ALTERNATIVES ANALYSIS

for the

ARSENIC TRIOXIDE SUPERFUND SITE

Prepared by

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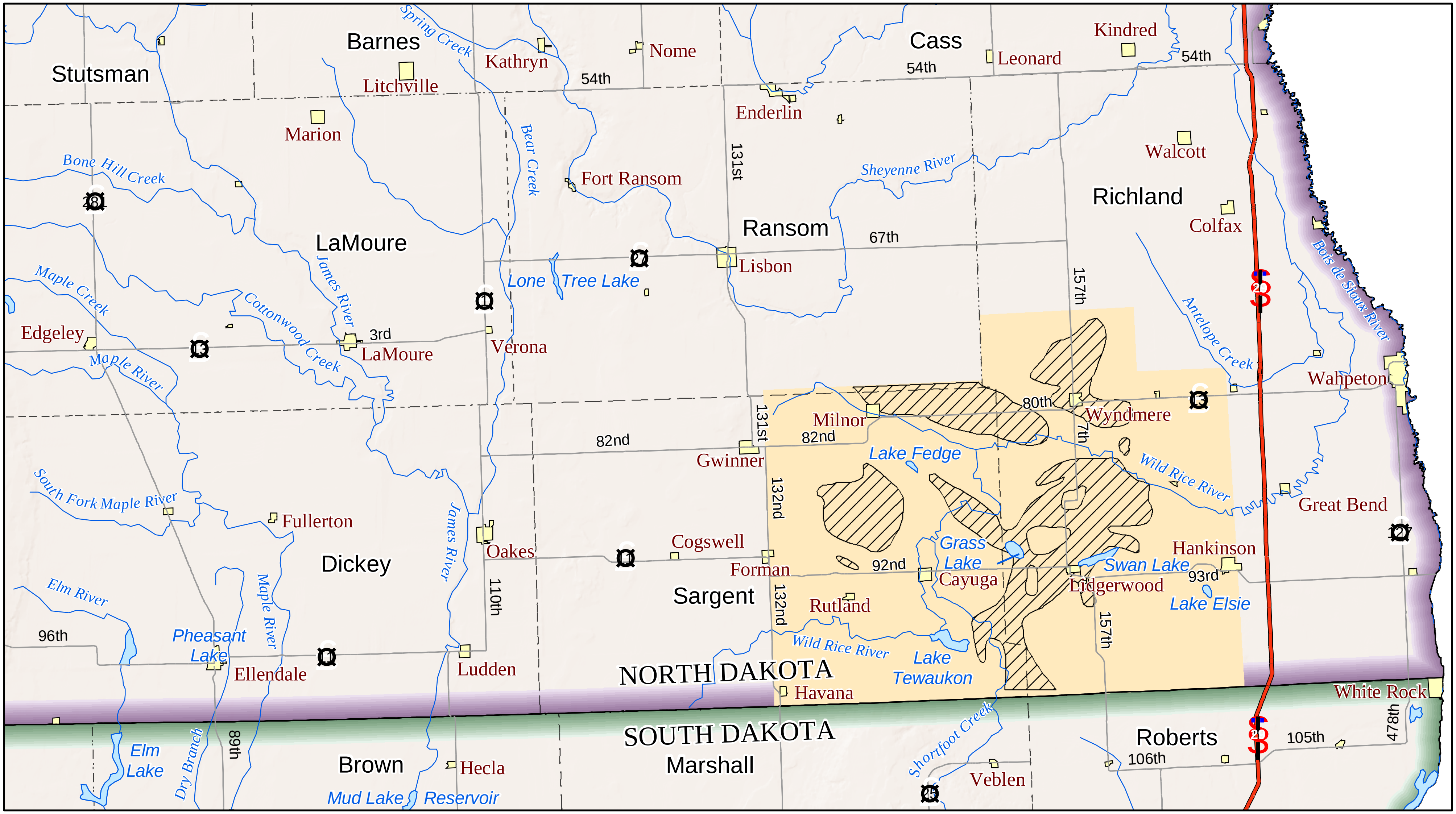
Arsenic Trioxide NPL Site - North Dakota



Interstate Highway

US, State, or County Highway

State Boundary

County Boundary

River

Lake

Urban Area

Area of Arsenic exceedences >= 50 parts per billion (original project site)

Original Arsenic Trioxide NPL Project Site (ATS) Boundary

0 5 10

Miles

Date:
April 1, 2005

Sources:
Base Data: US Census Bureau TIGER data (2000).
Site Data: US EPA Region 8 staff and regional project managers (2003).

Coordinate System Information:
Coordinate System: State Plane
Projection: Lambert Conformal Conic
FIPS Zone: 3302 (ND South)
Units: Meters
Datum: NAD 83
Spheroid: GRS 1980

ILS EPA

TABLE OF CONTENTS

INTRODUCTION

This Alternative Analysis was prepared by the North Dakota Department of Health (NDDH) to evaluate and select remedial alternatives for the Arsenic Trioxide Site (ATS). A modification to the existing remedy is required to reduce arsenic concentrations in drinking water to levels below the new federally-mandated Maximum Contaminant Level (MCL) of 0.010 milligrams per liter (mg/l) for arsenic.

As required by statute, a Five-Year Review Report (Five-Year Review) for the ATS was prepared by the U.S. Environmental Protection Agency (EPA) in June of 2003. The objective of the Five-Year Review was to determine if the previously implemented remedy for the ATS continues to be protective of human health and of the environment. The Five-Year Review concluded that, due to the lowering of the Safe Drinking Water Act (SDWA) arsenic MCL, the previously-implemented remedy may no longer be protective of human health, and that improvements or modifications to the ATS remedy are necessary to provide residents living within the ATS with drinking water that meets the new arsenic MCL.

This Alternative Analysis summarizes the three alternatives determined to be potentially viable and cost effective at providing treated water to affected users within the ATS. These alternatives include providing treated water by:

- Connecting residents within the project area to the existing rural water supply and distribution system;
- Constructing new, or modifying existing, stand-alone community water treatment plants; and
- Installing individual point-of-use (POU) water treatment systems for rural residents.

BACKGROUND

Site Location and Setting

The ATS encompasses approximately 568 square miles in Sargent, Ransom, and Richland counties in southeastern North Dakota. The boundary of the ATS is shown on Figure 1. The ATS is comprised primarily of farmland and a few small cities, including Hankinson, Lidgerwood, Wyndmere, and Milnor.

Site History

In 1979, the NDDH instituted a drinking water monitoring program for public water supply systems, pursuant to the requirements of the Federal and State Safe Drinking Water Act. Results of water samples collected during the monitoring program indicated arsenic levels exceeding the MCL of 0.050 mg/l in samples collected from the Lidgerwood, Rutland, and Wyndmere water supply systems. Drinking water monitoring programs implemented for private wells near the three communities identified a large area in southeastern North Dakota that contained elevated concentrations of arsenic in the groundwater resources. The highest arsenic concentrations were in an area located in portions of Ransom, Richland, and Sargent counties (see Figure 1). Arsenic concentrations in groundwater were found to be highly variable, and concentrations as high as 1.5 mg/l were observed. In response to the elevated arsenic concentrations, the ATS was proposed for listing as a “State Pick” on the National Priorities List (NPL) in October 1981; the final listing occurred on September 8, 1983.

Additional sampling of private and public water supply wells located in surrounding communities and rural areas was conducted during a Remedial Investigation (RI) completed by the NDDH between 1982 and 1986. Analytical results of groundwater samples identified the widespread occurrence of elevated arsenic concentrations in groundwater. The elevated concentrations of arsenic were attributed, in part, to the use of arsenic-laced grasshopper bait used in the 1930s and 1940s to control grasshopper populations. Arsenic trioxide, sodium arsenate, Paris Green, and other arsenic compounds were mixed with bait material (e.g., oats) and applied to farm fields. Excess or waste materials were often buried or dumped in pits or low-lying areas.

An emergency response action was instituted in 1986 to address the immediate health impacts of arsenic in groundwater to people utilizing private wells in the area. The emergency response action consisted of installing point-of-use (POU) treatment units on one tap per affected household. A clay cap was installed over a bait mixing area identified near Wyndmere as part of the emergency response action.

Previous Remedial Actions

The NDDH conducted a Feasibility Study (FS) to identify and evaluate potential remediation alternatives for the ATS that would protect human health by providing water with arsenic concentrations below the arsenic MCL (NDDH, 1986). The EPA issued a Record of Decision (ROD) for the ATS on September 26, 1986, which contained the following remedy:

- No modifications to the Lidgerwood and Wyndmere water distribution systems were warranted because they were already providing users with water containing arsenic concentrations below the arsenic MCL.

- Expand the existing Richland Rural Water system (now Southeast Water Users District) to provide treated water to affected water users located within the boundary of the ATS.
- Construct a new water treatment and distribution system (or expand and extend the existing rural water system) to provide treated water to users located outside of the existing rural water system boundaries.

Several issues pertaining to the remedy were identified after the ROD was signed. Lidgerwood requested that costs associated with the construction of its water treatment plant and the replacement of its distribution system be considered as part of the remedy for the ATS and be, therefore, reimbursable. In addition, the Lidgerwood water treatment plant could not provide consistent treated water quality after its initial six months of operation. Wyndmere’s water treatment plant, due to its size and age, was not capable of providing water that met the arsenic

MCL during periods of high water demand. Wyndmere requested that the expansion of its water treatment plant capacity be considered as part of the remedy for the ATS.

A Cooperative Agreement was awarded to the State in April 1987 to evaluate the Lidgerwood and Wyndmere water treatment plants, the extent of repairs required at the Lidgerwood plant, and problems associated with treatment capacity at the Wyndmere plant. Based on additional data, the ROD Amendment signed on February 5, 1988 provided:

- Reimbursement through the Superfund Program for allowable costs related to construction of the treatment plant at Lidgerwood;

- Funding for modification of the Lidgerwood water treatment plant; and

- Funding for costs associated with additional storage capacity and making minor modifications to the Wyndmere water treatment plant.

In addition, the ROD amendment designated the Richland Rural water treatment plant as Operable Unit 1 (OU 1) and the Wyndmere and Lidgerwood plants as Operable Unit 2 (OU 2).

Groundwater with elevated arsenic concentrations was identified near Milnor after the completion of water quality monitoring conducted between 1986 and February 1990. As a result, EPA elected to expand the rural water distribution system to serve the residents of Milnor. The selected remedy was detailed in an Explanation of Significant Differences (ESD) that was signed on September 25, 1992. The Milnor expansion of the rural water system was designated as OU 1, Phase 2.

With the modifications included in the ESD, the primary components of the ATS Remedy included:

- Expansion of the Richland Rural Water treatment plant and water distribution system to provide treated water to the residents of Milnor and to residents located in rural areas of the ATS;

- Modification and expansion of the Lidgerwood and Wyndmere water treatment plants to increase treatment capability and water storage capacity;

- Monitoring of the water quality of the Lidgerwood and Wyndmere water treatment plants, the glacial aquifer, and private wells; and
- Implementation of institutional controls to encourage public participation in the ATS project and to limit the use of private water supply wells within the boundaries of the ATS.

The primary components of the remedy for the ATS were implemented between 1986 and 1992.

RECENT REGULATORY ACTIONS AND STUDIES

Lowering of the Arsenic MCL

In February of 2002, the EPA finalized the Arsenic Rule, which lowered the arsenic MCL from 0.050 mg/l to 0.010 mg/l. The Arsenic Rule becomes enforceable in January 2006.

Five-Year Reviews

Federal statute requires that a review of the remedy implemented at a Superfund site be conducted every five years to determine if the remedy continues to be protective of human health and the environment. An initial Five-Year Review for the ATS was completed on January 19, 1999. No recommendations or follow-up actions for the ATS were noted in the initial Five-Year Review.

A second Five-Year Review was completed between July 2002 and May 2003 (EPA, 2003). The second Five-Year Review was expedited due to the lowering of the arsenic MCL. The second Five-Year Review concluded that the ATS remedy may no longer be protective of human health due to the lowering of the arsenic MCL. Consequently, modifications to the ATS remedy are required to provide residents living within the ATS boundary with drinking water containing arsenic concentrations which complies with the new MCL.

Five-Year Reviews will continue to be conducted to ensure that the selected remedy continues to be protective of human health and the environment. The next Five-Year Review will be completed by June 2008.

SPECIAL CONSIDERATIONS FOR THE ARSENIC TRIOXIDE SITE REMEDY

Hydrogeology

The study site is underlain by two general types of groundwater systems. The first system consists of the Dakota Sandstone Aquifer (Dakota Aquifer). The Dakota Aquifer is a deep bedrock aquifer that underlies the state of North Dakota, including the entire ATS site. The depth of the Dakota Aquifer ranges from approximately 200 feet in eastern Richland County to approximately 1,000 feet in northwestern Ransom County. The yield of wells installed in the Dakota Aquifer generally ranges from less than five (5) gallons per minute (gpm) in Richland County to less than ten (10) gpm in Ransom and Sargent Counties. Water from the Dakota Aquifer is highly mineralized and is generally not desirable for public or domestic use (Dennis, 1949). Data collected during the RI indicated that the primary ions in Dakota Aquifer water are sodium and sulfate. Total dissolved solids in water samples collected from Dakota aquifer wells located within the ATS ranged from 2,170 to 4,090 mg/l (Roberts, 1985). As reported in the 1985 RI Report, the average arsenic concentration in samples collected from 48 wells installed in the Dakota Aquifer was 0.010 mg/l or greater. The Dakota Aquifer is generally not considered feasible for supplying residents within the ATS with a suitable source of potable water or for blending with water obtained from the shallow glacial drift aquifers within the ATS.

The second general type of groundwater systems within the ATS are the shallow, glacial till aquifers which are used as the primary water supply source for rural and community water systems. Glacial drift aquifers that underlie the ATS include the Spiritwood, Brampton, Sheyenne Delta, Milnor Channel, Gwinner, Brightwood, and Hankinson aquifers. With the exception of the Spiritwood aquifer, the glacial drift aquifers located within the ATS are shallow, and are generally exposed at or near ground surface. Groundwater in the shallow aquifers is under unconfined, water table conditions. The Spiritwood Aquifer is a deep, confined aquifer that is overlain by glacial till. The glacial drift aquifers provide water for most of the cities within the ATS, including Hankinson (Hankinson Aquifer), Lidgerwood (Milnor Channel Aquifer), and Wyndmere (Sheyenne Delta Aquifer). The shallow glacial drift aquifers are capable of higher pumping rates (up to 1,000 gallons per minute) and produce water of higher quality than water from the Dakota Aquifer.

The shallow aquifer systems are complex in that they are not uniform or stratified. The mapped boundaries of the aquifers are generally defined by a "yield rate" (e.g., 50 gpm boundary), consequently, the lateral extent of the aquifers has not been conclusively identified. The interconnectedness of aquifers that overlie each other or overlap is also not well understood.

Background Arsenic Concentration and ATS Remedial Action Goal for Arsenic

Many complex factors need to be considered when attempting to determine a background arsenic concentration for groundwater within the study area, including geology and hydrology, arsenic application rates and land application areas, arsenic disposal practices, precipitation, and water extraction from the aquifer. These factors can account for variability of arsenic concentrations throughout the study area. Previous documents prepared for the ATS have referenced a "background" arsenic concentration of 0.025 mg/l in groundwater. Although the RI report attempted to use scientific models to establish a background level for arsenic in groundwater, a background level was not conclusively determined. It appears that the background concentration of 0.025 mg/l was arbitrarily established at a concentration representing one-half of the existing MCL level of 0.050 mg/l.

The goal of the revised remedy for the ATS will be to provide users with drinking water that contains arsenic concentrations less than 0.010 mg/l. This goal is protective of human health and is consistent with the intent of the original ATS remedy.

Community and Public Involvement

This Alternatives Analysis will be made available to the public for review and comment. The public notice and comment process will be conducted according to the process described in 40 CFR Part 124. Community and public information meetings will be scheduled throughout the project area to discuss the alternatives and solicit public comment.

The State of North Dakota has been designated as the "lead agency" for the ATS project. The selection of the final remedy, however, will be completed by the EPA after their review and consideration of all comments and concerns expressed by the public, affected communities, rural residents, and the State of North Dakota. The final remedy for the ATS will be summarized in an Explanation of Significant Differences that will be prepared by EPA.

IDENTIFICATION AND SUMMARY OF ALTERNATIVES

Introduction

This section summarizes the three alternatives determined to be potentially viable and cost effective for providing treated water to affected users within the ATS, including:

- Expanding the existing rural water system (operated and maintained by Southeast Water Users District [SEWUD]);
- Constructing new, or expanding existing, stand-alone community water treatment plants; and
- Providing rural residents with POU water supply systems.

A discussion of applicable or relevant and appropriate requirements (ARARs), remedial action objectives (RAOs), preliminary remediation goals (PRGs), the area of attainment, and institutional controls is presented prior to the summary of potentially viable alternatives.

Applicable or Relevant and Appropriate Requirements (ARARs)

The primary ARAR that requires a modification of the previous remedy is the lowering of the arsenic MCL. In- February 2002, the EPA finalized the Arsenic Rule, which lowered the arsenic MCL from 0.050 mg/l to 0.010 mg/l. The Arsenic Rule becomes enforceable in January 2006. A modification of the previous remedy is required to provide users with drinking water that meets the new arsenic MCL.

Remedial Action Objective (RAO)

The RAO for the ATS is to maintain protectiveness of human health by preventing the human ingestion of drinking water that contains arsenic in a concentration that exceeds the arsenic MCL of 0.010 mg/l.

Preliminary Remediation Goal (PRG) and Area of Attainment

Preliminary remediation goals (PRGs) are developed to determine the level of contamination that a remedial action will address. The effectiveness of a remedial action at a site is evaluated by comparison to the PRGs. The PRG for the ATS is to provide all residents within the ATS boundary with drinking water that has an arsenic concentration below the arsenic MCL.

The area of attainment defines the area where the RAOs will be applied. The area of attainment is the original ATS boundary designated in the Record of Decision.

Institutional Controls

Institutional controls for the ATS will be implemented, where practical, to prevent or limit the potential exposure to arsenic-impacted soil and groundwater. Institutional controls may include, but are not limited to:

- Zoning restrictions to prevent the development of capped areas;
- Groundwater use restrictions to limit groundwater use in contaminated aquifers;
- Deed notices filed in public land records indicating that the property is located within the ATS;
- Public advisories to notify the public of risks associated with the ATS;
- Water quality monitoring of new wells installed within the ATS; and
- Public information and training regarding soil and groundwater conditions within the ATS.

The identification, evaluation, and selection of appropriate institutional controls for the ATS will be addressed during remedial design.

Identification of Potential Alternatives

The discussion of potential water supply alternatives is broken down separately for each water user potentially affected by the new arsenic MCL, including the cities of Wyndmere, Lidgerwood, and Hankinson and rural residents currently utilizing private water supply wells. For each user, the current water system is described, and potentially feasible water supply alternatives are identified and discussed.

Lidgerwood

<u>Existing Water Supply and Distribution System and Water Quality</u>

Construction of Lidgerwood's water treatment plant was completed in 1986. It was constructed as a conventional aeration, detention, and filtration plant designed to remove iron and manganese by precipitation and filtration; an added benefit of the system was the co-precipitation and removal of arsenic. Chlorine is added for disinfection and to inhibit microbial growth. After construction, the water treatment plant was difficult to operate, and the water produced was frequently of unacceptable quality. The system was subsequently modified by expanding the treatment building, adding a 23,000-gallon potable water storage reservoir, automating the backwash system, and implementing several operational changes. After plant modification, testing, and monitoring, it was determined that the treatment plant was able to consistently reduce source water arsenic concentrations to approximately 0.020 to 0.030 mg/l.

Lidgerwood obtains water from two wells installed in the Milnor Channel Aquifer. The current capacity of the water treatment plant is 250 gallons per minute (gpm) and the treated water is distributed to approximately 740 residents. The existing water treatment plant has continuing operational difficulties and it is not expected to meet the new arsenic MCL of 0.010 mg/l. The new arsenic MCL was exceeded in the three most recent samples collected in July 1994 (0.0190 mg/l), September 1998 (0.0257 mg/l), and June 2001 (0.0322 mg/l). The arsenic concentration in the raw water ranges from 0.038 to 0.1462 mg/l (Battelle, 2004).

Required Water Supply

Water supply needs for Lidgerwood was determined by an evaluation completed by Advanced Engineering and Environmental Services, Inc. (AE2S) in December 2004; a copy of the evaluation is included in Appendix A. The required design flow rate for the treatment system is 200 gpm. The amount of water sold by the city is approximately 55,400,000 gallons per year.

Current Water Treatment Study

The city of Lidgerwood applied for, and was accepted as, a test site under an EPA Office of Research and Development program designed to evaluate cost-effective treatment technologies to assist small communities in achieving the arsenic MCL in their public water systems.

A System Performance Evaluation Study Plan for the Lidgerwood demonstration site was prepared by Battelle in January 2004. The Lidgerwood study will consist of modifying the existing process by installing an iron addition system to supplement the natural iron level to verify if this action will increase the arsenic removal efficiency of the system.

The Lidgerwood study is currently in progress and operational data has not been published.

Potential Alternatives

The Lidgerwood study has not been completed, consequently, potential alternatives for effective water treatment, and their associated costs, has not been fully evaluated. If the study is successful, it is possible that limited modifications may be required to bring the plant into compliance. If the study is not successful, the city could modify the existing plant or construct a new water treatment plant.

Treated water could also be supplied to Lidgerwood by connecting the city's existing water distribution system to SEWUD's rural water system. The SEWUD plant is currently capable of providing Lidgerwood with a capacity of 60 gpm without modifying the existing plant. The capacity of SEWUD's plant would need to be increased by 140 gpm to provide Lidgerwood with the 200 gpm they require for their water supply. Connection to the rural water system would require modifications to SEWUD's existing facility, including installing one additional water supply well and associated raw water transmission piping, and expanding the existing treatment building. In addition, approximately 15,000 feet of 6-inch finished-water piping would be needed to connect Lidgerwood's water storage reservoir to SEWUD's water supply distribution system.

Hankinson

Existing Water Supply and Distribution System and Water Quality

The city of Hankinson currently does not have a water treatment plant. The Hankinson water supply system consists of four wells installed in the Hankinson Aquifer and a small raw water metering building. The water is also chemically treated with fluoride for dental health and chlorine for disinfection. Water from the Hankinson wells supplies approximately 1,060 residents.

Hankinson's water supply system is not capable of providing water with arsenic concentrations below the new arsenic MCL. The new arsenic MCL was exceeded in samples collected in July 1994 (0.0183 mg/l), September 1998 (0.0142 mg/l), and June 2001 (0.0174 mg/l).

Required Water Supply

Water supply needs for Hankinson, and the costs associated with potential water supply alternatives, were determined by an evaluation completed by AE2S and Moore Engineering. Information gathered during the evaluation was provided to the NDDH in a July 15, 2004 letter prepared by Moore Engineering, updated cost information was provided by AE2S in December 2004. Copies of supporting information are included in Appendix A.

The following considerations are required when evaluating potential water treatment and supply options for Hankinson:

- the required design flow for the treatment system is 300 gpm,
- the amount of water sold by the city is approximately 46,000,000 gallons per year.
- an additional 200,000 gallons of underground water storage capacity is required,
- existing easements with nearby landowners will need to be amended,
- 12 pasture taps will need to be abandoned, and
- water will need to be supplied to approximately nine users near Hankinson that are not currently connected to the city water supply system.

Potential Alternatives

The two alternatives considered the most viable water treatment and supply alternatives for Hankinson are:

- Construct a stand-alone water treatment plant.

- Connect the city's existing water distribution system to SEWUD's rural water distribution system.

The city of Hankinson could construct and operate a stand-alone water treatment plant to provide treated water to the community. The water could be effectively treated using an iron/manganese treatment process (Moore Engineering, 2004). Components of this alternative include amending existing easements, expanding the existing well field, constructing a water treatment plant, modifying the existing water transmission lines, and installing an underground water storage tank.

Treated water could also be supplied to Hankinson by connecting the city's existing water distribution system to SEWUD's rural water system. The SEWUD plant is currently capable of providing Hankinson with a capacity of 130 gpm without modifying the existing plant. The capacity of SEWUD's plant would need to be increased by 170 gpm to provide Hankinson with the 300 gpm they require for their water supply. The connection to the rural water system would require modifications to SEWUD's existing facility, including installing one additional water supply well; expanding the existing treatment plant building; and installing additional pressure filters, pumps, controls, chemical feed equipment, etc. A 200,000 gallon underground storage reservoir would be constructed near Hankinson along with a finished water distribution line connecting the tank to Hankinson's existing well field line.

Wyndmere

Existing Water Supply and Distribution System and Water Quality

In 1987, the NDDH investigated concerns expressed by the city of Wyndmere that their existing water treatment plant did not have the capacity to meet periods of high water demand. The existing facility was constructed in approximately 1965, and consists of an oxidation, precipitation, and filtration system. In February 1988, the EPA amended the ROD to address the capacity issue associated with the Wyndmere plant. Initially, modifications to the plant were made between August 1989 and January 1990 to increase the treatment capacity and a 50,000 gallon potable water storage tank was installed. Problems with the backwash cycle were experienced when plant operation resumed. Plant testing indicated that a post-chlorination system, rather than a backwash system, was required for proper plant operation; modification activities were conducted between April 1990 and January 1991. Post-construction testing indicated that the plant was able to reduce arsenic concentrations from approximately 0.085 mg/l in the source water to 0.002 mg/l following treatment and when operating at a much reduced rate.

Wyndmere obtains water from two wells installed in the Sheyenne Delta Aquifer. The current capacity of the water treatment plant is 100 gpm, and the treated water is distributed to approximately 535 residents. An inspection conducted by the EPA as part of the Five-Year Review indicated that the new arsenic MCL of 0.010 mg/l can only be achieved when the system is operated at approximately 60 percent (i.e., 60 gpm) of design capacity. As a result, the treatment plant is operated for 15 to 16 hours per day during the winter months and even longer periods of time during the summer months. Additional plant capacity is required to consistently meet the arsenic MCL during periods of peak water demand. Although the new arsenic MCL was achieved in the sample collected in June 2001 (0.00721 mg/l), samples collected in July 1994 (0.0102 mg/l) and September 1998 (0.0105 mg/l) did not meet the new MCL. It does not appear that the existing water treatment plant will consistently produce water with arsenic concentrations below 0.010 mg/l, even when operating at a reduced capacity.

Required Water Supply

Water supply needs and associated costs were outlined in an April 12, 2004 letter prepared for SEWUD by AE2S, in an April 15, 2004 letter submitted to the NDDH by Nathan Brandt (Mayor, city of Wyndmere), and in cost estimate information provided by AE2S in December 2004. Appropriate system information is included in Appendix A. Based on information contained in the letters, the following items need to be considered when evaluating and selecting potential remedies for the city of Wyndmere:

- The existing water treatment plant was constructed in approximately 1965. Consequently, the existing plant is well beyond its useful life and is in very poor condition. Upgrading the existing plant does not appear to be an option for providing treated water to the community over the next 20 years.

- The water treatment plant should be designed for a minimum of 140 gpm water capacity. In addition to providing existing residents with treated water, the community is anticipated to grow in the next few years.

- The amount of water sold by the city is approximately 27,700,000 gallons per year.

Potential Alternatives

The two alternatives that are considered the most viable water treatment and supply alternatives for Wyndmere are:

- Demolish the existing water treatment plant and construct a new treatment plant.

- Connect Wyndmere's existing water distribution system to SEWUD's rural water distribution system.

The city of Wyndmere could demolish the existing water treatment plant and construct a new plant to provide treated water to the community. The water could be effectively treated using a gravity filter system with chlorine and potassium permanganate feed systems (AE2S, 2004). Components of this alternative include demolishing the existing plant, amending existing easements, expanding the existing well field, constructing a water treatment plant, modifying the existing water transmission lines, and installing an underground water storage tank.

The second option would be to supply treated water to Wyndmere by connecting the city's existing water distribution system to SEWUD's rural water distribution system. Connecting Wyndmere to the existing rural water system would require installing one additional water supply well and associated pumps, controls, and piping at SEWUD's existing facility. It would also be necessary to install finished-water piping and complete pump modifications at SEWUD's reservoir B.

Rural Households

Existing Water Supply and Distribution System

Residents located within the ATS boundary, but outside the limits of the water distribution systems of nearby cities, were initially given the opportunity to be connected to the rural water system operated by Richland Rural Water (now SEWUD). Construction to expand SEWUD's treatment plant and installation of the distribution piping was started in 1990. Plant expansion consisted of drilling two new wells and adding additional water storage reservoirs. The initial construction was completed by September 1991.

Construction activities to add the city of Milnor to the distribution system commenced in September 1991. A 132,000 gallon water storage reservoir and associated distribution piping were completed in September 1992. The water storage and distribution system served approximately 300 homes and businesses. Activities completed between September 1992 and June 1993 included final system testing, construction restoration, and the addition of one additional water supply well.

Estimation of Potential Households

It is estimated that there are approximately 610 households located within the ATS boundary that are not connected to either the rural water system or to a community water system; these households are believed to utilize private wells for their water supply. The number of potential households was initially evaluated by SEWUD. SEWUD contacted the local phone company who services the southeastern portion of North Dakota and, based on information obtained, prepared a map showing all locations within SEWUD's distribution network that are listed as having a current phone number. The phone locations were compared to SEWUD's rural water connection location map to evaluate which of those locations were not currently connected to the rural water system.

For purposes of the Alternative Analysis, it is assumed that there are 610 potential households within the existing ATS boundary that are not currently served by rural water or by a nearby community water system. The NDDH will conduct public information meetings to further refine the number of potential households utilizing untreated groundwater to meet their domestic needs. The amount of water used by rural households is estimated at 34,620,000 gallons per year (AE2S, 2005).

Potential Alternatives for Rural Households

Two alternatives are considered for providing treated water to rural residents; connecting households to the existing rural water system and installing POU systems at individual households.
Treated water could be supplied to rural households by expanding the current rural water system maintained and operated by SEWUD. To provide treated water to the rural households, the water treatment plant would require an upgrade in capacity of 400 gallons per minute. Modifications to the existing plant would include installing two additional water supply wells, installing three additional 200-gallon per minute pressure filters, and installing additional raw water supply piping. It is assumed that the average piping run to each household would be one mile (5,280 feet). The estimated pipe run length is based on similar rural water system layouts and would need to be verified during the design phase of the project (AE2S, 2004).

Treated water could also be provided to rural households by POU water treatment systems installed at each household. A typical system, as proposed by Culligan, would consist of a twin water softener for pretreatment (e.g., iron removal) followed by a reverse osmosis treatment unit for arsenic removal. Treated water would be stored in a small holding tank and would be distributed through a single faucet installed in the household. The reverse osmosis system is capable of producing 30 gallons of treated water per day. Reject water produced during the treatment process (three gallons reject per one gallon treated) would be discharged to the sanitary waste disposal system (septic tank and drainfield). Reject water from the water softener would also be discharged to the sanitary waste disposal system.

DETAILED ANALYSIS OF ALTERNATIVES

Evaluation Criteria

This section presents information to compare potential water supply alternatives for the ATS. Each potential alternative is assessed against EPA's nine evaluation criteria to compare the relative performance of the alternatives and identify advantages and disadvantages of each alternative. The nine evaluation criteria serve as the basis for the detailed analysis and the subsequent selection of an appropriate remedy. The nine evaluation criteria are:

1. Overall protectiveness of human health and the environment
2. Compliance with ARARs
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, and volume of contamination
5. Short-term effectiveness
6. Implementability
7. Cost
8. State and support agency acceptance
9. Community acceptance.

The nine criteria are divided into three groups, threshold criteria, balancing criteria, and modifying criteria. Threshold criteria are those criteria that must be met by a particular alternative in order for it to be eligible for selection as a remedy. There is little flexibility in meeting the threshold criteria; either they are met by a particular remedy or that remedy is not considered acceptable. The following is a summary of the threshold criteria:

- Overall protection of human health and the environment. The assessment against this criterion describes how the alternative achieves and maintains protection of human heath and the environment.

- Compliance with ARARs. Compliance with ARARs is one of the statutory requirements of remedy selection. The assessment against this criterion describes how the alternative complies with ARARS, or presents the rationale for waiving an ARAR.

Balancing criteria are the technical criteria upon which the comparative analysis is based. The five balancing criteria weigh the trade-offs between the alternatives. The following is a summary of the balancing criteria:

- Long-term effectiveness and permanence. This criterion evaluates the long-term effectiveness of the remedy in maintaining protectiveness of human health and the environment after completion of the remedy. An emphasis is placed on implementing remedies that ensure protection of human health and the environment in the future as well as in the short term.

- Reduction of toxicity, mobility, and volume of contamination. This criterion addresses the statutory preference for remedies that employ treatment as a principal element. The assessment against this criterion evaluates the anticipated performance of the specific treatment technologies a remedy may employ.

- Short-term effectiveness. The assessment against this criterion examines the effectiveness of the alternatives in protecting human health and the environment during the construction and implementation of a remedy until the response objectives have been met.

- Implementability. The assessment against this criterion evaluates the technical and administrative feasibility of the alternatives and the availability of required goods and services.

- Cost. This assessment evaluates the capital and operation and maintenance (O&M) costs for each alternative. Cost elements include costs for capital construction for process equipment, engineering services for design and construction oversite, contractor overhead and profit, and contingencies. O&M costs for the rural water (SEWUD) and community stand-alone treatment alternatives are not used in evaluating the cost for each alternative, as these costs are not reimbursed by the Superfund program. O&M costs for SEWUD and the community systems are included in the fee charged for water service. The O&M costs for POU system should be included in the alternative evaluation, as these costs would need to be included in the remedy to ensure compliance with the SDWA.

Modifying criteria will be evaluated following comment on the Alternatives Analysis and will be addressed in the Explanation of Significant Differences. The modifying criteria are not discussed in the remainder of this document. The following is a summary of the modifying criteria:

- State Acceptance. This criterion reflects the state's apparent preferences among or concerns about the alternatives.

- Community Acceptance. This criterion reflects the communities' apparent preferences among or concerns about the alternatives.

Detailed Analysis of Alternatives

This section provides a detailed analysis of the potential remedy alternatives. The evaluation of alternatives is broken down separately for each water user potentially affected by the new arsenic MCL, including the cities of Wyndmere, Lidgerwood, and Hankinson and rural households currently utilizing private water supply wells. It should be noted that the costs for rural water supply presented in this section are prorated for each water user, and is based on the assumption that rural households and the cities of Lidgerwood, Wyndmere, and Hankinson would all utilize SEWUD for their supply of treated water. If one or more of the potential users are provided with an alternative water supply, the costs for SEWUD supplying water for the remaining users may need to be modified.

A summary of the alternative analysis is included in Table 1.

City of Lidgerwood

The two water supply alternatives considered for the city of Lidgerwood are to modify the existing water treatment plant or to connect the city's existing water distribution system to SEWUD's rural water system.

TABLE 1 - Summary of Alternatives

City/Alternative	Overall Protectiveness of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume of Contamination	Short-Term Effectiveness	Implementability	Cost [1]
Lidgerwood							
Stand-Alone Treatment System	Yes	Yes	Medium	High	High	High	**$874,000 - $1,961,000[2]** $107,700 O&M[6][2][7]
Rural Water Supply	Yes	Yes	High	High	High	High	$371,000 SEWUD[3] $140,000 City[4] **$511,000 Total CC**[5] $71,600 O&M[6]
Hankinson							
Stand-Alone Treatment System	Yes	Yes	Medium	High	High	High	**$1,961,000 Total CC[5]** $89,300 O&M[6][7]
Rural Water Supply	Yes	Yes	High	High	High	High	$450,000 SEWUD[3] $773,000 City[4] **$1,223,000 Total CC**[5] $59,400 O&M[6]
Wyndmere							
Stand-Alone Treatment System	Yes	Yes	Medium	High	High	High	**$874,000 Total CC[5]** $54,400 O&M[6][7]
Rural Water Supply	Yes	Yes	High	High	High	High	$240,000 SEWUD[3] $511,000 City[4] **$751,000 Total CC**[5] $36,200 O&M[6]
Rural Households							
POU System	Health - Yes Environment - No	Yes	Low	Low	High	High	**$1,419,000 Total CC[5])** $249,700 O&M
Rural Water Supply	Yes	Yes	High	High	High	High	$1,190,000 SEWUD[3] $13,340,000 City[4] **$14,530,000 Total CC**[5] $44,800 O&M

(1) Cost estimates in 2004 dollars.
(2) See cost estimates for Hankinson and Wyndmere, respectively for estimated costs.
(3) Costs associated with upgrading SEWUD's plant.
(4) Costs associated with water distribution to residents.
(5) Total capital costs associated with the alternative.
(6) Annual Operation & Maintenance (O&M) costs. O&M costs are not included under the Superfund program but are included for informational purposes.
(7) O&M costs are based on a typical iron and manganese package gravity treatment plant.

Overall protection of human health and the environment. Both alternatives would achieve a high level of overall protectiveness of human health and the environment by reducing arsenic concentrations in drinking water to below the arsenic MCL.

Compliance with ARARs. Both alternatives would achieve a high level of compliance with ARARs by providing residents with a water supply that meets the MCL for arsenic.

Long-term effectiveness and permanence. The rural water alternative would achieve a high level of long-term effectiveness and permanence by providing a reliable, long-term water supply solution. SEWUD's system is large enough that it can attract and sustain a fully qualified staff at the treatment plant. The rural water alternative is also better able to respond to future changes in the SDWA by spreading the costs of operation over a larger population.

The level of long-term effectiveness and permanence of the stand-alone treatment plant alternative is partially dependant on the ability of the city to maintain qualified, full-time water treatment plant personnel, which, given the rural setting and economic climate of the area, may be somewhat difficult to achieve long-term. Consequently, the stand-alone water treatment plant may provide a lower level of long-term effectiveness and permanence than the rural water alternative.

Reduction of toxicity, mobility, and volume of contamination. Both alternatives are capable of providing a high level of reduction of toxicity, mobility, and volume of contamination. Both alternatives would effectively remove arsenic from the raw water and provide residents with a water source that contains arsenic in concentrations below the arsenic MCL.

Short-term effectiveness. Both alternatives provide a high level of short-term effectiveness since there would be minimal impacts to human health and the environment during the construction and implementation of the remedy.

Implementability. Both alternatives are highly implementable and the components required for the alternatives are readily available.

Cost. The Lidgerwood study has not been completed, consequently, potential alternatives for effective water treatment, and their associated costs, has not been fully evaluated. If the study is successful, it is possible that no other modifications of the existing system are required or that minimal upgrades would be required to provide the city with treated water. If the study is not successful, the city could modify the existing plant or construct a new treatment plant. The estimated capital costs would likely be between $874,000 (cost of Wyndmere stand-alone plant) and $1,961,000 (cost of Hankinson stand-alone plant), assuming that the treatment plant would be a typical iron and manganese gravity filtration system. The annual O&M cost for maintaining the stand-alone system is estimated at $1.94 per 1,000 gallons treated, for a total estimated annual O&M cost of $107,700 (AE2S, 2005). Cost estimate information is included in Appendix A.

The capital costs for connecting Lidgerwood's existing water distribution system to SEWUD's rural water system are estimated at $511,000 (AE2S, 2004); this estimate includes approximately

$371,000 for costs associated with increasing the capacity of the rural water system. The O&M cost incurred by SEWUD to provide treated water to Lidgerwood is estimated at $1.29 per 1,000 gallons treated, for a total estimated annual O&M cost of $71,600 (AE2S, 2005). Cost estimate information is included in Appendix A.

City of Hankinson

The two water supply alternatives considered for Hankinson are to construct a stand-alone water treatment plant or to connect the city's existing water distribution system to SEWUD's rural water system.

Overall protectiveness of human health and the environment. Both alternatives would achieve a high level of protectiveness to human health and the environment by reducing arsenic concentrations in drinking water to below the arsenic MCL.

Compliance with ARARs. Both alternatives would achieve a high level of compliance with ARARs by providing residents with a water supply that meets the MCL for arsenic.

Long-term effectiveness and permanence. The rural water alternative would achieve a high level of long-term effectiveness and permanence by providing a reliable, long-term water supply solution. SEWUD's system is large enough that it can retain and sustain a fully qualified staff at the treatment plant. The rural water alternative is also better able to respond to future changes in the SDWA by spreading the costs of operation over a larger population.

The level of long-term effectiveness and permanence of the stand-alone treatment plant alternative is partially dependant on the ability of the city to maintain qualified, full-time water treatment plant personnel, which, given the rural setting and economic climate of the area, may be somewhat difficult to achieve long-term. Consequently, the stand-alone water treatment plant may provide a lower level of long-term effectiveness and permanence than the rural water alternative.

Reduction of toxicity, mobility, and volume of contamination. Both alternatives are capable of providing a high level of reduction of toxicity, mobility, and volume of contamination. Both alternatives would effectively remove arsenic from the raw water and provide residents with a water source that contains arsenic in concentrations below the arsenic MCL.

Short-term effectiveness. Both alternatives provide a high level of short-term effectiveness since there would be minimal impacts to human health and the environment during the construction and implementation of the remedy.

Implementability. Both alternatives are implementable and the components required for the alternatives are readily available.

Cost. The capital costs for constructing a stand-alone water treatment plant are estimated at $1,961,000 (Moore, 2004). The annual O&M coss for maintaining the stand-alone system is estimated at $1.94 per 1,000 gallons treated, for a total estimated annual O&M cost of $89,300

(AE2S, 2005). Cost estimate information is included in Appendix A.

The capital costs for connecting Hankinson's existing water distribution system to SEWUD's rural water system are estimated at $1,223,000 (AE2S, 2004); this estimate includes approximately $450,000 for costs associated with increasing the capacity of the rural water system. The annual O&M cost incurred by SEWUD to provide treated water to Hankinson is estimated at approximately $1.29 per 1,000 gallons treated, for a total estimated annual O&M cost of $59,400 (AE2S, 2005). Cost estimate information is included in Appendix A.

City of Wyndmere

The two water supply alternatives considered for the city of Wyndmere are to demolish the existing plant and construct a new water treatment plant or to connect the city's existing water distribution system to SEWUD's rural water system.

Overall protectiveness of human health and the environment. Both alternatives provide a high level of protectiveness of human health and the environment by reducing arsenic concentrations in drinking water to below the arsenic MCL.

Compliance with ARARs. Both alternatives would produce water with arsenic concentrations below the arsenic MCL. Both water supply alternative provide a high level of compliance with the ARARs presented in this document.

Long-term effectiveness and permanence. The rural water alternative would achieve a high level of long-term effectiveness and permanence by providing a long-term water supply solution. SEWUD's system is large enough that it can retain and sustain a fully qualified staff at the treatment plant. The rural water alternative is also better able to respond to future changes in the SDWA by spreading the costs of operation over a larger population.

The level of long-term effectiveness and permanence of the stand-alone treatment plant alternative is partially dependent on the ability of the city to maintain qualified, full-time water treatment plant personnel, which, given the rural setting and economic climate of the area, may be somewhat difficult to achieve long-term. Consequently, the stand-alone water treatment plant may provide a lower level of long-term effectiveness and permanence than the rural water alternative.

Reduction of toxicity, mobility, and volume of contamination. Both alternatives are capable of providing a high level of reduction of toxicity, mobility, and volume of contamination. Both alternatives would effectively remove arsenic from the raw water and provide residents with a water source that contains arsenic in concentrations below the arsenic MCL.

Short-term effectiveness. Both alternatives provide a high level of short-term effectiveness since there would be minimal impacts to human health and the environment during the construction and implementation of the remedy.

Implementability. Both alternatives are highly implementable and the components required for the alternatives are readily available.

Cost. A cost estimate to demolish the existing plant and construct a new 140 gpm package gravity filtration system with chlorine and potassium permanganate feed systems was prepared by AE2S; the capital costs for constructing a new plant are approximately $874,000 (AE2S, December 2004). The annual O&M cost for maintaining the stand-alone system is estimated at $1.94 per 1,000 gallons treated, for a total estimated annual O&M cost of $54,400 (AE2S, 2005). Cost estimate information is included in Appendix A.

The capital costs for connecting Wyndmere's existing water distribution system to SEWUD's rural water system are estimated at $751,000 (AE2S, December 2004); this estimate includes approximately $240,000 for costs associated with increasing the capacity of the rural water system. The annual O&M cost incurred by SEWUD to provide treated water to Wyndmere is estimated at approximately $1.29 per 1,000 gallons treated, for a total estimated annual O&M cost of $36,200 (AE2S, 2005). Cost estimate information is included in Appendix A.

Rural Households

The two water supply alternatives considered for the rural households are to install a POU treatment system at each household or to connect each household to SEWUD's rural water system.

Overall protectiveness of human health and the environment. The rural water alternative provides a high level of overall protectiveness of human health and the environment. Residual arsenic-laden wastes generated during the arsenic removal process are properly handled and disposed of in a manner that is protective of human health and the environment.

If installed and maintained properly, individual POU systems would be protective of human health by providing residents with water that contains arsenic in concentrations below the MCL. However, individual POU treatment systems are not fully protective of the environment. Wastewater generated during the treatment process contains concentrated levels of arsenic that are reintroduced into the environment via the on-site sanitary waste disposal system. The wastewater is discharged into the resident's septic tank and drainfield and can migrate back into the shallow aquifer, thereby creating additional arsenic "hot spots." Consequently, the POU does not meet the criteria of protecting the environment.

Compliance with ARARs. The rural water supply alternative achieves compliance with the ARARs presented in this document. SEWUD's treatment facility would provide rural households with water containing arsenic concentrations below the arsenic MCL. SEWUD's water supply is tested regularity as part of the SDWA, consequently, the system's compliance with the arsenic MCL will be evaluated periodically. If installed and maintained properly, POU systems could achieve compliance with ARARs.

Long-term effectiveness and permanence. The rural water supply alternative provides a high level of long-term effectiveness and permanence. Based on the operating history of the existing rural water system, a long-term supply of treated water is readily available and easy to achieve.

POU systems are often not feasible for long term use due to high mineral content of the treated water and the limited expertise of the individuals at properly maintaining the systems. The long term protection for rural users provided with POU systems will be lower than the rural water alternative, and a large part of the success of the alternative will depend on the long-term maintenance of the system.

The EPA has approved centrally managed POU treatment devices as a means of complying with the SDWA, and POU treatment strategies have been used successfully at other sites. A key factor in their success has been the requirement that the POU units must be owned, controlled, and maintained by the public water system or by a contractor hired by the public water system (EPA, 2002). The final responsibility for the quality and quantity of the water provided by the POU units is retained by a central entity, generally the public water system. The lack of a primary entity responsible for compliance makes the long-term effectiveness and permanence of the POU alternative for the ATS low as compared to the rural water alternative.

<u>Reduction of toxicity, mobility, and volume of contamination</u>. The rural water alternative achieves a high level of reducing the toxicity, mobility, and volume of contamination. The treatment plant will reduce arsenic concentrations in the water source. The toxicity of arsenic in the water will be reduced as a result of mass removal. There will be a corresponding reduction in mobility since the majority of mass is removed through the treatment process.

The POU alternative would effectively reduce the toxicity and volume of arsenic in the treated water at the tap and provide the user with water that meets the arsenic MCL. Wastewater generated during the treatment process will contain concentrated levels of arsenic that are reintroduced into the environment via the on-site sanitary waste disposal system. The wastewater is discharged into the resident's septic tank and drainfield and can migrate back into the shallow aquifer, thereby creating additional arsenic "hot spots." The toxicity and volume of contamination can actually be increased by the discharge of the wastewater from the treatment system into the subsurface. Consequently, the POU alternative ranks low in reducing the overall toxicity, mobility, and volume of contamination.

<u>Short-term effectiveness</u>. Both alternatives have a high level of short-term effectiveness since there are minimal impacts to human health and the environment during the construction and implementation of the remedy.

<u>Implementability</u>. Both alternatives are easy to implement and the components are readily available.

<u>Cost</u>. Although 610 potential households have been identified within the ATS, it is not likely that all households will require an alternative water source or will want to participate in the remedy for the ATS. For cost estimating purposes, it is assumed that 90 percent (550) of the identified households will be provided with an alternate source of water that meets the arsenic MCL.

The estimated initial capital cost of providing POU systems to 550 households within the ATS is \$1,419,000. The initial capital cost of the POU treatment unit (water softener and reverse osmosis unit) is approximately \$2,580. The water softener has a 10-year estimated life span and a replacement cost of \$1,698. The treatment unit membrane has a 7-year life span and a replacement cost of \$125. The annual O&M costs for the POU alternative are estimated at \$249,700, and include costs associated with collecting a water sample for compliance purposes

(AE2S, 2005). Cost details for the POU treatment alternative are provided in Appendix A.

The estimated cost to provide 550 rural households with water supplied by SEWUD is $14,530,000. The total cost includes approximately $1,190,000 of required upgrades to SEWUD's plant (e.g., well field expansion, plant expansion and modification) and $13,339,000 for service to the rural households. The estimated cost per rural household is $24,252, which includes installing all pipe to rural water standards, pipe fittings and valves, boring, seeding, and site cleanup. The O&M cost incurred by SEWUD to provide treated water to rural households is estimated at approximately $1.29 per 1,000 gallons treated, for a total estimated annual O&M cost of $44,800 (AE2S, 2005). Cost details for the rural water alternative are provided in Appendix A.

Comparison of Alternatives and Selection of Preferred Alternative

This section provides a comparison of the potential remedy alternatives and the identification of the preferred alternatives. The discussion is broken down separately for each water user potentially affected by the new arsenic MCL, including the cities of Wyndmere, Lidgerwood, and Hankinson and rural households currently utilizing private water supply wells. A generalized comparison summary for all users is presented in Table 1.

<u>Lidgerwood</u>

The two alternatives considered for Lidgerwood are to construct and operate a stand-alone water treatment plant or to connect the existing water distribution system to SEWUD's rural water system. Except for the long term effectiveness and permanence and cost criteria, both alternatives compare favorably. Both alternatives are capable of achieving a high level of protectiveness of human health and the environment by reducing arsenic concentrations in drinking water to below the arsenic MCL, consequently, the threshold criteria of overall protectiveness of human health and the environment and compliance with ARARs is met.

Both alternatives rate high for the criteria of reduction of toxicity, mobility, and volume of contamination; short-term effectiveness; and implementability. The rural water supply alternative rates higher for the long-term effectiveness and permanence criterion. Small communities such as Lidgerwood may experience difficulties (e.g., inability to pay a competitive salary) in hiring and retaining qualified treatment plant operators.

Based on a comparison of the evaluation criteria, the preferred alternative for Lidgerwood is to connect the existing water distribution system to SEWUD's rural water supply system. The rural water alternative would provide a reliable, long-term source of treated water at a cost less than that of a stand-alone water treatment plant.

<u>Hankinson</u>

The two alternatives considered for Hankinson are to construct and operate a stand-alone water treatment plant or to connect the existing water distribution system to SEWUD's rural water system. Except for the long term effectiveness and permanence and cost criteria, both alternatives compare favorably. Both alternatives are capable of achieving a high level of protectiveness of human health and the environment by reducing arsenic concentrations in drinking water to below the arsenic MCL, consequently, the threshold criteria of overall protectiveness of human health and the environment and compliance with ARARs is met.

Both alternatives rate high for the criteria of reduction of toxicity, mobility, and volume of contamination; short-term effectiveness; and implementability. The rural water supply alternative rates higher for the long-term effectiveness and permanence criterion. Small communities such as Hankinson may experience difficulties in hiring and maintaining qualified treatment plant operators.

Based on a comparison of the evaluation criteria, the preferred alternative for Hankinson is to connect the existing water distribution system to SEWUD's rural water supply system. The rural water alternative would provide a reliable, long-term source of treated water at a cost less than that of a stand-alone water treatment plant.

Wyndmere

The two alternatives considered for Wyndmere are to construct and operate a stand-alone water treatment plant or to connect the existing water distribution system to SEWUD's rural water system. Except for the long term effectiveness and permanence and cost criteria, both alternatives compare favorably. Both alternatives are capable of achieving a high level of protectiveness of human health and the environment by reducing arsenic concentrations in drinking water to below the arsenic MCL, consequently, the threshold criteria of overall protectiveness of human health and the environment and compliance with ARARs is met.

Both alternatives rate high for the criteria of reduction of toxicity, mobility, and volume of contamination; short-term effectiveness; and implementability. The rural water supply alternative rates higher for the long-term effectiveness and permanence criterion. Small communities such as Wyndmere may experience difficulties in hiring and maintaining qualified treatment plant operators.

Based on a comparison of the evaluation criteria, the preferred alternative for Wyndmere is to connect the existing water distribution system to SEWUD's rural water supply system. The rural water alternative would provide a reliable, long-term source of treated water at a cost less than that of a stand-alone water treatment plant.

Rural Households

The two water supply alternatives considered for rural households located within the ATS boundary are individual POU treatment systems or to expand the rural water system to provide households with treated water.
If installed and maintained properly, POU systems could reduce arsenic to levels below the arsenic MCL. However, because the arsenic removed during the treatment process is reintroduced into the environment (via the septic system) and, depending on the treatment selected, at a concentrated level, the threshold criteria of overall protection of human health and the environment is not satisfied, and the alternative is not considered for implementation.

POU systems were also ruled out in the FS completed in 1986. The previous FS evaluated both POU and Point of Entry (POE) water treatment options for rural households. POU and POE treatment systems were determined not to be protective of human health and the environment and were, therefore, not considered for implementation. As stated in the ROD, "The various Point of Use/Point of Entry alternatives were evaluated in the FS and by EPA. These included activated alumina, reverse osmosis, distillation, and bottled water. The Point of Use/Point of

Entry Alternatives are characterized by inherent variability and inconsistency associated with occupant operation and maintenance of the system. Therefore, because of lack of reliability and proper assurance of implementation and maintenance of these alternatives, adequate protection of public health could not be guaranteed. These types of technologies rely heavily on institutional controls and would not provide a permanent remedy. Point of Use system also does not provide treatment for all of the water in the household. Therefore, it was determined that these alternatives would not effectively prevent, mitigate, or minimize threats to and provide protection of public health, welfare and the environment."

The rural water alternative satisfies the threshold criteria and provides a reliable, long-term water supply solution for rural residents. Consequently, the preferred remedy for rural households is to provide treated water by expanding the existing rural water system.

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APPENDIX A

WATER SUPPLY SYSTEM DETAILS

AND

COST ESTIMATES

Lidgerwood

Arsenic Trioxide Superfund (ATS) Project
Assumptions for Service to the City of Lidgerwood
Southeast Water Users District
December 9, 2004

Water Supply

- **Water Usage**
  - Lidgerwood – 200 acre-feet or 65,165,760 gallons
- **SEWUD Well Field**
  - Construct four (4) wells, as pitless units with meter manholes and with capacities between 200 and 250 gallons per minute (gpm), to serve Hankinson, Wyndmere, Lidgerwood, and approximately 550 additional rural users
  - Install 2,000 feet of 12-inch and 7,500 feet of 8-inch raw water transmission pipeline to serve Hankinson, Wyndmere, Lidgerwood, and approximately 550 additional rural users
  - Assumed Lidgerwood's share was 17.5 percent of well field costs and raw water supply line modifications costs

Treatment

- **Treatment Expansion**
  - Water service at 200 gpm assumed for Lidgerwood
  - Assumed 60 gpm of existing capacity for Lidgerwood
  - Need to expand the existing treatment by 140 gpm for service to Lidgerwood
  - Service to Hankinson, Wyndmere, Lidgerwood, and approximately 550 Rural Users will require four (4) new 200 gpm pressure filters, high service pumps, associated pipe, controls, and chemical feed equipment – expand WTP building 50 feet by 56 feet
  - Assumed Lidgerwood's share was 17.5 percent of SEWUD WTP Expansion costs

Finished Water Distribution

- **Potential Service**
  - Requires 15,000 feet of 6-inch finished water transmission line (pipe will tie into Lidgerwood WTP underground storage reservoir or into raw water line)
  - Assumed Lidgerwood's share was 100 percent (i.e., specifically for Lidgerwood)

Opinion of Total Probable Project Cost – Arsenic Trioxide Superfund Project

- **Service to Lidgerwood**

Lidgerwood	May 2004$ (ENR BCI = 3956)	Dec 2004$ (ENR BCI = 4123)
SEWUD Well Field Construction (17.5% share of costs)	$87,727	$91,430
Raw Water Supply Line Modifications (17.5% share of costs)	$28,070	$29,255
SEWUD WTP Expansion (17.5% share of costs)	$240,185	$250,324
Service to Lidgerwood – Finished Water Transmission Line	$133,500	$139,136
Incremental Opinion of Total Probable Project Cost	**$489,481**	**$510,145**

Hankinson

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www.mooreengineeringinc.com

July 15, 2004

Mr. David Glatt
Chief – Environmental Health Section
ND Department of Health
Box 5520
Bismarck, ND 58506-5520

Re: City of Hankinson – Water Treatment/Service Needs

Dear Mr. Glatt:

Please find the Reconciliation of Water Service Engineering Data provided on behalf of the City of Hankinson.

The reconciliation data is a joint effort between Moore Engineering and Advanced Engineering (AE2S) to determine the water needs of Hankinson and determine estimated costs for service to the City by rural water or for a stand-alone water treatment plant. The City of Hankinson and the South East Water Users District (SEWUD) directed AE2S and Moore to prepare the information after meeting to discuss the Cities water needs.

The information is being provided as part of the comment process to the Draft Focused Feasibility Study that was provided by USEPA.

If you require additional data or have any questions please contact me at this office.

Yours truly,
MOORE ENGINEERING, INC.

Tom Wesolowski, P.E.
City Engineer

Cc: Joe O'Meara – Mayor City of Hankinson

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Reconciliation of Water Service Engineering Data
City of Hankinson, ND
July 12, 2004

- The design flow for the City of Hankinson shall be 300 gallons per minute (gpm).
- The anticipated annual water usage from the future City of Hankinson high service pumps or at the future master meter from Southeast Water Users District (SEWUD) shall be 54,000,000 gallons.
- The anticipated annual water sold by the City of Hankinson shall be 46,000,000 gallons (assume approximately 15% loss in distribution system).
- As indicated in the Moore Engineering comment letter, additional storage capacity will be required for the City of Hankinson. Based on current and projected demands, it was agreed that 200,000 gallons of additional underground storage would be required for the City of Hankinson. The new 200,000 gallon underground storage reservoir will be located in the northwest corner of the City of Hankinson under either alternative. The future water treatment plant (WTP) or future master meter will be located adjacent to the storage.
- As part of the original easement agreement between the landowners and the City of Hankinson when the well line was installed in the 1950s, pasture taps were installed for the landowners along the easement. These landowners could use, at no cost, as much water as needed for their livestock from these pasture taps. Over time, however, some of these landowners started to use the water for household use. The water used for human consumption is currently metered, and payment is made to the City of Hankinson. With the recent change in the arsenic standard, the City recognizes that they will not be able to continue to serve these users without treatment of the water first. Furthermore, the City does not wish to continue the practice of providing free water for livestock use to these landowners once the water is treated. Additionally, if the City of Hankinson decides to be served by rural water, the SEWUD finished water distribution line will be installed adjacent to the existing Hankinson well field line within the existing easement. Consequently, both parties feel that it is important that these easements be amended. Amending the easements would exclude the allowance of the pasture taps and free water for livestock and allow for future water line(s) to be installed within the original easement. Amending the easements would require compensation to be made to the landowners in exchange for the change in service. It was agreed upon that the cost to amend these easements would be estimated to equal approximately $25,000.
- There are a total of twelve (12) pasture taps on the City of Hankinson raw water line that will need to be abandoned and capped as a precaution so that these taps are not used for potable water consumption in the future.

- The comment letter provided by Moore Engineering identified that there were two (2) households located within City limits on private wells and five (5) households connected to the well line that will need to be provided with a potable water source with arsenic levels below 10 parts per billion (ppb). After meeting with the Joe O'Meara, Mayor for the City of Hankinson, it was identified that there were actually four (4) households located within the City limits currently on private wells along with the five (5) households connected to the well line. Three (3) of the households along the well line are located just outside the city limits of City of Hankinson. The City of Hankinson has agreed to provide water service to the internal and close external residents as part of the Arsenic Trioxide Superfund project.
- Two (2) of the households connected to the well line are located more than 1½ miles north of the City of Hankinson. SEWUD has agreed that they will serve these residents as part of the Arsenic Trioxide Superfund project. The draft FFS report assumed 425 rural households would be served as part of the Arsenic Trioxide Superfund project. These users will be included in the count for service from SEWUD.
- Updated capital cost estimates are provided for service to the City of Hankinson both as a stand-alone WTP and with service from rural water (SEWUD). All capital costs provided herein meet the design flow and anticipated annual usage as discussed above.

	Total Project Costs	
	Stand-alone WTP	SEWUD Option 3
Service to Hankinson (300 gpm)		
Iron and Manganese Treated Water - Hankinson		
Amended Easements	$25,000.00	$25,000.00
Well Field Expansion and Raw Water Transmission	$6,000.00	$93,800.00
Water Treatment	$1,500,000.00	$337,300.00
Finished Water Transmission	$0.00	$172,700.00
Finished Water Storage @ Hankinson	$270,000.00	$384,300.00
Hankinson Distribution Modifications to serve existing users on wells	$160,000.00	$160,000.00
Total Project Cost -- Iron and Manganese Treated Water - Hankinson	$1,961,000.00	$1,173,100.00

This document was prepared by Tom Wesolowski, PE of Moore Engineering and Brian Bergantine, PE of AE2S.

Arsenic Trioxide Superfund (ATS) Project
Assumptions for Service to the City of Hankinson
Southeast Water Users District
December 9, 2004

Water Supply

- **Water Usage**
  - Hankinson – 250 acre-feet or 81,457,200 gallons
- **SEWUD Well Field**
  - Construct four (4) wells, as pitless units with meter manholes and with capacities between 200 and 250 gallons per minute (gpm), to serve Hankinson, Wyndmere, Lidgerwood, and approximately 550 additional rural users
  - Install 2,000 feet of 12-inch and 7,500 feet of 8-inch raw water transmission pipeline to serve Hankinson, Wyndmere, Lidgerwood, and approximately 550 additional rural users
  - Assumed Hankinson's share was 21.2 percent of well field costs and raw water supply line modifications costs

Treatment

- **Treatment Expansion**
  - Water service at 300 gpm assumed for Hankinson
  - Assumed 130.5 gpm of existing capacity for Hankinson
  - Need to expand the existing treatment by 169.5 gpm for service to Hankinson
  - Service to Hankinson, Wyndmere, Lidgerwood, and approximately 550 Rural Users will require four (4) new 200 gpm pressure filters, high service pumps, associated pipe, controls, and chemical feed equipment – expand WTP building 50 feet by 56 feet
  - Assumed Hankinson's share was 21.2 percent of SEWUD WTP Expansion costs

Finished Water Distribution

- **Potential Service**
  - Amend easements on raw water line
  - Requires 15,460 feet of 8-inch finished water transmission line (pipe will tie into the new reservoir)
  - New 200,000 gallon ground storage reservoir
  - Requires modifications to the existing distribution system to serve users on existing well line
  - Assumed Hankinson's share was 100 percent (i.e., specifically for Hankinson)

Opinion of Total Probable Project Cost – Arsenic Trioxide Superfund Project

- **Service to Hankinson**

	May 2004$ (ENR BCI = 3956)	**Dec 2004$** (ENR BCI = 4123)
Hankinson		
SEWUD Well Field Construction (21.2% share of costs)	$106,214	$110,698
Raw Water Supply Line Modifications (21.2% share of costs)	$33,985	$35,420
SEWUD WTP Expansion (21.2% share of costs)	$290,801	$303,077
Amended Easements	$25,000	$26,055
Service to Hankinson – Finished Water Transmission Line	$172,700	$179,990
Finished Water Storage at Hankinson	$384,300	$400,523
Hankinson Distribution Modifications to serve existing users	$160,000	$166,754
Incremental Opinion of Total Probable Project Cost	**$1,173,000**	**$1,222,517**

Wyndmere

Arsenic Trioxide Superfund (ATS) Project
Assumptions for Service to the City of Wyndmere
Southeast Water Users District
December 9, 2004

Water Supply

- **Water Usage**
  - Wyndmere – 100 acre-feet or 32,582,880 gallons
- **SEWUD Well Field**
  - Construct four (4) wells, as pitless units with meter manholes and with capacities between 200 and 250 gallons per minute (gpm), to serve Hankinson, Wyndmere, Lidgerwood, and approximately 550 additional rural users
  - Install 2,000 feet of 12-inch and 7,500 feet of 8-inch raw water transmission pipeline to serve Hankinson, Wyndmere, Lidgerwood, and approximately 550 additional rural users
  - Assumed Wyndmere's share was 11.3 percent of well field costs and raw water supply line modifications costs

Treatment

- **Treatment Expansion**
  - Water service at 140 gpm assumed for Wyndmere
  - Assumed 49.5 gpm of existing capacity for Wyndmere
  - Need to expand the existing treatment by 90.5 gpm for service to Wyndmere
  - Service to Hankinson, Wyndmere, Lidgerwood, and approximately 550 Rural Users will require four (4) new 200 gpm pressure filters, high service pumps, associated pipe, controls, and chemical feed equipment – expand WTP building 50 feet by 56 feet
  - Assumed Wyndmere's share was 11.3 percent of SEWUD WTP Expansion costs

Finished Water Distribution

- **Potential Service**
  - Requires 37,000 feet of 8-inch finished water transmission line (pipe will tie into existing system)
  - Requires pump and control modifications at Reservoir B of SEWUD
  - Assumed Wyndmere's share was 100 percent (i.e., specifically for Wyndmere)

Opinion of Total Probable Project Cost – Arsenic Trioxide Superfund Project

- **Service to Wyndmere**

	May 2004$ (ENR BCI = 3956)	Dec 2004$ (ENR BCI = 4123)
Wyndmere		
SEWUD Well Field Construction (11.3% share of costs)	$56,710	$59,104
Raw Water Supply Line Modifications (11.3% share of costs)	$18,145	$18,911
SEWUD WTP Expansion (11.3% share of costs)	$155,264	$161,818
Service to Wyndmere – Finished Water Transmission Line	$490,300	$510,998
Incremental Opinion of Total Probable Project Cost	**$720,419**	**$750,831**

Wyndmere WTP Expansion (3 - 70 gpm pressure filters)
Southeast Area Regional Expansion
March 29, 2004
P806-01 004 05
OPINION OF PROBABLE TOTAL PROJECT COST

Wyndmere WTP Expansion (3 - 70 gpm pressure filters)

	1. General Conditions	
	Insurance, Bonds, Mobilization, Travel, Subsistence, Etc.	$20,000
	2. General Construction	
	General Conditions	$22,940
	Division 3 - Concrete	$71,060
	Division 4 - Masonry	$49,920
	Division 5 - Metals	$3,900
	Division 6 - Wood/Plastic	$14,300
	Division 7 - Thermal & Moisture Protection	$16,200
	Division 8 - Doors & Windows	$9,100
	Division 9 - Finishes	$14,090
	Division 10 - Specialties	$980
	Division 11 - Equipment	$254,800
	Subtotal General Construction	$457,290
	3. Mechanical Construction	
	Division 15 - Mechanical	$11,050
	4. Electrical Construction	
	Division 16 - Electrical	$85,440
	Opinion of Probable Construction Costs	$573,780
2.5%	Administrative and Legal	$14,350
17.5%	Engineering Feasibility & Design	$100,420
7.5%	Engineering (Construction Period)	$43,040
15.0%	Contingencies	$86,070
	Opinion of Probable Total Project Costs	**$817,660**
	March 2004 ENR BCI	3859
	Current ENR BCI - December 2004	4123
	Revised Opinion of Probable Total Project Costs (Dec 2004$)	**$873,600**

City of Wyndmere

P.O. Box 220
Wyndmere, N.D. 58081

April 15, 2004

Mr. David Glatt
Chief – Environmental Health Section
North Dakota Department of Health
PO Box 5520
Bismarck, ND 58506-5520

Re: City of Wyndmere Comments
Arsenic Trioxide Superfund Site, North Dakota

Dear Mr. Glatt:

Thank you for giving us the opportunity to provide to you comments with regards to the Draft Final Report of the Focused Feasibility Study (FFS): Arsenic Trioxide Superfund Site, North Dakota dated March 2004 prepared by the US Army Corps of Engineers (USCOE) for the Environmental Protection Agency (EPA) and the North Dakota Department of Health (NDDH). Developing alternatives which provide reliable, long-term safe drinking water that meets the new arsenic regulation, provide sufficient capacity to meet our future water needs and adequately project the financial impacts for the residents of Wyndmere is very important, as the deadline for the compliance with the arsenic regulation is nearing.

Based on our review of the draft FFS and the comment letter prepared by Advanced Engineering and Environmental Services, Inc. (AE2S) for Southeast Rural Water Users District (SEWUD), we are very concerned about the insufficient water demands that were assumed for the City of Wyndmere in the draft FFS, the age and condition of our existing water treatment plant (WTP) with respect to alternatives that suggest upgrading the plant as a feasible alternative, and the estimated capital costs and operation and maintenance (O&M) costs projected in the draft FFS. Please accept this letter as a summary of our view on the issues that directly impact the City of Wyndmere.

A new manufacturing facility, Tublicks, has just recently been constructed within Wyndmere that manufactures molasses livestock feed and supplement blocks. This facility will be requiring extensive additional water during its start-up (60 gpm for 2 hours), shut-down (60 gpm for 2 hours), and flushing operations, along with its regular demands. Wyndmere has also been considered for a butcher facility which may require a considerable amount of water in comparison to our existing WTP capacity. Therefore, because of the new and potential for additional economic development coupled with our existing peak day water usage, we strongly recommend that the demands for Wyndmere be increased from the 42 gpm assumed within the draft FFS to the 140 gpm reported in the comment letter from SEWUD. The gpm demand should also be further evaluated during the preliminary and final designs of the project to ensure this amount adequately meets the needs of our community.

We also have concerns over the trade-offs that are currently necessary between sacrificing water quantity for water quality with the operation of the existing WTP. Currently, our WTP is consistently operated at a capacity less than its rated capacity of 100 gpm because of the poor treatment performance experienced when operated above capacities of 65 gpm. As a result, the WTP is operated for 15 to 16 hours in winter months and even longer periods of time and higher capacities during the summer months, resulting in water quality problems. With the new manufacturing process, we will likely need to operate round the clock at higher capacity during peak day demands, further sacrificing the water quality to our residents. Although sacrificing the water quality may be an acceptable regulatory practice in the short-term, this will be an

P.O. Box 220
Wyndmere, N.D. 58081

unacceptable practice when the new arsenic regulation becomes enforceable. Under the original Arsenic Trioxide Superfund project, we made changes to our treatment process system and added some storage. Even with these changes, we are currently unable to produce finished water that consistently meets the new arsenic regulation.

Another concern we have is the age and condition of our WTP. The facility is nearly 40 years old and is well beyond its useful life. As a result, it should be recognized that upgrading the existing water treatment plant does not appear to be an option that meets the needs of our community over the next 20 years or more.

The capital and O&M costs presented within the draft FFS appeared to be extremely low and inadequate. The financial ramification that this project could have on our residents is huge. We support the cost estimates provided in the comment letter to us by SEWUD. Based on my review of the SEWUD comment letter, the total opinion of probable cost for treatment and distribution from SEWUD would be approximately $741,483 for the City of Wyndmere, which appears to be more feasible than construction of a new 140 gpm WTP. It was also noted that the O&M costs that were assumed in the draft FFS were low. Our 2004 budget for the O&M of the WTP is $44,100. This is over 2.75 times higher than the amount that was assumed in the draft FFS. With O&M being a large part of the present worth cycle coasts and the inadequate demands assumed for Wyndmere, it is apparent that the costs and conclusions drawn within the report are inaccurate.

As a small community, we may also have a difficult time recruiting and retaining an operator(s) with the skill level required for most of the treatment processes presented with the draft FFS. On the other hand, it is my understanding that SEWUD has certified operators with the skills necessary to properly maintain and operate the water system. Additionally, because of their larger user base, SEWUD has the ability to retain these operators more easily because they can offer a more competitive salary.

We support the data used to prepare the revised present worth life cycle cost estimates in the SEWUD comment letter. Based on the information provided in the draft FFS and the SEWUD comment letter, it is our position that bulk service to the Wyndmere from SEWUD is more economical than construction of a new WTP in Wyndmere. Consequently, we support the connection of Wyndmere to SEWUD for our community as part of this project.

The City of Wyndmere appreciates the opportunity to provide comments on this important document. Because of the financial ramifications associated with the remedies proposed within this draft FFS report on our community, we highly recommend that the draft FFS be revisited, and the necessary changes be made before the final FFS is issued. If you have any questions, please contact our City Auditor, Rochelle 'Susie' Huseth at (701) 439-2412.

Sincerely,

Nathan Brandt, Mayor
City of Wyndmere

NB/rsh

Rural Households

Arsenic Trioxide Superfund (ATS) Project
Assumptions for Service to the 550 Rural Users
Southeast Water Users District
December 9, 2004

Water Supply

- **Water Usage**
  - Arsenic Trioxide Superfund Rural (550 additional users) – 125 acre-feet or 40,728,600 gallons
- **SEWUD Well Field**
  - Construct four (4) wells, as pitless units with meter manholes and with capacities between 200 and 250 gallons per minute (gpm), to serve Hankinson, Wyndmere, Lidgerwood, and approximately 550 additional rural users
  - Install 2,000 feet of 12-inch and 7,500 feet of 8-inch raw water transmission pipeline to serve Hankinson, Wyndmere, Lidgerwood, and approximately 550 additional rural users
  - Assumed Rural Users' share was 50.0 percent of well field costs and raw water supply line modifications costs

Treatment

- **Treatment Expansion**
  - Water service at 412.5 gpm assumed for additional rural users
  - Assumed 12.5 gpm of existing capacity for rural
  - Need to expand the existing treatment by 400 gpm for service to additional rural users
  - Service to Hankinson, Wyndmere, Lidgerwood, and approximately 550 Rural Users will require four (4) new 200 gpm pressure filters, high service pumps, associated pipe, controls, and chemical feed equipment – expand WTP building 50 feet by 56 feet
  - Assumed Rural Users' share was 50.0 percent of SEWUD WTP Expansion costs
  - An additional $130,277 in modifications are required for the rural expansion

Finished Water Distribution

- **Potential Service**
  - Assumed an average pipeline length of 5,400 feet of polyvinyl (PVC) [size varies from 2-inch Class 160 PVC to 6-inch Class 160 PVC] per rural user based on the estimated rural density. The estimated rural density was based on similar rural water system layouts and will need to be verified after actual sign-ups as part of the preliminary and final design.
  - Assumed a cost of $24,252 per user for finished water transmission based on December 2004 updated estimates. Cost includes installing all pipe to rural water standards, fittings, valves, bores, seeding, site cleanup, and necessary appurtenances.

Opinion of Total Probable Project Cost – Arsenic Trioxide Superfund Project

- **Service to Rural**

	May 2004$ (ENR BCI = 3956)	Dec 2004$ (ENR BCI = 4123)
Rural		
SEWUD Well Field Construction (50.0% share of costs)	$250,650	$261,231
Raw Water Supply Line Modifications (50.0% share of costs)	$80,200	$83,586
SEWUD WTP Expansion (50 % share of costs)	$686,250	$715,220
Additional Modifications to SEWUD WTP	$125,000	$130,277
Service to 550 Rural Users – Finished Water Transmission Line[1]	$12,798,500	$13,338,780
Incremental Opinion of Total Probable Project Cost	**$13,940,600**	**$14,529,094**

[1] Assumed an average pipeline length of 5,400 feet per user based on the densities of similar rural water systems. The average pipeline length, and the associated cost, will need to be verified after actual sign-ups as part of the preliminary and final design.

Annual O&M Cost Estimates

Arsenic Trioxide Superfund (ATS) Project
Estimated Annual O&M Costs
March 22, 2005

Southeast Water Users District — Based on data provided from SEWUD - 2004 O&M Costs.

Electricity Includes wells, main WTP, and reservoirs	$82,707	
Chemical Feed	$16,227	
Labor, Benefits, and Payroll Costs	$70,098	
Parts and Maintenance Includes well maintenance, leak repair, filter media replacement, etc.	$16,934	
Transportation, Testing, and Other Costs		
Transportation	$16,000	
Testing	$3,000	
Insurance and misc.	$4,000	
Total Annual O&M Costs:	$208,966	
Cost per 1,000 gallons of water (based on 161,952,000 gallons)		
O&M Costs per 1,000 gallons =	**$1.29**	

Iron and Manganese Package Gravity Plant — Based on Hankinson example.

Well Maintenance (Assume $500 per year)	$500	Cost based on Devils Lake well maintenance per gallon cost
Well Field/Pump Station Power	$3,800	Cost based on Devils Lake well field power per gallon cost
Filter Media Replacement (Assumes replacement of two filters media every 20 years)	$2,000	Based on discussion with Gary Warner - Tonka Equipment Cost was $1,000 in 2004 Moore Engineering Report
Chemical Feed	$14,000	From 2004 Moore Engineering Report
Energy Costs	$15,000	From 2004 Moore Engineering Report
Labor, Benefits, and Payroll Costs	$49,000	Adjusted from 2004 Moore Engineering Report Includes $35,000 * 40 percent markup for benefits
Misc.	$5,000	- From 2004 Moore Engineering Report
Total Annual O&M Costs:	$89,300	
Cost per 1,000 gallons of water (based on 46,000,000 gallons)		As supplied to the NDDH in the reconcilation of water engineering data from Moore Eng. and AE2S - July 15, 2004
O&M Costs per 1,000 gallons =	**$1.94**	

Arsenic Trioxide Superfund (ATS) Project
Estimated Annual O&M Costs
March 22, 2005

Reverse Osmosis WTP Based on estimate for Devils Lake, ND. Resource is Grand Forks-Traill Water District, Thompson, ND.

	Devils Lake (3 mgd)*	Adjusted for Hankinson (300 gpm)
Well Maintenance Assume $5,000 per well every 10 years	$4,000	$670
Well Field/Pump Station Power	$30,250	$5,100
Water Treatment Chemicals	$107,350	$19,000
Process and High Service Pumping Equipment Power	$116,500	$14,700
General Treatment Facility Utilities	$35,000	$4,500
Labor Adjusted labor includes one full time employee at $40,000 and 40 percent for benefits and one half-time employee at $30,000 and 40 percent for benefits	$185,000	$58,100
General System Maintenance	$32,500	$4,100
Membrane Replacement Assume $210,000 every 5 years	$42,000	$20,000
Insurance	$10,000	$1,300
Misc. O&M (Tel., Fuel, etc)	$25,000	$3,200

*Assume an average annual usage of 365,000,000 gallons

Total Annual O&M Costs: $130,670.00

Cost per 1,000 gallons of water (based on 46,000,000 gallons)

O&M Costs per 1,000 gallons = $2.84

Arsenic Trioxide Superfund (ATS) Project
Estimated Annual O&M Costs
March 22, 2005

Point of Use (POU) Based on system that includes a water softener and a reverse osmosis treatment unit on one tap in household.

Salt for water softener (Assume 2 bags per month at $4 per bag)	$96
Annual water softener replacement (Assumes $1000 replacement over 15 years)	$67
Prefilter cartridge replacement (Assumes replacement of $12 cartridge filter every 3 months)	$48
Indirect labor for getting salt, adding salt to water softener, and replacement of prefilters (Assumes $10 per month)	$120
POU maintenance contract Includes changing the reverse osmosis filter on a yearly basis	$130
POU compliance testing Includes collection of water sample and performing arsenic testing on a yearly basis	$60
Annual O&M Costs Per User:	$521
Estimated Rural Users:	550 users
Total Annual O&M Costs:	$286,367
Estimate POU Capacity Per User:	30 gpd — As supplied by NDDH in a draft of the AA
=	10,950 gpy

Cost per 1,000 gallons of water (based on 6,022,500 gallons) Number of users multiplied by gallons per year

O&M Costs per 1,000 gallons = $47.55