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

CITY OF MORTON

PWS ID# 0400001, CCN# P0736

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 City of Morton PWS, PWS ID# 040001, Certificate of Convenience and Necessity (CCN) #P0736, located in Cochran County. The water system serves a population of 2,245 and includes 970 connections. The water source comes from six groundwater wells completed to depths ranging from 206 feet to 261 feet in the Ogallala Aquifer. Wells #2 (G0400001B), #4 (G0400001D), #5 (G0400001E), #6 (G0400001F), 7(G0400001G), and #8 (G0400001H) are rated at 90 gallons per minute (gpm), 325 gpm, 100 gpm, 250 gpm, 225 gpm, and 150 gpm, respectively. Wells #1 and #3 are inactive.

During the period of October 2006 to March 2007, the City of Morton recorded arsenic concentrations between 0.0107 and 0.011 milligrams per liter (mg/L). Fluoride values recorded during September 1996 and March 2007 ranging from 3.7 mg/L to 4.3 mg/L. These values are above the 0.01 mg/L maximum contaminant level (MCL) for arsenic and 4 mg/L MCL for fluoride. Therefore, City of Morton faces compliance issues under the water quality standards for arsenic and fluoride.

Basic system information for the City of Morton PWS is shown in Table ES.1.

Table ES.1 City of Morton PWS
Basic System Information

Population served	2,245
Connections	970
Average daily flow rate	0.332 million gallons per day (mgd)
Peak demand flow rate	922.2 gallons per minute
Water system peak capacity	2.405 mgd
Typical arsenic range	0.0107 mg/L – 0.011 mg/L
Typical fluoride range	3.7 mg/L to 4.3 mg/L

STUDY METHODS

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

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

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

- Assess each of the potential alternatives with respect to economic and non-economic criteria;
- Prepare a feasibility report and present the results to the PWS.

This basic approach is summarized in Figure ES.1.

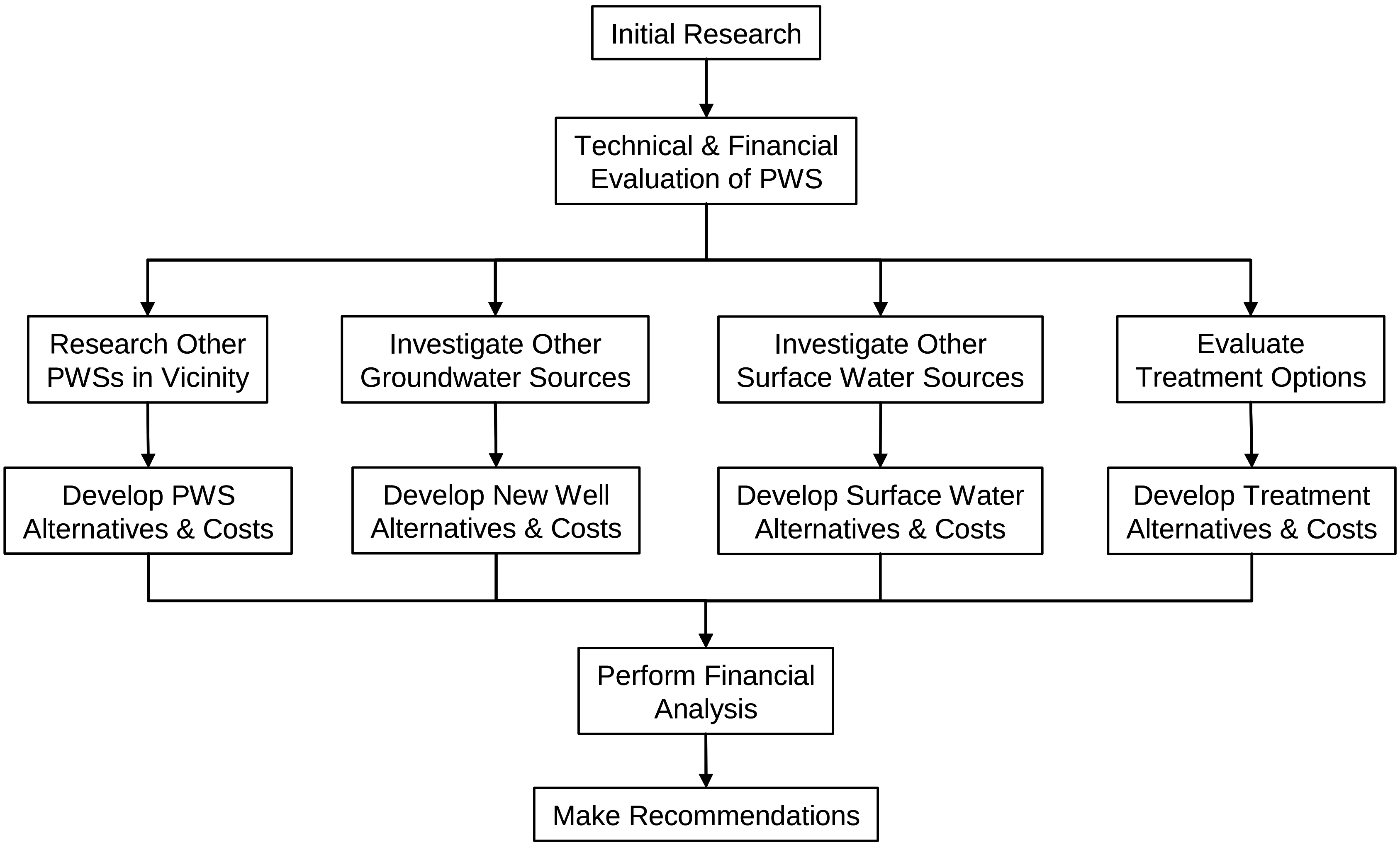
HYDROGEOLOGICAL ANALYSIS

The City of Morton PWS obtains groundwater from the Ogallala-North Texas Aquifer. Arsenic and fluoride are commonly found in area wells at concentrations greater than the MCL. Samples from some of the City of Morton PWS wells, taken in February 2007, contained acceptable levels of both constituents. It is possible that not all of the City of Morton wells have elevated concentrations of fluoride and arsenic. The water quality of each of the system wells should be characterized. If one or more of the wells is found to produce compliant water, as much production as possible should be shifted to that well as a method of achieving compliance. It may also 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.

There are several private irrigation wells within approximately 3 miles of the City of Morton PWS contained acceptable levels of fluoride and other constituents. These wells would require additional testing before consideration as water supply wells. Also, these wells have not been tested for uranium, which can be a concern in the area.

Additionally, regional analyses show that concentrations of fluoride and arsenic tend to decrease with well depth. Therefore, deepening or casing off shallow portions of existing City of Morton PWS wells might help to improve water quality, provided the aquifer is thick enough.

Figure ES.1 Summary of Project Methods



COMPLIANCE ALTERNATIVES

The City of Morton PWS is managed by the Mayor, Mr. Eddie Akin. Overall, the system had an adequate level of FMT capacity. The system had some areas that needed improvement to be able to address future compliance issues; however, the system does have many positive aspects, including dedicated and knowledgeable staff, and successful pursuit of funding opportunities. Areas of concern for the system included lack of compliance with fluoride and arsenic standards, potentially insufficient revenue from rate structure, lack of recent efforts toward capital improvement planning, and lack or a source water and wellhead protection plan.

There are several PWSs within 35 miles of City of Morton. Many of these nearby systems also have water quality problems, but the Canadian River Municipal Water Authority (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 an alternative where treated surface water is obtained through the City of Levelland. In addition to the City of Levelland, the Lubbock Public Water System is a potential large regional water supplier.

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

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

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

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

FINANCIAL ANALYSIS

Financial analysis of the City of Morton PWS indicated that water and wastewater revenue from the current rate structure is insufficient to cover the cost of operation and maintenance. The current rate structure does not allow for a reserve fund for capital improvements, including any treatment needed to comply with current and future regulations and emergencies. The current average water and wastewater bill represents approximately 1.5 percent of the median household income (MHI) for the City of Morton. Separate financial data for water and wastewater were not readily available. To understand the impact of compliance alternatives for the water system, cost for operation and maintenance were estimated based on expenses from similar sized systems. Table ES.2 provides a summary of the financial impact of implementing selected compliance alternatives. The alternatives were selected to highlight results for the best alternatives from each different type or category.

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

Table ES.2 Selected Financial Analysis Results

Alternative	Funding Option	Average Annual Water Bill	Percent of MHI
Current	NA	$342*	1.3
To meet current expenses	NA	$342	1.3
Purchase Water from Lubbock PWS	100% Grant	$684	2.5
	Loan/Bond	$1,283	4.8
New well at City of Whiteface	100% Grant	$362	1.3
	Loan/Bond	$669	2.5
Central EDR treatment	100% Grant	$1,147	4.3
	Loan/Bond	$1,435	5.3
Point-of-use	100% Grant	$1,177	4.4
	Loan/Bond	$1,276	4.7
Public dispenser	100% Grant	$520	1.9
	Loan/Bond	$528	2.0

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

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ACRONYMS AND ABBREVIATIONS

µg/L	Micrograms per liter
°F	Degrees Fahrenheit
ANSI	American National Standards Institute
AFY	acre-feet per year
BAT	Best available technology
BEG	Bureau of Economic Geology
CA	cellulose acetate
CCN	Certificate of Convenience and Necessity
CD	Community Development
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
EDAP	Economically Distressed Areas Program
EDR	Electrodialysis reversal
FMT	Financial, managerial, and technical
GAM	Groundwater Availability Model
gpd	gallons per day
gpm	Gallons per minute
IX	Ion exchange
MCL	Maximum contaminant level
mg/L	Milligram per liter
mgd	Million gallons per day
MHI	Median household income
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.
POE	Point-of-entry
POU	Point-of-use
RFP	Revolving Fund Program
RO	Reverse osmosis

RUS	Rural Utilities Service
RWAF	Economically Distressed Areas Program
SDWA	Safe Drinking Water Act
STEP	Small Towns Environment Program
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TDS	Total dissolved solids
TFC	thin film composite
TWDB	Texas Water Development Board
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WAM	Water Availability Model
WEP	Water and Environment Program

SECTION 1
INTRODUCTION

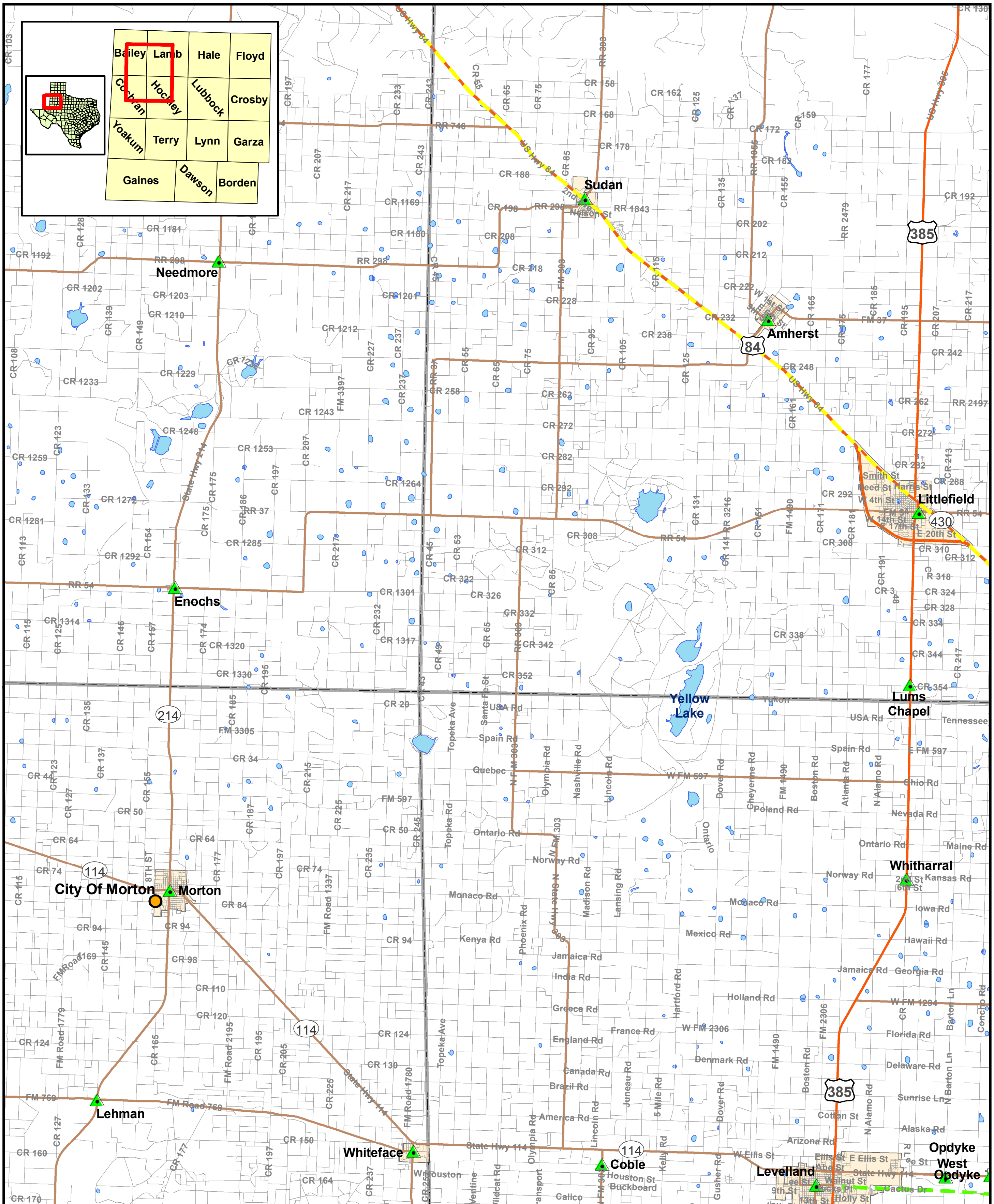
The University of Texas Bureau of Economic Geology (BEG) and its subcontractor, Parsons Transportation Group Inc. (Parsons), were contracted by the Texas Commission on Environmental Quality (TCEQ) to assist with identifying and analyzing compliance alternatives for use by Public Water Systems (PWS) to 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 City of Morton PWS, PWS ID# 040001, Certificate of Convenience and Necessity (CCN) #P0736, located in Cochran County, hereinafter referred to in this document as the "City of Morton PWS." Recent sample results from the City of Morton PWS exceeded the MCL for arsenic of 0.01 milligrams per liter (mg/L) and 4 mg/L for fluoride (USEPA 2008; TCEQ 2004).

The location of the City of Morton 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.



Legend

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

N

Miles

0 2 4

Figure 1.1

CITY OF MORTON

Location Map

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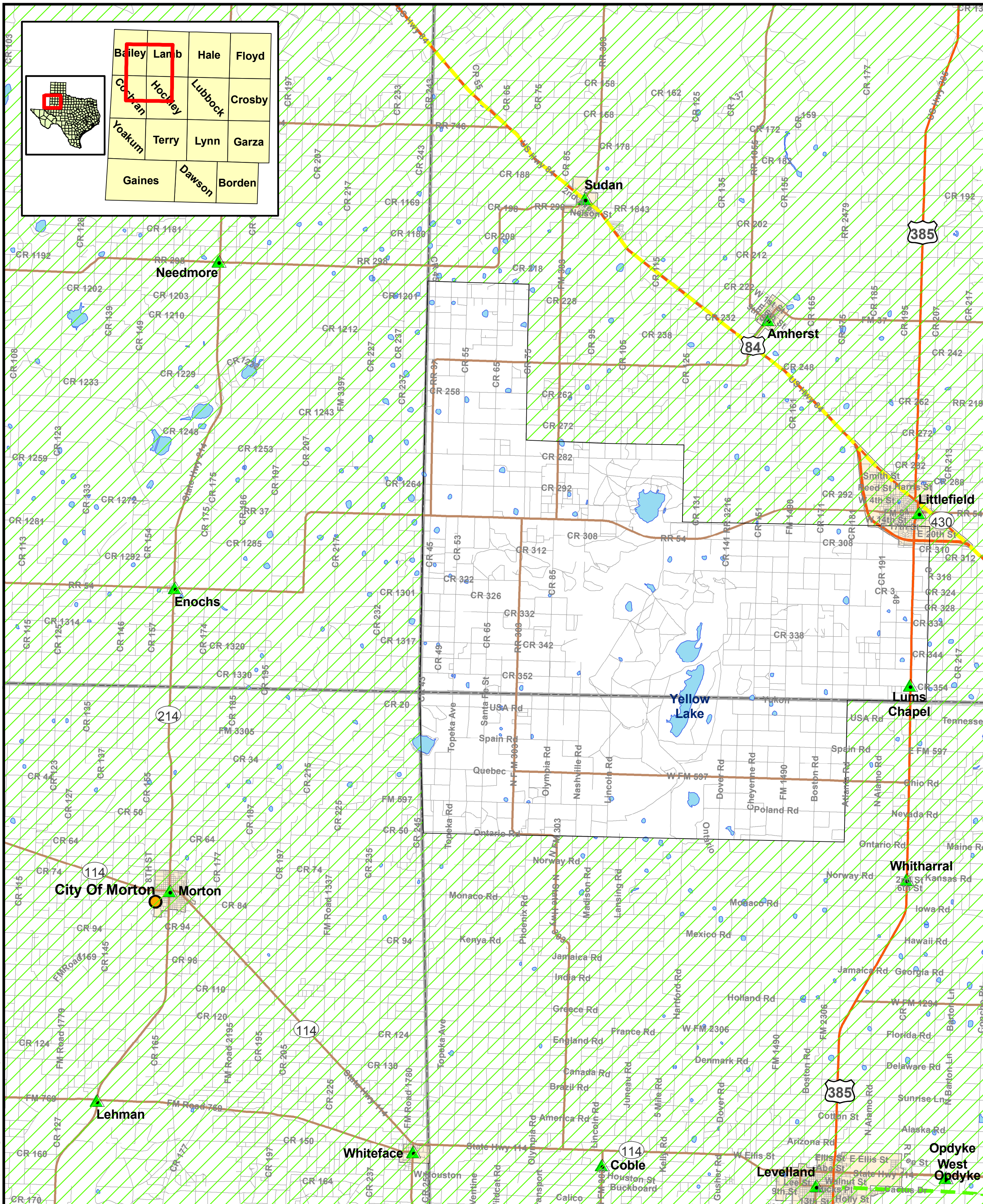

Legend

- Study System
- PWS's
- Cities
- City Limits
- Counties
- Interstate
- Highway
- Major Road
- Minor Road
- High Plains UWCD No.1

N

Miles
0 2 4

Figure 1.2

CITY OF MORTON

Groundwater Conservation Districts

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1.1 PUBLIC HEALTH AND COMPLIANCE WITH MCLS

The goal of this project is to promote compliance for PWSs that supply drinking water exceeding regulatory MCLs. This project only addresses those contaminants and does not address any other violations that may exist for a PWS. As mentioned above, the City of Morton water system had recent sample results exceeding the MCL for arsenic and fluoride.

In general, contaminant(s) in drinking water above the MCL(s) can have both short-term (acute) and long-term or lifetime (chronic) effects. Potential health effects from 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) 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 (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).

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 and fluoride abatement options. Section 2 describes the method used to develop and assess compliance alternatives. The groundwater sources of arsenic and fluoride are addressed in Section 3. Findings for the City of Morton 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 City of Morton PWS involve arsenic and fluoride. The following subsections explore alternatives considered as potential options for obtaining/providing compliant drinking water.

1.4.1 Existing Public Water Supply Systems

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

1.4.1.1 Quantity

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

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

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

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

1.4.1.2 Quality

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

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

1.4.2 Potential for New Groundwater Sources

1.4.2.1 Existing Non-Public Supply Wells

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

- Existing data sources (see below) will be used to identify wells in the areas that have satisfactory quality. For the City of Morton 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 for Fluoride and Arsenic

Various treatment technologies were also investigated as compliance alternatives for treatment of fluoride and arsenic 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 4.0 mg/L. The USEPA BATs for fluoride removal include activated alumina adsorption and reverse osmosis (RO). 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 Arsenic

In January 2001, the USEPA published a final rule in the Federal Register that established an MCL for arsenic of 0.01 mg/L (USEPA 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 are to have completed 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 10 μg/L, including:

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

1.4.5 Description of Treatment Technologies

RO, EDR, and adsorption are identified by USEPA as BATs for removal of both fluoride and arsenic. In this case, adsorption is not a feasible technology because of the high TDS and alkalinity of the groundwater. Also effectiveness of an adsorption media suitable for reduction of both fluoride and arsenic is relatively low and requires frequent replacement. RO is also a viable option for point of entry (POE) and POU systems. A description of these technologies 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. A newer, lower pressure type membrane, similar in operation to RO, is nanofiltration (NF), which has higher rejection for divalent ions than mono-valent ions. NF is sometimes used instead of 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 and arsenic. 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, 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 flow 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, arsenic, and total dissolved solids (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 (^{o}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 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 purchase and installation more expensive. Point-of-entry and POU treatment units would be purchased and owned by the PWS. These solutions are decentralized in nature, and require utility personnel entry into houses or at least onto private property for installation, maintenance, and testing. Due to the large number of treatment units that would be employed and would be largely out of the control of the PWS, it is very difficult to ensure 100 percent compliance. Prior to selection of a POE or POU program for implementation, consultation with TCEQ would be required to address measurement and determination of level of compliance.

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

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

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

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

independently certified according to those standards may be used as part of a compliance strategy.

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

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

1.4.7 Water Delivery or Central Drinking Water Dispensers

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

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

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

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

SECTION 2
EVALUATION METHOD

2.1 DECISION TREE

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

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

2.2 DATA SOURCES AND DATA COLLECTION

2.2.1 Data Search

2.2.1.1 Water Supply Systems

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

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

Figure 2.1
TREE 1 – EXISTING FACILITY ANALYSIS

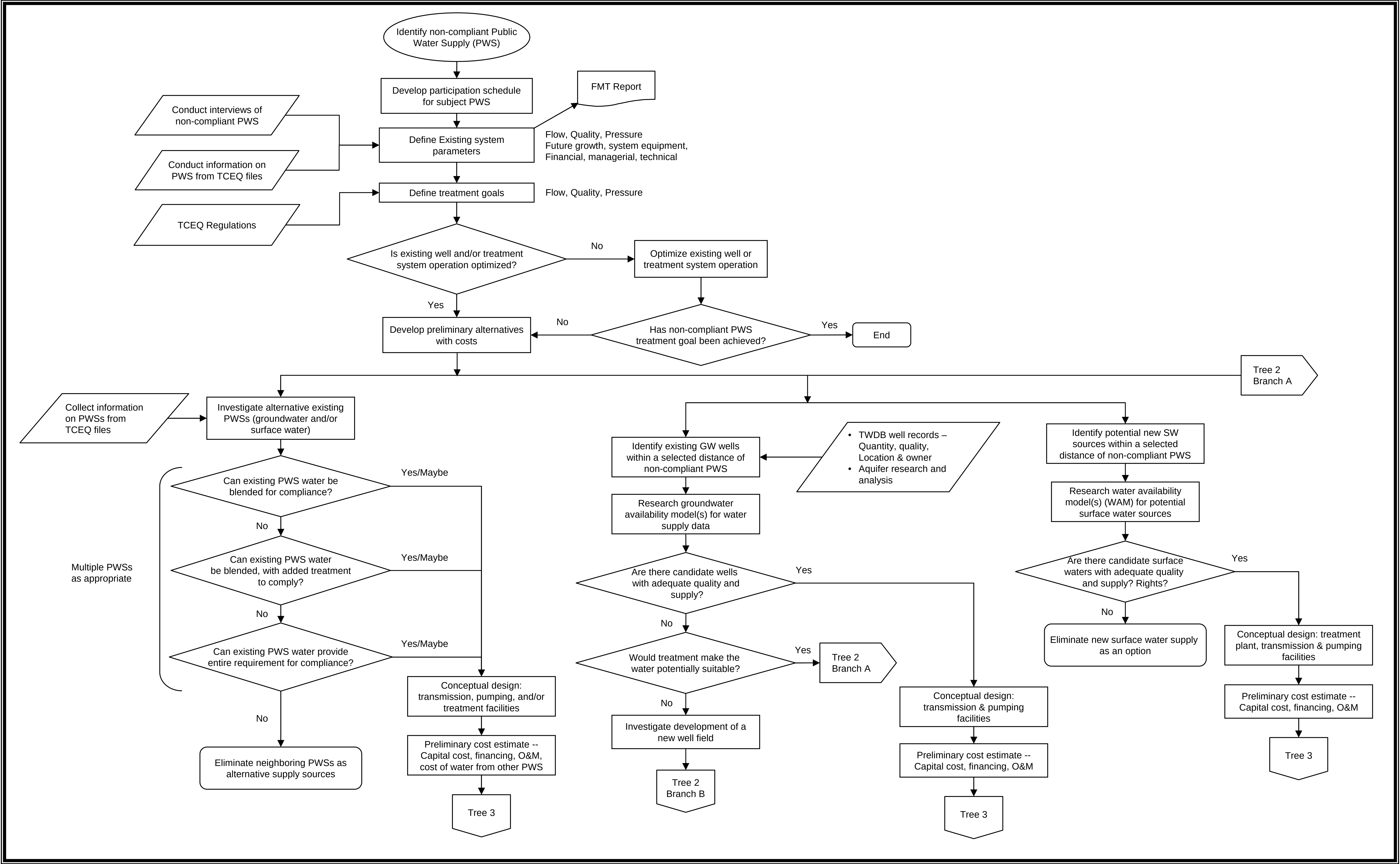
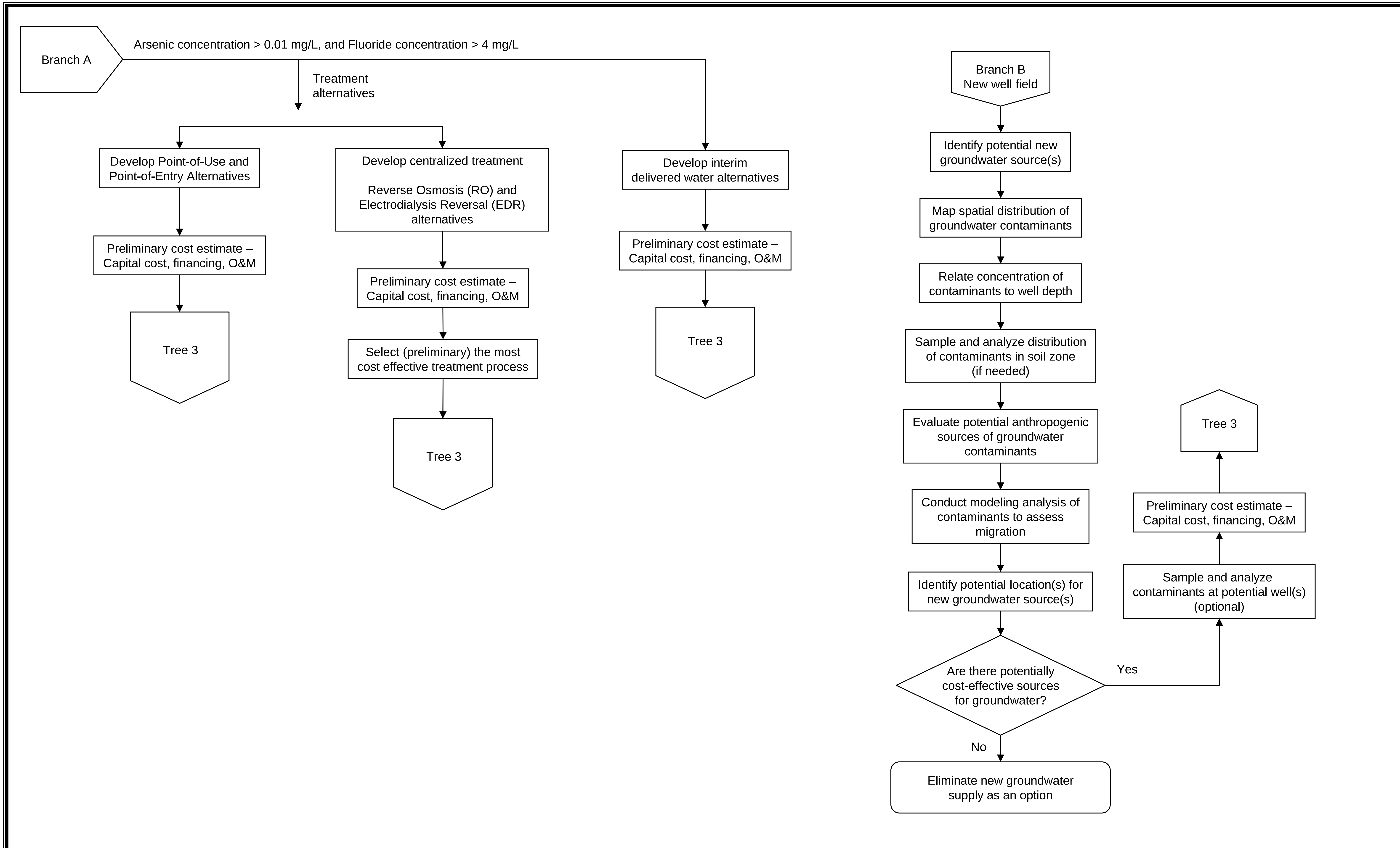


Figure 2.2
TREE 2 – DEVELOP TREATMENT ALTERNATIVES



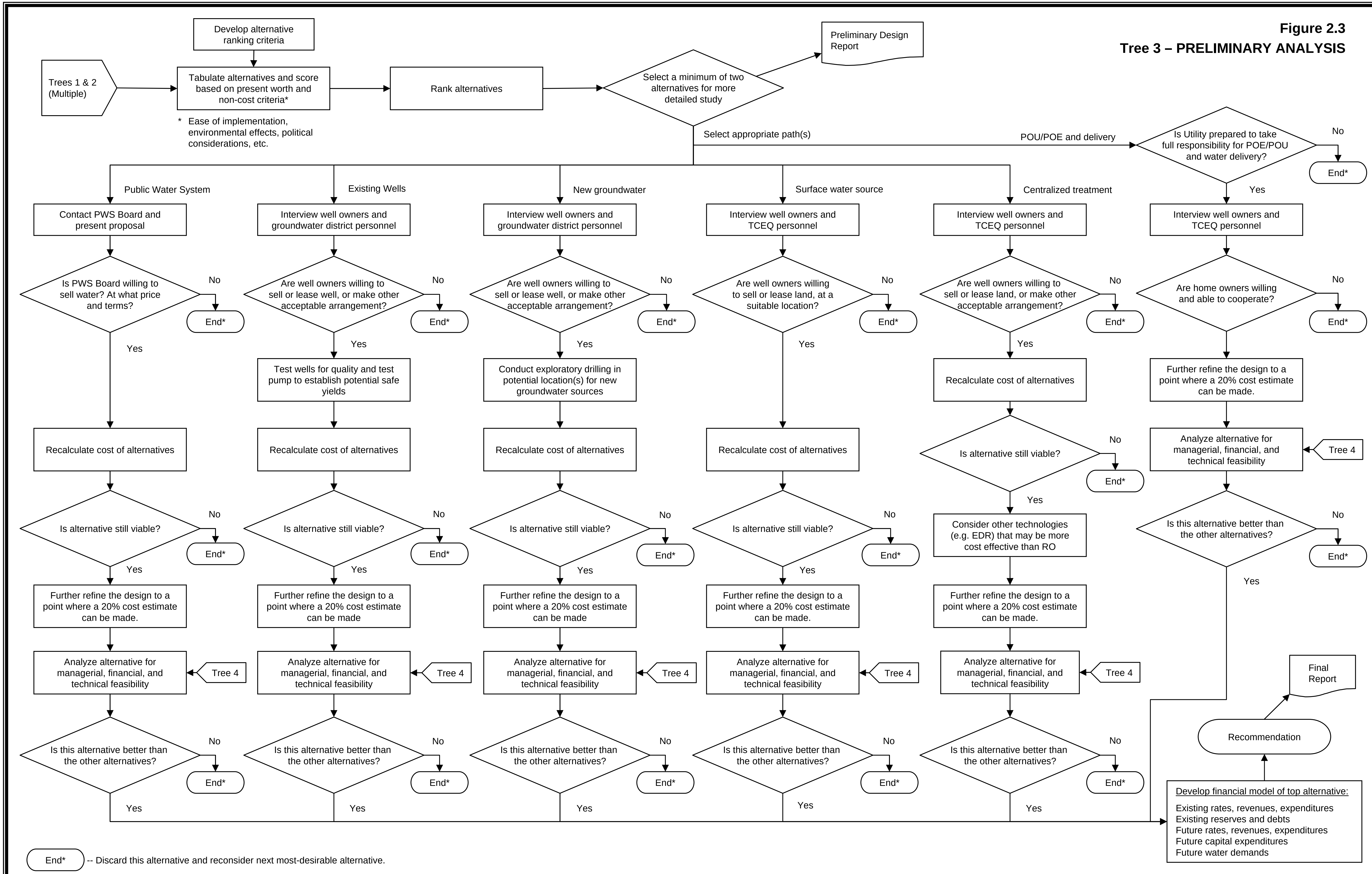
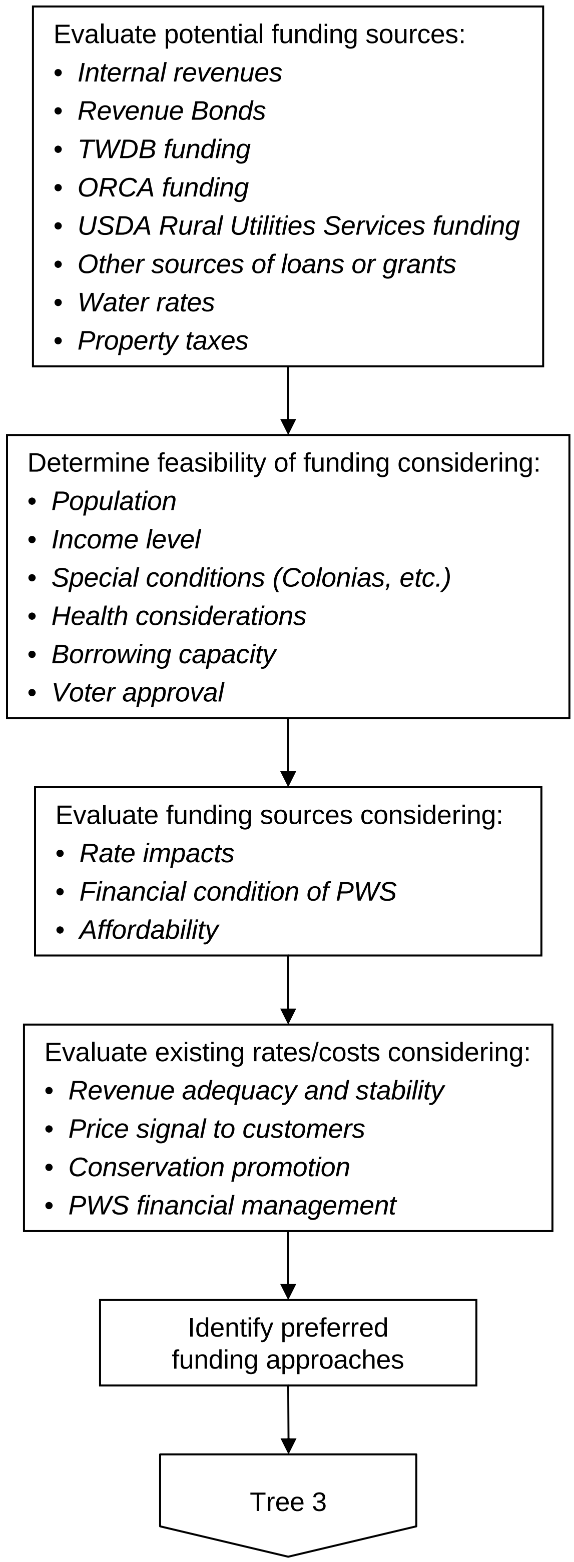


Figure 2.3
Tree 3 – PRELIMINARY ANALYSIS
Develop alternative ranking criteria
Trees 1 & 2 (Multiple)
Tabulate alternatives and score based on present worth and non-cost criteria*
* Ease of implementation, environmental effects, political considerations, etc.
Rank alternatives
Select a minimum of two alternatives for more detailed study
Preliminary Design Report
Select appropriate path(s)
POU/POE and delivery
Is Utility prepared to take full responsibility for POE/POU and water delivery?
Public Water System
Contact PWS Board and present proposal
Is PWS Board willing to sell water? At what price and terms?
Existing Wells
Interview well owners and groundwater district personnel
Are well owners willing to sell or lease well, or make other acceptable arrangement?
Test wells for quality and test pump to establish potential safe yields
New groundwater
Conduct exploratory drilling in potential location(s) for new groundwater sources
Surface water source
Interview well owners and TCEQ personnel
Are well owners willing to sell or lease land, at a suitable location?
Centralized treatment
Are well owners willing to sell or lease land, or make other acceptable arrangement?
Consider other technologies (e.g. EDR) that may be more cost effective than RO
Are home owners willing and able to cooperate?
Recalculate cost of alternatives
Is alternative still viable?
Further refine the design to a point where a 20% cost estimate can be made.
Analyze alternative for managerial, financial, and technical feasibility
Tree 4
Is this alternative better than the other alternatives?
Yes
No
End*
Final Report
Recommendation
Develop financial model of top alternative:
Existing rates, revenues, expenditures
Existing reserves and debts
Future rates, revenues, expenditures
Future capital expenditures
Future water demands
End* -- Discard this alternative and reconsider next most-desirable alternative.

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

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

2.2.1.7 Demographic Data

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

2.2.2 PWS Interviews

2.2.2.1 PWS Capacity Assessment Process

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

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

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

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

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

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

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

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

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

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

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

2.2.2.2 Interview Process

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

2.3 ALTERNATIVE DEVELOPMENT AND ANALYSIS

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

2.3.1 Existing PWS

The neighboring PWSs were identified, and the extents of their systems were investigated. PWSs farther than 35 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 and arsenic are RO and EDR. RO and EDR can remove fluoride as well as arsenic, selenium, 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 treatment 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 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 EPA 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 which 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 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, the purchase of well fields, and the purchase or lease of rights to produce groundwater. Interim financing of water projects and water quality enhancement projects such as wastewater collection and treatment projects are also eligible. Some funds are used to enable a rural water utility to obtain water or wastewater service supplied by a larger utility or to finance the consolidation or regionalization of neighboring utilities. Three Texas agencies that offer financial assistance for water infrastructure are the following:

- Texas Water Development Board has several programs that offer loans at interest rates lower than the market offers to finance projects for public drinking water systems that facilitate compliance with primary drinking water regulations, and additional subsidies may be available for disadvantaged communities. Low interest rate loans with short and long-term finance options at tax exempt rates for water or water-related projects give an added benefit by making construction purchases qualify for a sales tax exemption. Generally, the program targets customers with eligible water supply projects for all political subdivisions of the state (at tax exempt rates) and Water Supply Corporations (at taxable rates) with projects.
- Office of Rural Community Affairs (ORCA) is a Texas state agency with a focus on rural Texas by making state and federal resources accessible to rural communities. Funds from the US Department of Housing and Urban Development Community Development Block Grants (CDBG) are administered by ORCA for small, rural communities with populations less than 50,000 that can not directly receive federal grants. These communities are known as non- entitlement areas. One of the program objectives is to meet a need having a particular urgency, which represents an immediate threat to the health and safety of residents, principally for low- and moderate-income persons.
- United States Department of Agriculture Rural Development Texas (Texas Rural Development) coordinates federal assistance to rural Texas to help rural Americans to improve the quality of their lives. The Rural Utilities Service (RUS) programs provide funding for water and wastewater disposal systems.

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

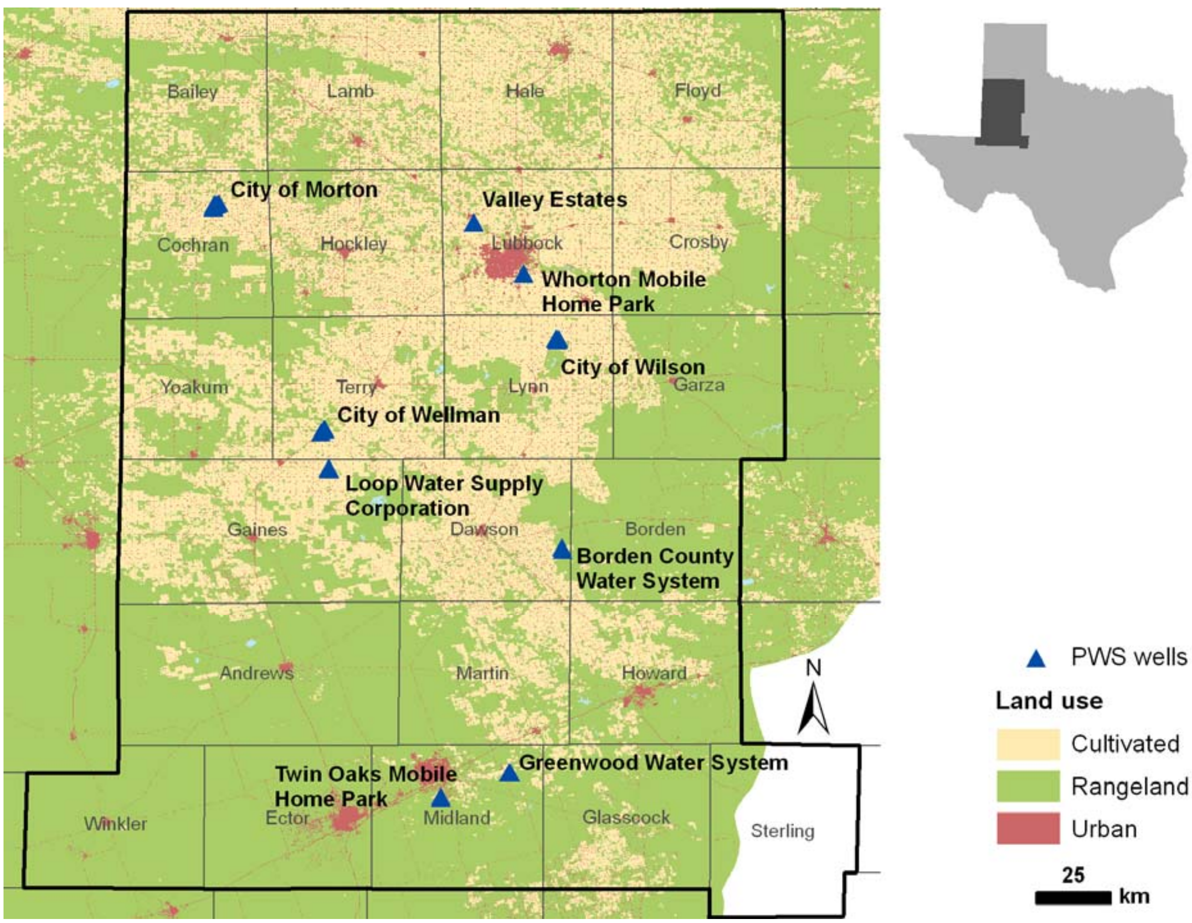
SECTION 3
UNDERSTANDING SOURCES OF CONTAMINANTS

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).

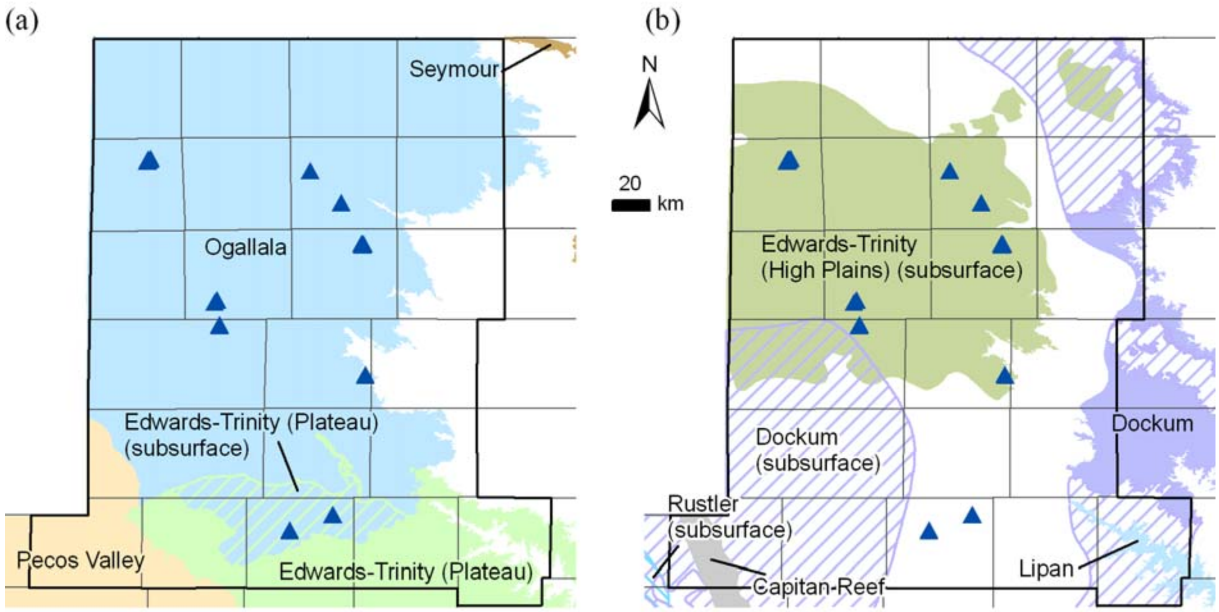
Figure 3.1 Regional Study Area and Locations of the PWS Wells Assessed



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

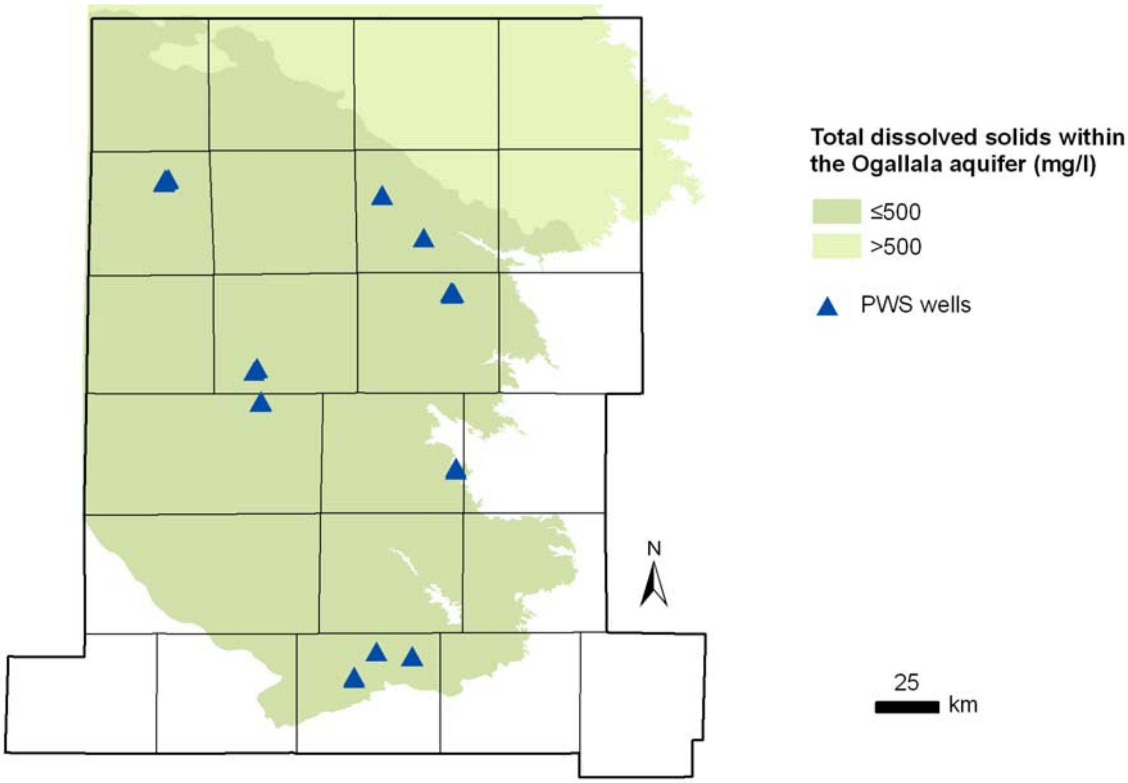
Figure 3.2 Major (a) and Minor (b) Aquifers in the Study Area



"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.

Water quality in the Ogallala aquifer is distinctively different in the northern portion of the study area. Thus, this study analyzes the Ogallala aquifer in two parts: Ogallala-North (TDS ≤ 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.

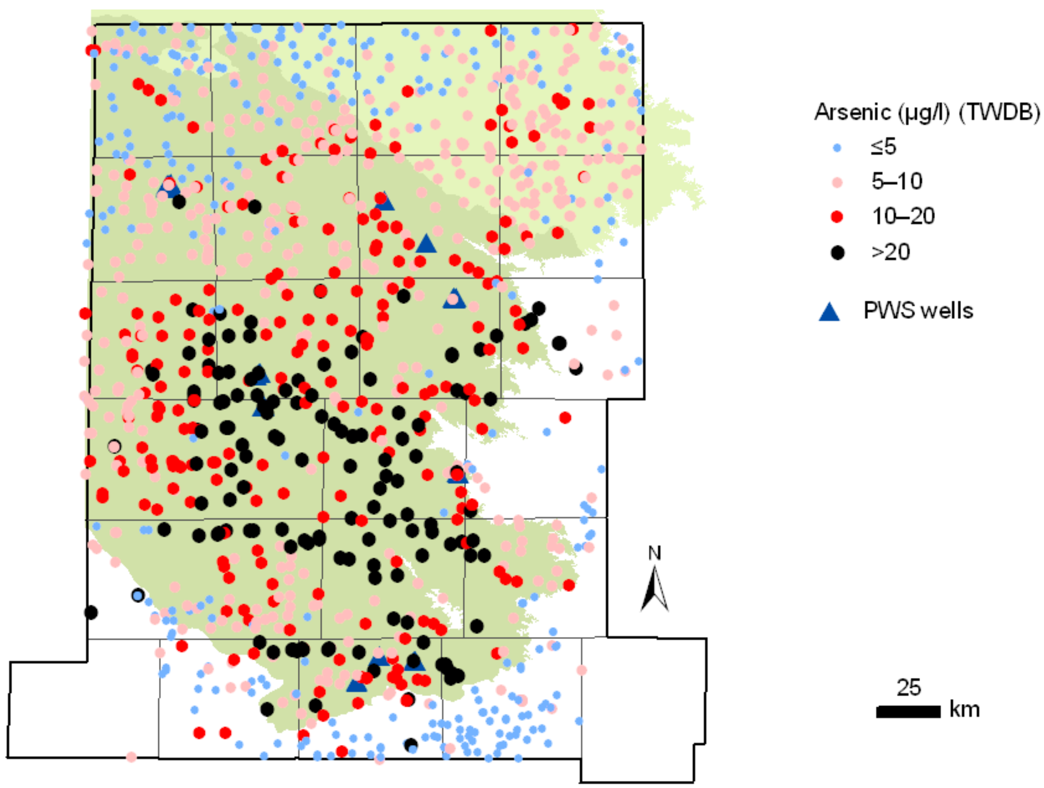
3.1.2 Contaminants of Concern in the Study Area

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



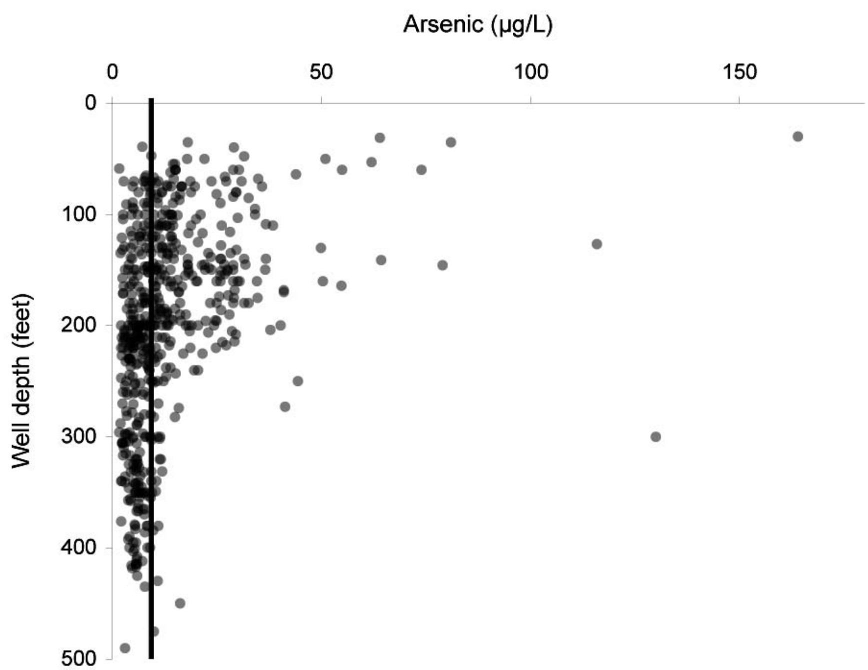
Data presented here are from the TWDB database. The most recent sample for each well is shown. Table 3.1 gives the percentage of wells with arsenic exceeding the MCL (10 µg/L) in each of the major aquifers in the study area.

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.

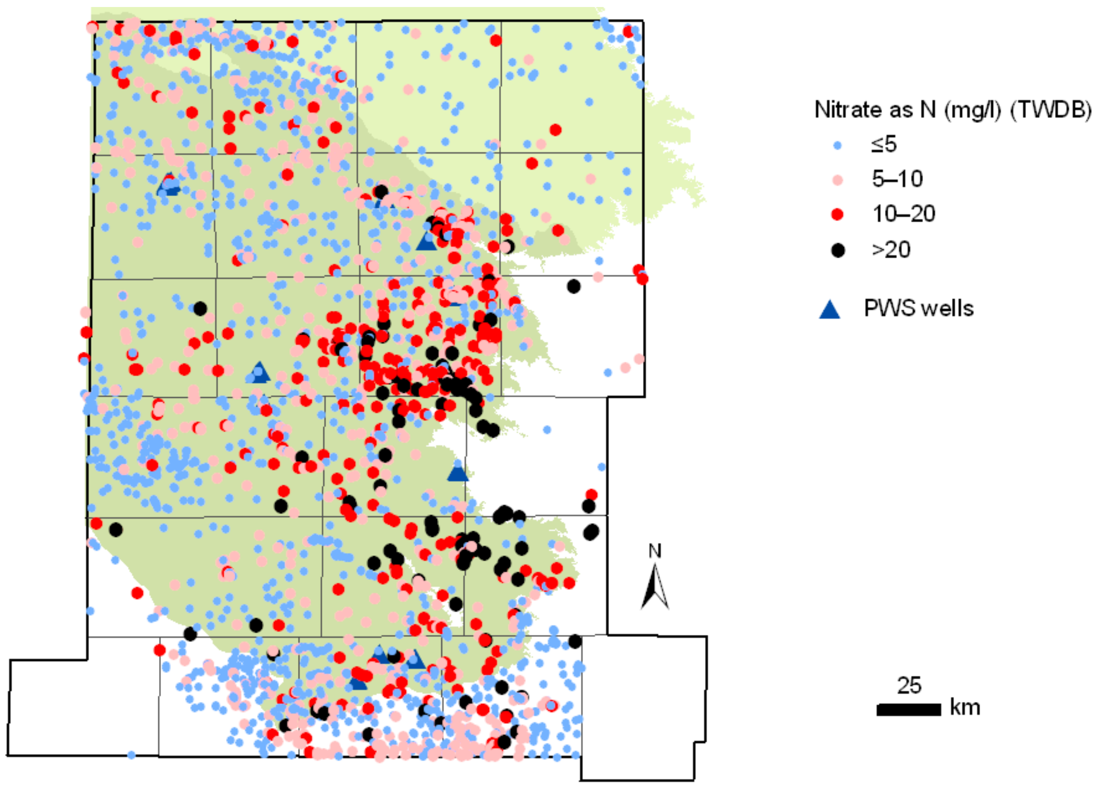
Figure 3.5 Arsenic Concentrations and Well Depths in the Ogallala Aquifer



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



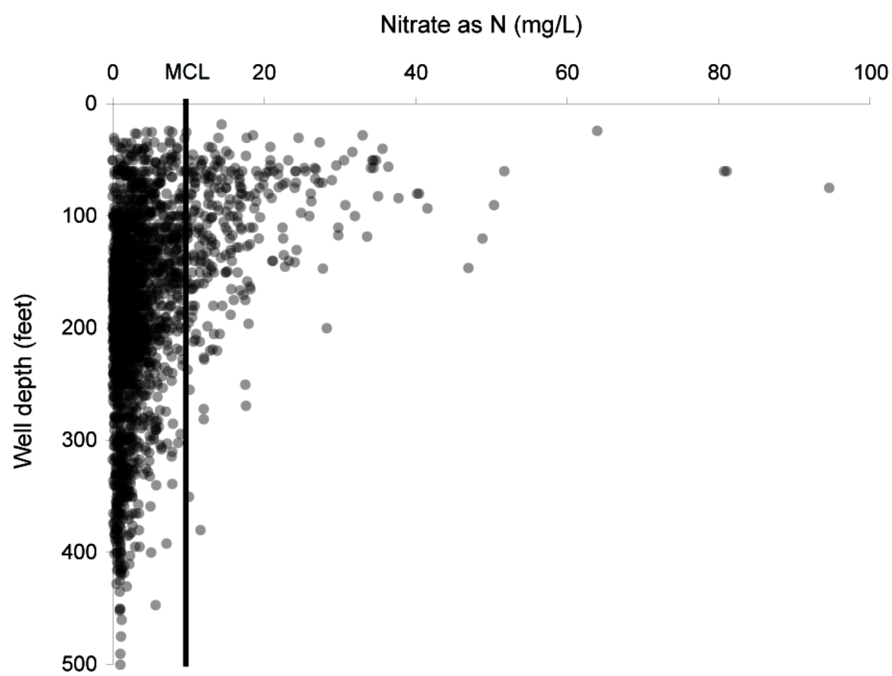
Data presented here are from the TWDB database. The most recent measurement from each well is shown. Table 3.2 shows the percentage of wells with nitrate as N exceeding the MCL (10 mg/L).

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.

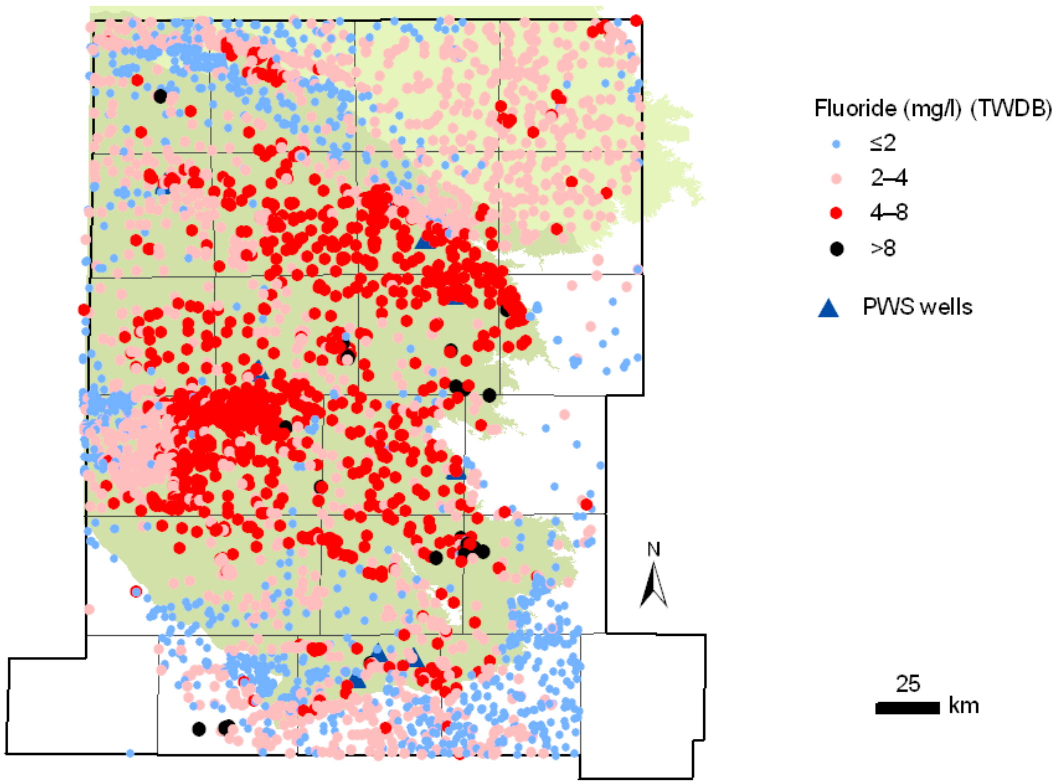
Figure 3.7 Nitrate as N Concentrations and Well Depths in the Ogallala Aquifer within the Study Area



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



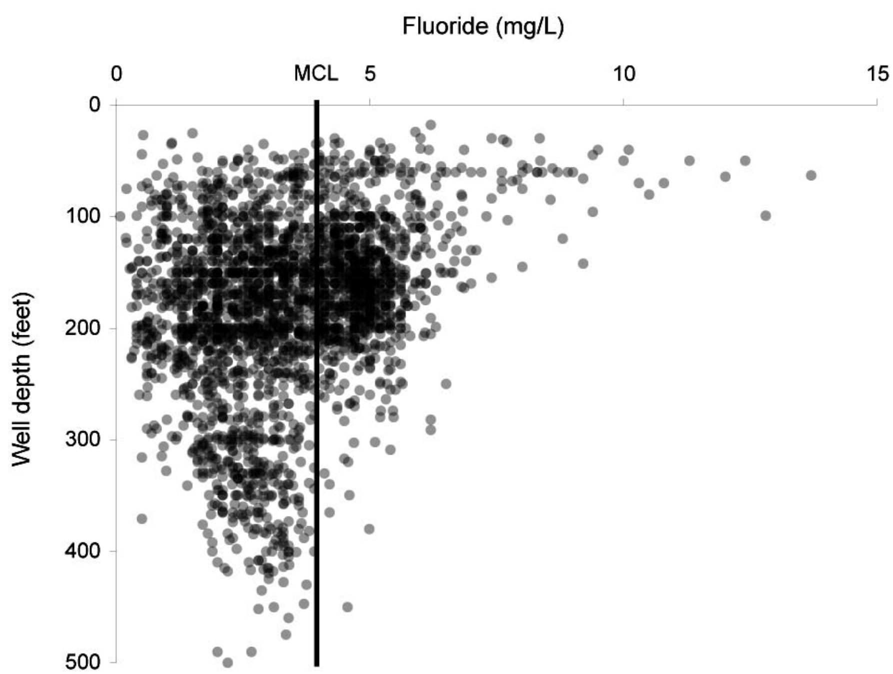
Data presented here are from the TWDB database. The most recent measurement from each well is shown. Table 3.3 shows the percentage of wells with fluoride exceeding the MCL (4 mg/L).

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.

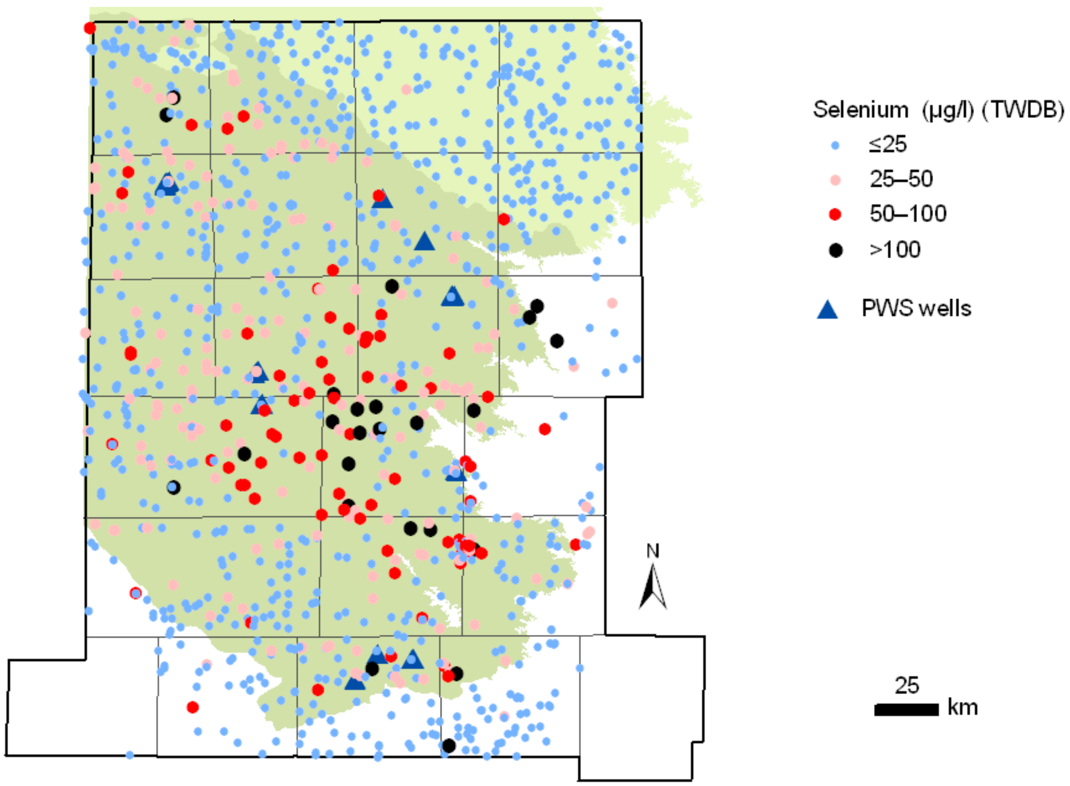
Figure 3.9 Fluoride Concentrations and Well Depths in the Ogallala Aquifer within the Study Area



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



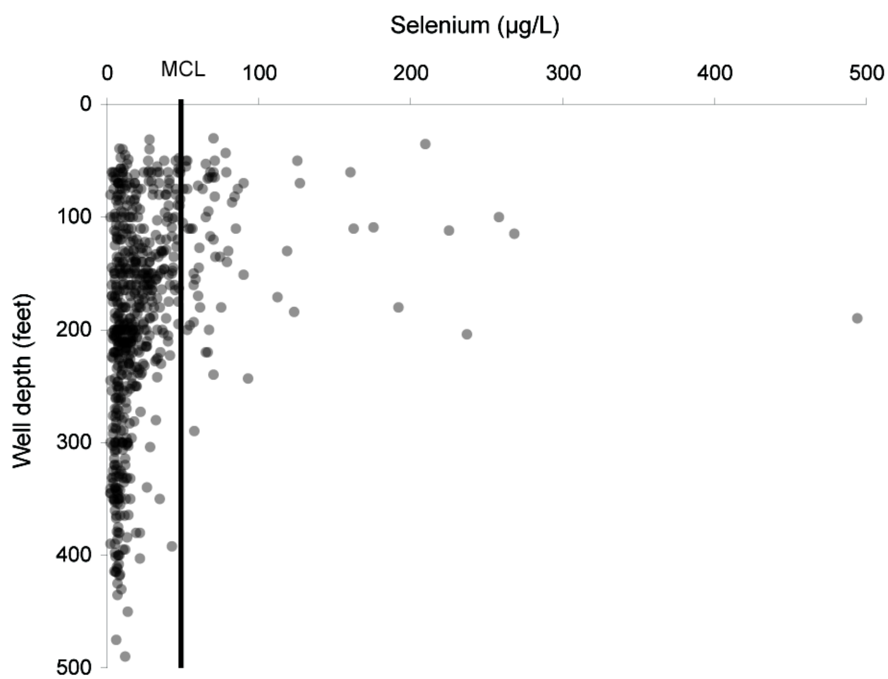
Data presented here are from the TWDB database. The most recent sample for each well is shown. Table 3.4 shows the percentage of wells with selenium concentrations exceeding the selenium MCL (50 µg/L).

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.

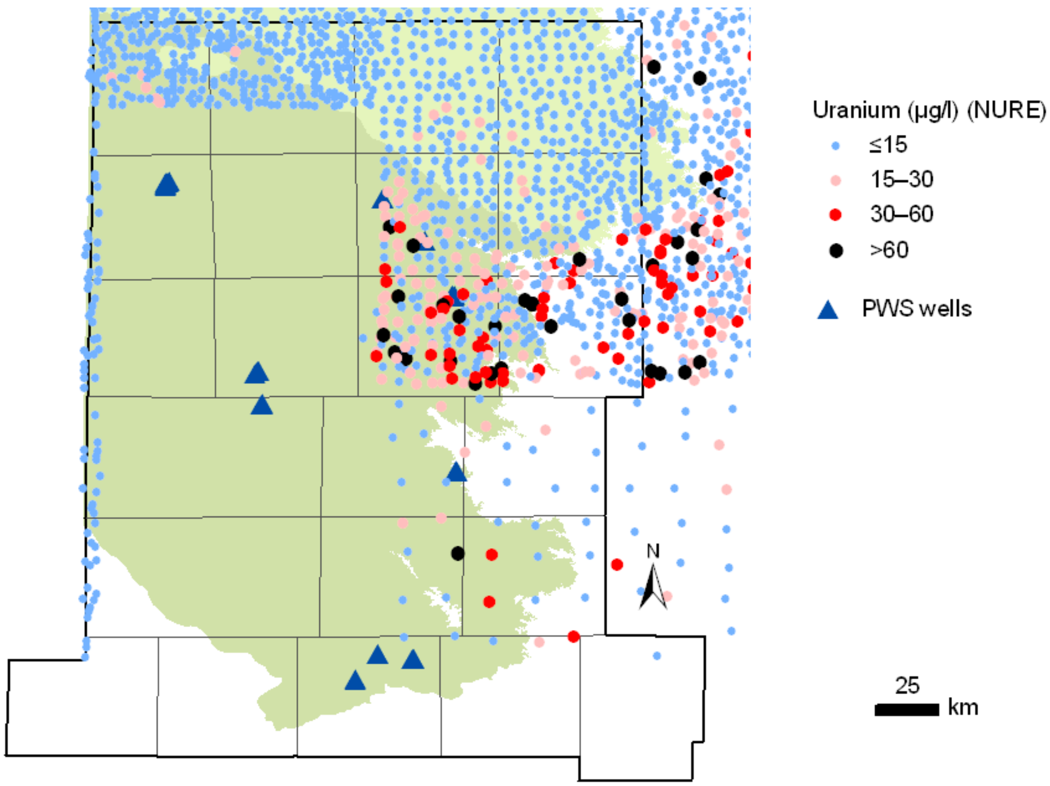
Figure 3.11 Selenium Concentrations and Well Depths in the Ogallala Aquifer within the Study Area



Uranium

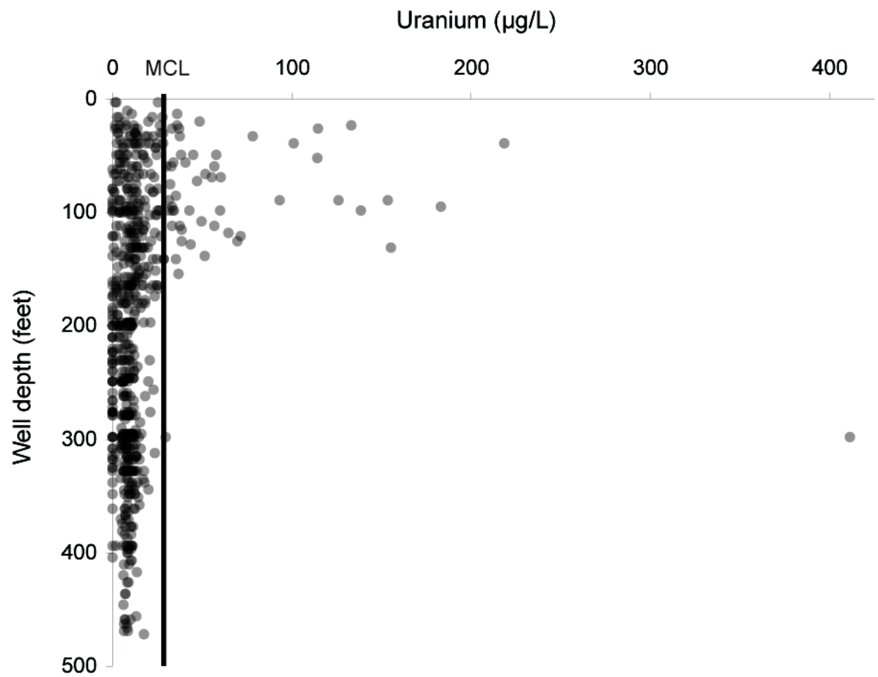
The TWDB rarely tests wells for uranium content in water samples, but the NURE database provides a large dataset of uranium levels in the area. This database only includes wells from part of the study area, as shown in Figure 3.12. Even with this limited distribution of measurements, it is clear that 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 paleoupland 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 OF THE CITY OF MORTON PWS

The City of Morton PWS has eight wells, G0400001A–H, that range in depth from 197–275 feet and are all designated as being within the Ogallala aquifer. These wells are sampled from two sample taps, one connected to wells G0400001A, D, G, and H and one connected to wells G0400001B, C, E, and F. Therefore, available water quality data can be associated with these groups of wells but not with a single well. Table 3.5 summarizes fluoride and arsenic concentrations measured from the City of Morton PWS.

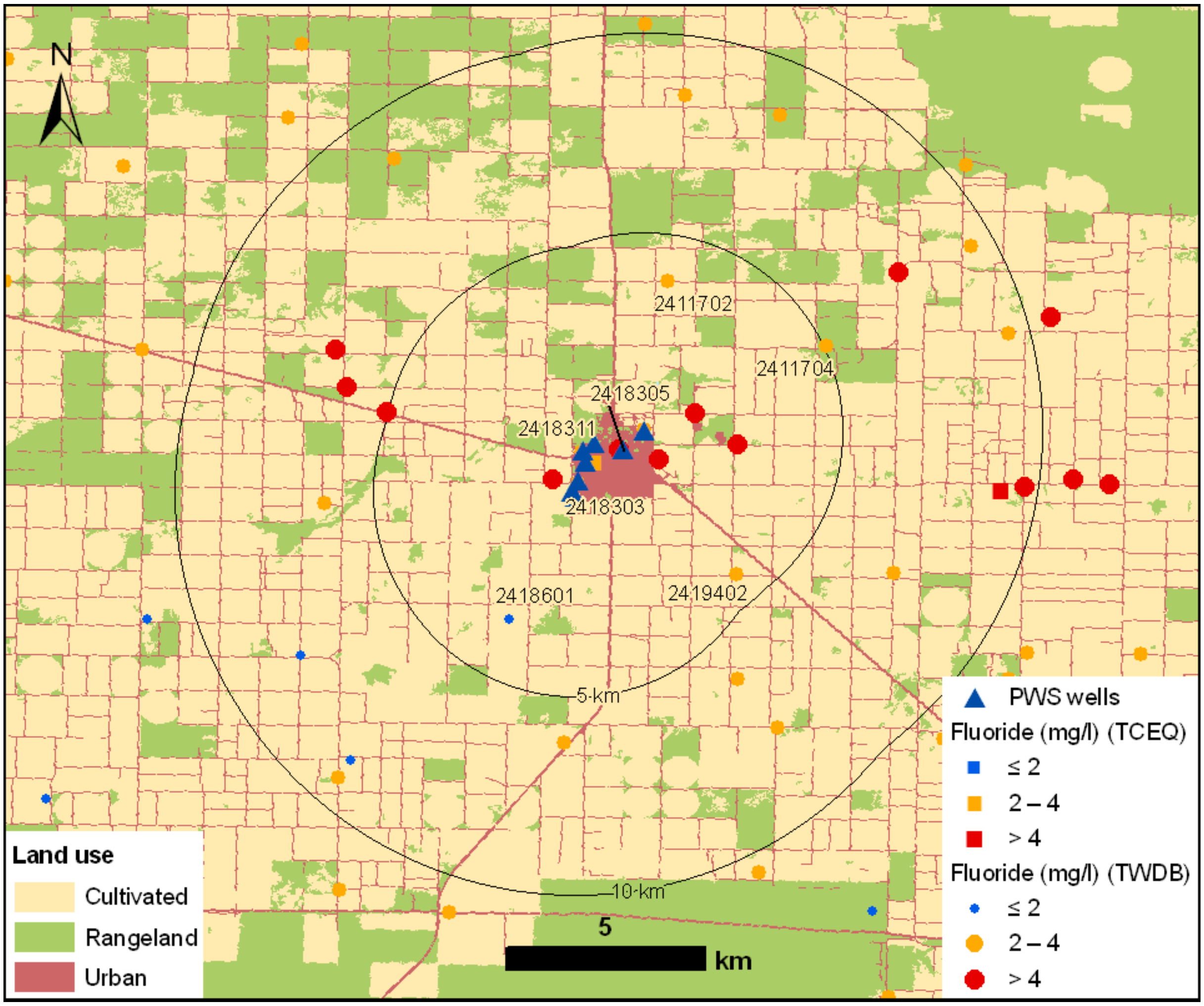
Table 3.5 Fluoride and Arsenic Concentrations from the City of Morton PWS

Date	Fluoride (mg/L)	Arsenic (µg/L)	Wells sampled
9/17/1996	3.6	10.4	unknown
6/18/1997	4.2	11.6	G0400001A, D, G, H
6/18/1997	4.3	10.1	G0400001B, C, E, F
9/23/1997	3.8	-	G0400001A–H
1/20/1998	4.0	34.8	unknown
5/8/2000	3.9	12.0	G0400001A–H
10/11/2001	3.8	-	G0400001A, D, G, H
6/3/2002	3.4	13.9	G0400001A, D, G, H
6/3/2002	3.7	11.8	G0400001B, C, E, F
2/27/2003	3.8	-	G0400001A, D, G, H
5/6/2003	4.0	-	G0400001B, C, E, F
5/6/2003	4.0	-	G0400001A, D, G, H
6/21/2004	3.8	-	G0400001A, D, G, H
6/21/2004	4.3	-	G0400001B, C, E, F
12/14/2004	4.2	-	G0400001B, C, E, F
2/24/2005	3.6	10.4	G0400001A, D, G, H
2/24/2005	3.9	9.9	G0400001B, C, E, F
6/15/2005	-	13.7	G0400001A, D, G, H
6/15/2005	4.1	11.3	G0400001B, C, E, F
8/29/2005	-	14.5	G0400001A, D, G, H
8/29/2005	4.1	15.1	G0400001B, C, E, F
12/6/2005	3.7	10.2	G0400001A, D, G, H
12/6/2005	4.1	8.9	G0400001B, C, E, F
2/15/2006	3.4	11.6	G0400001A, D, G, H
2/15/2006	4.0	11.4	G0400001B, C, E, F
5/23/2006	-	12.9	G0400001A, D, G, H
5/23/2006	4.1	10.2	G0400001B, C, E, F
8/31/2006	-	10.4	G0400001A, D, G, H
8/31/2006	4.2	9.0	G0400001B, C, E, F
11/16/2006	-	10.0	G0400001A, D, G, H
11/16/2006	4.2	8.9	G0400001B, C, E, F
2/19/2007	3.6	9.4	G0400001A, D, G, H
2/19/2007	4.0	9.1	G0400001B, C, E, F

Data from the TCEQ PWS Database.

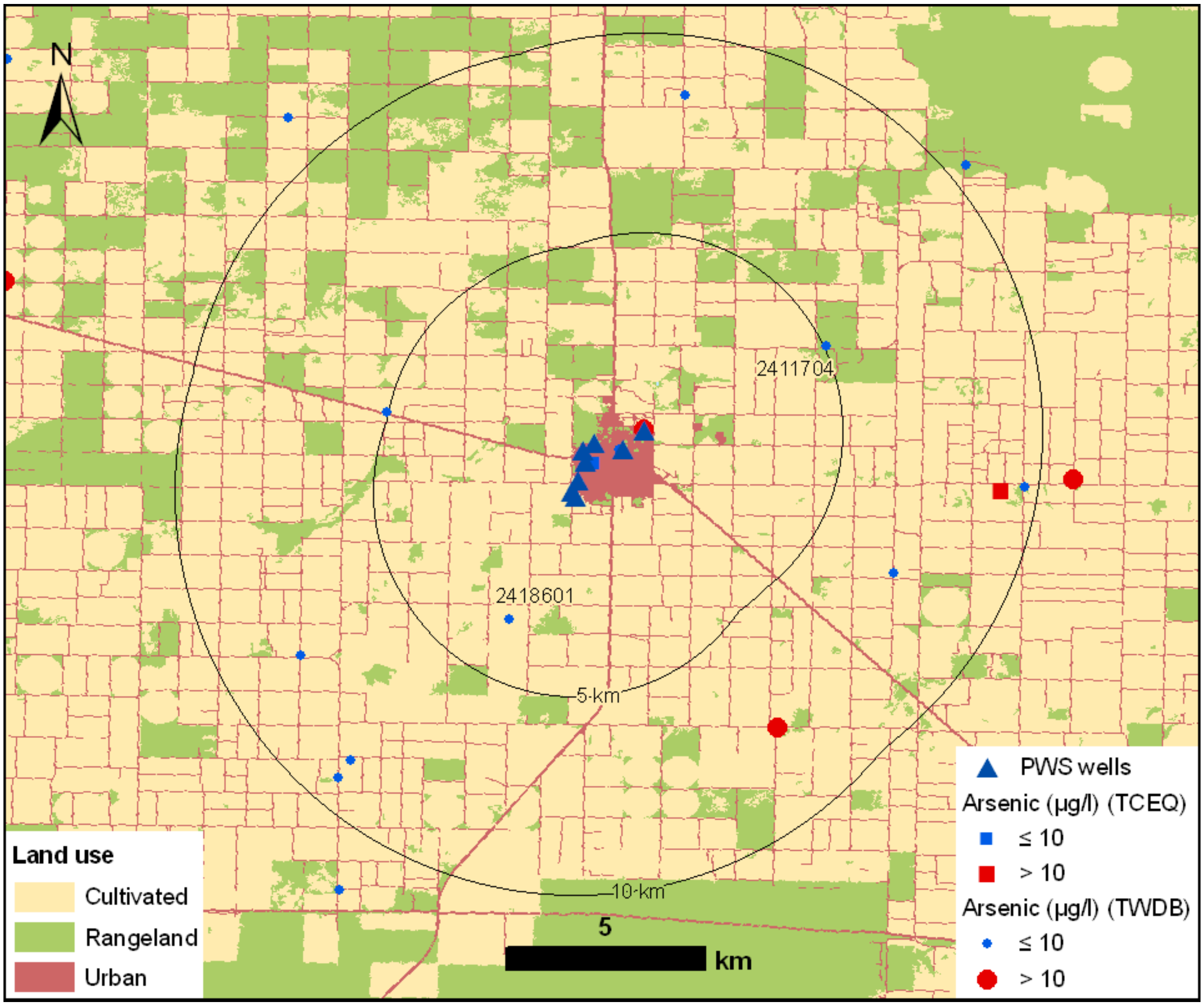
Between 1996 and 2007, 10 of 28 water samples contained fluoride levels above the MCL (4 mg/L). Over the same time, 18 of 25 samples contained arsenic levels above the MCL (10 µg/L). The most recent measurements from both entry points, taken in February 2007, show acceptable levels of both constituents. It is possible that a change in the mixtures of well waters at the entry points caused this decrease. Pumping records might help to indicate what mixture of water resulted in the lower solute concentrations. In addition, sampling each well separately would identify wells with particularly high or low concentrations of these constituents. Figures 3.14 and 3.15 show nearby measured concentrations of fluoride and arsenic, respectively.

1 **Figure 3.14 Fluoride Concentrations within 5- and 10-km Buffers around the City of**
2 **Morton PWS Wells**



3

Figure 3.15 Arsenic Concentrations within 5- and 10-km Buffers around the City of Morton PWS Wells



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

A number of wells within 3.1 miles of the PWS wells show acceptable levels of fluoride (Figure 3.14). Table 3.6 summarizes additional information about these wells. Two of the wells, 2418601 and 2411704, were sampled for arsenic, fluoride, nitrate, and selenium in 2003 and contained levels below the MCLs for all constituents. These wells are currently in use for irrigation. Two other wells, 2418305 and 2419402, are currently unused but have not been tested for arsenic and selenium and were last sampled several decades ago. None of these wells has been tested for uranium.

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)
2411702	C.L. Taylor	156	Ogallala	irrigation	8/14/1968	-	3.3	0.9	-
2411704	Nelda & Leland Lynch	unknown	Ogallala	irrigation	8/27/2003	3.1	3.34	3.7	12.7
2418303	City of Morton (well 3)	207	Ogallala	public supply	6/4/1996	-	2.99	4.3	-
2418305	City of Morton	207	Ogallala	unused	3/5/1947	-	4	1.0	-
2418311	City of Morton	261	Ogallala	public supply	10/11/1995	-	2.8	0.2	-
2418601	C.C. Slaughter Farms	238	Ogallala	irrigation	8/8/2003	8.55	1.84	2.4	22.6
2419402	C.C. Slaughter Farms	183	Ogallala	unused	8/7/1968	-	3.4	0.79	-

3.2.1 Summary of Alternative Groundwater Sources for the City of Morton PWS

Several wells in the TWDB database that are located within approximately 3 miles of the City of Morton PWS contained acceptable levels of fluoride and other constituents (Table 3.6). Wells 2411704 and 2418601 were tested most recently and are the only wells shown to have arsenic and selenium concentrations below the MCLs. Wells 2418305 and 2419402 are listed as unused and might be currently available as alternative water supply sources. However, these and other wells have not been tested recently, and none of the wells has been tested for uranium. These wells should be tested for all constituents of concern before being considered for an alternative water supply.

The most recent samples from the City of Morton PWS wells, taken in 2007, contained fluoride and arsenic concentrations below the MCLs. It is possible that a certain mix of waters from the PWS wells could provide water that consistently meets quality standards. This could be verified with pumping records or by testing each well separately. In addition, regional analyses show that concentrations of fluoride and arsenic tend to decrease with well depth. Therefore, deepening or casing off shallow portions of existing PWS wells might help to improve water quality.

SECTION 4 ANALYSIS OF THE CITY OF MORTON PWS

4.1 DESCRIPTION OF EXISTING SYSTEM

4.1.1 Existing System

The location of the City of Morton PWS is shown in Figure 4.1. The system serves a population of 2,245 and includes 970 connections. The water sources for this community water system are six wells that range in depth from approximately 206 feet deep to 261 feet and have a total production 2.405 mgd. The wells are scattered around the town and all are located within the city limits. Wells #2 (G0400001B), #4 (G0400001D), #5 (G0400001E), #6 (G0400001F), #7 (G0400001G), and #8 (G0400001H) are rated at 90 gallons per minute (gpm), 325 gpm, 100 gpm, 250 gpm, 225 gpm, and 150 gpm, respectively. The wells are in two groups that feed the distribution system separately through ground storage tanks and service pumps. The water is chlorinated using chlorine gas before the ground storage tanks. There is a standpipe and an elevated storage tank, which both float on the distribution system.

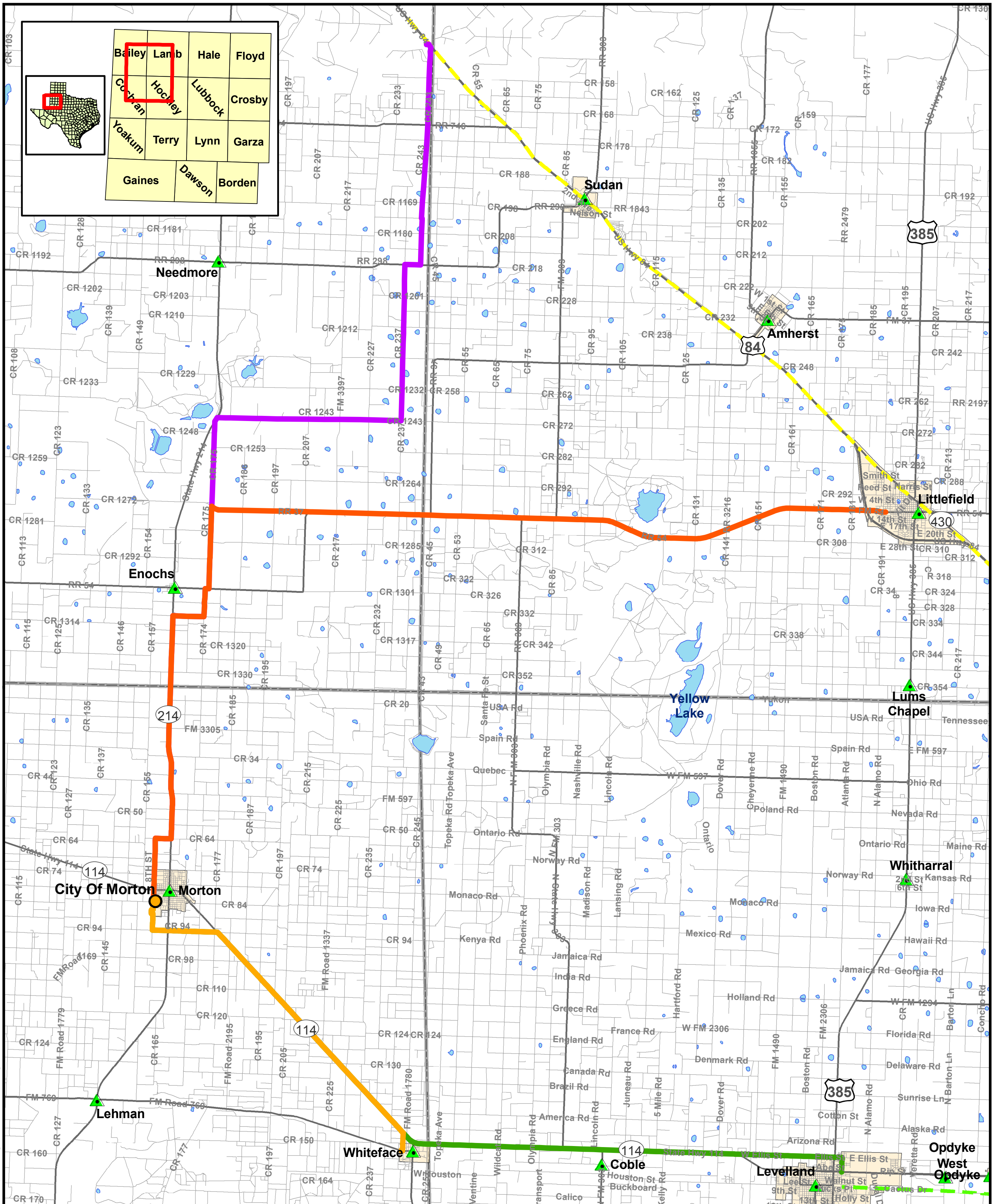
Groundwater in the area is gradually being depleted. The water level in one of the wells is currently only about 6 feet above the top of the pump thus reducing its capacity. The water level is expected to continue to drop which will reduce the City's capacity to provide water even further.

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 and fluoride concentrations. The system has more than one well, and since arsenic and fluoride concentrations can vary significantly between wells, arsenic and fluoride concentrations should be determined for each well. If one or more wells happens to produce water with acceptable arsenic and fluoride levels, as much production as possible should be shifted to that well. It may also 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.

During the period of October 2006 to March 2007, the City of Morton recorded arsenic concentrations between 0.0107 and 0.011 mg/L. Fluoride values recorded during September 1996 and March 2007 ranging from 3.7 mg/L to 4.3 mg/L. These values are above the 0.01 mg/L MCL for arsenic and 4 mg/L MCL for fluoride. Therefore, City of Morton faces compliance issues under the water quality standards for arsenic and fluoride.

Basic system information is as follows:

- Population served: 2,245
- Connections: 970



Legend

- Study System
- PWS's
- Cities
- City Limits
- Counties
- Major Road
- Minor Road
- CRMWA Pipeline
- Lubbock Pipeline
- Grass Valley Pipeline
- MT-1 City of Levelland - 28 Miles
- MT-2 Lubbock Public Water System - 37.8 Miles
- MT-3 City of Whiteface - 13.2 Miles
- MT-4 Littlefield Municipal Water System - 38.3 Miles

Figure 4.1

CITY OF MORTON

Pipeline Alternative

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- Average daily flow: 0.332 mgd
- Total production capacity: 2.405 mgd

Basic system raw water quality data are as follows:

- Total arsenic range: 0.0107 to 0.011 mg/L
- Typical fluoride range: 3.7 to 4.3 mg/L
- Typical calcium range: 57 to 84 mg/L
- Typical chloride range: 95 to 217 mg/L
- Typical iron range: 0.01 to 2.84 mg/L
- Typical magnesium range: 23 to 104 mg/L
- Typical manganese range: <0.001 to 0.052 mg/L
- Typical nitrate range: 1.41 – 5.88 mg/L
- Typical selenium range: 0.0167 – 0.0292 mg/L
- Typical sodium range: 109 to 166 mg/L
- Typical sulfate range: 172– 382 mg/L
- Total hardness as CaCO3 range: 414 – 589 mg/L
- Typical pH range: 7.4 to 7.6 pH
- Total alkalinity as CaCO3 range: 184 – 215 mg/L
- Typical bicarbonate range: 231 – 262 mg/L
- Typical total dissolved solids range: 650 to 1083 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 City of Morton Water System

The project team conducted a capacity assessment of the City of Morton Water System on July 14, 2008. Results of this evaluation are separated into four categories: general assessment of capacity, positive aspects of capacity, capacity deficiencies, and capacity concerns. The general assessment of capacity describes the overall impression of technical, managerial, and financial capability of the water system. The positive aspects of capacity describe the strengths of the system. These factors can provide the building blocks for the system to improve capacity deficiencies. The capacity deficiencies noted are those aspects that are creating a particular problem for the system related to long-term sustainability. Primarily, these problems are related to the system's ability to meet current or future compliance, ensure proper revenue to pay the expenses of running the system, and to ensure the proper operation of the system. The last category, capacity concerns, are items that are not causing significant problems for the system at this time. However, the system may want to address them before they become problematic.

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

The project team interviewed the following individuals.

- Brenda Shaw, City Manager and Secretary
- Frank Enriquez, Water Supervisor

4.1.2.1 General Structure of the Water System

The City of Morton provides water, sewer, and gas service to its residents. The water system has 970 connections and serves approximately 2,245 residents. The Water Supervisor holds a Groundwater C License and oversees two other certified operators.

The base water rate is $10 a month and includes 2,000 gallons of water. The rate is $2.50 per 1,000 gallons for usage over 2,000 gallons. The last two rate increases occurred in 2005 and 2007. The water system exceeds the standards for arsenic and fluoride. Bottled water is provided upon request for children under the age of 14.

4.1.2.2 General Assessment of Capacity

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

4.1.2.3 Positive Aspects of Capacity

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

- **Dedicated and Knowledgeable Staff** – The City Manager has been with the city for 17 years in various positions and the Water Supervisor has been with the city for 28 years. They are both knowledgeable about the water system and are committed to providing safe drinking water.
- **Pursues Funding Opportunities** – The City has been able to fund system capital improvements with various grants for both the water and wastewater systems. This has included installation of two new tanks.

4.1.2.4 Capacity Deficiencies

The following capacity deficiencies were noted in conducting the assessment and seriously impact the ability of the water system to comply with current and future regulations and ensure long-term sustainability.

- **Lack of Compliance with Fluoride and Arsenic Standards –** The water system is not in compliance with fluoride and arsenic standards. While the City has been investigating treatment options and costs, there is still no clear plan for compliance.
- **Potentially Insufficient Revenue from Rate Structure –** Water and wastewater revenues and expenses are tracked separately. At the end of 2007 it appears the City had to transfer funds from gas revenues to cover shortfalls in both the water and wastewater fund. The shortfall in the water fund was relatively minor, but the City should be concerned that in the future water revenues will not be sufficient to cover expenses associated with complying with regulations. Although the water rates are reviewed annually along with the budget, there has not been enough revenue to add to the existing reserve account in the last several years. To ensure the long-term sustainability of the water system, a thorough review of water system expenses needs to be considered when reviewing the rate structure.

4.1.2.5 Potential Capacity Concerns

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

- **Efforts Toward Capital Improvement Planning** – The City did develop a capital improvement plan in 1999 for the water system, but it has not been updated since, although the water supervisor has identified needed projects, such as water line replacement and replacement of water meters. The lack of a comprehensive long-term plan could negatively impact the system's ability to develop a budget and associated rate structure to ensure compliance with current and future regulations. The City will be receiving a planning grant and perhaps some of that funding could be used to develop a current capital improvement plan.
- **Lack of a Source Water and Wellhead Protection Plan** - Although participation in the source water protection program through TCEQ is voluntary, it is recommended the

water system participate in the program to better protect its water source. In addition, the water system should develop a wellhead protection plan. Although not required, wellhead protection plans provide a valuable resource to the water system in the maintenance and protection of the water wells the system relies on for safe drinking water. As a first step, the system should contact TCEQ to inquire about participating in the source water protection plan.

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 City of Morton PWS were reviewed with regard to their reported drinking water quality and production capacity. PWSs that appeared to have water supplies with water quality issues were ruled out from evaluation as alternative sources, while those without identified water quality issues were investigated further. Small systems were only considered if they were within 15 miles of the City of Morton 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 35 miles of the study system. A distance of 35 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 35 miles of the City of Morton. 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 35 Miles of the City of Morton PWS

PWS ID	PWS Name	Distance from City of Morton (miles)	Comments/Other Issues
0400013	MORTON COUNTRY OF MORTON INC	5.5	Small GW system. WQ issues: arsenic and fluoride
0090011	MAPLE WATER SUPPLY CORP	11.63	Small GW system. WQ issues: nitrate and sulfate
0400020	WHITEFACE ISD	11.74	Small GW system. WQ issues: arsenic and sulfate
0400002	CITY OF WHITEFACE	12.22	Small GW system. Marginal arsenic. **Evaluate Further**
1100005	PEP SCHOOL	13.58	Small GW system. No WQ issues
0400012	BLEDSOE WATER SUPPLY CORP	14.79	Small GW system. WQ issue: No WQ issues.
0400003	GIRLSTOWN USA	19.08	Small GW system. WQ issues: arsenic and fluoride
1100039	OXY PERMIAN MALLET PLANT	20.95	Small GW system. WQ issues: arsenic and Fluoride
1100022	ALTURA SLAUGHTER GASOLINE PLANT	20.96	Small GW system. WQ issue: fluoride
1100027	EXXON MOBIL OIL CORP SUNDOWN	21.69	Small GW system. No WQ issues
1100003	CITY OF SUNDOWN	24.02	Larger GW system. WQ issues: arsenic, fluoride, and nitrate

PWS ID	PWS Name	Distance from City of Morton (miles)	Comments/Other Issues
1100002	CITY OF LEVELLAND	24.26	Larger SW/GW system. No WQ issues. **Evaluate Further**
1100011	WHITHARRAL WATER SUPPLY CORP	25.49	Small GW system. WQ issues: gross alpha, nitrate, and sulfate
1100017	OCCIDENTAL PERMIAN LTD E SLAUGHTER	25.72	Small GW system. WQ issues: arsenic and fluoride
1400026	ALLSUPS 256	27.52	Small GW system. WQ issue: nitrate
1520002	LUBBOCK PUBLIC WATER SYSTEM	27.62	Larger SW/GW system. No WQ issues. **Evaluate Further**
1100034	WAYNEBOS INC	28.15	Small GW system. WQ issues: arsenic, fluoride, and nitrate
1100030	OPDYKE WEST WATER SUPPLY	28.37	Small GW system. WQ issues: arsenic, fluoride, gross alpha, and nitrate
1400006	CITY OF AMHERST	29.01	Small GW system. No WQ issues
1400005	CITY OF SUDAN	29.49	Small GW system. WQ issue: nitrate
1400003	LITTLEFIELD MUNICIPAL WATER SYSTEM	34.6	Large GW system. No WQ issues. **Evaluate Further**

WQ = water quality
GW = groundwater

After the PWSs in Table 4.1 with water quality problems were eliminated from further consideration, the remaining PWSs were screened by proximity to the City of Morton PWS and sufficient total production capacity for selling or sharing water. Based on the initial screening summarized in Table 4.1, four alternatives were selected for further evaluation. These alternatives are summarized in Table 4.2. Descriptions of these public water systems follow Table 4.2.

Table 4.2 Public Water Systems within the Vicinity of the City of Morton PWS Selected for Further Evaluation

PWS ID	PWS Name	Pop	Connec-tions	Total Production (mgd)	Avg Daily Usage (mgd)	Approx. Dist. from City of Morton	Comments/Other Issues
0400002	CITY OF WHITEFACE	544	191	0.662	0.763	12.22	Smaller GW system. No WQ issues. Add two new wells.
1100002	CITY OF LEVELLAND	15,187	5,715	9.079	1.756	24.26	Larger SW/GW system. No WQ issues
1520002	LUBBOCK PUBLIC WATER SYSTEM	222,473	81,059	156.34	37.979	27.62	Larger SW/GW system. No WQ issues
1400003	LITTLEFIELD MUNICIPAL WATER SYSTEM	6,509	2,560	4.00	1.538	34.60	Larger GW system. No WQ issues

WQ = water quality
GW = groundwater
SW = storm water

4.2.1.1 City of Whiteface (0400002)

The City of Whiteface is located approximately 12 miles southwest of the City of Morton. Its total production capacity is 0.662 MGD from groundwater for a population of 544 (191 connections). The average daily consumption is 0.073 mgd. The city has three wells located near the city limits between 220 to 260 feet in depth. According to available information on this PWS, there are no reported exceedances for constituents of concern above the associated MCLs. The city currently is experiencing minimal growth, although there are attempts to bring in industry. Without such industry it is likely that the City of Whiteface will have excess water capacity. A decision to wholesale this water would require approval of the city council (no one has ever approached the city for whole sale water). The city does not report any issues with its distribution lines, but no significant infrastructure improvements have been made in the last 10 years. With the possible availability of water and interest in adding additional revenue to the city, the option of wholesaling water may be of interest to the city.

4.2.1.2 City of Levelland (1100002)

The City of Levelland is located approximately 24 miles southeast from the City of Morton PWS. Its average water demand is 1.8 MGD for a population of about 14,200 people and it has a total production capacity of 7.9 MGD. The City of Levelland is one of 11 member cities that receive water through an agreement with the Canadian River Municipal Water Authority (CRMWA). The water received from the CRMWA is treated at the City of Lubbock water treatment plant. In addition to this water, the City of Levelland also maintains a well field that is the source of about 10 to 20 percent of its water supply. The Levelland well field has 21 wells, but only nine are currently in operation. There are seven wells that are near a USEPA Superfund site (114th Street Plume) and are only used for emergency purposes as they are prone to contamination. Four wells have elevated levels of fluoride just above the MCLs, and one well has benzene contamination. Some of the wells in the well field have been reported with elevated levels of iron and manganese, which is monitored.

The existing capacity is sufficient to meet current demands, but any additional customers would require system upgrades. The City of Levelland is currently (2008) in the preliminary stages of looking at new well production to meet growth in demand. Although it has not drilled any test wells, it is looking to purchase water rights from public institutions that are no longer operating. The addition of new production capacity would also include new storage, transmission lines, and pump stations. Officials from the City of Smyer have approached Levelland about wholesaling CRMWA water. This is under discussion, but no price or rules have been established. This would be the first time the City of Levelland would consider wholesaling water to another community.

It does appear that the City of Levelland has some excess capacity. Technical investigations are underway to develop additional water resources, and city leaders are open to discuss providing nearby communities wholesale water.

4.2.1.3 City of Lubbock PWS (1520002)

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 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.

4.2.1.4 Littlefield Municipal Water System (1400003)

The Littlefield Municipal Water System is located approximately 35 miles northeast from the City of Morton PWS. Its maximum water system production is 4.91 mgd with an estimated peak use of 3 mgd for a population of about 6,509 people or 2,560 connections. The city has 11 sections of land with water rights located approximately 7 miles northeast of the city. Only two sections have wells and the city is open to adding additional wells and providing water to neighboring communities. Its current excess capacity is approximately 1.9 mgd. The city council would have to approve any water sales. Littlefield currently wholesales water to one light industry and one subdivision outside the city limits. Water price ranges from $1.80 to $2.25 per thousand gallons.

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 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.

Two wells operated by the PWS are completed in the southern Ogallala Aquifer, both at a depth of 143 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 City of Morton 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 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 on 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 acre feet per year [AFY] in the year 2010) over the next 50 years, as several proposed long-term management strategies are implemented along the Brazos Basin.

The 2007 State Water Plan indicates that in Cochran 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, additional water needs would be 73,140 AF. This deficit would be largely associated with increased irrigation use.

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 Cochran 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. City of Levelland. Compliant water would be purchased from the City of Levelland to be used by the City of Morton. A pipeline would be constructed to convey water from the City of Levelland to the City of Morton (Alternative MT-1).

2. Lubbock Public Water System. Treated water would be purchased from the City of Lubbock to be used by the City of Morton. A pipeline would be constructed to convey water from the City of Lubbock's Bailey County well field pipeline to the City of Morton (Alternative MT-2).

3. City of Whiteface. Two new groundwater wells would be completed in the vicinity of the well field at the City of Whiteface. A pipeline would be constructed to the City of Morton (Alternative MT-3).

4. Littlefield Municipal Water System. Two new groundwater wells would be completed in the vicinity of the well at Littlefield Municipal Water System. A pipeline would be constructed to the City of Morton (Alternative MT-4).

5. New Wells at 10, 5, and 1 mile. Installing two new wells within 10, 5, or 1 mile of the City of Morton PWS may produce compliant water in place of the water produced by the existing active wells. A pipeline and pump station would be constructed to transfer the water to the City of Morton PWS (Alternatives MT-5, MT-6, and MT-7).

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 MT-8, and the central EDR treatment alternative is Alternative MT-9.

4.3.2 Point-of-Use Systems

POU treatment using RO technology is valid for fluoride and arsenic removal. The POU treatment alternative is MT-10.

4.3.3 Point-of-Entry Systems

POE treatment using RO technology is valid for fluoride and arsenic removal. The POE treatment alternative is MT-11.

4.4 BOTTLED WATER

Providing bottled water is considered an interim measure to be used until a compliance alternative is implemented. Even though the community is small and people know each other; it would be reasonable to require a quarterly communication advising customers of the need to take advantage of the bottled water program. An alternative to providing delivered bottled water is to provide a central, publicly accessible dispenser for treated drinking water. Alternatives addressing bottled water are MT-12, MT-13, and MT-14.

4.5 ALTERNATIVE DEVELOPMENT AND ANALYSIS

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

4.5.1 Alternative MT-1: Purchase Treated Water from the City of Levelland

This alternative involves purchasing potable water from the City of Levelland, which will be used to supply the City of Morton. The City of Levelland currently has sufficient excess capacity for this alternative to be feasible. It is assumed that City of Morton would obtain all its water from the City of Levelland.

This alternative would require construction of a pipeline and five pump stations with five 5,000-gallon feed tanks beginning at a Levelland water main to the City of Morton PWS. The required pipeline would be 8-inches in diameter, approximately 28.0 miles long, and follow west on State Highway 114 near Interstate Highway 385 in Levelland, passing through the City of Whiteface and continuing on to the City of Morton. By definition this alternative involves regionalization, since the City of Morton would be obtaining drinking water from an existing larger supplier. Also, other PWSs near City of Morton or along the pipeline route are in need of compliant drinking water and could share in implementation of this alternative.

The estimated capital cost for this alternative includes constructing the pipeline, feed tanks, pump stations, and distribution pumps. The estimated O&M cost for this alternative includes the purchase price for the treated water minus the cost related to current operation of the City of Morton's wells, 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 $7.44 million, with an estimated annual O&M cost of $331,300. 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 Levelland provides water on a large scale, and has adequate O&M resources. From the perspective of the City of Morton, 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 Levelland to purchase treated drinking water. There is one other small PWS that is relatively close to the City of Morton PWS that also has water quality problems and would be a good candidate for sharing the cost for obtaining water from the City of Levelland. The cost to the City of Morton for this alternative could be reduced if the other PWS would be willing to share the costs. The analysis for a shared solution is presented in Appendix E. This analysis shows that the City of Morton could expect to save up to $1.59 million on the capital cost for this alternative, which is a savings up to 21 percent.

4.5.2 Alternative MT-2: 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 City of Morton. 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 City of Morton would obtain all its water from the City of Lubbock.

This alternative would require construction of a pipeline and six pump stations with six 5,000-gallon feed tanks beginning at the Lubbock's Bailey County well field pipeline to the existing intake point for City of Morton. The required pipeline would be 8-inches in diameter and approximately 37.8 miles long. Starting at the Bailey County well field pipeline near the intersection of State Highway 84 and County Road (CR) 243, the proposed pipeline would follow south along CR 243 crossing Rural Route 298 where it would continue south on CR 237, turning west on CR 1243 to CR 175 south to State Highway 214, continuing on to the City of Morton distribution system.

By definition this alternative involves regionalization, since City of Morton would be obtaining drinking water from an existing larger supplier. Also, other PWSs near City of Morton and along the pipeline route are in need of compliant drinking water and could share in implementation of this alternative.

The estimated capital cost for this alternative includes constructing the pipeline, feed tanks, pump stations, and distribution pumps. The estimated O&M cost for this alternative includes the purchase price for the treated water minus the cost related to current operation of the City of Morton's wells, 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 $9.78 million, with an estimated annual O&M cost of $282,800. 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 City of Morton, 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.

4.5.3 Alternative MT-3: New Well in the Vicinity of the City of Whiteface

This alternative involves completing two new wells in the vicinity of City of Whiteface, and constructing a pump station and pipeline to transfer the pumped groundwater to the City of Morton PWS. Based on the water quality data in the TCEQ database, it is assumed that groundwater from these wells would be compliant with drinking water MCLs. An agreement would need to be negotiated with the City of Whiteface to expand its well field.

This alternative would require completing two new 300-foot wells at the City of Whiteface well field, and constructing a pipeline to the existing intake point for the City of Morton PWS. Three pump stations and three 5,000 gallon feed tanks would also be required to overcome pipe friction and the elevation differences between the City of Whiteface and the City of Morton PWS. The required pipeline would be constructed of 8-inch pipe and would follow north on FM 1780 to Highway 114 north to CR 94 west, continuing on to the City of Morton. Using this route, the pipeline required would be approximately 13.2 miles long. The pipeline would terminate at the existing storage tanks owned by the City of Morton.

Each 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 City of Morton, 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 or along the pipeline route 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 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 $3.81 million, with an estimated annual O&M cost of $93,600. 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 City of Morton's perspective, this alternative would be characterized as easy to operate and repair, since O&M and repair of pipelines and pump stations is well understood, and City of Morton personnel currently operate pipelines and a pump station. If the decision was made to perform blending then the operational complexity would increase.

4.5.4 Alternative MT-4: New Well in the Vicinity of Littlefield Municipal Water System

This alternative involves completing two new wells in the vicinity of Littlefield Municipal Water System, and constructing six pump stations and pipeline to transfer the pumped groundwater to the City of Morton PWS. 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 Littlefield Municipal Water System to expand its well field.

This alternative would require completing two new 300-foot wells at the Littlefield Municipal Water System, and constructing a pipeline from the wells to the existing intake point for the City of Morton PWS. Six pump stations and six 5,000 gallon feed tanks would also be required to overcome pipe friction and the elevation differences between Littlefield Municipal Water System and the City of Morton PWS. The required pipeline would be constructed of 8-inch pipe and would follow RR 54 west from Littlefield to CR 175 then south to State Highway 214, continuing on to the City of Morton. Using this route, the pipeline required would be approximately 38.3 miles long. The pipeline would terminate at the existing storage tanks owned by the City of Morton.

Each 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 City of Morton, 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 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 $10.17 million, with an estimated annual O&M cost of $224,200. 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. From the City of Morton's perspective, this alternative would be characterized as easy to operate and repair, since O&M and repair of pipelines and pump stations is well understood, and City of Morton personnel currently operate pipelines and a pump station. If the decision was made to perform blending then the operational complexity would increase.

4.5.5 Alternative MT-5: New Well at 10 miles

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

This alternative would require constructing two new 300-foot wells, a new pump station with a 5,000-gallon feed tank near the new wells, an additional pump station and 5,000 gallon feed tank along the pipeline, and a pipeline from the new well/feed tank to the existing intake point for the City of Morton system. The pump stations and feed tanks would be necessary to overcome pipe friction and changes in land elevation. For this alternative, the pipeline is assumed to be approximately 10 miles long, and would be 8-inches in diameter and discharge to the existing storage tanks at the City of Morton PWS. Each pump station would include a feed tank, two transfer pumps, including one standby, and would be housed in a building.

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

The estimated capital cost for this alternative includes installing the well, constructing the pipeline, the pump stations, the feed tanks, service pumps and pump houses. The estimated O&M cost for this alternative includes O&M for the pipeline and pump stations. The estimated capital cost for this alternative is $2.83 million, and the estimated annual O&M cost for this alternative is $70,400.

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

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

4.5.6 Alternative MT-6: New Well at 5 miles

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

This alternative would require constructing two new 300-foot wells, a new pump station with a 5,000 gallon feed tank near the new well, and a pipeline from the new well/feed tank to the existing intake point for the City of Morton 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 8-inches in diameter, approximately 5 miles long, and would discharge to the existing storage tanks at the City of Morton PWS. The pump station near the well would include two transfer pumps, including one standby, and would be housed in a building.

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

The estimated capital cost for this alternative includes installing the wells, and constructing the pipeline, pump station, and feed tank. The estimated O&M cost for this alternative includes O&M for the pipeline and pump station. The estimated capital cost for this alternative is $1.51 million, and the estimated annual O&M cost for this alternative is $36,400.

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

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

4.5.7 Alternative MT-7: New Well at 1 mile

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

This alternative would require constructing two new 300-foot wells and a pipeline from the new wells to the existing intake point for the City of Morton system. Since the new wells are relatively close, a pump station would not be necessary. For this alternative, the pipeline is assumed to be 8 inches in diameter, approximately 1 mile long, and would discharge to the existing storage tanks at the City of Morton PWS.

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 $441,000, and the estimated annual O&M cost for this alternative is $2,700.

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

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

4.5.8 Alternative MT-8: Central RO Treatment

This system would continue to pump water from the existing wells, and would treat the water through an RO treatment systems prior to distribution. In this case, two separate RO units would be required, one for each group of wells. For this option, 100 percent of the raw water would be treated to obtain compliant water. The RO process concentrates impurities in the reject stream which would require disposal. It is estimated the total RO reject generation would be approximately 97,000 gallons per day (gpd) when the systems are operated at the average daily consumption (0.332 mgd).

This alternative consists of constructing the RO treatment plants near the existing ground storage tanks. Each RO plant includes 1100 square foot buildings with paved driveways; skids with the pre-constructed RO plants; two sets of two transfer pumps, a 15,000-gallon tank for storing the treated water, and a 1,800,000-gallon pond for reject from wells 4, 7, and 8 and a

1,000,000-gallon pond for storing reject water from wells 2, 5, and 6. The treated water would be chlorinated and stored in the new treated water tanks prior to being pumped into the existing ground storage tanks. The entire facility is fenced.

The estimated capital cost for this alternative is $3.6 million, and the estimated annual O&M cost is $978,400.

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.

4.5.9 Alternative MT-9: Central EDR Treatment

The system would continue to pump water from the existing wells, and would treat the water through two EDR systems prior to distribution. In this case, two separate EDR units would be required, one for each group of wells. For this option the EDR treatment units 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 71,000 gpd when the system is operated at the average daily consumption (0.332 mgd).

This alternative consists of constructing the EDR treatment plants near the existing ground storage tanks. Each EDR plant includes a 500 square foot building with a paved driveway; a skid with the pre-constructed EDR system; two transfer pumps; a 15,000-gallon tank for storing the treated water, and a pond for storing concentrated water. The total reject pond volume for both plants combined would be 2.2-million gallons. The treated water would be chlorinated and stored in the new treated water tank prior to being pumped into the existing ground storage tanks. The entire facility is fenced.

The estimated capital cost for this alternative is $3.6-million and the estimated annual O&M cost is $780,700.

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.

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

This alternative consists of the continued operation of the City of Morton well field, plus treatment of water to be used for drinking or food preparation at the point of use to remove fluoride 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. City of Morton 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 City of Morton or contract personnel into the houses of customers. As a result, cooperation of customers would be important for success implementing this alternative. The treatment units could be installed for access without house entry, but that would complicate the installation and increase costs.

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

This alternative does not present options for a regional solution.

The estimated capital cost for this alternative includes purchasing and installing the POU treatment systems. The estimated O&M cost for this alternative includes the purchase and replacement of filters and membranes, as well as periodic sampling and record keeping as required by the Texas Administrative Code (TAC_ (Title 30, Part I, Chapter 290, Subchapter F, Rule 290.106). The estimated capital cost for this alternative is $1.23 million, and the estimated annual O&M cost for this alternative is $810,000. For the cost estimate, it is assumed that one POU treatment unit will be required for each of the 970 connections in the City of Morton 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 City of Morton PWS, this alternative would be characterized as more difficult to operate owing to the in-home requirements and the large number of individual units.

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

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

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

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

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

This alternative does not present options for a regional solution.

The estimated capital cost for this alternative includes purchasing and installing the POE treatment systems. The estimated O&M cost for this alternative includes the purchase and replacement of filters and membranes, as well as periodic sampling and record keeping. The estimated capital cost for this alternative is $14.76 million, and the estimated annual O&M cost for this alternative is $2.08 million. For the cost estimate, it is assumed that one POE treatment unit will be required for each of the 970 existing connections to the City of Morton 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 City of Morton PWS, this alternative would be characterized as more difficult to operate owing to the on-property requirements and the large number of individual units.

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

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

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

City of Morton PWS personnel would be responsible for maintenance of the treatment unit, including media or membrane replacement, periodic sampling, and necessary repairs. The spent media or membranes will require disposal. This alternative relies on a great deal of cooperation and action from the customers 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 $89,200, and the estimated annual O&M cost for this alternative is $173,100.

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

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

4.5.13 Alternative MT-13: 100 Percent Bottled Water Delivery

This alternative consists of the continued operation of the City of Morton 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 the City of Morton PWS would find it most convenient and economical to contract a bottled water service. The bottle delivery program would have to be flexible enough to allow the delivery of smaller containers should customers be incapable of lifting and manipulating 5-gallon bottles. Blending is not an option in this case. It should be noted that this alternative would be considered an interim measure until a compliance alternative is implemented.

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

This alternative does not present options for a regional solution.

The estimated initial capital cost is for setting up the program. The estimated O&M cost for this alternative includes program administration and purchase of the bottled water. The estimated capital cost for this alternative is $27,000, and the estimated annual O&M cost for this alternative is $1.05 million. For the cost estimate, it is assumed that each person requires one gallon of bottled water per day.

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

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

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

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

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

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

The estimated capital cost for this alternative includes purchasing a water truck and construction of the storage tank to be used for the drinking water dispenser. The estimated O&M cost for this alternative includes O&M for the truck, maintenance for the tank, water quality testing, record keeping, and water purchase, The estimated capital cost for this alternative is $149,500, and the estimated annual O&M cost for this alternative is $39,400.

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 the City of Morton, this alternative would be characterized as relatively easy to operate, but the water hauling and storage would have to be done with care to ensure sanitary conditions.

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

4.5.15 Summary of Alternatives

Table 4.3 provides a summary of the key features of each alternative for City of Morton PWS.

1

Table 4.3 Summary of Compliance Alternatives for City of Morton PWS

Alt No.	Alternative Description	Major Components	Capital Cost[1]	Annual O&M Cost	Total Annualized Cost	Reliability	System Impact	Remarks
MT-1	Purchase Water from City of Levelland	- Five new pump stations / feed tanks - 28-mile pipeline	$7,435,000	$331,300	$979,500	Good	N	Agreement must be successfully negotiated with City of Levelland. Blending may be possible. Costs could possibly be shared with small systems along pipeline route.
MT-2	Purchase Water from Lubbock PWS	- Six new pump stations / feed tanks - 37.8-mile pipeline	$9,778,400	$282,800	$1,135,300	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.
MT-3	Install new compliant wells at City of Whiteface	- Two new wells - Three new pump stations / feed tanks - 13.2-mile pipeline	$3,807,000	$93,600	$425,500	Good	N	Agreement must be successfully negotiated with City of Whiteface, or land must be purchased. Blending may be possible. Costs could possibly be shared with small systems along pipeline route.
MT-4	Install new compliant wells at City of Littlefield	- Two new wells - Six new pump stations / feed tanks - 38.3-mile pipeline	$10,168,900	$224,200	$1,110,700	Good	N	Agreement must be successfully negotiated with City of Littlefield, or land must be purchased. Blending may be possible. Costs could possibly be shared with small systems along pipeline route.
MT-5	Install new compliant wells at 10 Miles	- Two new wells - Two new pump stations / feed tanks - 10-mile pipeline	$2,825,300	$70,400	$316,700	Good	N	May be difficult to find well with good water quality. Costs could possibly be shared with small systems along pipeline route.
MT-6	Install new compliant wells at 5 Miles	- Two new wells - One new pump station / feed tank - 5-mile pipeline	$1,511,300	$36,400	$168,200	Good	N	May be difficult to find well with good water quality. Costs could possibly be shared with small systems along pipeline route.
MT-7	Install new compliant well at 1 Miles	- Two new wells - 1-mle pipeline	$441,000	$2,700	$41,100	Good	N	May be difficult to find well with good water quality.
MT-8	Continue operation of City of Morton well field with central RO treatment	- Two Central RO treatment plants	$3,579,100	$978,400	$1,290,400	Good	T	Two treatment units are required, one for each group of wells. Costs could possibly be shared with nearby small systems.
MT-9	Continue operation of City of Morton well field with central EDR Treatment	- Two Central EDR treatment plants	$3,579,000	$780,700	$1,092,700	Good	T	Two treatment units are required, one for each group of wells. Costs could possibly be shared with nearby small systems.
MT-10	Continue operation of City of Morton well field, and POU treatment	- POU treatment units	$1,232,400	$810,000	$917,400	Fair	T, M	Only one compliant tap in home. Cooperation of residents required for installation, maintenance, and testing. Management of program may be significant.

Alt No.	Alternative Description	Major Components	Capital Cost[1]	Annual O&M Cost	Total Annualized Cost	Reliability	System Impact	Remarks
MT-11	Continue operation of City of Morton well field, and POE treatment	- POE treatment units	$14,764,600	$2,080,700	$3,367,900	Fair (*better than POU*)	T, M	All home taps compliant and less resident cooperation required.
MT-12	Continue operation of City of Morton well field, but furnish 5 public dispensers for treated drinking water	- Water treatment and dispenser unit	$89,200	$173,100	$180,800	Fair/interim measure	T,	Does not provide compliant water to taps, and requires a lot of effort by customers.
MT-13	Continue operation of City of Morton well field, but furnish bottled drinking water for all customers	- Set up bottled water system	$27,000	$1,050,500	$1,052,800	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.
MT-14	Continue operation of City of Morton well field, but furnish public dispenser for trucked drinking water.	- Construct storage tank and dispenser - Purchase potable water truck	$149,500	$39,400	$52,400	Fair/interim measure	M	Does not provide compliant water to taps, and requires a lot of effort by customers.

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

4.6 COST OF SERVICE AND FUNDING ANALYSIS

To evaluate the financial impact of implementing the compliance alternatives, a 30-year financial planning model was developed. This model can be found in Appendix D. The financial model is based on estimated cash flows, with and without implementation of the compliance alternatives. Data for such models are typically derived from established budgets, audited financial reports, published water tariffs, and consumption data. The City of Morton operates a PWS with 970 connections serving a population of 2,245. Information for City of Morton that was available to complete the financial analysis included 2007 revenues and expenses, 2007 water usage records, and current water rates, as well as data from other similar sized systems. The financial reports were for combined water and wastewater operations, and not just the water system alone.

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

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

4.6.1 Financial Plan Development

According to the City of Morton financial statements for FY2007, a total of 121.18 million gallons of water were sold in fiscal year 2007. Combined revenue from water and wastewater services was $392,139. Combined operating expenses for water and wastewater service were $398,131 for the year ended September 30, 2007.

4.6.2 Current Financial Condition

4.6.2.1 Cash Flow Needs

Using the water rates and usage as noted above, the current average annual water bill for the City of Morton was estimated to be $404 or about 1.5 percent of the City of Morton median household income of $26,921, as given in the 2000 Census.

A review of the actual water and wastewater revenues and the actual operating expenses for the City of Morton water and wastewater services suggest that utility revenues may not be sufficient sustain operations. Operating expenses for water related services exceeded revenues by approximately $5,992, or 1.5 percent. Additionally, the City of Morton PWS may need to raise rates in the future to service the debt associated with any capital improvements for the various alternatives that may be implemented to address compliance issues as well as for funding reserve accounts and other future capital projects. Other aspects of government are not capable of transferring sufficient funds to compensate for the unfavorable balance of funds for water and wastewater services.

4.6.2.2 Ratio Analysis

The financial reports provided total assets and liabilities for the City, so the current ratio and the debt to net worth ratio could not be calculated for the water and wastewater services.

Current Ratio

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

Debt to Net Worth Ratio.

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

Operating Ratio = 0.985

The Operating Ratio is a financial term defined as a company's revenues divided by the operating expenses. An operating ratio of 1.0 means that a utility is collecting just enough money to meet expenses. In general, an operating ratio of 1.25 or higher is desirable. An operating ratio of 0.985, based on both water and waster services indicates that the City of Morton may need to raise water and wastewater rates to sustain water and wastewater services.

4.6.3 Financial Plan Results

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

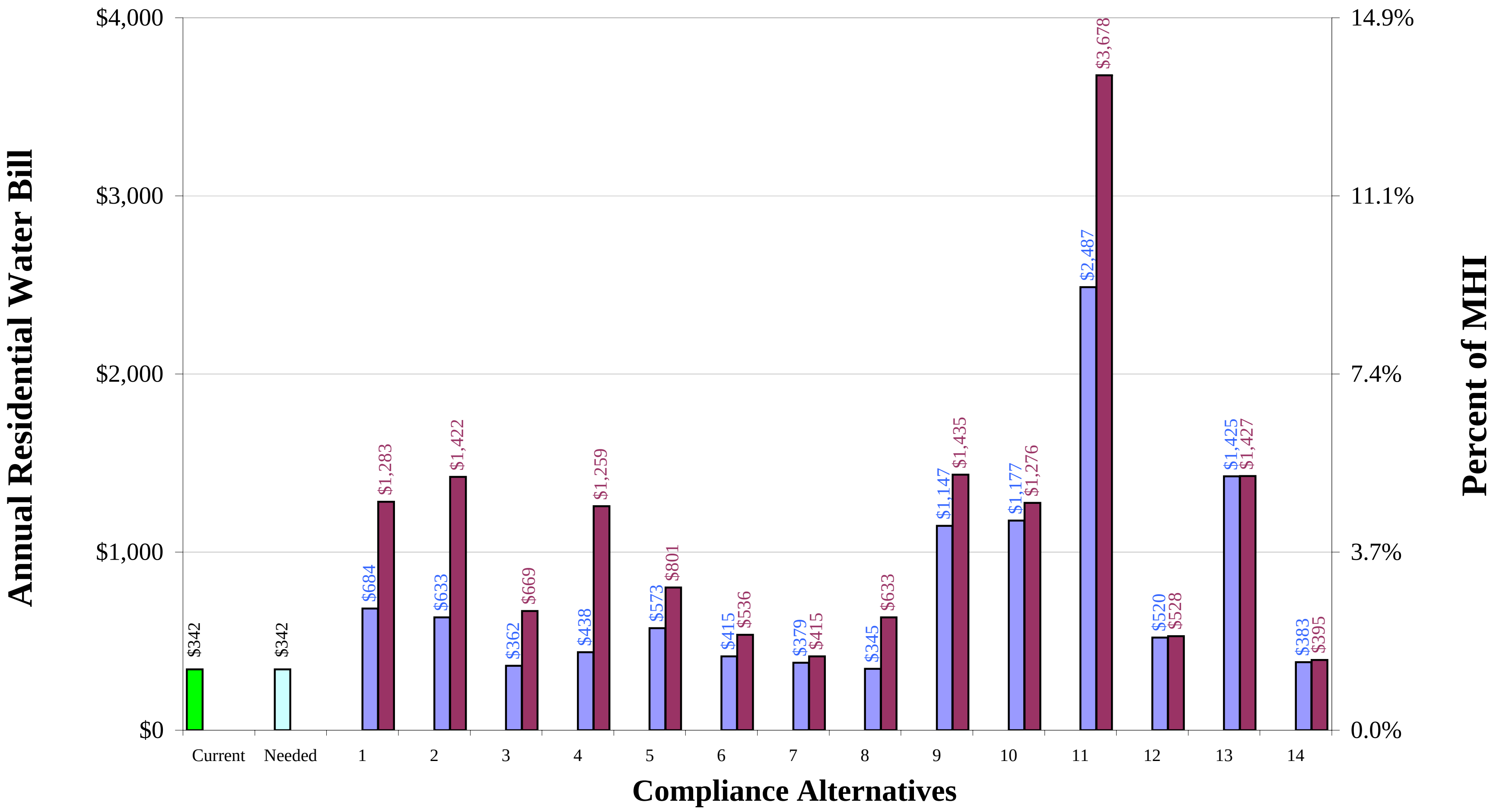
Results of the financial impact analysis are provided in Table 4.4 and Figure 4.2. Table 4.4 and Figure 4.2 present rate impacts assuming that revenues match expenses, without funding reserve accounts, and that operations and implementation of compliance alternatives are funded with revenue and are not paid for from reserve accounts. Figure 4.2 provides a bar chart that, in terms of the yearly billing to an average customer, shows the following:

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

City of Morton
Table 4.4 Financial Impact on Households

Alternative	Description		All Revenue	100% Grant	75% Grant	50% Grant	SRF	Bond
1	Purchase Water from City of Leveland	Maximum % of MHI	29.7%	2.5%	3.1%	3.7%	4.0%	4.8%
		Percentage Rate Increase Compared to Current	2239%	100%	143%	187%	212%	275%
		Average Annual Water Bil	$8,007	$684	$833	$983	$1,067	$1,283
2	Purchase Water from Lubbock PWS	Maximum % of MHI	38.7%	2.4%	3.1%	3.8%	4.2%	5.3%
		Percentage Rate Increase Compared to Current	2945%	85%	143%	200%	232%	315%
		Average Annual Water Bil	$10,423	$633	$831	$1,028	$1,138	$1,422
3	New Well at Whiteface	Maximum % of MHI	15.8%	1.3%	1.6%	1.9%	2.1%	2.5%
		Percentage Rate Increase Compared to Current	1146%	6%	28%	51%	63%	95%
		Average Annual Water Bil	$4,267	$362	$439	$516	$558	$669
4	New Well at Littlefield	Maximum % of MHI	40.2%	1.6%	2.4%	3.2%	3.6%	4.7%
		Percentage Rate Increase Compared to Current	3062%	28%	88%	148%	181%	268%
		Average Annual Water Bil	$10,825	$438	$643	$848	$963	$1,259
5	New Well at 10 Miles	Maximum % of MHI	12.1%	2.1%	2.3%	2.6%	2.7%	3.0%
		Percentage Rate Increase Compared to Current	851%	67%	84%	101%	110%	134%
		Average Annual Water Bil	$3,255	$573	$630	$687	$719	$801
6	New Well at 5 Miles	Maximum % of MHI	7.1%	1.5%	1.7%	1.8%	1.8%	2.0%
		Percentage Rate Increase Compared to Current	455%	21%	30%	39%	44%	57%
		Average Annual Water Bil	$1,900	$415	$445	$476	$492	$536
7	New Well at 1 Mile	Maximum % of MHI	3.0%	1.4%	1.4%	1.5%	1.5%	1.5%
		Percentage Rate Increase Compared to Current	133%	11%	13%	16%	18%	21%
		Average Annual Water Bil	$797	$379	$388	$397	$402	$415
8	Central Treatment - RO	Maximum % of MHI	15.0%	1.3%	1.5%	1.8%	2.0%	2.4%
		Percentage Rate Increase Compared to Current	1078%	1%	22%	43%	55%	85%
		Average Annual Water Bil	$4,032	$345	$417	$489	$529	$633
9	Central Treatment - EDR	Maximum % of MHI	15.0%	4.3%	4.5%	4.8%	4.9%	5.3%
		Percentage Rate Increase Compared to Current	1078%	235%	256%	277%	289%	319%
		Average Annual Water Bil	$4,032	$1,147	$1,219	$1,291	$1,331	$1,435
10	Point-of-Use Treatment	Maximum % of MHI	6.0%	4.4%	4.5%	4.6%	4.6%	4.7%
		Percentage Rate Increase Compared to Current	371%	244%	251%	258%	262%	273%
		Average Annual Water Bil	$1,612	$1,177	$1,202	$1,227	$1,240	$1,276
11	Point-of-Entry Treatment	Maximum % of MHI	57.8%	9.2%	10.3%	11.4%	12.1%	13.7%
		Percentage Rate Increase Compared to Current	4446%	627%	713%	800%	849%	974%
		Average Annual Water Bil	$15,563	$2,487	$2,785	$3,082	$3,248	$3,678
12	Public Dispenser for Treated Drinking Water	Maximum % of MHI	1.9%	1.9%	1.9%	1.9%	1.9%	2.0%
		Percentage Rate Increase Compared to Current	52%	52%	53%	53%	53%	54%
		Average Annual Water Bil	$520	$520	$522	$524	$525	$528
13	Supply Bottled Water to 100% of Population	Maximum % of MHI	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%
		Percentage Rate Increase Compared to Current	316%	316%	316%	317%	317%	317%
		Average Annual Water Bil	$1,425	$1,425	$1,425	$1,426	$1,426	$1,427
14	Central Trucked Drinking Water	Maximum % of MHI	1.8%	1.4%	1.4%	1.4%	1.4%	1.5%
		Percentage Rate Increase Compared to Current	45%	12%	13%	14%	14%	15%
		Average Annual Water Bil	$496	$383	$386	$389	$390	$395

Figure 4.2
Alternative Cost Summary: City of Morton



Current Average Monthly Bill = $28.53
Mediuan Household Income = $26921
Average Monthly Residential Usage = 10411 gallons

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

4.6.4 Evaluation of Potential Funding Options

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

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

4.6.4.1 TWDB Funding Options

The programs offered by the TWDB include the Drinking Water State Revolving Fund (DWSRF), Rural Water Assistance Fund (RWAF), State Loan Program (Development Fund II), and Economically Distressed Areas Program (EDAP).

Drinking Water State Revolving Fund

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

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

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 links "Clean Water State Revolving Fund Loan Program."

State Loan Program (Development Fund II)

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

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

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

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 "Water and Wastewater Loan Program."

Economically Distressed Areas Program

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

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

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

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 “Economically Distressed Area Program.”

4.6.4.2 ORCA Funding Options

Created in 2001, ORCA seeks to strengthen rural communities and assist them with community and economic development and healthcare by providing a variety of rural programs, services, and activities. Of their many programs and funds, the most appropriate programs related to drinking water are the Community Development (CD) Fund and Texas Small Towns Environment Program (STEP). These programs offer attractive funding packages to help make improvements to potable water systems to mitigate potential health concerns.

Community Development Fund

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

Texas Small Towns Environment Program

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

4.6.4.3 Rural Development

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

Water and Wastewater Disposal Program

The major components of the RFP are loan, loan guarantees, and grant funding for water and waste disposal systems. Entities must demonstrate that they cannot obtain reasonable loans at market rates, but have the capacity to repay loans, pledge security, and operate the facilities. Grants can be up to 75 percent of the project costs, and loan guarantees can be up to 90 percent of eligible loss. Loans are not to exceed a 40-year repayment period, require tax or revenue pledges, and are offered at three rates:

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

SECTION 5
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APPENDIX A
PWS INTERVIEW FORM

CAPACITY DEVELOPMENT ASSESSMENT FORM

*Prepared By*___________________________________ *Date*___________________________

Section 1. Public Water System Information

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

3. County [ ]

4. Owner [ ] Address [ ]
   Tele. [ ] E-mail [ ]
   Fax [ ] Message [ ]

5. Admin [ ] Address [ ]
   Tele. [ ] E-mail [ ]
   Fax [ ] Message [ ]

6. Operator [ ] Address [ ]
   Tele. [ ] E-mail [ ]
   Fax [ ] Message [ ]

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

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

11. Source Type [ ]

12. Total PWS Annual Water Used [ ]

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

    Total Coliform [ ] Chemical/Radiological [ ]

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

A. Basic Information

1. Name of Water System:

2. Name of Person Interviewed:

3. Position:

4. Number of years at job:

5. Number of years experience with drinking water systems:

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

7. Certified Water Operator (Yes or No):

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

   7b. How long have you been certified?

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

B. Organization and Structure

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

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

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

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

    3b. May we see a copy?

C. Personnel

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

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

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

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

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

D. Communication

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

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

3. How are your work priorities set?

4. How are work tasks delegated to staff?

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

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

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

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

9. Describe communication between utility and customers.

E. Planning and Funding

1. Describe the rate structure for the utility.

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

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

3. How often are the rates reviewed?

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

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

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

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

8. How is the budget approved or adopted?

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

    9a. How are budget shortfalls handled?

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

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

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

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

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

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

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

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

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

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

F. Policies, Procedures, and Programs

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

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

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

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

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

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

7. Approximately how many complaints are there per month?

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

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

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

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

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

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

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

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

G. Operations and Maintenance

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

    a. Process Control

    b. Purchases of supplies or small equipment

    c. Compliance sampling/reporting

    d. Staff scheduling

2. Describe your utility's preventative maintenance program.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

H. SDWA Compliance

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

2. How were the violations handled?

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

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

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

I. Emergency Planning

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

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

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

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

Attachment A

A. Technical Capacity Assessment Questions

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

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

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

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

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

   YES ☐ NO ☐

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

   _____NM Small System _____Class 2

   _____NM Small System Advanced _____Class 3

   _____Class 1 _____Class 4

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

   YES ☐ NO ☐ No Deficiencies ☐

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

   Source ☐ Storage ☐

   Treatment ☐ Distribution ☐

   Other _____

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

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

   Radionuclides YES ☐ NO ☐ Doesn't Apply ☐

   Arsenic YES ☐ NO ☐ Doesn't Apply ☐

   Stage 1 Disinfectants and Disinfection By-Product (DBP)

   YES ☐ NO ☐ Doesn't Apply ☐

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

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

   YES ☐ NO ☐

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

YES ☐ NO ☐

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

Drought _____ Limited Supply _____

System Failure _____ Other _____

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

YES ☐ NO ☐ Don't Know ☐

If YES, please complete the following table.

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

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

YES ☐ NO ☐

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

Source ☐ Storage ☐

Treatment ☐ Distribution ☐

Other ☐ _____

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

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

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

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

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

13. Are there any dead end lines in the system?
YES ☐ NO ☐

14. Does the system have a flushing program?
YES ☐ NO ☐
If YES, please describe.

15. Are there any pressure problems within the system?
YES ☐ NO ☐
If YES, please describe.

16. Does the system disinfect the finished water?
YES ☐ NO ☐
If yes, which disinfectant product is used? ______

Interviewer Comments on Technical Capacity:

B. Managerial Capacity Assessment Questions

17. Has the system completed a 5-year Infrastructure Capital Improvement Plan (ICIP) plan?
YES ☐ NO ☐
If YES, has the plan been submitted to Local Government Division?
YES ☐ NO ☐

18. Does the system have written operating procedures?
YES ☐ NO ☐

19. Does the system have written job descriptions for all staff?
YES ☐ NO ☐

20. Does the system have:

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

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

Water quality violations
YES ☐ NO ☐

Public notification
YES ☐ NO ☐

Sampling exemptions
YES ☐ NO ☐

22. Please describe how the above records are maintained:

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

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

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

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

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

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

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

If yes, from which agency and how much?

Describe the project?

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

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

YES ☐ NO ☐

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

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

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

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

Interviewer Comments on Managerial Capacity:

C. Financial Capacity Assessment

30. Does the system have a budget?

YES ☐ NO ☐

If YES, what type of budget?

Operating Budget ☐

Capital Budget ☐

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

YES ☐ NO ☐

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

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

YES ☐ NO ☐

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

34. Are rates reviewed annually?

YES ☐ NO ☐

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

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

Operation & Maintenance ☐

Infrastructure Repair & replacement ☐

Staffing ☐

Emergency/Reserve fund ☐

Debt payment ☐

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

YES ☐ NO ☐

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

YES ☐ NO ☐

If yes, is this policy implemented?

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

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

[Convert to % of active connections

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

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

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

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

YES ☐ NO ☐

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

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

YES ☐ NO ☐

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

YES ☐ NO ☐

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

YES ☐ NO ☐

If yes, please describe.

41. Has the system ever had a financial audit?

YES ☐ NO ☐

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

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

Interviewer Comments on Financial Assessment:

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

APPENDIX B
COST BASIS

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

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

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

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

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

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

Electrical power cost is estimated to be $0.04 per kWH, as supplied by Xcel Energy. 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.

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

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

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

Table B.1
Summary of General Data
City Of Morton
0400001
General PWS Information

Service Population	2,245	**Number of Connections**	970
Total PWS Daily Water Usage	0.332 (mgd)	**Source**	Site visit list

Unit Cost Data

General Items	**Unit**	**Unit Cost**
Treated water purchase cost	See alternative	
Water purchase cost (trucked)	$/1,000 gals	$ 1.52
Contingency	20%	n/a
Engineering & Constr. Management	25%	n/a
Procurement/admin (POU/POE)	20%	n/a
Pipeline Unit Costs	**Unit**	**Unit Cost**
PVC water line, Class 200, 08"	LF	$ 27
Bore and encasement, 12"	LF	$ 240
Open cut and encasement, 12"	LF	$ 130
Gate valve and box, 08"	EA	$ 785
Air valve	EA	$ 2,050
Flush valve	EA	$ 1,025
Metal detectable tape	LF	$ 2.00
Bore and encasement, length	Feet	200
Open cut and encasement, length	Feet	50
Pump Station Unit Costs	**Unit**	**Unit Cost**
Pump	EA	$ 8,000
Pump Station Piping, 08"	EA	$ 1,315
Gate valve, 08"	EA	$ 785
Check valve, 08"	EA	$ 1,470
Electrical/Instrumentation	EA	$ 10,250
Site work	EA	$ 2,560
Building pad	EA	$ 5,125
Pump Building	EA	$ 10,250
Fence	EA	$ 6,150
Tools	EA	$ 1,025
5,000 gal feed tank	EA	$ 10,000
Backflow preventer, 8"	EA	$ 6,075
Backflow Testing/Certification	EA	$ 105
Well Installation Unit Costs	**Unit**	**Unit Cost**
Well installation	See alternative	
Water quality testing	EA	$ 1,280
25 HP Well Pump	EA	$ 7,550
Well electrical/instrumentation	EA	$ 5,635
Well cover and base	EA	$ 3,075
Piping	EA	$ 3,075
100,000 gal ground storage tank	EA	$ 100,000
Electrical Power	$/kWH	$ 0.038
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
20,000 gal ground storage tank	EA	$ 25,000
Site improvements	EA	$ 3,075
Potable water truck	EA	$ 75,000
Water analysis, per sample	EA	$ 205
Potable water truck O&M costs	$/mile	$ 3.00

Central Treatment Unit Costs	**Unit**	**Unit Cost**
General		
Site preparation	acre	$ 4,000
Slab	CY	$ 1,000
Building	SF	$ 60
Building electrical	SF	$ 8.00
Building plumbing	SF	$ 8.00
Heating and ventilation	SF	$ 7.00
Fence	LF	$ 15
Paving	SF	$ 2.00
General O&M		
Building power	kwh/yr	$ 0.038
Equipment power	kwh/yr	$ 0.038
Labor, O&M	hr	$ 40
Analyses	test	$ 200
Reject Pond		
Reject pond, excavation	CYD	$ 3
Reject pond, compacted fill	CYD	$ 7
Reject pond, lining	SF	$ 1.50
Reject pond, vegetation	SY	$ 1.50
Reject pond, access road	LF	$ 30
Reject water haulage truck	EA	$ 100,000
Reverse Osmosis		
Electrical	JOB	$ 40,000
Piping	JOB	$ 20,000
RO package plant Wells 4, 7 and 8	UNIT	$ 710,000
RO package plant Wells 2, 5 and 6	UNIT	$ 530,000
Transfer pumps (7.5 hp)	EA	$ 7,500
Permeate tank	gal	$ 3
RO materials and chemicals	kgal	$ 0.75
RO chemicals	year	$ 2,000
Backwash disposal mileage cost	miles	$ 1.50
Backwash disposal fee	1,000 gal/yr	$ 5.00
EDR		
Electrical	JOB	$ 50,000
Piping	JOB	$ 20,000
Product storage tank	gal	$ 3.00
EDR package plant - Well 1	UNIT	$ 860,000
EDR package plant - Well 2	UNIT	$ 640,000
EDR materials	kgal	$ 0.48
EDR chemicals	kgal	$ 0.40
Backwash disposal mileage cost	miles	$ 1.50
Backwash disposal fee	1,000 gal/yr	$ 5.00
Transfer pumps (7.5 hp)	EA	$ 7,500

APPENDIX C
COMPLIANCE ALTERNATIVE CONCEPTUAL COST ESTIMATES

This appendix presents the conceptual cost estimates developed for the compliance alternatives. The conceptual cost estimates are given in Tables C.1 through C.14 The cost estimates are conceptual in nature (+50%/-30%), and are intended for making comparisons between compliance options and to provide a preliminary indication of possible water rate impacts. Consequently, these costs are pre-planning level and should not be viewed as final estimated costs for alternative implementation.

Table C.1

PWS Name *City Of Morton*
Alternative Name *Purchase Water from City of Levelland*
Alternative Number *MT-1*

Distance from Alternative to PWS (along pipe)	28.0	miles
Total PWS annual water usage	121.180	MG
Treated water purchase cost	$ 1.52	per 1,000 gals
Pump Stations needed w/ 1 feed tank each	5	
On site storage tanks / pump sets needed	0	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	-	n/a	n/a	n/a
Number of Crossings, open cut	59	n/a	n/a	n/a
PVC water line, Class 200, 08"	147,840	LF	$ 27	$ 3,991,680
Bore and encasement, 12"	-	LF	$ 240	$ -
Open cut and encasement, 12"	2,950	LF	$ 130	$ 383,500
Gate valve and box, 08"	30	EA	$ 785	$ 23,211
Air valve	29	EA	$ 2,050	$ 59,450
Flush valve	30	EA	$ 1,025	$ 30,307
Metal detectable tape	147,840	LF	$ 2	$ 295,680
Subtotal				**$ 4,783,828**
Pump Station(s) Installation				
Pump	10	EA	$ 8,000	$ 80,000
Pump Station Piping, 08"	5	EA	$ 1,315	$ 6,575
Gate valve, 08"	20	EA	$ 785	$ 15,700
Check valve, 08"	10	EA	$ 1,470	$ 14,700
Electrical/Instrumentation	5	EA	$ 10,250	$ 51,250
Site work	5	EA	$ 2,560	$ 12,800
Building pad	5	EA	$ 5,125	$ 25,625
Pump Building	5	EA	$ 10,250	$ 51,250
Fence	5	EA	$ 6,150	$ 30,750
Tools	5	EA	$ 1,025	$ 5,125
5,000 gal feed tank	5	EA	$ 10,000	$ 50,000
100,000 gal ground storage tank	-	EA	$ 100,000	$ -
Backflow Preventor	-	EA	$ 6,075	$ -
Subtotal				**$ 343,775**
Subtotal of Component Costs				**$ 5,127,603**
Contingency	20%			$ 1,025,521
Design & Constr Management	25%			$ 1,281,901
TOTAL CAPITAL COSTS				**$ 7,435,024**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	28.0	mile	$ 275	$ 7,700
Subtotal				**$ 7,700**
Water Purchase Cost				
From PWS	121,180	1,000 gal	$ 1.52	$ 184,194
Subtotal				**$ 184,194**
Pump Station(s) O&M				
Building Power	59,000	kWH	$ 0.038	$ 2,242
Pump Power	1,380,781	kWH	$ 0.038	$ 52,470
Materials	5	EA	$ 1,540	$ 7,700
Labor	1,825	Hrs	$ 60.00	$ 109,500
Tank O&M	-	EA	$ 1,025	$ -
Backflow Test/Cert	-	EA	$ 105	$ -
Subtotal				**$ 171,912**
O&M Credit for Existing Well Closure				
Pump power	206,014	kWH	$ 0.038	$ (7,829)
Well O&M matl	2	EA	$ 1,540	$ (3,080)
Well O&M labor	360	Hrs	$ 60	$ (21,600)
Subtotal				**$ (32,509)**
TOTAL ANNUAL O&M COSTS				**$ 331,297**

Table C.2

PWS Name	***City Of Morton***
Alternative Name	***Purchase Water from Lubbock PWS***
Alternative Number	***MT-2***

Distance from Alternative to PWS (along pipe)	37.8	miles
Total PWS annual water usage	121.180	MG
Treated water purchase cost	$ 0.83	per 1,000 gals
Pump Stations needed w/ 1 feed tank each	6	
On site storage tanks / pump sets needed	0	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	2	n/a	n/a	n/a
Number of Crossings, open cut	46	n/a	n/a	n/a
PVC water line, Class 200, 08"	199,519	LF	$ 27	$ 5,387,013
Bore and encasement, 12"	400	LF	$ 240	$ 96,000
Open cut and encasement, 12"	2,300	LF	$ 130	$ 299,000
Gate valve and box, 08"	40	EA	$ 785	$ 31,324
Air valve	38	EA	$ 2,050	$ 77,900
Flush valve	40	EA	$ 1,025	$ 40,901
Metal detectable tape	199,519	LF	$ 2	$ 399,038
Subtotal				**$ 6,331,177**
Pump Station(s) Installation				
Pump	12	EA	$ 8,000	$ 96,000
Pump Station Piping, 08"	6	EA	$ 1,315	$ 7,890
Gate valve, 08"	24	EA	$ 785	$ 18,840
Check valve, 08"	12	EA	$ 1,470	$ 17,640
Electrical/Instrumentation	6	EA	$ 10,250	$ 61,500
Site work	6	EA	$ 2,560	$ 15,360
Building pad	6	EA	$ 5,125	$ 30,750
Pump Building	6	EA	$ 10,250	$ 61,500
Fence	6	EA	$ 6,150	$ 36,900
Tools	6	EA	$ 1,025	$ 6,150
5,000 gal feed tank	6	EA	$ 10,000	$ 60,000
100,000 gal ground storage tank	-	EA	$ 100,000	$ -
Backflow Preventor	-	EA	$ 6,075	$ -
Subtotal				**$ 412,530**
Subtotal of Component Costs				**$ 6,743,707**
Contingency	20%			$ 1,348,741
Design & Constr Management	25%			$ 1,685,927
TOTAL CAPITAL COSTS				**$ 9,778,375**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	37.8	mile	$ 275	$ 10,392
Subtotal				**$ 10,392**
Water Purchase Cost				
From PWS	121,180	1,000 gal	$ 0.83	$ 100,579
Subtotal				**$ 100,579**
Pump Station(s) O&M				
Building Power	70,800	kWH	$ 0.038	$ 2,690
Pump Power	1,604,912	kWH	$ 0.038	$ 60,987
Materials	6	EA	$ 1,540	$ 9,240
Labor	2,190	Hrs	$ 60.00	$ 131,400
Tank O&M	-	EA	$ 1,025	$ -
Backflow Test/Cert	0	EA	$ 105	$ -
Subtotal				**$ 204,317**
O&M Credit for Existing Well Closure				
Pump power	206,014	kWH	$ 0.038	$ (7,829)
Well O&M matl	2	EA	$ 1,540	$ (3,080)
Well O&M labor	360	Hrs	$ 60	$ (21,600)
Subtotal				**$ (32,509)**
TOTAL ANNUAL O&M COSTS				**$ 282,780**

Table C.3

PWS Name	***City Of Morton***
Alternative Name	***New Well at Whiteface***
Alternative Number	***MT-3***

Distance from PWS to new well location	13.2	miles
Estimated well depth	300	feet
Number of wells required	2	
Well installation cost (location specific)	$150.5	per foot
Pump Stations needed w/ 1 feed tank each	3	
On site storage tanks / pump sets needed	0	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	-	n/a	n/a	n/a
Number of Crossings, open cut	29	n/a	n/a	n/a
PVC water line, Class 200, 08"	69,941	LF	$ 27	$ 1,888,407
Bore and encasement, 12"	-	LF	$ 240	$ -
Open cut and encasement, 12"	1,450	LF	$ 130	$ 188,500
Gate valve and box, 08"	14	EA	$ 785	$ 10,981
Air valve	21	EA	$ 2,050	$ 43,050
Flush valve	14	EA	$ 1,025	$ 14,338
Metal detectable tape	69,941	LF	$ 2	$ 139,882
Subtotal				**$ 2,285,158**
Pump Station(s) Installation				
Pump	6	EA	$ 8,000	$ 48,000
Pump Station Piping, 08"	3	EA	$ 1,315	$ 3,945
Gate valve, 08"	12	EA	$ 785	$ 9,420
Check valve, 08"	6	EA	$ 1,470	$ 8,820
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	3	EA	$ 10,000	$ 30,000
100,000 gal ground storage tank	-	EA	$ 100,000	$ -
Backflow Preventor	0	EA	$ 6,075	$ -
Subtotal				**$ 206,265**
Well Installation				
Well installation	600	LF	$ 150.5	$ 90,300
Water quality testing	4	EA	$ 1,280	$ 5,120
Well pump	2	EA	$ 7,550	$ 15,100
Well electrical/instrumentation	2	EA	$ 5,635	$ 11,270
Well cover and base	2	EA	$ 3,075	$ 6,150
Piping	2	EA	$ 3,075	$ 6,150
Subtotal				**$ 134,090**
Subtotal of Component Costs				**$ 2,625,513**
Contingency	20%			$ 525,103
Design & Constr Management	25%			$ 656,378
TOTAL CAPITAL COSTS				**$ 3,806,993**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	13.2	mile	$ 275	$ 3,643
Subtotal				**$ 3,643**
Pump Station(s) O&M				
Building Power	35,400	kWH	$ 0.038	$ 1,345
Pump Power	636,834	kWH	$ 0.038	$ 24,200
Materials	3	EA	$ 1,540	$ 4,620
Labor	1,095	Hrs	$ 60.00	$ 65,700
Tank O&M	-	EA	$ 1,025	$ -
Backflow Cert/Test	0	EA	$ 105	$ -
Subtotal				**$ 95,865**
Well O&M				
Pump power	50,478	kWH	$ 0.038	$ 1,918
Well O&M matl	2	EA	$ 1,540	$ 3,080
Well O&M labor	360	Hrs	$ 60	$ 21,600
Subtotal				**$ 26,598**
O&M Credit for Existing Well Closure				
Pump power	206,014	kWH	$ 0.038	$ (7,829)
Well O&M matl	2	EA	$ 1,540	$ (3,080)
Well O&M labor	360	Hrs	$ 60	$ (21,600)
Subtotal				**$ (32,509)**
TOTAL ANNUAL O&M COSTS				**$ 93,597**

Table C.4

PWS Name	***City Of Morton***
Alternative Name	***New Well at Littlefield***
Alternative Number	***MT-4***

Distance from PWS to new well location	38.3	miles
Estimated well depth	300	feet
Number of wells required	2	
Well installation cost (location specific)	$150.5	per foot
Pump Stations needed w/ 1 feed tank each	6	
On site storage tanks / pump sets needed	0	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	2	n/a	n/a	n/a
Number of Crossings, open cut	54	n/a	n/a	n/a
PVC water line, Class 200, 08"	202,075	LF	$ 27	$ 5,456,025
Bore and encasement, 12"	400	LF	$ 240	$ 96,000
Open cut and encasement, 12"	2,700	LF	$ 130	$ 351,000
Gate valve and box, 08"	40	EA	$ 785	$ 31,726
Air valve	42	EA	$ 2,050	$ 86,100
Flush valve	40	EA	$ 1,025	$ 41,425
Metal detectable tape	202,075	LF	$ 2	$ 404,150
Subtotal				**$ 6,466,426**
Pump Station(s) Installation				
Pump	12	EA	$ 8,000	$ 96,000
Pump Station Piping, 08"	6	EA	$ 1,315	$ 7,890
Gate valve, 08"	24	EA	$ 785	$ 18,840
Check valve, 08"	12	EA	$ 1,470	$ 17,640
Electrical/Instrumentation	6	EA	$ 10,250	$ 61,500
Site work	6	EA	$ 2,560	$ 15,360
Building pad	6	EA	$ 5,125	$ 30,750
Pump Building	6	EA	$ 10,250	$ 61,500
Fence	6	EA	$ 6,150	$ 36,900
Tools	6	EA	$ 1,025	$ 6,150
5,000 gal feed tank	6	EA	$ 10,000	$ 60,000
100,000 gal ground storage tank	-	EA	$ 100,000	$ -
Backflow Preventor	0	EA	$ 6,075	$ -
Subtotal				**$ 412,530**
Well Installation				
Well installation	600	LF	$ 150.5	$ 90,300
Water quality testing	4	EA	$ 1,280	$ 5,120
Well pump	2	EA	$ 7,550	$ 15,100
Well electrical/instrumentation	2	EA	$ 5,635	$ 11,270
Well cover and base	2	EA	$ 3,075	$ 6,150
Piping	2	EA	$ 3,075	$ 6,150
Subtotal				**$ 134,090**
Subtotal of Component Costs				**$ 7,013,046**
Contingency	20%			$ 1,402,609
Design & Constr Management	25%			$ 1,753,262
TOTAL CAPITAL COSTS				**$ 10,168,917**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	38.3	mile	$ 275	$ 10,525
Subtotal				**$ 10,525**
Pump Station(s) O&M				
Building Power	70,800	kWH	$ 0.038	$ 2,690
Pump Power	1,787,737	kWH	$ 0.038	$ 67,934
Materials	6	EA	$ 1,540	$ 9,240
Labor	2,190	Hrs	$ 60.00	$ 131,400
Tank O&M	-	EA	$ 1,025	$ -
Backflow Cert/Test	0	EA	$ 105	$ -
Subtotal				**$ 211,264**
Well O&M				
Pump power	268,569	kWH	$ 0.038	$ 10,206
Well O&M matl	2	EA	$ 1,540	$ 3,080
Well O&M labor	360	Hrs	$ 60	$ 21,600
Subtotal				**$ 34,886**
O&M Credit for Existing Well Closure				
Pump power	206,014	kWH	$ 0.038	$ (7,829)
Well O&M matl	2	EA	$ 1,540	$ (3,080)
Well O&M labor	360	Hrs	$ 60	$ (21,600)
Subtotal				**$ (32,509)**
TOTAL ANNUAL O&M COSTS				**$ 224,166**

Table C.5

PWS Name *City Of Morton*
Alternative Name *New Well at 10 Miles*
Alternative Number *MT-5*

Distance from PWS to new well location	10.0 miles
Estimated well depth	300 feet
Number of wells required	2
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	0

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	-	n/a	n/a	n/a
Number of Crossings, open cut	16	n/a	n/a	n/a
PVC water line, Class 200, 08"	52,800	LF	$ 27	$ 1,425,600
Bore and encasement, 12"	-	LF	$ 240	$ -
Open cut and encasement, 12"	800	LF	$ 130	$ 104,000
Gate valve and box, 08"	11	EA	$ 785	$ 8,290
Air valve	11	EA	$ 2,050	$ 22,550
Flush valve	11	EA	$ 1,025	$ 10,824
Metal detectable tape	52,800	LF	$ 2	$ 105,600
Subtotal				**$ 1,676,864**
Pump Station(s) Installation				
Pump	4	EA	$ 8,000	$ 32,000
Pump Station Piping, 08"	2	EA	$ 1,315	$ 2,630
Gate valve, 08"	8	EA	$ 785	$ 6,280
Check valve, 08"	4	EA	$ 1,470	$ 5,880
Electrical/Instrumentation	2	EA	$ 10,250	$ 20,500
Site work	2	EA	$ 2,560	$ 5,120
Building pad	2	EA	$ 5,125	$ 10,250
Pump Building	2	EA	$ 10,250	$ 20,500
Fence	2	EA	$ 6,150	$ 12,300
Tools	2	EA	$ 1,025	$ 2,050
5,000 gal feed tank	2	EA	$ 10,000	$ 20,000
100,000 gal ground storage tank	-	EA	$ 100,000	$ -
Subtotal				**$ 137,510**
Well Installation				
Well installation	600	LF	$ 150.5	$ 90,300
Water quality testing	4	EA	$ 1,280	$ 5,120
Well pump	2	EA	$ 7,550	$ 15,100
Well electrical/instrumentation	2	EA	$ 5,635	$ 11,270
Well cover and base	2	EA	$ 3,075	$ 6,150
Piping	2	EA	$ 3,075	$ 6,150
Subtotal				**$ 134,090**
Subtotal of Component Costs				**$ 1,948,464**
Contingency	20%			$ 389,693
Design & Constr Management	25%			$ 487,116
TOTAL CAPITAL COSTS				**$ 2,825,272**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	10.0	mile	$ 275	$ 2,750
Subtotal				**$ 2,750**
Pump Station(s) O&M				
Building Power	23,600	kWH	$ 0.038	$ 897
Pump Power	461,210	kWH	$ 0.038	$ 17,526
Materials	2	EA	$ 1,540	$ 3,080
Labor	730	Hrs	$ 60.00	$ 43,800
Tank O&M	-	EA	$ 1,025	$ -
Subtotal				**$ 65,303**
Well O&M				
Pump power	268,569	kWH	$ 0.038	$ 10,206
Well O&M matl	2	EA	$ 1,540	$ 3,080
Well O&M labor	360	Hrs	$ 60	$ 21,600
Subtotal				**$ 34,886**
O&M Credit for Existing Well Closure				
Pump power	206,014	kWH	$ 0.038	$ (7,829)
Well O&M matl	2	EA	$ 1,540	$ (3,080)
Well O&M labor	360	Hrs	$ 60	$ (21,600)
Subtotal				**$ (32,509)**
TOTAL ANNUAL O&M COSTS				**$ 70,430**

Table C.6

PWS Name *City Of Morton*
Alternative Name *New Well at 5 Miles*
Alternative Number *MT-6*

Distance from PWS to new well location	5.0	miles
Estimated well depth	300	feet
Number of wells required	2	
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	0	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	-	n/a	n/a	n/a
Number of Crossings, open cut	8	n/a	n/a	n/a
PVC water line, Class 200, 08"	26,400	LF	$ 27	$ 712,800
Bore and encasement, 12"	-	LF	$ 240	$ -
Open cut and encasement, 12"	400	LF	$ 130	$ 52,000
Gate valve and box, 08"	5	EA	$ 785	$ 4,145
Air valve	6	EA	$ 2,050	$ 12,300
Flush valve	5	EA	$ 1,025	$ 5,412
Metal detectable tape	26,400	LF	$ 2	$ 52,800
Subtotal				**$ 839,457**
Pump Station(s) Installation				
Pump	2	EA	$ 8,000	$ 16,000
Pump Station Piping, 08"	1	EA	$ 1,315	$ 1,315
Gate valve, 08"	4	EA	$ 785	$ 3,140
Check valve, 08"	2	EA	$ 1,470	$ 2,940
Electrical/Instrumentation	1	EA	$ 10,250	$ 10,250
Site work	1	EA	$ 2,560	$ 2,560
Building pad	1	EA	$ 5,125	$ 5,125
Pump Building	1	EA	$ 10,250	$ 10,250
Fence	1	EA	$ 6,150	$ 6,150
Tools	1	EA	$ 1,025	$ 1,025
5,000 gal feed tank	1	EA	$ 10,000	$ 10,000
100,000 gal ground storage tank	-	EA	$ 100,000	$ -
Subtotal				**$ 68,755**
Well Installation				
Well installation	600	LF	$ 150.5	$ 90,300
Water quality testing	4	EA	$ 1,280	$ 5,120
Well pump	2	EA	$ 7,550	$ 15,100
Well electrical/instrumentation	2	EA	$ 5,635	$ 11,270
Well cover and base	2	EA	$ 3,075	$ 6,150
Piping	2	EA	$ 3,075	$ 6,150
Subtotal				**$ 134,090**
Subtotal of Component Costs				**$ 1,042,302**
Contingency	20%			$ 208,460
Design & Constr Management	25%			$ 260,575
TOTAL CAPITAL COSTS				**$ 1,511,338**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	5.0	mile	$ 275	$ 1,375
Subtotal				**$ 1,375**
Pump Station(s) O&M				
Building Power	11,800	kWH	$ 0.038	$ 448
Pump Power	230,605	kWH	$ 0.038	$ 8,763
Materials	1	EA	$ 1,540	$ 1,540
Labor	365	Hrs	$ 60.00	$ 21,900
Tank O&M	-	EA	$ 1,025	$ -
Subtotal				**$ 32,651**
Well O&M				
Pump power	268,569	kWH	$ 0.038	$ 10,206
Well O&M matl	2	EA	$ 1,540	$ 3,080
Well O&M labor	360	Hrs	$ 60	$ 21,600
Subtotal				**$ 34,886**
O&M Credit for Existing Well Closure				
Pump power	206,014	kWH	$ 0.038	$ (7,829)
Well O&M matl	2	EA	$ 1,540	$ (3,080)
Well O&M labor	360	Hrs	$ 60	$ (21,600)
Subtotal				**$ (32,509)**
TOTAL ANNUAL O&M COSTS				**$ 36,403**

Table C.7

PWS Name	***City Of Morton***
Alternative Name	***New Well at 1 Mile***
Alternative Number	***MT-7***

Distance from PWS to new well location	1.0 miles
Estimated well depth	300 feet
Number of wells required	2
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	0

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	-	n/a	n/a	n/a
Number of Crossings, open cut	2	n/a	n/a	n/a
PVC water line, Class 200, 08"	5,280	LF	$ 27	$ 142,560
Bore and encasement, 12"	-	LF	$ 240	$ -
Open cut and encasement, 12"	100	LF	$ 130	$ 13,000
Gate valve and box, 08"	1	EA	$ 785	$ 829
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				**$ 170,081**
Pump Station(s) Installation				
Pump	-	EA	$ 8,000	$ -
Pump Station Piping, 08"	-	EA	$ 1,315	$ -
Gate valve, 08"	-	EA	$ 785	$ -
Check valve, 08"	-	EA	$ 1,470	$ -
Electrical/Instrumentation	-	EA	$ 10,250	$ -
Site work	-	EA	$ 2,560	$ -
Building pad	-	EA	$ 5,125	$ -
Pump Building	-	EA	$ 10,250	$ -
Fence	-	EA	$ 6,150	$ -
Tools	-	EA	$ 1,025	$ -
5,000 gal feed tank	-	EA	$ 10,000	$ -
100,000 gal ground storage tank	-	EA	$ 100,000	$ -
Subtotal				**$ -**
Well Installation				
Well installation	600	LF	$ 150.5	$ 90,300
Water quality testing	4	EA	$ 1,280	$ 5,120
Well pump	2	EA	$ 7,550	$ 15,100
Well electrical/instrumentation	2	EA	$ 5,635	$ 11,270
Well cover and base	2	EA	$ 3,075	$ 6,150
Piping	2	EA	$ 3,075	$ 6,150
Subtotal				**$ 134,090**
Subtotal of Component Costs				**$ 304,171**
Contingency	20%			$ 60,834
Design & Constr Management	25%			$ 76,043
TOTAL CAPITAL COSTS				**$ 441,048**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	1.0	mile	$ 275	$ 275
Subtotal				**$ 275**
Pump Station(s) O&M				
Building Power	-	kWH	$ 0.038	$ -
Pump Power	-	kWH	$ 0.038	$ -
Materials	-	EA	$ 1,540	$ -
Labor	-	Hrs	$ 60.00	$ -
Tank O&M	-	EA	$ 1,025	$ -
Subtotal				**$ -**
Well O&M				
Pump power	268,569	kWH	$ 0.038	$ 10,206
Well O&M matl	2	EA	$ 1,540	$ 3,080
Well O&M labor	360	Hrs	$ 60	$ 21,600
Subtotal				**$ 34,886**
O&M Credit for Existing Well Closure				
Pump power	206,014	kWH	$ 0.038	$ (7,829)
Well O&M matl	2	EA	$ 1,540	$ (3,080)
Well O&M labor	360	Hrs	$ 60	$ (21,600)
Subtotal				**$ (32,509)**
TOTAL ANNUAL O&M COSTS				**$ 2,652**

Table C.8

PWS Name *City Of Morton*
Alternative Name *Central Treatment - Reverse Osmosis*
Alternative Number *MT-8*

Capital Costs

Cost Item	Wells 4, 7, and 8	Wells 2, 5 and 6	Total Cost
Reverse Osmosis Unit Purchase/Installation			
Site preparation	$3,600	$3,600	$ 7,200
Slab	$57,500	$55,000	$ 112,500
Building	$69,000	$66,000	$ 135,000
Building electrical	$9,200	$8,800	$ 18,000
Building plumbing	$9,200	$8,800	$ 18,000
Heating and ventilation	$8,050	$7,700	$ 15,750
Fence	$10,500	$10,500	$ 21,000
Paving	$9,000	$8,000	$ 17,000
Electrical	$40,000	$40,000	$ 80,000
Piping	$20,000	$20,000	$ 40,000
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	$710,000	$530,000	$ 1,240,000
Transfer pumps	$30,000	$30,000	$ 60,000
Permeate tank	$15,000	$15,000	$ 30,000
Feed Tank	$45,000	$45,000	
Reject pond:			
Excavation	$43,800	$26,250	$ 70,050
Compacted fill	$81,760	$49,000	$ 130,760
Lining	$43,800	$26,250	$ 70,050
Vegetation	$5,175	$4,050	$ 9,225
Access road	$51,000	$39,000	$ 90,000
Subtotal Design/Construction	**$1,261,585**	**$992,950**	**$ 2,164,535**
Contingency	$252,317	$198,590	$ 450,907
Design & Constr Management	$315,396	$248,238	$ 563,634
Reject water haulage truck	$200,000	$200,000	$ 400,000
	$ 2,029,298	**$ 1,639,778**	**$ 3,579,076**
	Well 1 RO	**Well 2 RO**	**Total Cost**

Annual Operations and Maintenance Costs

Cost Item	Wells 4, 7, and 8	Wells 2, 5 and 6	Total Cost
Reverse Osmosis Unit O&M			
Building Power	$399	$380	$ 779
Equipment power	$10,184	$6,118	$ 16,302
Labor	$60,000	$56,000	$ 116,000
RO materials and Chemicals	$59,100	$35,475	$ 94,575
Analyses	$4,800	$2,400	$ 7,200
Subtotal	**$ 134,483**	**$ 100,373**	**$ 234,856**
Backwash Disposal			
Disposal truck mileage	$353,550	$212,100	$ 565,650
Backwash disposal fee	$111,185	$66,711	$ 177,895
Subtotal	**$ 464,735**	**$ 278,811**	**$ 743,545**
	$ 599,218	**$ 379,184**	**$ 978,401**
	Well 1 RO	**Well 2 RO**	**Total Cost**

O&M costs are based on total water production, independent of plant location.

Table C.8.1

PWS Name *City Of Morton*
Alternative Name *RO - Wells 4, 7, 8*
Alternative Number *MT-8*

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Reverse Osmosis Unit Purchase/Installation				
Site preparation	0.90	acre	$ 4,000	$ 3,600
Slab	58	CY	$ 1,000	$ 57,500
Building	1,150	SF	$ 60	$ 69,000
Building electrical	1,150	SF	$ 8	$ 9,200
Building plumbing	1,150	SF	$ 8	$ 9,200
Heating and ventilation	1,150	SF	$ 7	$ 8,050
Fence	700	LF	$ 15	$ 10,500
Paving	4,500	SF	$ 2	$ 9,000
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	$ 710,000	$ 710,000
Transfer pumps	4	EA	$ 7,500	$ 30,000
Permeate tank	5,000	gal	$ 3	$ 15,000
Feed Tank	15,000	gal	$ 3	$ 45,000
Reject pond:				
Excavation	14,600	CYD	$ 3.00	$ 43,800
Compacted fill	11,680	CYD	$ 7.00	$ 81,760
Lining	29,200	SF	$ 1.50	$ 43,800
Vegetation	3,450	SY	$ 1.50	$ 5,175
Access road	1,700	LF	$ 30.00	$ 51,000
Subtotal of Design/Construction Costs				**$ 1,261,585**
Contingency	20%			$ 252,317
Design & Constr Management	25%			$ 315,396
Reject water haulage truck	2	EA	$ 100,000	$ 200,000
TOTAL CAPITAL COSTS				**$ 2,029,298**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Reverse Osmosis Unit O&M				
Building Power	10,500	kwh/yr	$ 0.038	$ 399
Equipment power	268,000	kwh/yr	$ 0.038	$ 10,184
Labor	1,500	hrs/yr	$ 40.00	$ 60,000
RO materials and Chemicals	78,800	kgal	$ 0.75	$ 59,100
Analyses	24	test	$ 200	$ 4,800
Subtotal				**$ 134,483**
Backwash Disposal				
Disposal truck mileage	235,700	miles	$ 1.50	$ 353,550
Backwash disposal fee	22,237	kgal/yr	$ 5.00	$ 111,185
Subtotal				**$ 464,735**
TOTAL ANNUAL O&M COSTS				**$ 599,218**

Table C.8.2

PWS Name *City Of Morton*
Alternative Name *RO - Wells 2, 5, 6*
Alternative Number *MT-8*

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Reverse Osmosis Unit Purchase/Installation				
Site preparation	0.90	acre	$ 4,000	$ 3,600
Slab	55	CY	$ 1,000	$ 55,000
Building	1,100	SF	$ 60	$ 66,000
Building electrical	1,100	SF	$ 8	$ 8,800
Building plumbing	1,100	SF	$ 8	$ 8,800
Heating and ventilation	1,100	SF	$ 7	$ 7,700
Fence	700	LF	$ 15	$ 10,500
Paving	4,000	SF	$ 2	$ 8,000
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	$ 530,000	$ 530,000
Transfer pumps	4	EA	$ 7,500	$ 30,000
Permeate tank	5,000	gal	$ 3	$ 15,000
Feed Tank	15,000	gal	$ 3	$ 45,000
Reject pond:				
Excavation	8,750	CYD	$ 3.00	$ 26,250
Compacted fill	7,000	CYD	$ 7.00	$ 49,000
Lining	17,500	SF	$ 1.50	$ 26,250
Vegetation	2,700	SY	$ 1.50	$ 4,050
Access road	1,300	LF	$ 30.00	$ 39,000
Subtotal of Design/Construction Costs				**$ 992,950**
Contingency	20%			$ 198,590
Design & Constr Management	25%			$ 248,238
Reject water haulage truck	2	EA	$ 100,000	$ 200,000
TOTAL CAPITAL COSTS				**$ 1,639,778**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Reverse Osmosis Unit O&M				
Building Power	10,000	kwh/yr	$ 0.038	$ 380
Equipment power	161,000	kwh/yr	$ 0.038	$ 6,118
Labor	1,400	hrs/yr	$ 40.00	$ 56,000
RO materials and Chemicals	47,300	kgal	$ 0.75	$ 35,475
Analyses	12	test	$ 200	$ 2,400
Subtotal				**$ 100,373**
Backwash Disposal				
Disposal truck mileage	141,400	miles	$ 1.50	$ 212,100
Backwash disposal fee	13,342	kgal/yr	$ 5.00	$ 66,711
Subtotal				**$ 278,811**
TOTAL ANNUAL O&M COSTS				**$ 379,184**

Table C.9

PWS Name *City Of Morton*
Alternative Name *Central Treatment - Electro-dialysis Reversal*
Alternative Number *MT-9*

Capital Costs

Cost Item	Wells 4, 7, and 8	Wells 2, 5 and 6	Total Cost
Electrodialysis Reversal System Purchase/Installation			
Site preparation	$1,600	$1,600	$ 3,200
Slab	$25,000	$25,000	$ 50,000
Building	$30,000	$30,000	$ 60,000
Building electrical	$4,000	$4,000	$ 8,000
Building plumbing	$4,000	$4,000	$ 8,000
Heating and ventilation	$3,500	$3,500	$ 7,000
Fence	$6,000	$6,000	$ 12,000
Paving	$5,000	$5,000	$ 10,000
Electrical	$50,000	$50,000	$ 100,000
Piping	$20,000	$20,000	$ 40,000
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	$860,000	$640,000	$ 1,500,000
Transfer pumps	$30,000	$30,000	$ 60,000
Permeate tank	$15,000	$15,000	$ 30,000
Feed Tank	$45,000	$45,000	$ 90,000
Reject pond:			
Excavation	$31,800	$19,050	$ 50,850
Compacted fill	$59,360	$35,560	$ 94,920
Lining	$31,800	$19,050	$ 50,850
Vegetation	$4,425	$3,450	$ 7,875
Access road	$43,500	$34,500	$ 78,000
Subtotal Design/Construction	**$1,269,985**	**$990,710**	**$ 2,260,695**
Contingency	$253,997	$198,590	$ 452,587
Design & Constr Management	$317,496	$248,238	$ 565,734
Reject water haulage truck	$200,000	$100,000	$ 300,000
	$ 2,041,478	**$1,537,538**	**$ 3,579,016**
	Well 1 EDR	**Well 2 EDR**	**Total Cost**

Annual Operations and Maintenance Costs

Cost Item		Wells 4, 7, and 8	Wells 2, 5 and 6	Total Cost
EDR Unit O&M				
Building Power		$171	$171	$ 342
Equipment power		$16,340	$9,804	$ 26,144
Labor		$48,000	$48,000	$ 96,000
Materials		$37,824	$22,704	$ 60,528
Chemicals		$31,520	$18,920	$ 50,440
Analyses		$4,800	$2,400	$ 7,200
	Subtotal	**$ 138,655**	**$ 101,999**	**$ 240,654**
Backwash Disposal				
Disposal truck mileage		$256,800	$154,050	$ 410,850
Backwash disposal fee		$80,740	$48,444	$ 129,184
	Subtotal	**$ 337,540**	**$ 202,494**	**$ 540,034**
		$ 476,195	**$ 304,493**	**$ 780,688**
		Well 1 EDR	**Well 2 EDR**	**Total Cost**

O&M costs are based on total water production, independent of plant location.

Table C.9.1

PWS Name *City Of Morton*
Alternative Name *EDR - Wells 4, 7, 8*
Alternative Number *MT-9*

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Electrodialysis Reversal System Purchase/Installation				
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	$ 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	$ 860,000	$ 860,000
Transfer pumps	4	EA	$ 7,500	$ 30,000
Product Water Tank	5,000	gal	$ 3.00	$ 15,000
Feed Tank	15,000	gal	$ 3.00	$ 45,000
Reject pond:				
Excavation	10,600	CYD	$ 3.00	$ 31,800
Compacted fill	8,480	CYD	$ 7.00	$ 59,360
Lining	21,200	SF	$ 1.50	$ 31,800
Vegetation	2,950	SY	$ 1.50	$ 4,425
Access road	1,450	LF	$ 30.00	$ 43,500
Subtotal of Design/Construction Costs				**$ 1,269,985**
Contingency	20%			$ 253,997
Design & Constr Management	25%			$ 317,496
Reject water haulage truck	2	EA	$ 100,000	$ 200,000
TOTAL CAPITAL COSTS				**$ 2,041,478**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
EDR Unit O&M				
Building Power	4,500	kwh/yr	$ 0.038	$ 171
Equipment power	430,000	kwh/yr	$ 0.038	$ 16,340
Labor	1,200	hrs/yr	$ 40.00	$ 48,000
Materials	78,800	kgal	$ 0.48	$ 37,824
Chemicals	78,800	kgal	$ 0.40	$ 31,520
Analyses	24	test	$ 200	$ 4,800
Subtotal				**$ 138,655**
Backwash Disposal				
Disposal truck mileage	171,200	miles	$ 1.50	$ 256,800
Backwash disposal fee	16,148	kgal/yr	$ 5.00	$ 80,740
Subtotal				**$ 337,540**
TOTAL ANNUAL O&M COSTS				**$ 476,195**

Table C.9.2

PWS Name *City Of Morton*
Alternative Name *EDR - Wells 2, 5, 6*
Alternative Number *MT-9*

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Re Electrodialysis Reversal System Purchase/Installation				
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	$ 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	$ 640,000	$ 640,000
Transfer pumps	4	EA	$ 7,500	$ 30,000
Product Water Tank	5,000	gal	$ 3.00	$ 15,000
Feed Tank	15,000	gal	$ 3.00	$ 45,000
Reject pond:				
Excavation	6,350	CYD	$ 3.00	$ 19,050
Compacted fill	5,080	CYD	$ 7.00	$ 35,560
Lining	12,700	SF	$ 1.50	$ 19,050
Vegetation	2,300	SY	$ 1.50	$ 3,450
Access road	1,150	LF	$ 30.00	$ 34,500
Subtotal of Design/Construction Costs				**$ 990,710**
Contingency	20%			$ 198,142
Design & Constr Management	25%			$ 247,678
Reject water haulage truck	1	EA	$ 100,000	$ 100,000
TOTAL CAPITAL COSTS				**$ 1,536,530**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
EDR Unit O&M				
Building Power	4,500	kwh/yr	$ 0.038	$ 171
Equipment power	258,000	kwh/yr	$ 0.038	$ 9,804
Labor	1,200	hrs/yr	$ 40.00	$ 48,000
Materials	47,300	kgal	$ 0.48	$ 22,704
Chemicals	47,300	kgal	$ 0.40	$ 18,920
Analyses	12	test	$ 200	$ 2,400
Subtotal				**$ 101,999**
Backwash Disposal				
Disposal truck mileage	102,700	miles	$ 1.50	$ 154,050
Backwash disposal fee	9,689	kgal/yr	$ 5.00	$ 48,444
Subtotal				**$ 202,494**
TOTAL ANNUAL O&M COSTS				**$ 304,493**

Table C.10

PWS Name ***City Of Morton***
Alternative Name ***Point-of-Use Treatment***
Alternative Number ***MT-10***

Number of Connections for POU Unit Installation 970 connections

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
POU-Treatment - Purchase/Installation				
POU treatment unit purchase	970	EA	$ 615	$ 596,550
POU treatment unit installation	970	EA	$ 155	$ 150,350
Subtotal				**$ 746,900**
Subtotal of Component Costs				**$ 746,900**
Contingency	20%			$ 149,380
Design & Constr Management	25%			$ 186,725
Procurement & Administration	20%			$ 149,380
TOTAL CAPITAL COSTS				**$ 1,232,385**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
O&M				
POU materials, per unit	970	EA	$ 230	$ 223,100
Contaminant analysis, 1/yr per unit	970	EA	$ 205	$ 198,850
Program labor, 10 hrs/unit	9,700	hrs	$ 40	$ 388,000
Subtotal				**$ 809,950**
TOTAL ANNUAL O&M COSTS				**$ 809,950**

Table C.11

PWS Name ***City Of Morton***
Alternative Name ***Point-of-Entry Treatment***
Alternative Number ***MT-11***

Number of Connections for POE Unit Installation 970 connections

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
POE-Treatment - Purchase/Installat				
POE treatment unit purchase	970	EA	$ 5,125	$ 4,971,250
Pad and shed, per unit	970	EA	$ 2,050	$ 1,988,500
Piping connection, per unit	970	EA	$ 1,025	$ 994,250
Electrical hook-up, per unit	970	EA	$ 1,025	$ 994,250
Subtotal				**$ 8,948,250**
Subtotal of Component Costs				**$ 8,948,250**
Contingency	20%			$ 1,789,650
Design & Constr Management	25%			$ 2,237,063
Procurement & Administration	20%			$ 1,789,650
TOTAL CAPITAL COSTS				**$ 14,764,613**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
O&M				
POE materials, per unit	970	EA	$ 1,540	$ 1,493,800
Contaminant analysis, 1/yr per uni	970	EA	$ 205	$ 198,850
Program labor, 10 hrs/unit	9,700	hrs	$ 40	$ 388,000
Subtotal				**$ 2,080,650**
TOTAL ANNUAL O&M COSTS				**$ 2,080,650**

Table C.12

PWS Name ***City Of Morton***
Alternative Name ***Public Dispenser for Treated Drinking Water***
Alternative Number ***MT-12***

Number of Treatment Units Recommended 5

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Public Dispenser Unit Installation				
POE-Treatment unit(s)	5	EA	$ 7,175	$ 35,875
Unit installation costs	5	EA	$ 5,125	$ 25,625
Subtotal				**$ 61,500**
Subtotal of Component Costs				**$ 61,500**
Contingency	20%			$ 12,300
Design & Constr Management	25%			$ 15,375
TOTAL CAPITAL COSTS				**89,175**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Program Operation				
Treatment unit O&M, 1 per unit	5	EA	$ 2,050	$ 10,250
Contaminant analysis, 1/wk per u	260	EA	$ 205	$ 53,300
Sampling/reporting, 1 hr/day	1,825	HRS	$ 60	$ 109,500
Subtotal				**$ 173,050**
TOTAL ANNUAL O&M COSTS				**$ 173,050**

Table C.13

PWS Name ***City Of Morton***
Alternative Name ***Supply Bottled Water to 100% of Population***
Alternative Number ***MT-13***

Service Population	2,245	
Percentage of population requiring supply	100%	
Water consumption per person	1.00	gpcd
Calculated annual potable water needs	819,425	gallons

Capital Costs

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

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Program Operation				
Water purchase costs	819,425	gals	$ 1.25	$ 1,024,281
Program admin, 9 hrs/wk	468	hours	$ 45	$ 21,060
Program materials	1	EA	$ 5,125	$ 5,125
Subtotal				**$ 1,050,466**
TOTAL ANNUAL O&M COSTS				**$ 1,050,466**

Table C.14

PWS Name ***City Of Morton***
Alternative Name ***Central Trucked Drinking Water***
Alternative Number ***MT-14***

Service Population	2,245	
Percentage of population requiring supply	100%	
Water consumption per person	1.00	gpcd
Calculated annual potable water needs	819,425	gallons
Travel distance to compliant water source	28	miles

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Storage Tank Installation				
20,000 gal ground storage tank	1	EA	$ 25,000	$ 25,000
Site improvements	1	EA	$ 3,075	$ 3,075
Potable water truck	1	EA	$ 75,000	$ 75,000
Subtotal				**$ 103,075**
Subtotal of Component Costs				**$ 103,075**
Contingency	20%			$ 20,615
Design & Constr Management	25%			$ 25,769
TOTAL CAPITAL COSTS				**$ 149,459**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Program Operation				
Water delivery labor, 4 hrs/wk	208	hrs	$ 60	$ 12,480
Truck operation, 1 round trip/wk	2,912	miles	$ 3.00	$ 8,736
Water purchase	819	1,000 gals	$ 1.52	$ 1,246
Water testing, 1 test/wk	52	EA	$ 205	$ 10,660
Sampling/reporting, 2 hrs/wk	104	hrs	$ 60	$ 6,240
Subtotal				**$ 39,362**
TOTAL ANNUAL O&M COSTS				**$ 39,362**

APPENDIX D
EXAMPLE FINANCIAL MODEL

City of Morton

Number of Alternatives	14	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	$ 26,921	City of Morton
Median HH Income -- Texas	$ 39,927	
Grant Funded Percentage	0%	Selected from Results
Capital Funded from Revenues	$ -	

	Base Year Growth/Escalation	2007
Accounts & Consumption		
Metered Residential Accounts		
Number of Accounts	0.0%	970
Number of Bills Per Year		12
Annual Billed Consumption		121,180,000
Consumption per Account Per Pay Period	0.0%	10,411
Consumption Allowance in Rates		-
Total Allowance		-
Net Consumption Billed		121,180,000
Percentage Collected		100.0%
Unmetered Residential Accounts		
Number of Accounts	0.0%	0
Number of Bills Per Year		12
Percentage Collected		100.0%
Metered Non-Residential Accounts		
Number of Accounts	0.0%	0
Number of Bills Per Year		12
Non-Residential Consumption		-
Consumption per Account	0.0%	-
Consumption Allowance in Rates		-
Total Allowance		-
Net Consumption Billed		-
Percentage Collected		0.0%
Unmetered Non-Residential Accounts		
Number of Accounts	0.0%	0
Number of Bills Per Year		12
Percentage Collected		100.0%
Water Purchase & Production		
Water Purchased (gallons)	0.0%	-
Average Cost Per Unit Purchased	0.0%	$ -
Bulk Water Purchases	0.0%	$ -
Water Production	0.0%	121,180,000
Unaccounted for Water		-
Percentage Unaccounted for Water		0.0%

City of Morton

Number of Alternatives 14 Selected from Results Sheet

Input Fields are Indicated by:

Residential Rate Structure	Allowance within Tier	
	-	
Estimated Average Water Rate ($/1000gallons)		$ 2.74
Non-Residential Rate Structure		
	-	
Estimated Average Water Rate ($/1000gallons)		$ 2.74
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%	331,699
Other 4	0.0%	-
Incremental O&M for Alternative	0.0%	-
Total Operating Expenses		331,699
Non-Operating Income/Expenditures		
Interest Income	0.0%	-
Other Income	0.0%	-
Other Expense	0.0%	-
Transfers In (Out)	0.0%	-
Net Non-Operating		-

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

Debt Service for City of Morton
Alternative Number = 14
Funding Source = Loan/Bond

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Existing Debt Service	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Principal Payments		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest Payment	0.00%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Term	25																															
Revenue Bonds		-	-	149,459	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forgiveness	0.00%	-	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Balance		-	-	149,459	146,735	143,847	140,786	137,542	134,103	130,457	126,593	122,497	118,155	113,553	108,674	103,503	98,021	92,211	86,052	79,523	72,603	65,267	57,492	49,250	40,513	31,252	21,435	11,030	0	0	0	0
Principal		-	-	2,724	2,888	3,061	3,245	3,439	3,646	3,864	4,096	4,342	4,602	4,879	5,171	5,482	5,810	6,159	6,529	6,920	7,336	7,776	8,242	8,737	9,261	9,817	10,406	11,030	-	-	-	-
Interest	6.00%	-	-	8,968	8,804	8,631	8,447	8,253	8,046	7,827	7,596	7,350	7,089	6,813	6,520	6,210	5,881	5,533	5,163	4,771	4,356	3,916	3,450	2,955	2,431	1,875	1,286	0	0	0	0	0
Total Debt Service		-	-	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,030	0	0	0	0
New Balance		-	-	146,735	143,847	140,786	137,542	134,103	130,457	126,593	122,497	118,155	113,553	108,674	103,503	98,021	92,211	86,052	79,523	72,603	65,267	57,492	49,250	40,513	31,252	21,435	11,030	0	0	0	0	0
Term	20																															
State Revolving Fund		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forgiveness	0.00%	-	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Principal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest	0.00%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Term	10																															
Bank/Interfund Loan				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forgiveness	0.00%	-	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Principal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest	8.00%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Term	25																															
RUS Loan			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forgiveness	0.00%		-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Principal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest	5.00%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Cashflow Projections for City of Morton
Alternative Number = 14
Funding Source = Loan/Bond

Estimated At Sept. 30 of Each Year

	Growth/ Escalation	2007 0	2008 1	2009 2	2010 3	2011 4	2012 5	2013 6	2014 7	2015 8	2016 9	2017 10	2018 11	2019 12	2020 13	2021 14	2022 15	2023 16	2024 17	2025 18	2026 19	2027 20	2028 21	2029 22	2030 23	2031 24	2032 25	2033 26	2034 27	2035 28	2036 29	2037 30
CASH FLOW PROJECTIONS																																
Beginning Unrestricted Cash Balance		$ -	345	345	-	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)
RECEIPTS																																
Operating Revenues																																
Water Base Rate-- Residential	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 1 -- Res	100,000	332,044	332,044	343,391	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,091	371,061	371,061	371,061	371,061
Water: Tier 2 -- Res	100,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 3 -- Res	200,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 4 -- Res	300,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unmetered Residential		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Base Rate - Non Residential	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 1 -- NR	100,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 2 -- NR	100,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 3 -- NR	200,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 4 -- NR	300,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unmetered Non Residential		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sewer Sales		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 3		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Operating Revenues		$ 332,044	$ 332,044	$ 343,391	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,753	$ 382,091	$ 371,061	$ 371,061	$ 371,061	$ 371,061
Capital Receipts																																
Grants Received		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SRF Proceeds		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bank/Interfund Loan Proceeds		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUS Loan Proceeds		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bond Proceeds		-	-	149,459	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Capital Receipts		-	-	149,459	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Receipts		332,044	332,044	492,850	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,091	371,061	371,061	371,061	371,061
EXPENDITURES																																
Operating Expenditures:																																
Salaries & Benefits	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Contract Labor	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Purchases	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chemicals, Treatment	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Utilities	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repairs, Maintenance, Supplies	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repairs	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Supplies	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Administrative Expenses	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Accounting and Legal Fees	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Insurance	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Automotive and Travel	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Professional and Directors Fees	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bad Debts	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Garbage Pick-up	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Miscellaneous	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 3	0.0%	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699	331,699
Other 4	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Incremental O&M for Alternative	0.0%	-	-	-	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362	39,362
Total Operating Expenses		331,699	331,699	331,699	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061	371,061
Non-Operating Income/Expenditures																																
Interest Income	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Income	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Expense	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transfers In (Out)	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Net Non-Operating		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Debt Service																																
Existing		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Proposed:																																
Revenue Bonds		-	-	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,030	0	0	0	0
State Revolving Fund		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bank Loan		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUS Loan		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service		-	-	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,692	11,030	0	0	0	0
Capital Expenditures	$ 149,459																															
Funded From Revenues/Reserves	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded From Grants	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded From SRF Loans		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded from Bank/Interfund Loans		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded from RUS Loan		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded from Bonds		-	-	149,459	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Capital Expenditures		-	-	149,459	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Expenditures		331,699	331,699	492,850	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,753	382,091	371,061	371,061	371,061	371,061
What Water Rev Needs to be		(331,699)	(331,699)	(343,391)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,753)	(382,091)	(371,061)	(371,061)	(371,061)	(371,061)
Water Rate Increase		0.00%	0.00%	3.42%	11.46%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-0.17%	-2.89%	0.00%	0.00%	0.00%
Net Cash Flow		345	345	-	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)
Reserves:																																
Working Capital (Months O&M)	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Replacement Reserve		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Required Reserves		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average Annual Water Bill	$ 395	$ 342	$ 342	$ 354	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 395	$ 394	$ 383	$ 383	$ 383	$ 383
Median Household Income		$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921	$ 26,921
Maximum % of MHI	1.5%	1.3%	1.3%	1.3%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.4%	1.4%	1.4%	1.4%
Percentage Rate Increase Compared to Current	15.3%		0.0%	3.4%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.3%	15.1%	11.8%	11.8%	11.8%	11.8%

APPENDIX E
ANALYSIS OF SHARED SOLUTIONS FOR OBTAINING WATER FROM LEVELLAND

E.1 OVERVIEW OF METHOD USED

There are a few small PWSs with water quality problems located in the vicinity of the City of Morton 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 the City of Morton are listed in Table E.1, along with their average water consumption and estimates of the capital cost for each PWS to construct an individual pipeline. It is assumed for this analysis that all the systems would participate in a shared solution.

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

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

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

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

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

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

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

E.2 SHARED SOLUTION FOR OBTAINING WATER FROM LEVELLAND

This alternative would consist of constructing a 24-mile 8-inch joint pipeline from Levelland to a split near City of Morton and Morton Country. A 4-mile 8-inch pipeline would connect the split to City of Morton and a 4-mile 4-inch pipeline would connect the split to Morton Country. The pipeline routing is shown in Figure E.1 at the end of this appendix. It is assumed four pump stations would be required to transfer the water from Levelland to the two public water systems.

The capital costs for each pipe segment and the total capital cost for the shared pipeline are summarized in Table E.2. Table E.3 shows the capital costs allocated to each PWS using Method A. Table E.4 shows the capital costs allocated to each PWS using Method B. Table E.5 shows the allocation of pipeline capital costs to each of the PWSs using Method C, as described above. Table E.6 provides a summary of the pipeline capital costs estimated for each PWS, and the savings that could be realized compared to developing individual pipelines. More detailed cost estimates for the pipe segments are shown at the end of this appendix in Tables E.7 through E.10.

Based on these estimates, the range of pipeline capital cost savings to the City of Morton could be up to $1.59 million if they were to implement a shared solution like this, which would be a savings up to 21 percent. These estimates are hypothetical and are only provided to approximate the magnitude of potential savings if this shared solution is implemented as described.

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

PWS	PWS #	Average Water Demand (mgd)	Water Demand as Percent of Total	Pipeline Capital Cost for Individual Solutions for Morton	Percent of Sum of Capital Costs for Individual Solutions for Morton
City of Morton	0400001	7435024	99%	$ 7,435,024	69%
Morton Country	0400013	3387981.55	1%	$ 3,387,982	31%
	Totals	**10823005.55**	**100%**	**$ 10,823,006**	**100%**

Notes: (a) Costs for Morton Country to are provided in Table E.10 and costs for City of Morton to
Levelland (one of the alternatives for the PWS) are provided in Appendix C.

Table E.2
Capital cost for Shared Pipeline from Levelland

Pipe Segment	Capital Cost
Pipe 1	$ 6,944,662
Pipe A	$ 987,037
Pipe B	$ 578,125
Totals	**$ 8,509,824**

Table E.3
Pipeline Capital Cost Allocation by Method A
Shared Pipeline Assement for Levelland

PWS	PWS #	Percentage Based On Flow	Total Costs
City of Morton	0400001	99%	$ 8,446,223
Morton Country	0400013	1%	$ 63,601
	Totals	**100%**	**$ 8,509,824**

Table E.4
Pipeline Capital Cost Allocation by Method B
Shared Pipeline Assesment for Levelland

Pipeline Segment	Pipe Segment Capital Cost	City of Morton		Morton Country	
		Percent Allocation Based on Water Use	Allocated Cost	Percent Allocation Based on Water Use	Allocated Cost
Pipe 1	$ 6,944,662	99%	$ 6,892,759	1%	$ 51,903
Pipe A	$ 987,037	100%	$ 987,037	0%	$ -
Pipe B	$ 578,125	0%	$ -	100%	$ 578,125
Totals	**$ 8,509,824**		**$ 7,879,795**		**$ 630,028**

Table E.5
Pipeline Capital Cost Allocation by Method C
Shared Pipeline Assesment for Levelland

PWS	PWS #	Cost for Individual Pipelines	Percentage based on Individual Solutions	Allocated Capital Cost
City of Morton	0400001	$ 7,435,024	69%	$ 5,845,950
Morton Country	0400013	$ 3,387,982	31%	$ 2,663,874
	Totals	**$ 10,823,006**	**100%**	**$ 8,509,824**

Table E.6
Pipeline Capital Cost Summary
Shared Pipelilne Assessment for Levelland

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
0400001	$ 7,435,024	$ 8,446,223	$ 7,879,795	$ 5,845,950	$ (1,011,199)	$ (444,771)	$ 1,589,074	-14%	-6%	21%
0400013	$ 3,387,982	$ 63,601	$ 630,028	$ 2,663,874	$ 3,324,380	$ 2,757,953	$ 724,107	98%	81%	21%
Totals	**$ 10,823,006**	**$ 8,509,824**	**$ 8,509,824**	**$ 8,509,824**	**$ 2,313,182**	**$ 2,313,182**	**$ 2,313,182**			

Table E.7

Main Link # 1
Total Pipe Length 24.04 miles
Number of Pump Stations Needed 4
Pipe Size 08" inches

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	-	n/a	n/a	n/a
Number of Crossings, open cut	57	n/a	n/a	n/a
PVC water line, Class 200, 08"	126,908	LF	$ 27	$ 3,426,516
Bore and encasement, 12"	-	LF	$ 240	$ -
Open cut and encasement, 12"	2,850	LF	$ 130	$ 370,500
Gate valve and box, 08"	26	EA	$ 785	$ 20,410
Air valve	25	EA	$ 2,050	$ 51,250
Flush valve	26	EA	$ 1,025	$ 26,650
Metal detectable tape	126,908	LF	$ 2.00	$ 253,816
Subtotal				**$ 4,149,142**
Pump Station(s) Installation				
Pump	8	EA	$ 8,000	$ 64,000
Pump Station Piping, 08"	8	EA	$ 1,315	$ 10,520
Gate valve, 08"	16	EA	$ 785	$ 12,560
Check valve, 08"	8	EA	$ 1,470	$ 11,760
Electrical/Instrumentation	4	EA	$ 10,250	$ 41,000
Site work	4	EA	$ 2,560	$ 10,240
Building pad	4	EA	$ 5,125	$ 20,500
Pump Building	4	EA	$ 10,250	$ 41,000
Fence	4	EA	$ 6,150	$ 24,600
Tools	4	EA	$ 1,025	$ 4,100
100,000 gal ground storage tank	4	EA	$ 100,000	$ 400,000
Subtotal				**$ 640,280**
Subtotal of Component Costs				**$ 4,789,422**
Contingency	20%			$ 957,884
Design & Constr Management	25%			$ 1,197,356
TOTAL CAPITAL COSTS				**$ 6,944,662**

Table E.8

Segment A

City of Morton

Private Pipe Size	08"	
Total Pipe Length	3.99	miles
Total PWS annual water usage	121,180,000.0	MG
Number of Pump Stations Needed	0	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost		Total Cost	
Pipeline Construction						
Number of Crossings, bore	-	n/a	n/a		n/a	
Number of Crossings, open cut	8	n/a	n/a		n/a	
PVC water line, Class 200, 08"	21,085	LF	$	27	$	569,295
Bore and encasement, 12"	-	LF	$	240	$	-
Open cut and encasement, 12"	400	LF	$	130	$	52,000
Gate valve and box, 08"	5	EA	$	785	$	3,925
Air valve	4	EA	$	2,050	$	8,200
Flush valve	5	EA	$	1,025	$	5,125
Metal detectable tape	21,085	LF	$	2.00	$	42,170
Subtotal					**$**	**680,715**
Pump Station(s) Installation						
Pump	-	EA	$	8,000	$	-
Pump Station Piping, 08"	-	EA	$	1,315	$	-
Gate valve, 08"	-	EA	$	785	$	-
Check valve, 08"	-	EA	$	1,470	$	-
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	$	-
100,000 gal ground storage tank	-	EA	$	100,000	$	-
Subtotal					**$**	**-**
Subtotal of Component Costs					**$**	**680,715**
Contingency	20%				$	136,143
Design & Constr Management	25%				$	170,179
TOTAL CAPITAL COSTS					**$**	**987,037**

Table E.9

Segment B

Morton Country

Private Pipe Size	04"	
Total Pipe Length	4.43	miles
Total PWS annual water usage	912,500.0	MG
Number of Pump Stations Needed	0	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost		Total Cost	
Pipeline Construction						
Number of Crossings, bore	-	n/a	n/a		n/a	
Number of Crossings, open cut	8	n/a	n/a		n/a	
PVC water line, Class 200, 04"	23,413	LF	$	12	$	280,956
Bore and encasement, 10"	-	LF	$	240	$	-
Open cut and encasement, 10"	400	LF	$	130	$	52,000
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	23,413	LF	$	2.00	$	46,826
Subtotal					**$**	**398,707**
Pump Station(s) Installation						
Pump	-	EA	$	8,000	$	-
Pump Station Piping, 04"	-	EA	$	550	$	-
Gate valve, 04"	-	EA	$	710	$	-
Check valve, 04"	-	EA	$	755	$	-
Electrical/Instrumentation	-	EA	$	10,250	$	-
Site work	-	EA	$	2,560	$	-
Building pad	-	EA	$	5,125	$	-
Pump Building	-	EA	$	10,250	$	-
Fence	-	EA	$	6,150	$	-
Tools	-	EA	$	1,025	$	-
5,000 gal ground storage tank	-	EA	$	10,000	$	-
Subtotal					**$**	**-**
Subtotal of Component Costs					**$**	**398,707**
Contingency	20%				$	79,741
Design & Constr Management	25%				$	99,677
TOTAL CAPITAL COSTS					**$**	**578,125**

Table E.10

***Cost for Morton Country only**

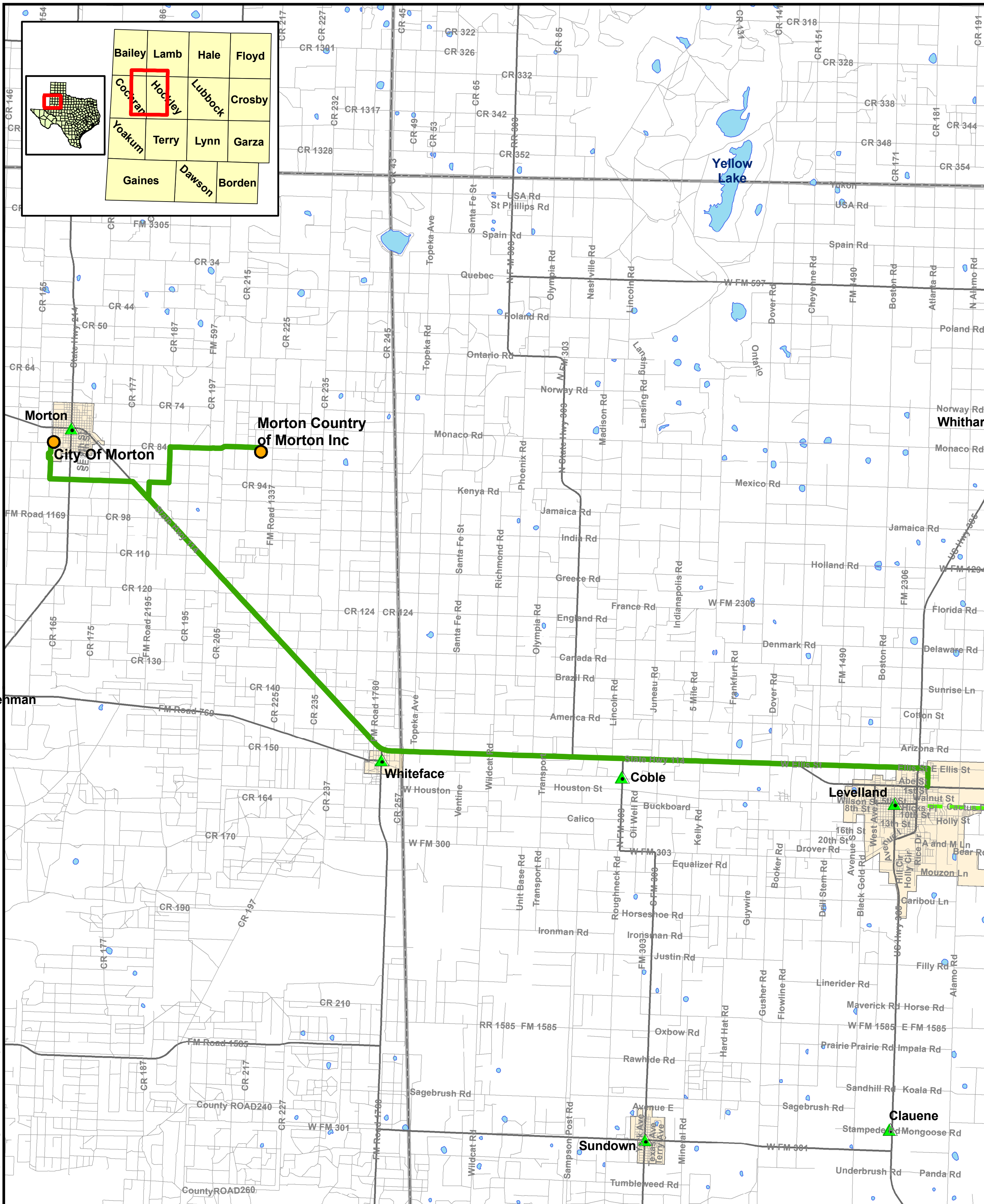
Segment B

Morton Country

Private Pipe Size	04"	
Total Pipe Length	28.47	miles
Total PWS annual water usage	912,500.0	MG
Number of Pump Stations Needed	1	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	-	n/a	n/a	n/a
Number of Crossings, open cut	8	n/a	n/a	n/a
PVC water line, Class 200, 04"	150,321	LF	$ 12	$ 1,803,852
Bore and encasement, 10"	-	LF	$ 240	$ -
Open cut and encasement, 10"	400	LF	$ 130	$ 52,000
Gate valve and box, 04"	31	EA	$ 710	$ 22,010
Air valve	29	EA	$ 2,050	$ 59,450
Flush valve	31	EA	$ 1,025	$ 31,775
Metal detectable tape	150,321	LF	$ 2.00	$ 300,642
Subtotal				**$ 2,269,729**
Pump Station(s) Installation				
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				**$ 2,336,539**
Contingency	20%			$ 467,308
Design & Constr Management	25%			$ 584,135
TOTAL CAPITAL COSTS				**$ 3,387,982**



Legend

- Study System
- PWS's
- Cities
- City Limits
- Counties
- Major Road
- Minor Road
- CRMWA Pipeline
- Lubbock Pipeline
- Grass Valley Pipeline
- MT/MC - 1

N

Miles
0 1.5 3

Figure E.1

CITY OF MORTON & MORTON COUNTRY OF MORTON INC. TO LEVELLAND

Shared Pipeline Alternative

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