WATER SYSTEM	330	117	0.031	LUBBOCK
1520106	COX ADDITION WATER SYSTEM	133	40	0.014	LUBBOCK
1520122	LUBBOCK COOPER ISD	1900	14	0.190	LUBBOCK
1520123	ROOSEVELT ISD	1600	11	0.048	LUBBOCK
1520149	WHORTON MOBILE HOME PARK	75	26	0.008	LUBBOCK
1520152	TOWN NORTH ESTATES	227	67	0.015	LUBBOCK
1520154	CHARLIE BROWNS LEARNING CENTER	47	3	0.005	LUBBOCK
1520155	COUNTRY SQUIRE MHP 2	75	16	0.008	LUBBOCK
1520156	ELM GROVE MOBILE HOME PARK	24	20	0.002	LUBBOCK
1520158	MILLER MOBILE HOME PARK	60	33	0.005	LUBBOCK
1520185	LUBBOCK RV PARK	133	100	0.009	LUBBOCK
1520188	CASEY ESTATES WATER	312	104	0.026	LUBBOCK
1520192	TERRELLS MOBILE HOME PARK	50	22	0.005	LUBBOCK
1520198	VALLEY ESTATES	70	36	0.007	LUBBOCK
1520199	WOLFFORTH PLACE	411	137	0.041	LUBBOCK
1520211	TEXIN ENTERPRISES	26	7	0.008	LUBBOCK
1520217	SOUTHWEST GARDEN WATER	375	125	0.028	LUBBOCK
1520223	PAUL COBB WATER SYSTEM	11	10	0.003	LUBBOCK
1520225	FAY BEN MOBILE HOME PARK	90	44	0.007	LUBBOCK
1520241	MANAGED CARE CENTER	40	5	0.003	LUBBOCK
1520247	COUNTRY VIEW MHP	76	23	0.004	LUBBOCK
1530001	ODONNELL CITY OF	1011	364	0.257	LYNN
1530003	WILSON CITY OF	532	212	0.050	LYNN
1530004	NEW HOME CITY OF	375	180	0.044	LYNN
1530005	GRASSLAND WATER SUPPLY CORP	85	27	0.008	LYNN
2230002	MEADOW CITY OF	547	230	0.138	TERRY
2230003	WELLMAN PUBLIC WATER SYSTEM	225	97	0.010	TERRY
TOTALS		23,932	8,066	3.586	

Table E.2
Public Water Systems associated with LARS-Lubbock Treatment Plant

PWS ID #	PWS Name	Population	Connections	Avg. Daily Consumption (mgd)	County
0850002	SOUTHLAND ISD	190	4	0.019	GARZA
1100010	SMYER CITY OF	480	180	0.051	HOCKLEY
1100011	WHITHARRAL WATER SUPPLY CORP	275	82	0.043	HOCKLEY
1100030	OPDYKE WEST WATER SUPPLY	140	63	0.018	HOCKLEY
1520005	WOLFFORTH CITY OF	3000	1150	0.439	LUBBOCK
1520009	BIG Q MOBILE HOME ESTATES	200	70	0.013	LUBBOCK
1520025	BUSTERS MOBILE HOME PARK	20	8	0.002	LUBBOCK
1520026	FAMILY COMMUNITY CENTER MHP	88	40	0.011	LUBBOCK
1520027	WAGON WHEEL MOBILE VILLAGE HOME PR	30	21	0.003	LUBBOCK
1520036	GREEN MOBILE HOME PARK	50	28	0.004	LUBBOCK
1520039	PECAN GROVE MOBILE HOME PARK	100	50	0.008	LUBBOCK
1520062	PLOTT ACRES	201	63	0.019	LUBBOCK
1520067	114TH STREET MOBILE HOME PARK	96	43	0.009	LUBBOCK
1520080	FRANKLIN WATER SERVICE COMPANY	152	64	0.011	LUBBOCK
1520094	TOWN NORTH VILLAGE WATER SYSTEM	330	117	0.031	LUBBOCK
1520106	COX ADDITION WATER SYSTEM	133	40	0.014	LUBBOCK
1520122	LUBBOCK COOPER ISD	1900	14	0.190	LUBBOCK
1520123	ROOSEVELT ISD	1600	11	0.048	LUBBOCK
1520149	WHORTON MOBILE HOME PARK	75	26	0.008	LUBBOCK
1520152	TOWN NORTH ESTATES	227	67	0.015	LUBBOCK
1520154	CHARLIE BROWNS LEARNING CENTER	47	3	0.005	LUBBOCK
1520155	COUNTRY SQUIRE MHP 2	75	16	0.008	LUBBOCK
1520156	ELM GROVE MOBILE HOME PARK	24	20	0.002	LUBBOCK
1520158	MILLER MOBILE HOME PARK	60	33	0.005	LUBBOCK
1520185	LUBBOCK RV PARK	133	100	0.009	LUBBOCK
1520188	CASEY ESTATES WATER	312	104	0.026	LUBBOCK
1520192	TERRELLS MOBILE HOME PARK	50	22	0.005	LUBBOCK
1520198	VALLEY ESTATES	70	36	0.007	LUBBOCK
1520199	WOLFFORTH PLACE	411	137	0.041	LUBBOCK
1520211	TEXIN ENTERPRISES	26	7	0.008	LUBBOCK
1520217	SOUTHWEST GARDEN WATER	375	125	0.028	LUBBOCK
1520223	PAUL COBB WATER SYSTEM	11	10	0.003	LUBBOCK
1520225	FAY BEN MOBILE HOME PARK	90	44	0.007	LUBBOCK
1520241	MANAGED CARE CENTER	40	5	0.003	LUBBOCK
1520247	COUNTRY VIEW MHP	76	23	0.004	LUBBOCK
1530003	WILSON CITY OF	532	212	0.050	LYNN
1530004	NEW HOME CITY OF	375	180	0.044	LYNN
TOTALS		11,994	3,218	1.209	

Table E.3
Public Water Systems associated with LARS-Lamesa Treatment Plant

PWS ID #	PWS Name	Population	Connections	Avg. Daily Consumption (mgd)	County
0170010	BORDEN COUNTY WATER SYSTEM	150	98	0.012	BORDEN
0580011	CITY OF ACKERLY	230	126	0.004	DAWSON
0580013	WELCH WATER SUPPLY CORP	354	115	0.035	DAWSON
0580025	KLONDIKE ISD	207	11	0.025	DAWSON
1530001	ODONNELL CITY OF	1011	364	0.257	LYNN
1530005	GRASSLAND WATER SUPPLY CORP	85	27	0.008	LYNN
TOTALS		2,037	741	0.341	

Table E.4
Public Water Systems associated with LARS-Brownfield Treatment Plant

PWS ID #	PWS Name	Population	Connections	Avg. Daily Consumption (mgd)	County
0830001	SEAGRAVES CITY OF	2396	931	0.344	GAINES
0830011	LOOP WATER SUPPLY CORP	300	113	0.040	GAINES
0830012	SEMINOLE CITY OF	5916	2540	1.410	GAINES
1100004	ROPESVILLE CITY OF	517	196	0.094	HOCKLEY
2230002	MEADOW CITY OF	547	230	0.138	TERRY
2230003	WELLMAN PUBLIC WATER SYSTEM	225	97	0.010	TERRY
TOTALS		9,901	4,107	2.036	

Table E.5
Summary of Cost Components
Lubbock Area Regional Solution (LARS)

Cost Item	Capital	O&M	Annualized 20yr, 6%
<i>LARS - Lamesa</i>			
Wells	\$ 783,000	\$ 96,638	\$ 164,904
Treatment Plant	\$ 3,126,200	\$ 318,331	\$ 590,887
Pipeline and Pump Stations	\$ 13,615,339	\$ 127,211	\$ 1,314,258
Subtotal	\$ 17,524,539	\$ 542,180	\$ 2,070,049
<i>LARS - Brownfield</i>			
Wells	\$ 4,698,000	\$ 579,281	\$ 988,874
Treatment Plant	\$ 14,227,400	\$ 1,677,715	\$ 2,918,125
Pipeline and Pump Stations	\$ 43,189,155	\$ 1,694,814	\$ 5,460,241
Subtotal	\$ 62,114,555	\$ 3,951,810	\$ 9,367,240
<i>LARS - Lubbock</i>			
<i>Wells</i>	\$ 2,740,500	\$ 339,603	\$ 578,533
Treatment Plant	\$ 7,252,900	\$ 871,540	\$ 1,503,881
Pipeline and Pump Stations	\$ 13,778,461	\$ 460,173	\$ 1,661,442
Subtotal	\$ 23,771,861	\$ 1,671,317	\$ 3,743,856
TOTAL	\$ 103,410,955	\$ 6,165,307	\$ 15,181,146

Table E.6
Lubbock Area Regional Solution - Treatment Plant at Lubbock
Summary of Cost Components

Item	Quantity	Unit	Capital	O&M
<i>Wells</i>				
New wells	28	EA	\$ 1,890,000	\$ 339,603
Contingency	20%		\$ 378,000	
Design & Constr Management	25%		\$ 472,500	
Subtotal			\$ 2,740,500	\$ 339,603
<i>Treatment</i>				
RO Treatment Plant	1	EA	\$ 5,002,000	\$ 871,540
Contingency	20%		\$ 1,000,400	
Design & Constr Management	25%		\$ 1,250,500	
Subtotal			\$ 7,252,900	\$ 871,540
<i>Pipeline</i>				
4" Pipeline w/complete installation	49.07	Miles	\$ 5,916,959	\$ 12,385
6" Pipeline w/complete installation	3.66	Miles	\$ 622,107	\$ 856
10" Pipeline w/complete installation	2.17	Miles	\$ 612,761	\$ 542
Contingency	20%		\$ 1,430,365	
Design & Constr Management	25%		\$ 1,787,957	
Subtotal			\$ 10,370,149	\$ 13,783
<i>Pump Stations</i>				
Pump Stations	13	EA	\$ 2,350,560	\$ 446,390
Contingency	20%		\$ 470,112	
Design & Constr Management	25%		\$ 587,640	
Subtotal			\$ 3,408,312	\$ 446,390
TOTAL COSTS			\$ 23,771,861	\$ 1,671,317

Table E.7

Lubbock Area Regional Solution - Treatment Plant at Lamesa
Summary of Cost Components

Item	Quantity	Unit	Capital	O&M
<i>Wells</i>				
New wells	8	EA	\$ 540,000	\$ 96,638
Contingency	20%		\$ 108,000	
Design & Constr Management	25%		\$ 135,000	
Subtotal			\$ 783,000	\$ 96,638
<i>Treatment</i>				
RO Treatment Plant	1	EA	\$ 2,156,000	\$ 318,331
Contingency	20%		\$ 431,200	
Design & Constr Management	25%		\$ 539,000	
Subtotal			\$ 3,126,200	\$ 318,331
<i>Pipeline</i>				
4" Pipeline w/complete installation	33.30	Miles	\$ 3,097,199	\$ 9,159
6" Pipeline w/complete installation	15.15	Miles	\$ 1,878,740	\$ 4,166
8" Pipeline w/complete installation	22.89	Miles	\$ 4,064,030	\$ 6,294
Contingency	20%		\$ 1,807,994	
Design & Constr Management	25%		\$ 2,259,992	
Subtotal			\$ 13,107,955	\$ 19,618
<i>Pump Stations</i>				
Pump Stations	5	EA	\$ 349,920	\$ 107,592
Contingency	20%		\$ 69,984	
Design & Constr Management	25%		\$ 87,480	
Subtotal			\$ 507,384	\$ 107,592
TOTAL COSTS			\$ 17,524,539	\$ 542,180

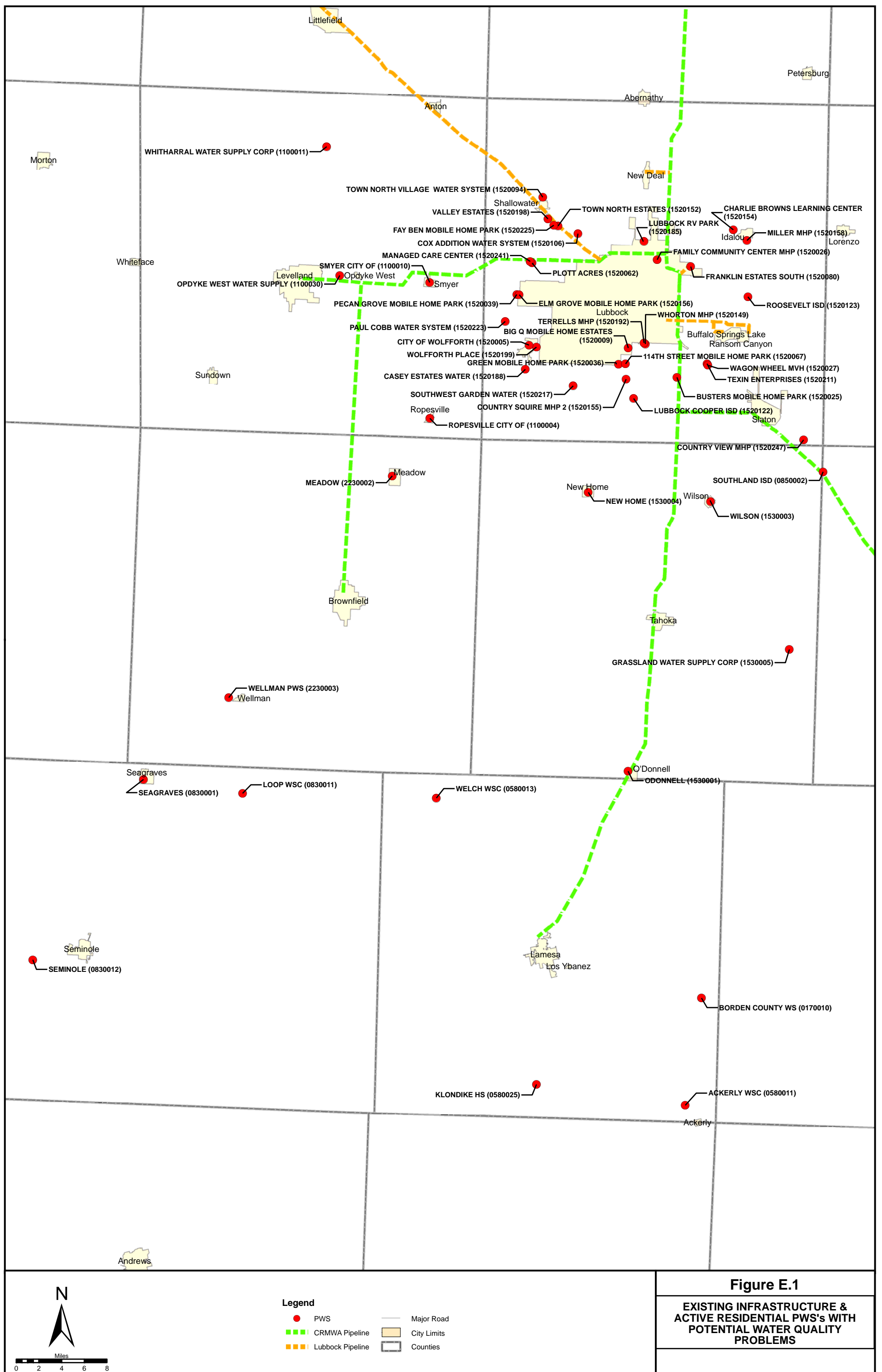
Table E.8
Lubbock Area Regional Solution - Treatment Plant at Brownfield
Summary of Cost Components

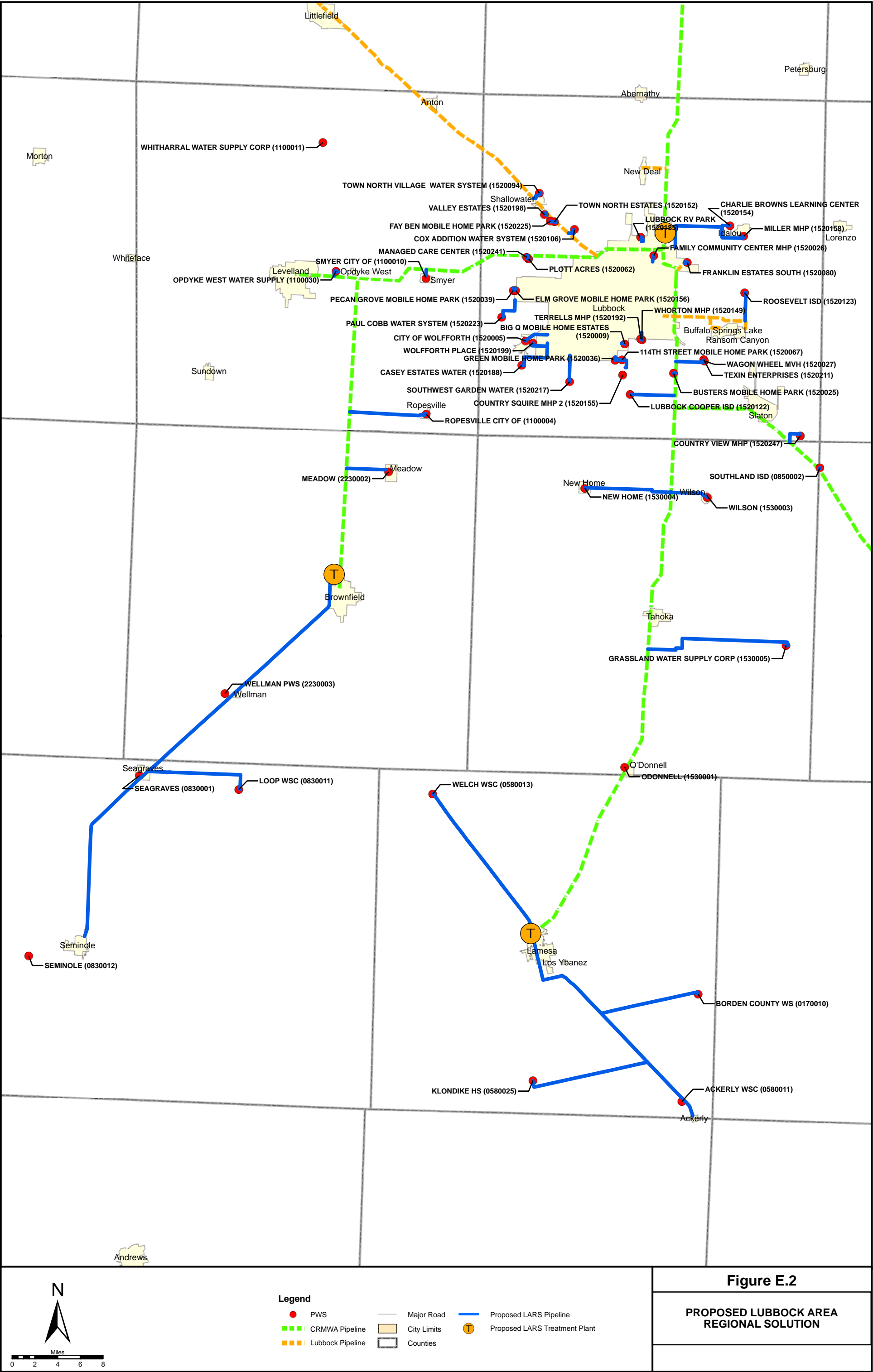
Item	Quantity	Unit	Capital	O&M
<i>Wells</i>				
New wells	48	EA	\$ 3,240,000	\$ 579,281
Contingency	20%		\$ 648,000	
Design & Constr Management	25%		\$ 810,000	
Subtotal			\$ 4,698,000	\$ 579,281
<i>Treatment</i>				
RO Treatment Plant	1	EA	\$ 9,812,000	\$ 1,677,715
Contingency	20%		\$ 1,962,400	
Design & Constr Management	25%		\$ 2,453,000	
Subtotal			\$ 14,227,400	\$ 1,677,715
<i>Pipeline</i>				
4" Pipeline w/complete installation	3.43	Miles	\$ 294,666	\$ 943
6" Pipeline w/complete installation	16.36	Miles	\$ 2,032,204	\$ 4,499
8" Pipeline w/complete installation	1.01	Miles	\$ 209,900	\$ 276
24" Pipeline w/complete installation	16.66	Miles	\$ 9,251,686	\$ 4,583
30" Pipeline w/complete installation	24.72	Miles	\$ 17,298,093	\$ 6,798
Contingency	20%		\$ 5,817,310	
Design & Constr Management	25%		\$ 7,271,637	
Subtotal			\$ 42,175,496	\$ 17,099
<i>Pump Stations</i>				
Pump Stations	6	EA	\$ 699,075	\$ 192,017
Contingency	20%		\$ 139,815	
Design & Constr Management	25%		\$ 174,769	
Subtotal			\$ 1,013,659	\$ 192,017
TOTAL COSTS			\$ 62,114,555	\$ 2,466,112

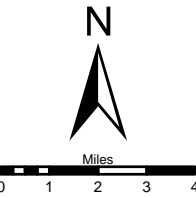
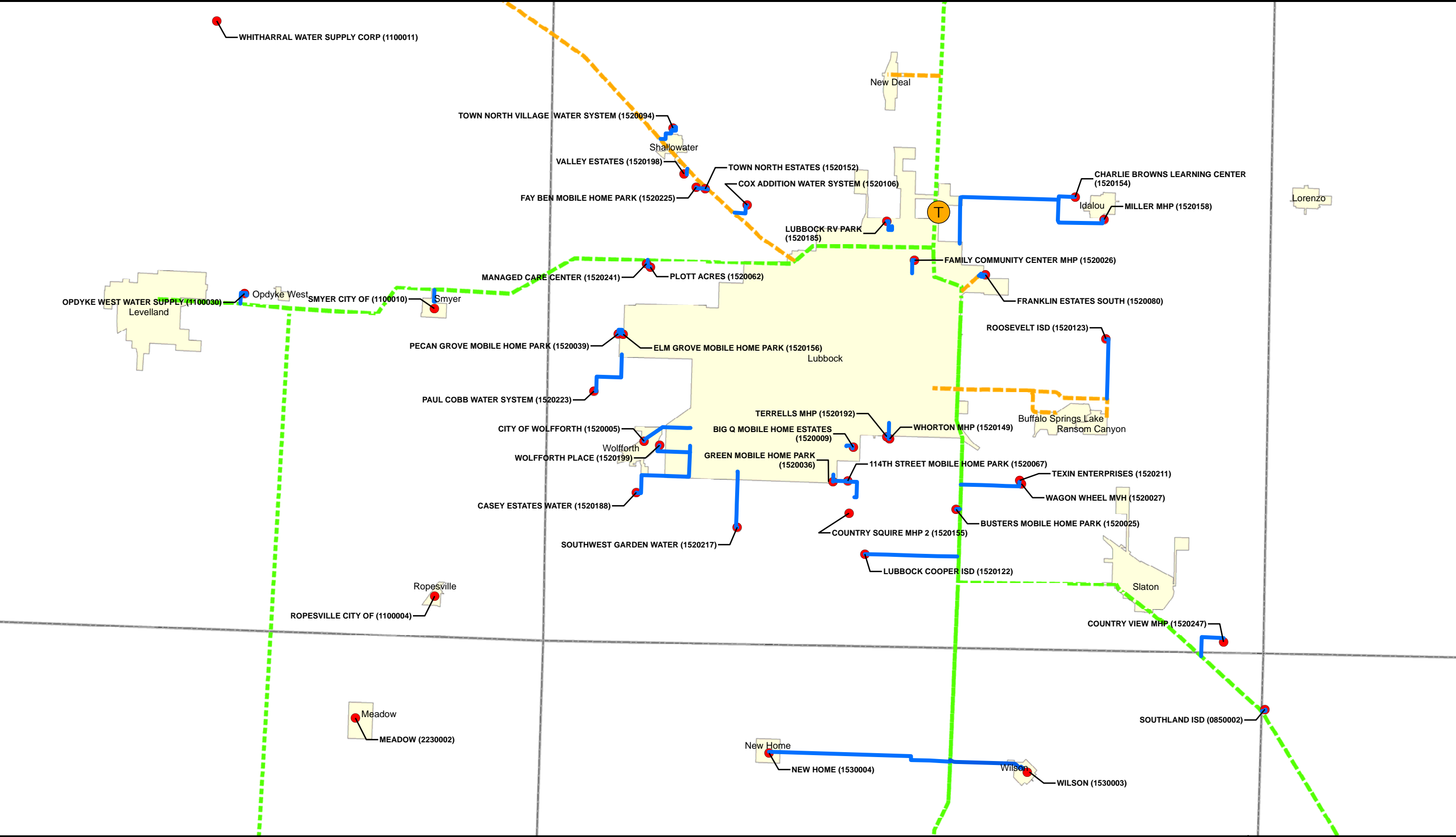
Table E.9
Lubbock Area Regional Solution (LARS)
Cost of Service

Component	Lubbock	Lamesa	Brownfield	Combined
Capital Cost	\$ 23,771,860.83	\$ 17,524,538.78	\$ 62,114,554.96	\$ 103,410,954.58
Annual O&M	\$ 1,671,316.90	\$ 542,180.24	\$ 3,951,810.23	\$ 6,165,307.37
Annualized 20 yr., 6%	\$ 3,743,856.06	\$ 2,070,049.39	\$ 9,367,240.19	\$ 15,181,145.64
Population	11,994	2,037	9,901	\$ 23,932.00
Connections	3,218	741	4,107	\$ 8,066.00
Annualized/Population	\$ 312.14	\$ 1,016.22	\$ 946.09	\$ 758.15
Annualized/Connection	\$ 1,163.41	\$ 2,793.59	\$ 2,280.80	\$ 2,079.27
Annualized/Connection as % of MHI*	3.05%	7.36%	6.00%	5.47%
Annualized/Connection/Month	\$ 96.95	\$ 232.80	\$ 190.07	\$ 173.27
Annual O&M/Population	\$ 139.35	\$ 266.17	\$ 399.13	\$ 268.21
Annual O&M/Connection	\$ 519.37	\$ 731.69	\$ 962.21	\$ 737.76
Annual O&M/Connection as % of MHI*	1.35%	1.91%	2.52%	1.93%
Annual O&M/Connection/Month	\$ 43.28	\$ 60.97	\$ 80.18	\$ 61.48

* The "percentage of MHI" is based on the MHI from the 2000 Census for Lubbock County and the census value has been marked up to reflect 2006 inflation adjusted dollars at \$37,863.



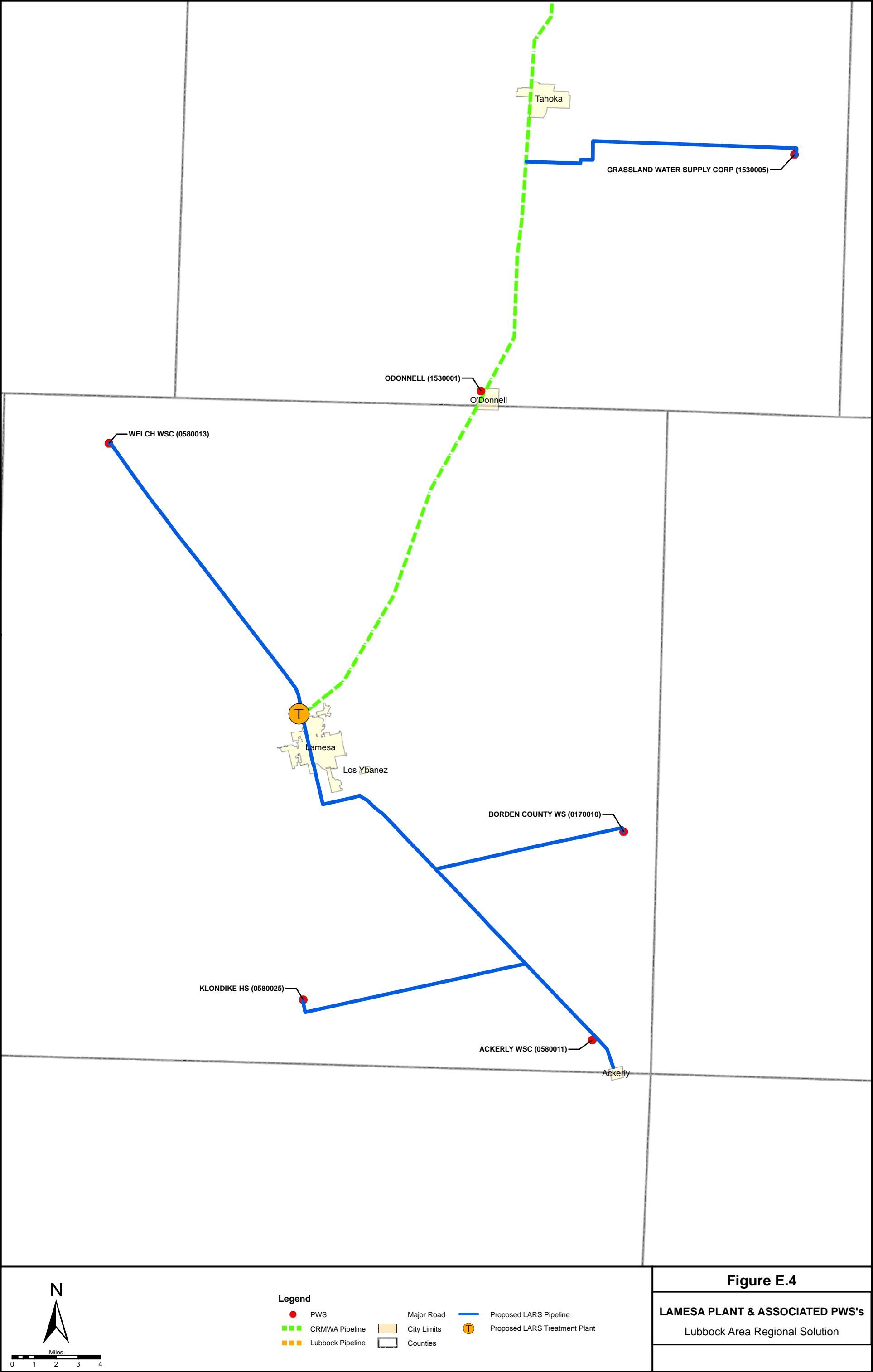




- Legend**
- PWS
 - CRMWA Pipeline
 - Lubbock Pipeline
 - Major Road
 - City Limits
 - Counties
 - Proposed LARS Pipeline
 - Proposed LARS Treatment Plant

Figure E.3

LUBBOCK PLANT & ASSOCIATED
PWS's
Lubbock Area Regional Solution



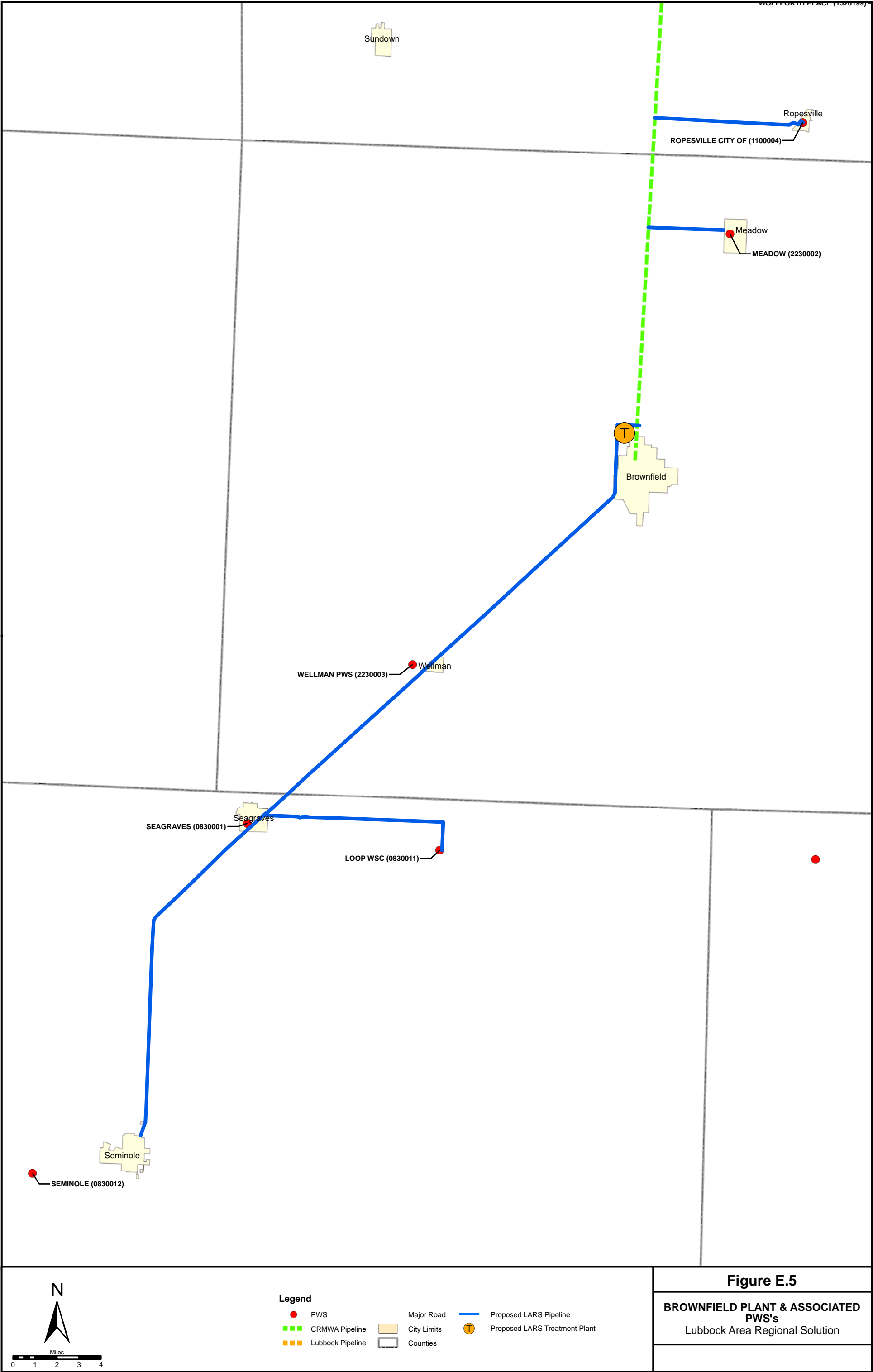


Figure E.5

BROWNFIELD PLANT & ASSOCIATED PWS's
Lubbock Area Regional Solution

Attachment E1

Texas Community Development Block Grants

Introduction

Every year, the U.S. Department of Housing and Urban Development (HUD) provides federal Community Development Block Grant (CDBG) funds directly to states, which, in turn, provide the funds to small, rural cities with populations of less than 50,000, and to counties that have a non-metropolitan population under 200,000 and are not eligible for direct funding from HUD. These small communities are called “non-entitlement” areas because they must apply for CDBG dollars through state agencies. The grants may be used for community and economic development activities, but are primarily used for housing rehabilitation, wastewater and drinking water facilities, public works facilities, and economic development. Seventy percent of grant funds must be used for activities that principally benefit low to moderate-income persons.

CDBG funds are administered through the Office of Rural Community Affairs (ORCA) and the Texas Department of Agriculture (TDA). ORCA administers the Texas Community Development Block Grant Program (Texas CDBG) and TDA administers the Texas Capital Fund (TCF) through an interagency agreement between ORCA and TDA. ORCA was created not only to focus on rural issues, but to monitor government performance, research problems and find solutions, and to coordinate rural programs among state agencies. TDA offers the infrastructure development program as part of the TCF, which provides assistance with public infrastructure projects needed to by businesses to create or retain jobs for low and moderate income persons.

ORCA’s CDBG program of Texas is the largest in the nation. The rural-focused program serves approximately 1,017 eligible rural communities, 245 rural counties, and provides services to over 375,000 low- to moderate-income beneficiaries each year. Of the 1,017 communities eligible for CDBG funds, 740 have a population of less than 3,000, and 424 have a population of less than 1,000. The demographics and rural characteristics of Texas have shaped a program that focuses on providing basic human needs and sanitary infrastructure to small rural communities in outlying areas.

Eligible Applicants

Eligible applicants are nonentitlement general purpose units of local government, including cities and counties that are not participating or designated as eligible to participate in the entitlement portion of the federal CDBG. Nonentitlement cities that are not participating in urban county programs through existing participation agreements are eligible applicants (unless the city’s population is counted toward the urban county CDBG allocation).

Nonentitlement cities are located predominately in rural areas and are cities with populations less than 50,000 thousand persons; cities that are not designated as a central city of a metropolitan statistical area; and cities that are not participating in urban county programs. Nonentitlement counties are also predominately rural in nature and are counties that generally have fewer than 200,000 persons in the nonentitlement communities and unincorporated areas located in the county.

Eligible Activities

Eligible activities under the Texas CDBG Program are listed in 42 United States Code (USC) Section 5305. The Texas CDBG staff reviews all proposed project activities included in applications for all fund categories. The Texas Department of Agriculture determines the eligibility of activities included in TCF applications.

All proposed activities must meet one of the following three National Program Objectives:

1. Benefit principally low- and moderate-income persons; or
2. Aid in the elimination of slums or blight; or
3. Meet other community development needs of particular urgency that represent an immediate threat to the health and safety of residents of the community.

Ineligible Activities

In general, any type of activity not described or referred to in 42 USC Section 5305 is ineligible. Specific activities ineligible under the Texas CDBG Program are:

1. Construction of buildings and facilities used for the general conduct of government (*e.g.*, city halls, courthouses, *etc.*);
2. Construction of new housing, except as last resort housing under 49 CFR Part 24 or affordable housing through eligible subrecipients in accordance with 24 CFR 570.204;
3. Financing of political activities;
4. Purchases of construction equipment (except in limited circumstances under the STEP Program);
5. Income payments, such as housing allowances; and
6. Most O&M expenses (including smoke testing, televising/video taping line work, or any other investigative method to determine the overall scope and location of the project work activities)

The TCF will not accept applications in support of public or private prisons, racetracks, and projects that address job creation/retention through a government supported facility. The TCF Program may be used to financially assist/facilitate the relocation of a business when certain requirements, as defined in the application guidelines, are met.

Primary Beneficiaries

The primary beneficiaries of the Texas CDBG Program are low to moderate income persons as defined under HUD, Section 8 Assisted Housing Program (Section 102(c)). Low income families are defined as those earning less than 50 percent of the area MHI. Moderate

income families are defined as those earning less than 80 percent of the area MHI. The area median family can be based on a metropolitan statistical area, a non-metropolitan county, or the statewide non-metropolitan MHI figure.

Section 108 Loan Guarantee Program

Section 108 is the loan guarantee provision of the Texas CDBG Program. Section 108 provides communities with a source of financing for economic development, housing rehabilitation, public facilities, and large-scale physical development projects. This makes it one of the most potent and important public investment tools that HUD offers to local governments. It allows these local governments to transform a small portion of their CDBG funds into federally guaranteed loans large enough to pursue physical and economic revitalization projects that can renew entire neighborhoods. Such public investment is often needed to inspire private economic activity, providing the initial resources, or simply the confidence that private firms and individuals may need to invest in distressed areas. Section 108 loans are not risk-free; however, local governments borrowing funds guaranteed by Section 108 must pledge their current and future CDBG allocations to cover the loan amount as security for the loan.

The loan is made by a private lender to an eligible nonentitlement city or county. HUD guarantees the loan; however, Texas CDBG must pledge the state's current and future CDBG nonentitlement area funds to cover any losses. To provide eligible nonentitlement communities an additional funding source, the State is authorizing a loan guarantee pilot program for 2008 consisting of one application up to a maximum of \$500,000 for a particular project. An application guide containing the submission date and qualifications will be available for applicants interested in being selected as the pilot project under this program.

APPENDIX F ANALYSIS OF SHARED SOLUTIONS FOR OBTAINING WATER FROM THE CRMWA

F.1 OVERVIEW OF METHOD USED

There are a few small PWSs with water quality problems located in the vicinity of the Valley Estates PWS 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.

The small PWSs with water quality problems near Valley Estates are listed in Table F.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 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

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

7 Method B is also based on allocating capital cost of the shared pipeline solution
8 proportionate to the amount of water used by the PWSs. However, rather than allocating the
9 *total* capital cost of the shared solution between each participating PWS, this approach splits
10 the shared pipeline into segments and allocates flow-proportional costs to the PWSs using each
11 segment. Costs for a pipeline segment are not shared by a PWS if the PWS does not use that
12 particular segment. For example, PWS #1 has an average daily water use of 0.3 mgd and PWS
13 #2 has an average daily use of 0.2 mgd. A 3-mile long pipeline segment is common to both
14 PWSs, while PWS #2 requires an additional 4-mile segment. Using this method, PWS #2
15 would be allocated 40 percent of the cost of the 3-mile segment and 100 percent of the cost of
16 the 4-mile segment. This method is a reasonable method for allocating cost when all the PWSs
17 are different in size and are located at different distances from the shared water source.

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

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

35 **F.2 SHARED SOLUTION FOR OBTAINING WATER FROM THE CRMWA**

36 This alternative would consist of constructing 5 miles of 4-inch joint pipeline from the
37 CRMWA pipeline to Valley Estates, Fay Ben MHP, and Town North Estates. The pipeline
38 routing is shown in Figure F.1 at the end of this appendix. It is assumed one pump station
39 would be required to transfer the water from the CRMWA pipeline to the three public water
40 systems.

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

9 Based on these estimates, the range of pipeline capital cost savings to Valley Estates could
10 be between \$412,500 to \$572,900 if they were to implement a shared solution like this, which
11 would be a savings between 48 to 67 percent. These estimates are hypothetical and are only
12 provided to approximate the magnitude of potential savings if this shared solution is
13 implemented as described.

14

Table F.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 for Valley Estates	Percent of Sum of Capital Costs for Individual Solutions for Valley Estates
Valley Estates	1520198	856,717	29%	\$ 856,717	42%
Fay Ben MHP	1520225	558,997	26%	\$ 558,997	28%
Town North Estates	1520152	606,673	44%	\$ 606,673	30%
Totals		2,022,386	100%	\$ 2,022,386	100%

Notes: (a) Costs for Fay Ben MHP and Town North Estates to CRMWA are provided in Tables E.12 and E.13.
Costs for Valley Estates to CRMWA (one of the alternatives for the PWS) are provided in Appendix C.

Table F.2
Capital cost for Shared Pipeline from CRMWA

Pipe Segment	Capital Cost
Pipe 1	\$ 545,481
Pipe 2	\$ 58,822
Pipe A	\$ 283,761
Pipe B	\$ 19,704
Pipe C	\$ 57,158
Totals	\$ 964,926

Notes: (b) Pipes 1 and 2 are identified as Main Links 1 and 2, respectively, and are common to both PWSs. The lettered pipes connect each PWS to the Main Links.

Table F.3
Pipeline Capital Cost Allocation by Method A
Shared Pipeline Assessment for Valley Estates

PWS	PWS #	Percentage Based On Flow	Total Costs
Valley Estates	1520198	29%	\$ 283,802
Fay Ben MHP	1520225	26%	\$ 255,422
Town North Estates	1520152	44%	\$ 425,703
Totals		100%	\$ 964,926

Table F.4
Pipeline Capital Cost Allocation by Method B
Shared Pipeline Assessment for Valley Estates

Pipeline Segment	Pipe Segment Capital Cost	Valley Estates		Fay Ben MHP		Town North Estates	
		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	\$ 545,481	29%	\$ 160,436	26%	\$ 144,392	44%	\$ 240,654
Pipe 2	\$ 58,822	0%	\$ -	38%	\$ 22,058	63%	\$ 36,764
Pipe A	\$ 283,761	100%	\$ 283,761	0%	\$ -	0%	\$ -
Pipe B	\$ 19,704	0%	\$ -	100%	\$ 19,704	0%	\$ -
Pipe C	\$ 57,158	0%	\$ -	0%	\$ -	100%	\$ 57,158
Totals	\$ 964,926		\$ 444,196		\$ 186,154		\$ 334,575

Table F.5
Pipeline Capital Cost Allocation by Method C
Shared Pipeline Assessment for Valley Estates

PWS	PWS #	Cost for Individual Pipelines	Percentage based on Individual Solutions	Allocated Capital Cost
Valley Estates	1520198	\$ 856,717	42%	\$ 408,759
Fay Ben MHP	1520225	\$ 558,997	28%	\$ 266,710
Town North Estates	1520152	\$ 606,673	30%	\$ 289,457
Totals		\$ 2,022,386	100%	\$ 964,926

Table F.6
Pipeline Capital Cost Summary
Shared Pipeline Assessment for Valley Estates

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
1520198	\$ 856,717	\$ 283,802	\$ 444,196	\$ 408,759	\$ 572,915	\$ 412,520	\$ 447,958	67%	48%	52%
1520225	\$ 558,997	\$ 255,422	\$ 186,154	\$ 266,710	\$ 303,575	\$ 372,842	\$ 292,287	54%	67%	52%
1520152	\$ 606,673	\$ 425,703	\$ 334,575	\$ 289,457	\$ 180,970	\$ 272,098	\$ 317,216	30%	45%	52%
Totals	\$ 2,022,386	\$ 964,926	\$ 964,926	\$ 964,926	\$ 1,057,460	\$ 1,057,460	\$ 1,057,460			

Table F.7**Main Link # 1****Total Pipe Length**

3.54 miles

Number of Pump Stations Needed

1

Pipe Size

04" inches

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Pipeline Construction</i>				
Number of Crossings, bore	-	n/a	n/a	n/a
Table Number of Crossings, open cut	5	n/a	n/a	n/a
PVC water line, Class 200, 04"	18,696	LF	\$ 12	\$ 224,352
Bore and encasement, 10"	-	LF	\$ 240	\$ -
Open cut and encasement, 10"	250	LF	\$ 130	\$ 32,500
Gate valve and box, 04"	4	EA	\$ 710	\$ 2,840
Air valve	4	EA	\$ 2,050	\$ 8,200
Flush valve	4	EA	\$ 1,025	\$ 4,100
Metal detectable tape	18,696	LF	\$ 2.00	\$ 37,392
Subtotal				\$ 309,384
<i>Pump Station(s) Installation</i>				
Pump	2	EA	\$ 8,000	\$ 16,000
Pump Station Piping, 04"	2	EA	\$ 550	\$ 1,100
Gate valve, 04"	4	EA	\$ 710	\$ 2,840
Check valve, 04"	2	EA	\$ 755	\$ 1,510
Electrical/Instrumentation	1	EA	\$ 10,250	\$ 10,250
Site work	1	EA	\$ 2,560	\$ 2,560
Building pad	1	EA	\$ 5,125	\$ 5,125
Pump Building	1	EA	\$ 10,250	\$ 10,250
Fence	1	EA	\$ 6,150	\$ 6,150
Tools	1	EA	\$ 1,025	\$ 1,025
5,000 gal ground storage tank	1	EA	\$ 10,000	\$ 10,000
Subtotal				\$ 66,810
Subtotal of Component Costs				\$ 376,194
Contingency	20%			\$ 75,239
Design & Constr Management	25%			\$ 94,049
TOTAL CAPITAL COSTS				\$ 545,481

Table F.8**Main Link # 2****Total Pipe Length**

0.41 miles

Number of Pump Stations Needed

0

Pipe Size

04" inches

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Pipeline Construction</i>				
Number of Crossings, bore	-	n/a	n/a	n/a
Table Number of Crossings, open cut	1	n/a	n/a	n/a
PVC water line, Class 200, 04"	2,163	LF	\$ 12	\$ 25,956
Bore and encasement, 10"	-	LF	\$ 240	\$ -
Open cut and encasement, 10"	50	LF	\$ 130	\$ 6,500
Gate valve and box, 04"	1	EA	\$ 710	\$ 710
Air valve	1	EA	\$ 2,050	\$ 2,050
Flush valve	1	EA	\$ 1,025	\$ 1,025
Metal detectable tape	2,163	LF	\$ 2.00	\$ 4,326
Subtotal				\$ 40,567
<i>Pump Station(s) Installation</i>				
Pump	-	EA	\$ 8,000	\$ -
Pump Station Piping, 04"	-	EA	\$ 550	\$ -
Gate valve, 04"	-	EA	\$ 710	\$ -
Check valve, 04"	-	EA	\$ 755	\$ -
Electrical/Instrumentation	-	EA	\$ 10,250	\$ -
Site work	-	EA	\$ 2,560	\$ -
Building pad	-	EA	\$ 5,125	\$ -
Pump Building	-	EA	\$ 10,250	\$ -
Fence	-	EA	\$ 6,150	\$ -
Tools	-	EA	\$ 1,025	\$ -
5,000 gal ground storage tank	-	EA	\$ 10,000	\$ -
Subtotal				\$ -
Subtotal of Component Costs				\$ 40,567
Contingency	20%			\$ 8,113
Design & Constr Management	25%			\$ 10,142
TOTAL CAPITAL COSTS				\$ 58,822

Table F.9**Segment A****Valley Estates****Private Pipe Size**

04"

Total Pipe Length

0.56 miles

Total PWS annual water usage

3,650,000.0 MG

Number of Pump Stations Needed

0

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Pipeline Construction</i>				
Table Number of Crossings, bore	3	n/a	n/a	n/a
Number of Crossings, open cut	1	n/a	n/a	n/a
PVC water line, Class 200, 04"	2,958	LF	\$ 12	\$ 35,496
Bore and encasement, 10"	600	LF	\$ 240	\$ 144,000
Open cut and encasement, 10"	50	LF	\$ 130	\$ 6,500
Gate valve and box, 04"	1	EA	\$ 710	\$ 710
Air valve	1	EA	\$ 2,050	\$ 2,050
Flush valve	1	EA	\$ 1,025	\$ 1,025
Metal detectable tape	2,958	LF	\$ 2.00	\$ 5,916
Subtotal				\$ 195,697
<i>Pump Station(s) Installation</i>				
Pump	-	EA	\$ 8,000	\$ -
Pump Station Piping, 04"	-	EA	\$ 550	\$ -
Gate valve, 04"	-	EA	\$ 710	\$ -
Check valve, 04"	-	EA	\$ 755	\$ -
Electrical/Instrumentation	-	EA	\$ 10,250	\$ -
Site work	-	EA	\$ 2,560	\$ -
Building pad	-	EA	\$ 5,125	\$ -
Pump Building	-	EA	\$ 10,250	\$ -
Fence	-	EA	\$ 6,150	\$ -
Tools	-	EA	\$ 1,025	\$ -
5,000 gal ground storage tank	-	EA	\$ 10,000	\$ -
Subtotal				\$ -
Subtotal of Component Costs				\$ 195,697
Contingency	20%			\$ 39,139
Design & Constr Management	25%			\$ 48,924
TOTAL CAPITAL COSTS				\$ 283,761

Table F.10**Segment B****Fay Ben MHP****Private Pipe Size**

04"

Total Pipe Length

0.04 miles

Total PWS annual water usage

3,285,000.0 MG

Number of Pump Stations Needed

0

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Pipeline Construction</i>				
Table 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"	236	LF	\$ 12	\$ 2,832
Bore and encasement, 10"	-	LF	\$ 240	\$ -
Open cut and encasement, 10"	50	LF	\$ 130	\$ 6,500
Gate valve and box, 04"	1	EA	\$ 710	\$ 710
Air valve	1	EA	\$ 2,050	\$ 2,050
Flush valve	1	EA	\$ 1,025	\$ 1,025
Metal detectable tape	236	LF	\$ 2.00	\$ 472
Subtotal				\$ 13,589
<i>Pump Station(s) Installation</i>				
Pump	-	EA	\$ 8,000	\$ -
Pump Station Piping, 04"	-	EA	\$ 550	\$ -
Gate valve, 04"	-	EA	\$ 710	\$ -
Check valve, 04"	-	EA	\$ 755	\$ -
Electrical/Instrumentation	-	EA	\$ 10,250	\$ -
Site work	-	EA	\$ 2,560	\$ -
Building pad	-	EA	\$ 5,125	\$ -
Pump Building	-	EA	\$ 10,250	\$ -
Fence	-	EA	\$ 6,150	\$ -
Tools	-	EA	\$ 1,025	\$ -
5,000 gal ground storage tank	-	EA	\$ 10,000	\$ -
Subtotal				\$ -
Subtotal of Component Costs				\$ 13,589
Contingency	20%			\$ 2,718
Design & Constr Management	25%			\$ 3,397
TOTAL CAPITAL COSTS				\$ 19,704

Table F.11**Segment C****Town North Estates****Private Pipe Size**

04"

Total Pipe Length

0.39 miles

Total PWS annual water usage

5,475,000.0 MG

Number of Pump Stations Needed

0

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Pipeline Construction</i>				
Table 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"	2,081	LF	\$ 12	\$ 24,972
Bore and encasement, 10"	-	LF	\$ 240	\$ -
Open cut and encasement, 10"	50	LF	\$ 130	\$ 6,500
Gate valve and box, 04"	1	EA	\$ 710	\$ 710
Air valve	1	EA	\$ 2,050	\$ 2,050
Flush valve	1	EA	\$ 1,025	\$ 1,025
Metal detectable tape	2,081	LF	\$ 2.00	\$ 4,162
Subtotal				\$ 39,419
<i>Pump Station(s) Installation</i>				
Pump	-	EA	\$ 8,000	\$ -
Pump Station Piping, 04"	-	EA	\$ 550	\$ -
Gate valve, 04"	-	EA	\$ 710	\$ -
Check valve, 04"	-	EA	\$ 755	\$ -
Electrical/Instrumentation	-	EA	\$ 10,250	\$ -
Site work	-	EA	\$ 2,560	\$ -
Building pad	-	EA	\$ 5,125	\$ -
Pump Building	-	EA	\$ 10,250	\$ -
Fence	-	EA	\$ 6,150	\$ -
Tools	-	EA	\$ 1,025	\$ -
10,000 gal ground storage tank	-	EA	\$ 15,000	\$ -
Subtotal				\$ -
Subtotal of Component Costs				\$ 39,419
Contingency	20%			\$ 7,884
Design & Constr Management	25%			\$ 9,855
TOTAL CAPITAL COSTS				\$ 57,158

Table F.12**Segment B****Fay Ben MHP**

Private Pipe Size

04"

Total Pipe Length

4.00 miles

Total PWS annual water usage

3,285,000.0 Gallons

Number of Pump Stations Needed

1

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Pipeline Construction</i>				
Table 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"	21,095	LF	\$ 12	\$ 253,140
Bore and encasement, 10"	-	LF	\$ 240	\$ -
Open cut and encasement, 10"	50	LF	\$ 130	\$ 6,500
Gate valve and box, 04"	5	EA	\$ 710	\$ 3,550
Air valve	4	EA	\$ 2,050	\$ 8,200
Flush valve	5	EA	\$ 1,025	\$ 5,125
Metal detectable tape	21,095	LF	\$ 2.00	\$ 42,190
Subtotal				\$ 318,705
<i>Pump Station(s) Installation</i>				
Pump	2	EA	\$ 8,000	\$ 16,000
Pump Station Piping, 04"	2	EA	\$ 550	\$ 1,100
Gate valve, 04"	4	EA	\$ 710	\$ 2,840
Check valve, 04"	2	EA	\$ 755	\$ 1,510
Electrical/Instrumentation	1	EA	\$ 10,250	\$ 10,250
Site work	1	EA	\$ 2,560	\$ 2,560
Building pad	1	EA	\$ 5,125	\$ 5,125
Pump Building	1	EA	\$ 10,250	\$ 10,250
Fence	1	EA	\$ 6,150	\$ 6,150
Tools	1	EA	\$ 1,025	\$ 1,025
5,000 gal ground storage tank	1	EA	\$ 10,000	\$ 10,000
Subtotal				\$ 66,810
Subtotal of Component Costs				\$ 385,515
Contingency	20%			\$ 77,103
Design & Constr Management	25%			\$ 96,379
TOTAL CAPITAL COSTS				\$ 558,997

Table F.13**Segment C****Town North Estates****Private Pipe Size**

04"

Total Pipe Length

4.34 miles

Total PWS annual water usage

5,475,000.0 MG

Number of Pump Stations Needed

1

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
<i>Pipeline Construction</i>				
Table 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"	22,940	LF	\$ 12	\$ 275,280
Bore and encasement, 10"	-	LF	\$ 240	\$ -
Open cut and encasement, 10"	50	LF	\$ 130	\$ 6,500
Gate valve and box, 04"	5	EA	\$ 710	\$ 3,550
Air valve	5	EA	\$ 2,050	\$ 10,250
Flush valve	5	EA	\$ 1,025	\$ 5,125
Metal detectable tape	22,940	LF	\$ 2.00	\$ 45,880
Subtotal				\$ 346,585
<i>Pump Station(s) Installation</i>				
Pump	2	EA	\$ 8,000	\$ 16,000
Pump Station Piping, 04"	2	EA	\$ 550	\$ 1,100
Gate valve, 04"	4	EA	\$ 710	\$ 2,840
Check valve, 04"	2	EA	\$ 755	\$ 1,510
Electrical/Instrumentation	1	EA	\$ 10,250	\$ 10,250
Site work	1	EA	\$ 2,560	\$ 2,560
Building pad	1	EA	\$ 5,125	\$ 5,125
Pump Building	1	EA	\$ 10,250	\$ 10,250
Fence	1	EA	\$ 6,150	\$ 6,150
Tools	1	EA	\$ 1,025	\$ 1,025
10,000 gal ground storage tank	1	EA	\$ 15,000	\$ 15,000
Subtotal				\$ 71,810
Subtotal of Component Costs				\$ 418,395
Contingency	20%			\$ 83,679
Design & Constr Management	25%			\$ 104,599
TOTAL CAPITAL COSTS				\$ 606,673

