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Redactions CBI and PII

HydroGeoLogic, Inc
Exceeding Expectations

Kansas City Operations

The following Appendices are available only on CD
Appendix F

August 3, 2012

Mr. Jim Seiler
AES Project Officer
U.S. Environmental Protection Agency, Region 7
901 North 5th Street
Kansas City, KS 66101

RE: Revised Final Feasibility Study Report for the
Garvey Elevator Site, Hastings, Nebraska
U.S. EPA Region 7 AES Contract No. EP-S7-05-05; Task Order No. 0033/0034
EPA Task Order Project Officer: Brian Zurbuchen, Ph.D.

Dear Mr. Seiler:

HydroGeoLogic, Inc. (HGL) is pleased to submit one hard copy and one electronic copy of the Revised Final Feasibility Study Report for the Garvey Elevator Site, Hastings, Nebraska. This document was prepared in accordance with Task Orders 0033/0034; our EPA-approved Task Order Proposal Revision 1 submitted on September 26, 2008; the Revised Final Work Plan dated June 25, 2009; and the Final Work Plan Addendum dated February 23, 2010. Responses to EPA's comments on the Final Feasibility Study Report transmitted on June 8, 2012 are shown below.

EPA COMMENTS:

Comment 1 *Attached below are two files that contain EPA's detailed analysis of alternatives as well as the summary table that numerically ranks each modifying criteria from the analysis. Appendix E of the FS Report contained the Detailed Analysis of Remedial Alternatives. Incorporate EPA's analysis into the one presented in the FS Report. If there are conflicting analyses, EPA's overrides the one in the June 2012 FS. Revise the numerical scoring of the criteria according to EPA's ranking. I want the analysis to be accurate and done in accordance with guidance. So, if there are any questions regarding EPA's analysis or numerical ranking, don't hesitate to contact me. Revise all relevant appendices, tables and text in the FS Report accordingly.*

Response **The information provided in the attachments has been incorporated into the report tables, text, and Appendix E.**

Comment 2 *HGL has already performed some corrections to the Appendix F - Detailed Remedial Alternatives Analysis Cost Information. Revise the Appendix F so that it includes these corrections.*

30284362

6340 Glenwood, Suite 200, Building #7, Overland Park, KS 66202
Phone: (913) 317-8860. Fax: (913) 317-8868
www.hgl.com

Response **Revisions to the alternatives costs have been incorporated into Appendix F. In addition, revisions have been made throughout the report text and tables to make these costs consistent.**

Comment 3 *On June 25, 2012, HGL submitted a revised PCL summary table (B.1) and associated calculation sheets via e-mail. Include these tables and calculations in a revised Appendix B. Revise text that refers to Appendix B so that it describes the calculation methodology.*

Response **Appendix B now includes the revised PCL tables and calculation sheets, and the text references to this appendix have been updated.**

Two hard and two electronic copies of these documents are concurrently being sent to Laurie Brunner at NDEQ. Should you have any questions or comments, please contact us at 913-317-8860.

Sincerely,

[redacted]

HGL [redacted]

[redacted]

AES Program Manager

Enclosure

cc: Ms. Laurie Brunner, Nebraska Dept. of Environmental Quality (2 copies)

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REVISED FINAL FEASIBILITY STUDY
GARVEY ELEVATOR SITE
HASTINGS, NEBRASKA

Prepared for:

U.S. Environmental Protection Agency Region 7
901 North 5th Street
Kansas City, KS 66101

Architect and Engineering Services Contract EP-S7-05-05
Task Order: 0033

August 2012

HGL
HydroGeoLogic, Inc

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REVISED FINAL FEASIBILITY STUDY
GARVEY ELEVATOR SITE
HASTINGS, NEBRASKA

Prepared for:

U.S. Environmental Protection Agency Region 7
901 North 5th Street
Kansas City, KS 66101

Prepared by:

HydroGeoLogic, Inc.
6340 Glenwood, Suite 200
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Overland Park, KS 66202

August 2012

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LIST OF ACRONYMS AND ABBREVIATIONS

AGP	Ag Products, Incorporated
AES	Architect and Engineering Services
amsl	above mean sea level
AOC	Administrative Order on Consent
ARAR	applicable or relevant and appropriate requirement
AST	aboveground storage tank
Bcy	bank cubic yards
bgs	below ground surface
CDM Smith	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	cubic feet per minute
CFR	Code of Federal Regulations
COC	contaminant of concern
COPC	contaminant of potential concern
cps	centimeters per second
CPT	cone penetrometer test
CSM	conceptual site model
DAF	dilution attenuation factor
1,2-DCA	1,2-dichloroethane
1,2-DCP	1,2-dichloropropane
DPT	direct-push technology
EB	enhanced bioremediation
EC	electrical conductivity
ENR	Engineering News Record
EPA	U.S. Environmental Protection Agency
ESA	Environmental Site Assessment
ESD	Explanation of Significant Differences
EZVI	emulsified zero-valent iron
FFS	focused feasibility study
FS	feasibility study
ft/day	feet per day
ft/ft	feet per foot
FRTR	Federal Remediation Technologies Roundtable
GET	groundwater extraction and treatment
gpd/ft	gallons per day per foot
gpm	gallons per minute
GRA	general response action

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HGL	HydroGeoLogic, Inc.
HHRA	human health risk assessment
HI	hazard index
HICA	Hastings Institutional Control Area
HMI	Human Machine Interface
hp	horsepower
IC	institutional control
ILCR	incremental lifetime cancer risk
INW	Instrumentation Northwest, Inc.
ISCO	in situ chemical oxidation
LUC	land use control
MCL	maximum contaminant level
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
MNA	monitored natural attenuation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDEQ	Nebraska Department of Environmental Quality
NPL	National Priorities List
O&M	operation and maintenance
OMB	Office of Management and Budget
PAH	polynuclear aromatic hydrocarbons
PA/SI	Preliminary Assessment/Site Inspection
PCE	tetrachloroethene
PLC	programmable logic controller
POTW	publicly owned treatment works
PCB	polychlorinated biphenyl
PCL	preliminary cleanup level
psi	pounds per square inch
psia	pounds per square inch absolute
PVC	polyvinyl chloride
RA	remedial action
RAO	remedial action objective
RAPMA	Remedial Action Plan Monitoring Act
RD	remedial design
RG	remediation goal
RI	remedial investigation
ROD	record of decision

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scfm	standard cubic feet per minute
Site	Garvey Elevator Superfund Site
SLERA	screening level ecological risk assessment
SQL	sample quantitation limit
START	Superfund Technical Assessment & Response Team
SVE	soil vapor extraction
TBC	to be considered
1,1,1-TCA	1,1,1-trichloroethane
TCE	trichloroethene
U.S.C.	United States Code
VCP	Voluntary Cleanup Program
VFD	variable-frequency drive
VOC	volatile organic compound

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EXECUTIVE SUMMARY

HydroGeoLogic, Inc. (HGL) is conducting a Feasibility Study (FS) at the Garvey Elevator Superfund Site, in Hastings, Nebraska (Site). This work is being executed under U.S. Environmental Protection Agency (EPA) Region 7 Architect and Engineering Services Contract EP-S7-05-05, Task Order 0033. CDM Federal Programs Corporation (CDM Smith) is a team subcontractor to HGL on the AES contract and provided key support in preparing this document.

The work performed during the feasibility study (FS) was in accordance with guidance developed by EPA for conducting a FS under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In addition, the cost estimates for each alternative were developed in accordance with *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study*.

SITE LOCATION, HISTORY, AND CONTAMINATION

The former Garvey Elevators, Inc. storage facility is located southwest and outside of the limits of the city of Hastings in Adams County, Nebraska. The facility is located on a 22-acre portion (Parcel ID – 010003207) of the 106-acre Site property. The grain storage facility, where fumigant was stored and used is an active 8-million bushel capacity grain elevator currently owned and operated by Ag Products, Incorporated.

The 22-acre portion of the former Garvey Elevators, Inc. property designated as the grain storage facility consists of a concrete headhouse and elevator, flat storage building, steel storage bins, and associated buildings for facility maintenance, offices, and chemical storage (Figure 2.2). The majority of the remaining 84 acres of the former Garvey Elevators, Inc. property is used for crop production. The area surrounding the grain storage facility is rural with a sparse distribution of residential properties to the north, east, and west. The nearest residence is immediately adjacent to northeast property boundary, approximately 1,200 feet north of the grain storage facility.

The Site is located in a predominately rural area with sparse distribution of residential properties north, east, and west of the Site; the nearest is less than 1/4 mile away. One municipal well and more than 35 private drinking water wells have been impacted by the volatile organic compound (VOC)-contaminated groundwater.

For remediation purposes, EPA has divided the site into two operable units (OUs). Operable Unit 1 (OU1) is defined as the contaminated soils and groundwater at the 22-acre property formerly owned and operated by Garvey Elevators, Inc. and considered to be “on site”. The known contaminants of concern (COCs) for OU1 by medium are:

- Indoor air: chloroform, tetrachloroethene (PCE), and trichloroethene (TCE)
- Soil and soil gas: carbon tetrachloride, chloroform, PCE, and TCE
- Groundwater: benzene, carbon tetrachloride, and chloroform

OU2 is the contaminated groundwater outside of OU1, in the general direction of groundwater flow. OU2 groundwater contamination extends approximately 4.3 miles to the east of OU1, for a total plume length (OU1 and OU2) of 4.7 miles. The known COCs for OU2 are carbon

tetrachloride, chloroform, and 1,2-dichloroethane (1,2-DCA) in groundwater. OU2 is considered to be "off site" groundwater contamination.

REMEDIAL ACTION OBJECTIVES

Based on current site data and evaluations of potential risk, the following remedial action objectives (RAOs) were identified:

- Prevent or minimize the release of carbon tetrachloride, chloroform, PCE, and TCE from the unsaturated OU1 source area soils to groundwater at concentrations that would exceed their respective preliminary cleanup levels (PCLs) in groundwater.
- Prevent further migration of benzene, carbon tetrachloride, chloroform and TCE contaminated groundwater in excess of their respective PCLs from the OU1 source area.
- Prevent further migration of carbon tetrachloride chloroform, and 1,2-DCA contaminated groundwater in excess of their respective PCLs from the OU2 area.
- Reduce the concentrations of benzene, carbon tetrachloride, chloroform and TCE in groundwater beneath the OU1 source area to concentrations less than or equal to their respective PCLs within a reasonable time frame, so that the aquifer is restored to its beneficial use.
- Prevent exposure of future residents to concentrations of chloroform, PCE, and TCE in indoor air at or above levels of concern for long-term exposure, from the vapor intrusion pathway at the OU1 source area.
- Reduce the concentrations of carbon tetrachloride, chloroform and 1,2-DCA in groundwater in OU2 to concentrations less than or equal to their respective PCLs within a reasonable time frame, so that the aquifer is restored to its beneficial use.
- Prevent exposure of current and future residents to concentrations of carbon tetrachloride, chloroform, and 1,2-DCA, in groundwater in OU2, at or above levels of concern for long-term exposure from its domestic use.

PRELIMINARY CLEANUP LEVELS

PCLs are developed based on the site-specific risk assessment; applicable or relevant and appropriate requirements (ARARs); and/or to be considered requirements (TBCs). Where ARARs are not available or are not sufficiently protective, EPA generally sets site-specific remediation levels for: (1) carcinogens at a level that represents an excess upper bound lifetime cancer risk to an individual of between 1E-04 to 1E-06; and (2) non-carcinogens such that the cumulative risks from exposure will not result in adverse effects to human populations (including sensitive sub-populations) that may be exposed during a lifetime or part of a lifetime, incorporating an adequate margin of safety (OSWER Directive 9283.1-33). Pursuant to CERCLA Section 121(d) and in consideration of the groundwater aquifer's current use as a drinking water source, the Safe Drinking Water Act is a relevant and appropriate standard, and therefore, PCLs for groundwater are based on the MCLs specified therein. PCLs for COCs are presented in Table ES.1 and are based on MCLs in drinking water and on standard EPA screening criteria for protection of groundwater for soils and soil gas. Additional PCLs address vapor intrusion.

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Table ES.1 Tentative List of Preliminary Cleanup Levels

Contaminant of Concern	Media					
		Soil	Soil Gas			
		Migration to GW		Migration to GW[e]		
	GW [a]	Fine-Grained Soils [c]	Vapor Intrusion [d]	Fine-Grained Soils	Coarse-Grained Soils	Indoor Air [f]
	µg/L	µg/kg	µg/m^3	µg/m^3	µg/m^3	µg/m^3
OU1						
Benzene	5	NA	NA	NA	NA	NA
Carbon Tetrachloride	5	45	NA	95,000	130,000	NA
Chloroform	80[b]	460	1	230,000	460,000	0.1
Tetrachloroethene	NA	NA	90	71,000	110,000	9
Trichloroethene	5	NA	4	39,000	66,000	0.4
OU2						
Carbon Tetrachloride	5	NA	NA	NA	NA	NA
Chloroform	80[b]	NA	NA	NA	NA	NA
1,2-Dichloroethane	5	NA	NA	NA	NA	NA

Notes:

GW = groundwater
NA = Preliminary Cleanup Levels are not applicable for this media at designated OU.
[a] Groundwater PCLs are MCLs unless otherwise noted.
[b] PCL is the MCL for total trihalomethanes (bromodichloromethane, bromoform, chloroform, dibromochloromethane). The National Primary Drinking Water Regulations for disinfection byproducts assigns an MCLG for chloroform of 70 ug/L (40 C.F.R. 141.53).
[c] Values were calculated using site-specific soil information in SSL formula from USEPA Soil Screening Guidance, 1996. H' and K_{oc} are from USEPA RSL April 2012 Tables. The resulting SSL was multiplied by a DAF of 20.
[d] Values are 1/10 of calculated site-specific risk-based levels for indoor air using formulas from Appendix D of the USEPA VI Guidance, 2002.
[e] Values for coarse- and fine-grained soils were calculated using the method specified by Y. Rong, 1996. MCL-based SSL's were used in the calculation when available. SSLs, H', and K_{oc} are from USEPA RSL April 2012 Tables.
[f] Values are calculated site-specific risk-based levels for indoor air using formulas from Appendix D of the USEPA VI Guidance, 2002. Toxicity values are from the USEPA RSL April 2012 Tables.

REMEDIAL ALTERNATIVES

Combining individual process options develops possible solutions, which are referred to as remedial alternatives, for on-site soil and groundwater contamination at OU1 and off-site groundwater contamination at OU2. The goal in developing the remedial alternatives is to provide both a range of cleanup options and sufficient detail to adequately compare the alternatives. The remedial alternatives evaluated in detail in this FS are:

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Alternatives to Address OU1 Contaminated Soil

- Alternative S1: No Action
- Alternative S2: Excavation, Treatment and Disposal of Contaminated Soil and Operation of Existing SVE System
- Alternative S3: Expand SVE System
- Alternative S4: Excavation, Treatment and Disposal of Contaminated Soil and Expand SVE System

Remedial Alternatives to Address OU1 Contaminated Groundwater

- Alternative SG1: No Action
- Alternative SG2: Maintain and Operate Existing GET System
- Alternative SG3: In Situ Treatment via Groundwater Amendments
- Alternative SG4: In Situ Treatment via Groundwater Amendments and Operation of Existing GET System

Remedial Alternatives to Address OU2 Contaminated Groundwater

- Alternative G1: No Action
- Alternative G2: Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume
- Alternative G3: Groundwater Recovery, Treatment, and Discharge at Mid-plume and Leading Edge of Plume
- Alternative G4: In Situ Treatment at Core of Plume and Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume

ALTERNATIVES TO ADDRESS OU1 CONTAMINATED SOIL

Alternative S1: No Action

Alternative S1 is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared. The No Action alternative would include discontinuing operation of the SVE system at the Site. The only actions that would be implemented for Alternative S1 are completion of Five Year Reviews as required by the NCP and periodic monitoring. There would be no change in the soil contaminant concentrations because no treatment, containment, or removal of contaminated soil is included in this alternative.

Alternative S2: Excavation, Treatment and Disposal of Contaminated Soil and Operation of Existing SVE System

Alternative S2 protects the environment through removal and on-site treatment and disposal of residual contaminated soil from the source area. Soil with contaminant concentrations exceeding cleanup goals would be excavated and treated on site. Excavation adjacent to the silos would require temporary shoring or protection depending on the excavation depth. Additional safety measures would be required with working in proximity to an active grain storage facility. The volume of excavation is approximately 90 bank cubic yards (bcy), with an area of 40 feet by 10 feet, 6 feet deep, in the region just north of the silos in or near the known source area of the former liquid fumigant AST area. Confirmatory sampling of the excavation sidewalls and floor would be performed to determine whether COCs are present above the cleanup goals. If needed, additional excavation would be done in an iterative process

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until confirmatory sampling results indicate that cleanup goals have been met. Clean fill from an on-site borrow pit would be used to backfill the excavated area. For purposes of this FS, it is assumed that the soil obtained from an on-site borrow area would be suitable for use as backfill.

Contaminated soil would be characterized and treated as needed on site. Soil would be placed in an on-site ex situ SVE treatment area to reduce concentrations to meet disposal requirements for on-site disposal. The ex-situ SVE treatment area would consist of contaminated soil placed on a polyethylene sheet, PVC pipe venting running through the contaminated soil. A blower would be used to remove contaminants and introduce oxygen to promote biological breakdown of contaminants. After soil contamination is reduced below cleanup goals, the treated soil would be placed into the on-site borrow pit, compacted, and seeded.

This alternative would make use of the existing in situ SVE system operation which was previously implemented at the site by the PRP. The five shallow and three deep SVE well system would continue to operate with no upgrades or expansions performed. Operations, maintenance, and system monitoring would continue to be performed.

For purposes of this FS, it is assumed that the SVE system would need to be operated an additional 5 years after excavation to achieve cleanup levels.

Alternative S3: Expand SVE System

Alternative S3 expands the treatment area of the SVE system by installing a shallow (20 to 50 feet bgs screen) and deep (60 to 110 feet bgs screen) SVE well in the source area. The current system at the site does not operate any emissions treatment process; however, a catalytic oxidation unit and scrubber exist and could be re-activated if treatment prior to discharge is needed to comply with state air regulations.

For purposes of this FS, it is assumed that the SVE system would need to be operated 10 years after installation of the additional SVE wells to achieve cleanup levels.

Alternative S3 would include the implementation of the necessary LUCs/ICs to protect human health and the environment.

Alternative S4: Excavation, Treatment and Disposal of Contaminated Soil and Expand SVE System

Alternative S4 combines Alternatives S2 and S3 to minimize the timeframe that the SVE system would be required to operate. This alternative protects the environment through removal, treatment and on-site disposal of residual contaminated soil from the source area as described in detail in Alternative S2 and continues to remove VOCs from the vadose zone on site as described in Alternative S3.

For purposes of this FS, it is assumed that the SVE system would need to be operated an additional 5 years after excavation to achieve cleanup levels.

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ALTERNATIVES FOR OU1 CONTAMINATED GROUNDWATER

Alternative SG1: No Action

Alternative SG1 is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared. The only actions that would be implemented for Alternative SG1 are completion of Five Year Reviews as required by the NCP, periodic groundwater monitoring in support of the Five Year Reviews, and dismantling of the existing GET system and abandonment of recovery wells. There would be no change in the groundwater contaminant concentrations because no treatment, containment, or removal of contaminated groundwater is included in this alternative.

Alternative SG2: Maintain and Operate Existing GET System

Under Alternative SG2, the GET system implemented at the Site under previous interim actions would continue to be maintained and operated as is. The system consists of eight existing recovery wells pumping to the treatment building where they combine in a single header and flow through bag filters and are treated by an air stripping unit.

Under Alternative SG2, the current GET system would continue to be operated to remove contaminants in groundwater, and O&M would continue. The GET system would not be expanded or otherwise enhanced. A recent groundwater model developed by HGL showed the current system is capturing the extent of the OU1 contamination effectively and preventing further migration of contaminants.

For purposes of this FS, it is assumed that groundwater monitoring would be conducted at the site quarterly for the first year, semiannually for 4 years, and annually for 25 years. The overall remediation time period for Alternative SG2 is estimated to be approximately 30 years based on groundwater modeling.

Alternative SG3: In Situ Treatment via Groundwater Amendments

Under Alternative SG3, in situ EB, in situ chemical oxidation, or in situ chemical reduction of chlorinated VOCs would be stimulated at the contaminant source area. These technologies are described in Section 5. Figure 7.3 shows the areas of groundwater contamination that would be targeted by in situ treatment. Bench- and pilot-scale studies would be conducted before full-scale implementation to determine the efficacy of EB, in situ chemical oxidation or reduction at the site. These studies would also determine the need for bioaugmentation at the site.

Depth to groundwater at OU1 is assumed to be shallow enough to make direct-push technology (DPT) feasible for injections. Multiple injection points would be tied together through a manifold system.

The existing GET system would be shut down during injections to prevent injected materials from being extracted and entering the treatment system. If the injections are successful, the GET system would be dismantled, and the equipment removed from the existing treatment building. The extraction piping would be removed and the recovery wells would be abandoned.

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For purposes of this FS, it is assumed that substrate injection would be conducted once a year for 5 years. Groundwater monitoring would be conducted at the site quarterly for the first year, then semiannually for 4 years. The overall remediation time period for Alternative SG3 is estimated to be 15 years based on groundwater modeling.

Alternative SG4: In Situ Treatment via Groundwater Amendments and Operation of Existing GET System

Alternative SG4 would combine components of Alternatives SG2 and SG3 to reduce the total cleanup time and decrease operating costs of the GET system. The in situ treatment would target areas of the OU1 plume with concentrations greater than 500 μg/L in the upper and medial aquifers. Due to the shallow depths, injections would be accomplished by DPT. The other components of the in situ alternative would be as described in Alternative SG3. The continued operation of the GET system would be adjusted so that only the peripheral extraction wells would pump at adjusted pumping rates so as not to extract injected materials into the system from the area being treated via injection of amendments.

For purposes of this FS, it is assumed that groundwater monitoring would be conducted at the site quarterly for the first year after injection and semiannually for 1 year. The overall remediation time period for Alternative SG4 is estimated to be 10 years after the initial injection based on groundwater modeling.

ALTERNATIVES FOR OU2 CONTAMINATED GROUNDWATER

Alternative G1: No Action

Alternative G1 is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared. The only actions that would be implemented for Alternative G1 are completion of Five Year Reviews as required by the NCP and periodic groundwater monitoring in support of Five Year Reviews. There would be no change in the groundwater contaminant concentrations because no treatment, containment, or removal of contaminated groundwater is included in this alternative.

Alternative G2: Groundwater Recovery, Treatment and Discharge at Leading Edge of Plume

Recovery wells would be installed at the leading edge of the OU2 groundwater plume and would focus on containing the groundwater plume from further migration in the medial and lower aquifers beyond Technical Boulevard. Groundwater would be pumped to a newly constructed treatment system, located along Blaine Avenue. The number of recovery wells, the approximate locations, and groundwater extraction rates has been estimated by a site-wide groundwater model. There is no groundwater contamination in the upper aquifer at the leading edge of the plume, therefore no recovery wells would be needed in this zone. It is currently estimated that three medial-level and three deep-level recovery wells pumping at a combined rate of approximately 825 gpm would be needed to intercept the contaminant plume. Recovery wells and piping would be installed and piped to the treatment system. The treatment system would be constructed in a similar manner to the GET system for OU1. Bag filters and an air stripper (sized according to the expected flow) would provide treatment prior to reinjection into the aquifer. Operation of the treatment system would prevent further migration of contaminated groundwater and restore the aquifer to levels at or below the PCLs for the site.

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Institutional controls (ICs) (legal and administrative controls) would provide protection of human health through the restriction of access to VOC-contaminated groundwater. The proposed IC area is illustrated on Figure 7.4.

Figure 7.5 shows the preliminary locations of recovery wells and the location of pipelines and the treatment system. Final locations would be based on the availability of right-of-way and easement agreements with property owners. If right-of-way is not available or easements cannot be obtained, the locations of recovery wells may not be in an optimum location for effective groundwater interception. The number of recovery wells necessary may need to be increased to compensate for locations that are not optimum.

For purposes of this FS, it is assumed that groundwater monitoring would be conducted at the site quarterly for the first year, semiannually for 4 years, and annually for 95 years. The overall remediation time period for Alternative G2 is estimated to be more than 100 years.

Alternative G3: Groundwater Recovery, Treatment and Discharge at Mid-plume and Leading Edge of Plume

Alternative G3 would have the same elements as Alternative G2, with the addition of recovery wells focused in the mid-plume area. Mid-plume recovery wells would target areas of the plume with carbon tetrachloride concentrations greater than 100 μg/L in the medial aquifer (C zone), generally around South Elm Avenue. The lower aquifer (D/E zone) mid-plume recovery wells would target the plume transect along Showboat Boulevard, where concentrations are found as high as 45 μg/L. The presence of recovery wells in the mid-plume area should reduce the timeframe of aquifer restoration. The number of recovery wells, the approximate locations, and groundwater extraction rates has been estimated by a sitewide groundwater model. There is no groundwater contamination in the upper aquifer at the leading edge of the plume, therefore no recovery wells would be needed in this zone. It is currently estimated that six medial-level and six deep-level recovery wells pumping at a combined rate of approximately 1,650 gpm would be needed to intercept the contaminant plume. Recovery wells and piping would be installed and piped to the treatment system. The treatment system would be constructed in a similar manner to the GET system for OU1. Bag filters and an air stripper (sized according to the expected flow) would provide treatment prior to reinjection into the aquifer. Operation of the treatment system would prevent further migration of contaminated groundwater and restore the aquifer to levels at or below the PCLs for the site. ICs would provide protection of human health through the restriction of access to VOC-contaminated groundwater. The proposed IC area is illustrated on Figure 7.4.

Figure 7.6 shows the preliminary locations of recovery wells and the location of pipelines and the treatment system. Final locations would be based on the availability of right-of-way and easement agreements with property owners. If right-of-way is not available or easements cannot be obtained, the locations of recovery wells may not be in an optimum location for effective groundwater interception. The number of recovery wells necessary may need to be increased to compensate for locations that are not optimum.

For purposes of this FS, it is assumed that groundwater monitoring would be conducted at the site quarterly for the first year; semiannually for 4 years, and annually for 70 years. The overall remediation time period for Alternative G3 is estimated to be 75 years.

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Alternative G4: In Situ Treatment at Core of Plume and Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume

Alternative G4 combines Alternative G2 with in situ treatment through groundwater amendments in the core of the contaminant plume. Operation of the treatment system would prevent further migration of contaminated groundwater and restore the aquifer to levels at or below the PCLs for the site. In situ treatment would further reduce concentrations, reducing the time table for aquifer restoration and operation of the treatment system. In situ treatment options are described in Section 5. ICs would provide protection of human health through the restriction of access to VOC-contaminated groundwater. The proposed IC area is illustrated on Figure 7.4.

The number of recovery wells, their approximate locations, and groundwater extraction rates has been estimated by a site-wide groundwater model. There is no groundwater contamination in the upper aquifer at the leading edge of the plume, therefore no recovery wells would be needed in this zone. It is currently estimated that three medial-level and three deep-level recovery wells pumping at a combined rate of approximately 825 gpm would be needed to intercept the contaminant plume.

For costing purposes, it is assumed that injection wells would be installed in one line perpendicular to the flow of groundwater. The injection wells would be located to treat groundwater with the highest concentrations of contaminants. It is likely that multiple injections would need to be conducted to achieve cleanup goals. For purposes of this FS, it is assumed that injections would be conducted annually for five years.

Figure 7.6 shows the preliminary locations of recovery wells, pipelines, treatment system, and injection wells to address groundwater contamination in the core of the contaminant plume.

For purposes of this FS, it is assumed that groundwater monitoring would be conducted at the site quarterly for the first year; semiannually for 4 years, and annually for 70 years. The overall remediation time period for Alternative G4 is estimated to be 75 years.

Analysis of Remedial Alternatives

A detailed evaluation of the remedial alternatives was performed using seven of the nine EPA evaluation criteria and is summarized in Table ES.2 for OU1 contaminated soil and groundwater and in Table ES.3 for OU2 contaminated groundwater.

- Protection of Human Health and the Environment
- Compliance with ARARs
- Long-Term Effectiveness and Performance
- Reduction of Toxicity, Mobility, or Volume
- Short-Term Effectiveness
- Implementability Cost

State and community acceptance criteria cannot be adequately addressed until after the FS Report is released for regulatory and public review. These criteria will be assessed in the Record of Decision responsiveness summary.

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Table ES.2
Summary of OU1 Comparative Analysis of Alternatives
Garvey Elevator Site
Hastings, NE

Remedial Alternative	Description	Threshold Criteria		Balancing Criteria				
		Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Present Value Cost (Dollars)
OU1 Contaminated Soil								
S1	No Action	—	—	⓿	⓿	⓿	⓿	$298,000
S2	Excavation, Treatment and Disposal of Contaminated soil and Operation of Existing SVE System	+	+	❸	❸	❸	❸	$929,000
S3	Expand SVE System	+	+	❹	❹	❸	❹	$1,168,000
S4	Excavation, Treatment and Disposal of Contaminated soil and Expand SVE System	+	+	❺	❹	❸	❸	$883,000
OU1 Contaminated Groundwater								
SG1	No Action	—	—	⓿	⓿	⓿	⓿	$1,061,000
SG2	Maintain and Operate Existing GET System	+	+	❺	❹	❹	❺	$6,340,000
SG3	In Situ Treatment via Groundwater Amendments	+	+	❹	❸	❸	❸	$12,346,000
SG4	In Situ Treatment via Groundwater Amendments and Operation of Existing GET System	+	+	❺	❹	❸	❸	▪ $10,143,000

Notes:

1. The numerical designations for the qualitative ratings system used in this table are not used to quantitatively assess remedial alternatives (for instance, individual rankings for an alternative are not additive).
2. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.

Legend for Qualitative Ratings System:

Threshold Criteria

— **Unacceptable**

\+ **Acceptable**

Balancing Criteria (Excluding Cost)

⓿ **None** **The "No Action" alternatives do not meet threshold criteria, but are carried through to provide a baseline.**

❶ **Low**

❷ **Low to Moderate**

❸ **Moderate**

❹ **Moderate to High**

❺ **High**

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Table ES.3
Summary of OU2 Comparative Analysis of Alternatives
Garvey Elevator Site
Hastings, NE

Remedial Alternative	Description	Threshold Criteria		Balancing Criteria				
		Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Present Value Cost (Dollars)
OU2 Contaminated Groundwater								
G1	No Action	—	—	❶	❶	❶	❶	$852,000
G2	Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume	+	+	❹	❹	❸	❹	$11,485,000
G3	Groundwater Recovery, Treatment, and Discharge at Mid-plume and Leading Edge of Plume	+	+	❹	❹	❹	❸	$15,550,000
G4	In Situ Treatment at Core of Plume and Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume	+	+	❹	❹	❸	❷	$36,651,000

Notes:

1. The numerical designations for the qualitative ratings system used in this table are not used to quantitatively assess remedial alternatives (for instance, individual rankings for an alternative are not additive).
2. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.

Legend for Qualitative Ratings System:

Threshold Criteria

— **Unacceptable**

\+ **Acceptable**

Balancing Criteria (Excluding Cost)

❶ **None** The "No Action" alternatives do not meet threshold criteria, but are carried through to provide a baseline.

❷ **Low**

❸ **Low to Moderate**

❹ **Moderate**

❺ **Moderate to High**

❻ **High**

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1.0 INTRODUCTION AND PURPOSE

HydroGeoLogic, Inc. (HGL) is conducting a Feasibility Study (FS) at the Garvey Elevator Superfund Site, in Hastings, Nebraska (Site). This work is being executed under U.S. Environmental Protection Agency (EPA) Region 7 Architect and Engineering Services (AES) Contract EP-S7-05-05, Task Order 0033. CDM Federal Programs Corporation (CDM Smith) is a team subcontractor to HGL on the AES contract and provided key support in preparing this document.

The work performed during the FS was in accordance with guidance developed by EPA for conducting an FS under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (EPA, 1988). In addition, the cost estimates for each alternative were developed in accordance with *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA, 2000a).

EPA has divided the site into two operable units (OUs). Operable Unit 1 (OU1), is defined as the contaminated soils and groundwater at the 22-acre property formerly owned and operated by Garvey Elevators, Inc. The known contaminants of concern (COCs) for OU1 by medium are:

- Indoor air: chloroform, tetrachloroethene (PCE), and trichlorothene (TCE)
- Soil and soil gas: carbon tetrachloride, chloroform, PCE, and TCE
- Groundwater: benzene, carbon tetrachloride, chloroform, and TCE

Operable Unit 2 (OU2) is the contaminated groundwater outside of OU1, in the general direction of groundwater flow. OU2 groundwater contamination extends approximately 4.3 miles to the east of OU1, for a total plume length (OU1 and OU2) of 4.7 miles. The known COCs for OU2 are carbon tetrachloride, chloroform, and 1,2-dichloroethane (1,2-DCA) in groundwater.

This report presents the results of the development, screening, and detailed evaluation of remedial alternatives to address contaminated soil and groundwater beneath the source areas at the Site. This report is organized as follows:

Section 1 discusses the purpose of the FS report, the report organization, and Site background information (Site location, Site description, operational history, and previous investigations).

Section 2 describes the characteristics of the Site, Site features and physical characteristics, a summary of the nature and extent of contamination at the Site with a focus on the three source areas, and a summary of the implementation of past and current treatment technologies.

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Section 3 describes the process for identifying preliminary remedial action objectives (RAOs) and preliminary cleanup levels (PCLs). This section also identifies potential applicable or relevant and appropriate requirements (ARARs) for the Site.

Section 4 describes the options for general response actions (GRAs) and the screening and evaluation of applicable remedial technologies and process options.

Section 5 describes the remedial alternatives and the screening process followed to reduce the remedial alternatives to those considered to be most suitable for possible implementation.

Section 6 describes the criteria used to evaluate the alternatives retained during the screening process completed in Section 5.

Section 7 presents a detailed analysis of the remedial alternatives and summarizes the comparative analysis conducted to compare and contrast the remedial alternatives.

Section 8 lists the references and documents referred to in this FS.

Appendix A provides a summary of Federal and State ARARs.

Appendix B provides a summary of the PCLs.

Appendix C documents the development and initial screening of potentially applicable remedial technologies and process options.

Appendix D documents the screening of alternatives.

Appendix E provides the detailed analysis of alternatives.

Appendix F provides the detailed alternative analysis cost information. Detailed analysis cost estimates have an expected accuracy range between +50 percent and -30 percent of the actual costs.

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2.0 BACKGROUND

2.1 SITE LOCATION AND DESCRIPTION

The former Garvey Elevators, Inc. storage facility is located southwest and outside of the limits of the city of Hastings in Adams County, Nebraska (Figure 2.1). The facility is located on a 22-acre portion (Parcel ID – 010003207) of the 106-acre Site property. The grain storage facility, where fumigant was stored and used (Figure 2.2), is an active 8-million bushel capacity grain elevator currently owned and operated by Ag Products, Incorporated (AGP).

The 22-acre portion of the former Garvey Elevators, Inc. property designated as the grain storage facility consists of a concrete headhouse and elevator, flat storage building, steel storage bins, and associated buildings for facility maintenance, offices, and chemical storage (Figure 2.2). The majority of the remaining 84 acres of the former Garvey Elevators, Inc. property is used for crop production. The area surrounding the grain storage facility is rural with a sparse distribution of residential properties to the north, east, and west. The nearest residence is immediately adjacent to northeast property boundary, approximately 1,200 feet north of the grain storage facility.

The Site is located in a predominately rural area with sparse distribution of residential properties north, east, and west of the Site; the nearest is less than 1/4 mile away. One municipal well and more than 35 private drinking water wells have been impacted by the volatile organic compound (VOC)-contaminated groundwater.

2.2 SITE HISTORY

2.2.1 History of Operations

Garvey Elevators, Inc. began operation as a grain storage facility in 1959. In their responses to the Request for Information Pursuant to Section 104 of the CERCLA, Garvey Elevators, Inc. stated that they used a liquid mixture of carbon tetrachloride and carbon disulfide as a grain fumigant from 1959-1985 (Garvey, 2003). The fumigant mixture is known as 80-20 fumigant (80 percent carbon tetrachloride and 20 percent carbon disulfide.) Some formulations of the 80-20 fumigant may also have contained a minor amount of ethylene dibromide.

In 1960, Garvey Elevators, Inc., installed an approximately 3,000-gallon aboveground storage tank (AST) to the north of the silos to store the liquid fumigant. Fumigant was piped from the AST up to the grain gallery via an underground pipe that exited the subsurface and extended up the north side of the silos to the gallery. Fumigant was applied from the top of the elevator gallery (HGL, 2008). According to one background document in the project file, a buried portion of this delivery pipe was found to be leaking and was replaced sometime before 1986 when the tank was removed (ENSR, 2005). However, during the 2008 interviews conducted

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by EPA and HGL in support of the Remedial Investigation (RI), none of the five former employees of Garvey Elevators, Inc. interviewed could recall that the broken piping had been replaced. Four of the five interviewees stated that the fittings leaked, or that staining was observed beneath the tanks fittings and around the tank (HGL, 2008). Use of the liquid fumigant was discontinued in 1985.

Garvey Elevators, Inc. was first identified as a source of carbon tetrachloride contamination in 1994 during a Phase I Environmental Site Assessment (ESA) conducted as part of AGP's due diligence procedures before purchasing the Garvey Elevators, Inc. property. During the ESA, carbon tetrachloride was reported in a water supply well located on the grain storage facility at 199 micrograms per liter (μg/L) (Terracon, 1994). This concentration exceeded the EPA maximum contaminant level (MCL) of 5 μg/L. Garvey Elevators, Inc. subsequently conducted several environmental investigations in the vicinity of the grain storage facility to determine the extent of carbon tetrachloride in soils and groundwater near the elevator, evaluate remedial alternatives, and estimate costs to conduct a remedial action (RA).

From 1994 through 2007, Garvey Elevators, Inc. installed 47 groundwater monitoring wells and completed numerous soil and soil gas sample borings. In 1998, Garvey Elevators, Inc. installed a soil vapor extraction (SVE) system and a groundwater extraction and treatment (GET) system in response to the soil and groundwater contamination. The SVE system consists of eight vapor extraction wells. The GET system consists of eight groundwater extraction wells, an air stripper and two injection wells that return treated water to the aquifer. Both of these treatment systems are currently operating at the Site and are discussed in more detail in Section 2.0. Garvey Elevators, Inc. also began sampling private wells at residences and businesses, and providing alternative water supplies for wells affected by the carbon tetrachloride originating from the grain storage facility.

A focused FS (FFS) was prepared to support an early action for OU1 with the short term objective of mitigating the ongoing source to groundwater contamination and providing containment of contaminated groundwater. As a contractor to EPA, HGL was tasked with conducting the necessary data gathering and preparation of the FFS. The FFS (HGL, 2009b) and information from the Interim Data Summary Report (HGL, 2009a) were used by EPA as a basis for selecting a remedy to mitigate certain threats to human health and the environment posed by the contaminated soil and groundwater beneath the source area at the Site. EPA issued an Interim Record of Decision (ROD) for the Garvey Elevator OU1 Superfund Site on June 30, 2010. The Interim ROD for OU1 addresses a portion of the contaminated soil and the groundwater beneath the grain storage facility.

The 2010 Interim ROD concluded that a selected interim remedy would include continued operation of the existing GET system, and possibly expanding the system to improve performance. After the Interim ROD was issued, further information was needed to develop an interim remedy. A remedial design (RD) field investigation was conducted from November 2010 through May 2011 to fill data gaps (HGL, 2011c).

Three nested wells in a single borehole were installed at five locations to support the evaluation of the influence of the GET system on the upper and medial aquifers. Telemetry

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stations were installed in 15 new monitoring wells and 4 existing multilevel wells located off facility property to wirelessly transmit transducer data to the GET system programmable logic controller (PLC) for compilation. Additional programming was added to the PLC to carry out and gather data from step-drawdown, constant-rate, and full GET system pumping tests.

A GET system pump test was conducted and water levels were monitored in 36 monitoring wells throughout the Site. Separate pump testing to estimate aquifer properties was completed for RW-2 and RW-7. Step-drawdown tests were performed concurrently at both wells to determine optimal pumping rates for the constant-rate tests.

The data collected was used to estimate aquifer parameters for the upper and medial aquifers, develop a numerical groundwater flow model to evaluate GET system effectiveness to contain contaminated groundwater to the Site and identify ideal location and depth for additional recovery wells. The results of the field investigation activities were presented in the Final Remedial Design Field Investigation Report (HGL, 2011c). Based on the data collected during the RD investigation, a numerical groundwater flow model was developed using MODFLOW-2000) and calibrated to assist in establishing capture zone(s) in the vicinity of the Site. Two independent capture zone analyses were conducted: one for the upper aquifer and one for the medial aquifer. The results of the groundwater flow modeling indicated that that both models are well calibrated when compared with actual measurement data (HGL, 2011d). Once a flow-system model is calibrated, the simulated head distribution approximates the measured field values and the probable flow paths may be ascertained with particle tracking analyses. These simulations involve placing particles within the model that are subsequently moved by advective flow, resulting in a series of flow paths. Particle tracking analyses were performed on the predicted head fields for both the shallow and medial aquifers. The simulation results indicate that the capture zone(s) created by the existing extraction wells extend beyond the boundaries of the on-site OU1 contaminant plume(s). Therefore, no additional on-site OU1 extraction wells are required. A detailed description of the groundwater flow modeling is presented in the Groundwater Flow Model Results Memorandum (HGL, 2011d).

It is important to note that based on information from the RI (HGL, 2011b), contaminants may migrate from OU1 downgradient with groundwater flow because the GET system does not extend into the lower aquifer zone and contamination is present outside the radius of influence of the system. Pumping that has occurred from the eight recovery wells installed as a component of the GET system appear to have made an impact in reducing contaminant concentrations in the upper zone of the aquifer. The historical and RI analytical data indicate that when the GET system is operating consistently, reduced levels of contamination are observed in the monitoring wells just off site along the railroad tracks at the eastern edge of the Site. It also appears that the GET system aids in inhibiting downward migration of the contamination on site.

The interim RD for OU1 was completed in September 2011 to address soil and contaminated groundwater at the grain storage facility (HGL, 2011e). There were no construction components associated with the existing SVE system. The primary purpose of the Interim RD was to assess the capture zone of contaminated groundwater from OU1 and determine if the current system was preventing downgradient migration and reduce concentrations of

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contaminants in OU1 groundwater, thereby reducing the risk to human health and the environment. The interim RD included the following elements:

- Replacing existing flow meters with magnetic flow meters
- Making minor upgrades to electrical infrastructure
- Updating PLC programming for system operation

An RI for sitewide soil and groundwater contamination was completed in 2011. After the completion of the sitewide FS, EPA will prepare a Proposed Plan and will ultimately issue the final action ROD to address sitewide soil and groundwater contamination.

2.2.2 Regulatory History

The release of carbon tetrachloride was first discovered at former Garvey Elevators, Inc. property during a 1994 Phase I ESA. The chronology of subsequent regulatory actions at the Site is summarized below:

- April 1995. Garvey Elevators, Inc. applied for participation in the Nebraska Department of Environmental Quality (NDEQ) Remedial Action Plan Monitoring Act (RAPMA) Voluntary Cleanup Program (VCP). While in the VCP, Garvey Elevators, Inc. conducted further site characterization, installed the GET and SVE systems in the source area, and provided alternative drinking water sources to impacted residents.
- April 2003. NDEQ completed a preliminary assessment/site inspection (PA/SI) of the former Garvey Elevators, Inc. Site to assess whether there was a potential threat to health and the environment and identify the sources of groundwater contamination (TetraTech, 2003).
- May 2003. Garvey Elevators, Inc. indicated that they would not remediate the entire contaminated groundwater plume while participating in the VCP (EPA, 2010).
- December 9, 2003. NDEQ requested EPA assistance because Garvey Elevators, Inc. was unwilling to fully characterize the downgradient extent of the contaminant plume associated with the grain elevator property (EPA, 2008).
- September 14, 2005. The Garvey Elevator Superfund Site was placed on the National Priorities List (NPL).
- September 2005. Garvey Elevators, Inc. signed an Administrative Order on Consent (AOC) with EPA to conduct removal actions and an RI/FS (EPA, 2005). In the AOC, Garvey Elevators, Inc. agreed to conduct investigation and source area treatment activities at the Garvey Elevator Superfund Site. In a separate Agreement between EPA, AGP, and Garvey Elevators, Inc., Garvey Elevators, Inc., using a portion of the proceeds of the sale of the grain storage facility to AGP, established an escrow account to fund response actions at the Site.
- March 27, 2008. Garvey Elevators, Inc. filed a voluntary petition for liquidation pursuant to Chapter 7 of the United States Bankruptcy Code in the United States Bankruptcy Court for the Northern District of Texas, Fort Worth Division. Following this development, in April 2008, EPA directed the former Garvey Elevators, Inc. and its contractors to halt work at the Site.
- May 19, 2008. EPA initiated fund-lead removal actions to address the immediate threat to human health posed by the contaminated private wells and to implement source control measures to prevent further impacts to groundwater at the source area. These

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activities, which are ongoing, include providing alternate water supplies or municipal water hookup for impacted and potential impacted residential/business private well users. It also includes source control measures of maintaining and operating the existing SVE and GET systems.

- October 2008. EPA Fund-lead RIs began.
- February 2010. EPA made available to the public for review and comment, the Proposed Plan for the interim remedy at OU1 of the Site. EPA held a public meeting to present the Proposed Plan on February 24, 2010, in Hastings, Nebraska.
- June 30, 2010. EPA issued the Interim ROD for OU1.

2.3 PHYSICAL SETTING

2.3.1 Topography

The topography of the area is relatively flat, with a slight slope to the east-southeast. The Site is located within the Loess Plains, a portion of the Great Plains physiographic province. The Platte River valley lies 15 miles north of the Site and flows to the northeast, and the Little Blue River valley lies 10 miles to the south and flows toward the east. Figure 2.3 shows the topography of the Site and surrounding area in 5-foot intervals.

2.3.2 Surface Water Hydrology

The local drainage basin consists of gently rolling loess plains and small meandering streams that occupy wide shallow valleys. Regionally, surface water flow is toward the south-southeast to the Little Blue River. The nearest named perennial surface water feature to the Site is Pawnee Creek, which is located about 0.5 miles south-southeast of the Site. There are no storm drains on the Site; therefore, surface water drainage generally follows topography. Drainage is poor in the area north of the silos in the area of the maintenance and storage buildings and office because the Site sits on a generally flat area that likely ponds water. Drainage to the east is curtained by the railroad tracks, which diverts surface waters on the very eastern portion of the Site property between the rail spur and the railroad tracks northward toward Highway 6. The area surrounding the flat storage grain building in the middle of the property drains surface water to the south-southwest from both the east and west.

2.3.3 Geology

2.3.3.1 Regional Geology

Adams County lies adjacent to the north-south axis of the Salina Basin, which was formed by deformation of the crystalline Precambrian bedrock. The Salina Basin extends from central Nebraska into north-central Kansas, and the thickest sedimentary accumulations in Nebraska are found within the Salina Basin (Miller and Appel, 1997). The crystalline Precambrian bedrock is overlain by the Upper Cretaceous-Age Niobrara Formation, which consists of yellow and light- to dark-gray marine chalky shale and chalk. The Niobrara surface in the area slopes to the southwest at an approximate gradient of 0.01 feet per foot (ft/ft). In the north-central portion of Adams County, the Niobrara Formation is overlain by the Upper

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Cretaceous-Age Pierre Shale, which can be described as a gray to black marine shale, and chalky shale. The uppermost portions are weathered and contain gray silty clay (Woodward-Clyde, 1990).The Tertiary Ogallala Formation occurs only as buried knobs in the south and western portions of Adams County (Keech and Dreeszen, 1968).

The Adams County area is underlain by approximately 100 to 500 feet of unconsolidated Pleistocene age deposits lying unconformably on the Pierre Shale, or the Niobrara Formation where the Pierre Shale is absent. The unconsolidated deposits consist of the Peoria Loess, Loveland Loess, and other Pleistocene sand and gravel deposits. The Peoria and Loveland loess consist of silts and clayey silts that were deposited during the Wisconsin and Illinois glaciations, respectively. An interglacial soil named the Loveland Soil (known in Illinois as the Sangamon soil) separates the loess units (Condra et al., 1947). Pleistocene sands and gravels occur below the loess units and range in thickness from 130 to 200 feet. These are stream-deposited sands and gravels containing thick, regionally discontinuous layers of clay and silt. Gravel beds occur within this unit and can be as thick as 10 feet. The local groundwater table usually occurs within this unit.

2.3.3.2 Site-Specific Geology

The following description of sediments consists of lithologic information from the monitoring wells completed on and downgradient of the grain storage facility during earlier Site investigations; downgradient monitoring wells completed for the RI; electrical conductivity (EC) logs collected from borings during the RI; cone penetrometer test (CPT) logs from past investigations; and from the Revised Final RI Report for the West Highway 6 & Highway 281 Site located approximately 1/2 to 3/4 of a mile to the northeast (HGL, 2011a).

The geology underlying the grain storage facility is summarized on Figure 2.4, which presents a generalized site-specific stratigraphic column based on descriptions of the soil cores, drilling cuttings, and EC logging.

The thickness of the surficial silts and clays ranges from 33 feet to 82.75 feet. The average thickness of these sediments across the study area is 63.9 feet. The coloration observed in the surficial silts and clays is variable, ranging from black to various shades of brown and gray. Iron oxide staining is locally superimposed on the base soil color. Lenses/layers of fine sand or silty/clayey fine sand are observed within the surficial silts and clays. These sands are predominantly quartz, and poorly graded. The seven CPT borings emplaced by ENSR in 2006 were approximately 85 feet deep. The CPT logs characterize the surficial materials as interbedded silts, clays, and sands (HGL, 2011b).

Underlying the surficial materials and extending to an approximate depth of 130 feet below ground surface (bgs) are numerous sand and gravel units that range from silty fine sands to poorly graded sands to well graded sands to silty gravels to well graded gravels with sands. These sand and gravel deposits comprise the upper zone of the Pleistocene aquifer. The observed coloration of the sand and gravel layers was various shades of gray, yellow, brown, and olive brown. The sands are predominantly quartz, with subangular to rounded grains and

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varying percentages of multicolored feldspar and other dark mineral grains. The gravels are granitic in nature, and predominantly fine gravels (less than 8 millimeters).

Underlying the upper zone of sands and gravels in the vicinity of former Garvey Elevators, Inc. property is an upper fine-grained unit (aquitard) of variable composition and thickness. Over the study area the upper aquitard was encountered at depths ranging from 115 to 138.5 feet bgs, depending on the ground surface elevation. Figure 2.5 shows the elevation contours of the top surface of the upper aquitard. In general, this unit dips to the east and downgradient from the Site.

Electroconductivity logs from direct-push technology (DPT) soil borings and monitoring well lithologic logs indicate that this unit consists of silt, silty clay, clayey silt, sandy silt, silty clayey sand, and sandy clay, the thickness ranges from 0.1 feet to 4 feet depending on location. Downgradient of the grain storage facility, thicknesses ranging from 0.45 feet to 7.3 feet were observed in EC borings. As Figure 2.6 illustrates, the thickness of the upper aquitard generally appears to undulate from north to south across the Site area.

The upper aquitard was consistently observed beneath the grain storage facility in both monitoring well borings drilled to or beneath it, and in the EC borings (except SB-32) completed during the RI. However, it was not reported in multilevel well MW-31 completed along the east perimeter of the Site (ENSR/AECOM, 2007).

In the downgradient direction (east/southeast) from the grain storage facility, the upper aquitard was not present at the MW-12, MW-17, and MW-18, according to their boring logs. It was observed in 8 of the 10 EC borings along the off-Site transects, and in the drill cuttings at 5 of the 7 new RI monitoring well locations.

It should be noted that discrepancies in detection of the upper aquitard may be the result of its relatively minor thickness, and the finer resolution of the EC logging compared to logging wash cuttings from mud drilling as was done at MW-12, MW-17, and MW-18. Additionally, the composition of the aquitard in certain areas may be almost indistinguishable from the surrounding sands if the gradational zone was extensive.

The medial aquifer zone at the Site consists of fine to coarse sands, silty sands, and sand-fine gravel mixtures from the bottom of the upper aquitard at approximately 132 feet bgs to approximately 150 feet bgs on site.

Both the medial aquifer zone and the lower aquifer zone to the top of the Niobrara Formation at approximately 240 feet bgs, consist of alternating layers of poorly-graded fine sand and well-graded fine to coarse sand with gravel. At selected locations, discontinuous lenses of well-graded gravel, silty sand, clayey sand, and clay were encountered. These sand and gravel deposits comprise the lower zone of the Pleistocene aquifer.

Coloration of the fine sands is in various shades of gray and brown with occasional localized iron oxide staining. The fine sands are subangular to rounded, loose to moderately dense, and consist primarily of quartz grains with varying percentages of feldspars and other dark minerals.

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Coloration in the well graded sands is in various shades of gray, yellow, and brown with occasional localized iron oxide staining. The well graded sands are also subangular to rounded, loose, and consisted primarily of quartz with varying percentages of feldspars and other dark minerals. Gravel in the well graded sands and gravel lenses range from < 1 to 6 centimeters, is granitic in nature, with larger clasts flattened and elongated.

Separating the medial and lower aquifer zones in some areas is a lower aquitard. As with the upper aquitard, this lower aquitard has a variable composition and thickness. On Site, the lower aquitard was observed at depths ranging from 147.7 bgs at SB-32 feet to 169.5 feet bgs at test well MW-33. This existing test well is located at the northwest corner of the Site property at an elevation about 10 feet higher than the ground surface at the elevator buildings.

Figures 2.7 and 2.8 illustrate the lower aquitard surface elevation and thickness, respectively. The thickness of the lower aquitard ranged from 0.7 feet to 3 feet in thickness. In general, the thickness of the lower aquitard was less than that of the upper aquitard. According to existing well logs, it has been described as sandy clayey silt, clayey silt, silt and fine sand, and silty clayey sand with gravel.

This lower aquitard was observed in 18 of the 25 existing monitoring well locations or RI electrical conductivity (EC) boring, and 3 of 7 new RI monitoring well locations within the study area. Generally, it does appear to be laterally continuous across the study area; however it does not appear to extend northward. It was not observed in borings during the drilling and EC logging for the West Highway 6 & Highway 281 Site (HGL, 2011a).

The unconsolidated materials are underlain by the Cretaceous age Niobrara Formation. The Niobrara generally consists of interbedded, soft, light grey calcareous shale and chalk. The Niobrara was encountered at depths of approximately 240 to 250 feet bgs at the Site and consisted of a weathered yellow to pale red shale with calcium carbonate veins to a grayish brown clay.

2.3.4 Hydrogeology

2.3.4.1 Regional Hydrogeology

Based on depth to water measurements made in new and existing groundwater monitoring wells, groundwater typically occurs between 105 feet to 125 feet bgs across the Site area. The aquifer beneath the Site was divided into aquifer zones for the purposes of the RI. The zones are as follows:

- upper aquifer zone – Zones A/B
- medial aquifer zone – Zone C
- lower aquifer zone
  - upper portion – Zone D
  - lower portion – Zone E

Lithologic logging conducted during the RI and previous investigations generally confirmed that three aquifer zones exist at the Site, which are separated by intervening aquitards. Generally these aquitards do appear continuous throughout the study area. However, the

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presence of these aquitards would not greatly inhibit the downward migration of contaminants due to the variation in thickness and composition of the aquitards, vertical hydraulic gradients, and the physical nature of the Site contaminants. This is confirmed by the presence of contaminants in all three aquifer zones at the Site and in the plume downgradient of the source areas. Figures 2.5 and 2.7 illustrate the elevation contours of the top of the upper aquitard and lower aquitard, respectively. Figures 2.6 and 2.8 show the thickness of the upper aquitard and lower aquitard, respectively.

The actual depths at which the aquifer zones and intervening aquitards are encountered vary with the monitoring point elevation. In general, the upper aquifer zone is unconfined and extends from the water table at approximately 115 feet bgs to approximately 130 feet bgs on Site. The upper aquitard, which occurs at 130 feet bgs to approximately 132 feet bgs on site, forms the base of the upper aquifer zone.

The medial aquifer zone extends from approximately 132 feet bgs to about 150 feet bgs on site. This aquifer zone is semiconfined by the overlying upper aquitard and an underlying lower aquitard that is the lower fine-grained unit. The lower aquitard extends from approximately 150 feet to 152 feet bgs on site.

The lower aquifer zone also is semiconfined and extends from the base of the lower aquitard to the top of the bedrock surface which is at approximately 233 feet bgs. The weathered shale of the Niobrara Formation forms the base of the lower aquifer zone.

2.3.4.2 Site-Specific Hydrogeology

Historical assessments on the availability of groundwater have indicated that aquifer transmissivity generally ranges from less than 50,000 gallons per day per foot (gpd/ft) in the northeastern corner and southernmost portions of the county, to more than 200,000 gpd/ft in the central part of the county.

Groundwater flow in the upper, intermediate, and lower aquifer zones is in an east-southeast direction based on water level measurements in the more than 30 monitoring wells distributed across the Site. The hydraulic gradient ranges from 0.0015 to 0.0020 ft/ft. The current local groundwater flow direction, in the area outside the influence of the GET system, is generally consistent with that observed before the installation of the GET system. The vertical hydraulic gradient between the upper and intermediate aquifer varies seasonally due to aquifer stresses created by irrigation wells in the area. During the irrigation season, the vertical hydraulic gradient is consistently downward in wells at the Site, with an average magnitude of 0.019 ft/ft. During the nonirrigation period, the vertical hydraulic gradient is not in a consistent direction at the Site, but the magnitudes of the gradient are similar.

Based on four pumping tests with various configurations, pumping rates, and durations, the hydraulic conductivity in the upper aquifer has been estimated to be approximately 100 feet per day (ft/day). Hydraulic conductivity in the intermediate and lower aquifer was estimated to be approximately 270 ft/day. Based on the above aquifer properties, the hydraulic gradient, and an effective porosity of 0.30, the groundwater flow rate is estimated to be 0.5 ft/day in the upper aquifer and 1.4 ft/day in the intermediate/lower aquifer.

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2.3.5 Existing Utilities

SVE and GET system treatment equipment and pipe terminations are housed in a pre-existing corrugated metal building. A concrete pad with a secondary containment curb surrounds all the GET piping and equipment. Another concrete pad was constructed for the SVE system equipment. Electric power and potable water are available at the treatment system building. Potable water for emergency shower/eyewash station is available. A telephone line also exists.

2.4 NATURE AND EXTENT OF CONTAMINATION

RI activities were conducted to define the nature and extent of contamination, update the conceptual site model, and quantitatively estimate the risk to human health and the environment (HGL, 2011b). Based on the final RI, the following provides a summary of the nature and extent of contamination of VOC contamination in soil, soil gas, and groundwater at the site that exceed established Federal or State limits, or in the event such limits have not been promulgated, that pose human health or ecological risks above acceptable limits. These preliminary remediation goals (PRGs) were presented in the RI to screen analytical results and identify contaminants of potential concern (COPCs) for the site. These tentative PRGs from the RI were based primarily on federal and state ARARs. In instances where ARARs were not available for the specific media or contaminant, then Federal guidance and advisory documents and then Federal risk-based guidelines (EPA Regional Screening Levels [RSLs] for Chemical Contaminants at Superfund Sites [EPA, 2010]) were used to develop the tentative PRGs for the site.

As detailed in the RI, several on-site potential contaminant source areas identified from past investigations and background research were evaluated. Surface soil, subsurface soil, sediment, soil gas, indoor/outdoor air, and groundwater samples were collected during the RI from monitoring wells and DPT borings to evaluate these potential source areas. Based on the DPT groundwater data, there appear to be two areas of elevated carbon tetrachloride concentrations at the grain storage facility: the liquid fumigant AST and the northeastern corner of the grain storage facility. The presence of carbon tetrachloride in the groundwater in the northeastern corner of the grain storage facility seems to indicate a second source area; however, no source was found during the DPT soil investigation in this area. Figure 2.9 shows the source areas identified during the RI. The following subsections provide media-specific discussion of the RI findings and identification of source areas.

2.4.1 Sediments

Sediment samples were collected from natural drainageways on the grain storage facility to evaluate the potential migration of contaminants from source areas into the surface water pathway. Sediment samples were collected at ten locations; eight from potentially contaminated drainageways on the grain storage facility and two from background locations.

Figure 2.10 illustrates sample locations and VOC results for sediment samples. Only two VOCs, acetone and 2-butanone, were the detected. Acetone was detected in all 11 samples (including the duplicate sample), and 2-butanone was detected in 10 of the 11 samples. None

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of the detected concentrations exceeded their respective PRGs that were identified in the RI. Both of the VOC analytes are common laboratory contaminants. Based on the analytical results, it was concluded that their presence in the samples is not likely related to former activities at the grain storage facility.

2.4.2 Subslab Soil Gas and Indoor Air

Ten subslab soil gas samples were collected within two buildings (six from within the office/shop building and four from within the maintenance building) at the grain storage facility, at locations where vapor intrusion might be considered an indoor worker health and safety issue due to their proximity to the former location of the liquid fumigant AST. One outdoor air sample was collected outside each of the two buildings.

Figure 2.11 and Figure 2.12 illustrate sample locations and VOC results for subslab soil gas and indoor/outdoor air samples. VOCs that exceeded their respective PRGs in one or more of the 10 subslab soil gas samples include chloroform, carbon tetrachloride, tetrachloroethene (PCE), and TCE. The presence of carbon tetrachloride and its degradation compound chloroform is likely related to the liquid fumigant used by the grain storage facility. Detections of the chlorinated solvents PCE, TCE, and 1,1,1-trichloroethane (1,1,1-TCA) may be related to the small-scale use of solvents at the elevator facility for parts washing. Of these three VOCs, PCE was detected at the highest levels and exceeded its PRG at six sample locations: SG-4, SG-5, and SG-6 in the maintenance/storage area of the office/shop building; and SG-7, SG-9, and SG-10 in the maintenance building. Most analytes detected are not constituents normally related to the use of liquid fumigant and their presence is also likely the result of maintenance and shop activities. Benzene, 1,2-dichloropropane (1,2-DCP), ethylbenzene, and methylene chloride all were detected above their respective PRGs in one or more indoor air samples.

Samples from the shop area within the maintenance building had the highest levels and most detections of VOCs. Except for methylene chloride, no VOCs were detected in the office and storage building above their respective PRGs. Due to a reporting limit higher than the PRG, it was not possible to determine if the sites most prevalent contaminants (carbon tetrachloride and chloroform) were present at levels above the PRG at certain sample locations.

In general, subslab soil gas had a higher prevalence of VOC detections in comparison to indoor air. The absence of VOCs in indoor air may be the result of the influence of operation of the SVE system during collection of the indoor air samples. Additional factors that may have influenced the indoor air sample results are the daily operations at the buildings, which include open doors and windows, persons entering and exiting the buildings, and the condition of the buildings which are poorly sealed.

Previous soil gas sampling at the site revealed the presence of chloroform and carbon tetrachloride in the vadose zone across a large portion of the site with the higher concentrations being present adjacent to source areas. Based on 2007 ENSR data, vapor phase carbon tetrachloride and chloroform are present in the deep subsurface soils (greater than 50 feet bgs) at elevated concentrations. It should be noted that this data was collected in 2007

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while the SVE system was shut down. This data is presented in the Final Interim Data Summary Report (HGL, 2009a) and incorporated into the FFS (HGL, 2009b) and Interim ROD (EPA, 2010). Based on that data, it was determined that the existing SVE system would continue to operate to protect the groundwater and site-specific soil gas-to-groundwater protection levels were established as presented in Tables ES.1 and B.1. The existing SVE system has been effective in reducing levels of carbon tetrachloride and chloroform within its area of influence. However, it is possible that operation of the system has increased volatilization of other VOCs in soil such as PCE and TCE, which has contributed to their presence in subslab soil gas samples.

2.4.3 Surface Soil

Sample locations and contaminants found near the source area for surface soils are shown in Figure 2.13. VOCs were analyzed in 16 surface soil samples, collected at a depth of 0 to 1 feet bgs. Chloroform was detected in two samples near the location of the former liquid fumigant at SB-01 (13 micrograms per kilogram [μg/kg]) and SB-02 (7.5 μg/kg).

One polychlorinated biphenyl (PCB), Aroclor 1248, was detected in one surface soil sample at a concentration exceeding its PRG of 104 μg/kg. The sample was collected in a low spot between the north-south grain bins and the transformer pad on the south side of the main. The oil from the transformer located on the pad is the likely source of the Aroclor 1248. The transformer is still active.

2.4.4 Subsurface Soil

A total of 105 subsurface soil samples were collected over multiple depth intervals from 31 locations and analyzed for contaminants. Source area sample locations and contaminants found are shown in Figure 2.14. VOCs were detected in samples collected from two locations: SB-02 (one sample) and SB-03 (five samples, including one field duplicate). Four VOCs were detected: acetone, 2-butanone, carbon tetrachloride, and chloroform. Of these four analytes, only carbon tetrachloride and chloroform were detected at concentrations exceeding their respective PRGs. At SB-03, which was completed to a depth of 20 feet bgs, the carbon tetrachloride concentrations ranged from 7.7 μg/kg to 77 μg/kg. Chloroform concentrations ranged from 10 μg/kg to 18 μg/kg.

The PRG for carbon tetrachloride was 3.4 μg/kg and the PRG for chloroform was 1.06 μg/kg. The PRGs for carbon tetrachloride and chloroform are the protection of groundwater indicating that soil contamination above the PRG in the subsurface soils may be acting as a continuing source for groundwater contamination.

Based on these analytical results, it appears that soil contamination is confined to the area directly adjacent to or beneath the former liquid fumigant AST and near the buried piping between the AST and the elevator. Neither contaminant was detected below 20 feet bgs; however, only one sample location at which it was detected (SB-02) was sampled below 20 feet bgs. Subsurface soil samples collected from locations north, east, and south of the former AST did not contain carbon tetrachloride or its degradation product chloroform.

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2.4.5 Sitewide Groundwater Contamination

Groundwater was evaluated in support of the RI by using DPT borings and sampling new and existing monitoring wells. Monitoring wells were sampled as a part of the baseline sampling event (June 2010). At the source area, DPT groundwater samples were collected from 12 locations from the upper aquifer (Zone A/B) and the medial aquifer (Zone C) in December 2009. Four downgradient DPT transects were placed downgradient from the grain storage facility as follows:

- Transect 1 – Six borings along Wabash Avenue approximately 1.6 miles downgradient
- Transect 2 – Seven borings along Showboat Boulevard approximately 3 miles downgradient
- Transect 3 – Five borings along Blaine Avenue/field access road approximately 4 miles downgradient
- Transect 4 – Three borings along Technical Boulevard approximately 4.5 miles downgradient

The downgradient DPT sampling for Transects 1, 2 and 3 was conducted from August to September 2009, and the DPT sampling for Transect 4 was conducted in December 2009.

Figure 2.16 illustrates the extent of the carbon tetrachloride plume based on the source area DPT sampling, downgradient DPT transect sampling and the baseline monitoring well sampling. The concentrations of carbon tetrachloride shown are the highest concentrations observed at each location regardless of depth. DPT samples were collected from August to December 2009, and groundwater samples were collected in June 2010.

2.4.5.1 Source Area

During the RI, the only VOCs detected above their respective PRGs in the source area were TCE and carbon tetrachloride. The elevated TCE detections were limited to three samples collected from the east side of the railroad tracks north of the grain storage facility. TCE in this area appears to be limited to the upper aquifer (A/B zones). There appear to be two areas of elevated carbon tetrachloride concentrations at the grain storage facility. In the A/B zone, carbon tetrachloride was detected in monitoring wells located on and immediately downgradient of the grain storage facility and in one well located approximately 300 feet downgradient of the former AST. In Zone C, the medial zone, it was detected in a well approximately 400 feet downgradient of the former AST. In the lower aquifer zone (Zone E), carbon tetrachloride was detected above the PRG in one well located in the northern portion of the grain storage area. The presence of carbon tetrachloride in the northeastern corner of the grain storage facility seems to indicate a second source area; however, no additional source was found during the DPT soil investigation in this area. Based on samples from the municipal well that were contaminated with carbon tetrachloride, the municipal well located to the northeast of the Site appears to have pulled contaminated water toward it. In addition, the Garvey water supply well appears to have pulled carbon tetrachloride contamination toward it when it was operating. This well could have caused cross contamination in the upper and medial aquifer zones after it was shut down because the well appears to be screened across both aquifer zones.

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2.4.5.2 Carbon Tetrachloride Groundwater Plume

The sampling results from the RI and historical investigations show there is a carbon tetrachloride plume coming from the source area at the former Garvey Elevator facility as shown in Figure 2.16. This figure does not include the most recent groundwater data from September 2011. As the plume migrates downgradient in the direction of ambient groundwater flow it also migrates downward. The downward migration is due to recharge at the water table as well as extraction of groundwater in the lower zones of the aquifer by irrigation wells. The migration downward is expected to be inhibited, but not prevented, by the aquitards due to their less permeable nature.

Upper Aquifer Zone (Zone A/B)

The carbon tetrachloride plume appears to be present in the upper aquifer zone (Zone A/B) from an area along the western border of the grain storage facility extending to an area between Transects 2 and 3 (approximately 1 mile east of Showboat Blvd). Figure 2.17 shows the source area plume for the upper zone based on the more recent groundwater sampling data from September 2011. The plume appears to bifurcate along the eastern property boundary. The two lobes of the plume in the figure are present from an area along the eastern border of the grain storage facility extending to somewhere downgradient of MW-12A and MW-18A. This apparent split is likely an artifact of contouring carbon tetrachloride concentrations from monitoring wells screened at different depths within the aquifer and the limited number of monitoring wells along the mid-point of the plume. Because there were few sampling points within this zone along the mid-point of the plume between the grain storage facility boundary and Transect 2, the exact location at which the two lobes of the plume merge is unknown. In addition, it appears that the plume is no longer present in the upper aquifer zone (Zone A/B) downgradient of Transect 2, probably because the carbon tetrachloride has migrated totally to the medial aquifer zone (Zone C) beyond that point.

Medial Aquifer Zone (Zone C)

The carbon tetrachloride plume appears to bifurcate along the eastern property boundary in the medial aquifer zone (Zone C). Figure 2.18, which is based on the more recent groundwater sampling data from September 2011, shows the two lobes of the plume extending from an area along the western border of the grain storage facility to an area upgradient of Transect 1 where the plumes appear to merge. This apparent split may be an artifact of contouring carbon tetrachloride concentrations from monitoring wells screened at different depths within the aquifer and the limited number of monitoring wells along the mid-point of the plume. Because there is a lack of sampling points within this zone along the mid-point of the plume between the grain storage facility boundary and Transect 1, the exact location at which the two lobes of the plume merge is unknown. Carbon tetrachloride is not present in this zone at Transect 3 locations; therefore, it has appears to have migrated totally to the lower aquifer zone (Zone D/E) somewhere downgradient of Transect 2.

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Lower Aquifer Zone (Zone D/E)

Based on the more recent groundwater sampling data from September 2011, the carbon tetrachloride plume appears to be present in the lower aquifer zone (Zone D/E) in two distinct areas within the source area, and a third area downgradient of the grain storage facility (Figure 2.19). While no DPT samples were collected directly below the grain storage facility in this zone, elevated carbon tetrachloride concentrations were observed at MW-6E and SB-38. Carbon tetrachloride was not present in this zone in the near downgradient areas, but was present at transect locations, indicating that the plume in this zone begins somewhere upgradient of Transect 1. The plume extends to MW-44D where carbon tetrachloride was detected. The leading edge of the plume is in the vicinity of MW- 44D/E as carbon tetrachloride was not detected in the DPT locations immediately to the north and south of this monitoring well. Cross section C-C' shows the migration of the main plume from the medial aquifer zone (Zone C) to the lower aquifer zone (Zone D/E) somewhere upgradient of Transect 1. The carbon tetrachloride plume appears to migrate deeper in the lower aquifer zone further downgradient from the Site.

2.4.5.3 Municipal and Private Water Supply Wells

Municipal well #13 and numerous privately owned water supply wells have historically had detections of carbon tetrachloride exceeding the PRG of 5 μg/L. All but one of the private water well users identified in the Removal Assessment (Tetra Tech, 2009) have either discontinued use of the wells, been connected to the municipal water supply by EPA, or use the well strictly for nonpotable purposes. One identified private well (1785 S. Elm) is still in use; however, EPA has installed and maintains a whole house treatment system. The city ceased use of municipal well #13 for production in 1997. All private wells are shown in Figure 2.20.

2.5 FATE AND TRANSPORT

Based on the results of the RI and previous Site investigations, it is apparent that a contaminant plume originates from the Garvey Elevator Superfund Site as a result of reported surface and subsurface releases of liquid fumigants that occurred between 1959 and 1985. The specific date, frequency, and liquid quantity of these releases are unknown. The contaminant plume identified and delineated through the RI and past investigations is approximately 4.7 miles long, 2,100 feet wide (in the upper aquifer zone [Zone A/B]), and continues to migrate to the east-southeast following the general direction of groundwater flow (Figure 2.21). The contaminant plume is composed primarily of carbon tetrachloride and, to a lesser extent, its degradation product chloroform.

The conceptual site model (CSM) developed for the Site depicts that carbon tetrachloride and other compounds associated with the liquid fumigant were released and migrated downward through the unsaturated sediment. A portion of the contaminants would have volatilized to the vapor phase or adsorbed to soil particles. The SVE system was installed by Garvey Elevators, Inc. to treat on-Site OU1 contaminated soils within the unsaturated zone. The system was installed in 1998, operated intermittently from 1999 through March 2008, and has been

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operated continuously since November 2008. The RI results show that low to trace levels of vapor phase contaminants have accumulated beneath the concrete floor of the office/shop building and the maintenance building.

Biodegradation of the carbon tetrachloride plume is occurring based on the presence of degradation products. Other processes, including dispersion, diffusion, and sorption, are also occurring. These natural attenuation processes are not occurring at a rate sufficient to reduce the size of the ground water contaminant plume that exceeds EPA national primary drinking water standards for COCs at the Site. The GET system was installed in 1998 by Garvey Elevators, Inc. to prevent contaminated groundwater from migrating off Site. Between 1999 and 2004, the system was frequently shutdown and operated only sporadically. Since EPA's Removal Program took over operation of the GET system in 2008, serious design and construction flaws have been identified and corrected. The concentrations of carbon tetrachloride and chloroform in effluent water samples collected from the eight GET recovery wells show an overall decreasing trend between 1999 and 2009 (HGL, 2009b). The GET system influent appears to be reaching asymptotic levels, but continued operation of the system has been recommended to help reduce off Site migration of on-Site OU1 contaminated groundwater.

2.6 RISK ASSESSMENT OVERVIEW

Pursuant to federal regulations (NCP Part 300.430(d)(2)), EPA is required to "…characterize the nature of and threat posed by the hazardous substances and hazardous materials and gather data necessary to assess the extent to which the release poses a threat to human health or the environment…"

A risk assessment is an evaluation of risk to human and ecological receptors posed by the presence of chemicals at a Site if no remedial action is performed. A summary of the human health risk assessment (HHRA) and screening level ecological risk assessments (SLERA) is provided in this section. The objective of these risk assessments was to characterize the potential risks associated with exposure to Site media (HGL, 2011b).

2.7 HUMAN HEALTH RISK ASSESSMENT

A baseline HHRA was prepared as part of the RI to evaluate whether chemical concentrations detected in media at the Site pose a significant threat to human health. A baseline HHRA consists of four components:

- Hazard identification, which involves the identification of all occurrences of contaminants in all environmental media at the site;
- Exposure assessment, which uses the conceptual site model to identify exposure routes, potential human exposure pathways, and potential human receptors;
- Toxicity assessment, which consists of the identification of all pertinent toxicology properties of the contaminants; and
- Risk characterization, which identifies the potential risk to human health from potential exposure to constituents detected in the environmental media at the site.

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Maximum detected chemical concentrations in surface and subsurface soil, groundwater, sediment, and soil gas were screened using the appropriate screening values to select contaminants of potential concern (COPCs) for the HHRA hazard identification. The CSM, agency guidance, site-specific information, and professional judgment were used to identify the following potential exposure pathways: current and future industrial workers (both indoor and outdoor), current and future adolescent trespassers, current and future off-property residents, future construction worker, and future on-property residents. The HHRA was subsequently reviewed and approved by EPA.

The exposure scenarios evaluated in the HHRA, and the estimated cancer and non-cancer risks calculated for each of the exposure scenarios are summarized as follows:

- Current/Future Indoor Industrial Worker exposure to Sediment and Subslab Soil Gas via vapor intrusion: Total incremental lifetime cancer risk (ILCR) = 9E-05; Total hazard index (HI) = 0.1. Based on this evaluation, the COPCs in sediment and subslab soil gas do not present a significant risk to a current/future indoor industrial worker under the assumed exposure scenario.
- Current/Future Outdoor Industrial Worker exposure to Sediment: Total ILCR = 1E-06; Total HI = 0. Based on this evaluation, the COPCs in sediment do not present a significant risk to a current/future outdoor industrial worker under the assumed exposure scenario.
- Future Construction Worker exposure to Sediment: Total ILCR = 1E-07; Total HI = 0. Based on this evaluation, the COPC in sediment does not present a significant risk to a future construction worker under the assumed exposure conditions.
- Current/Future Trespasser exposure to Sediment: Total ILCR = 2E-07; Total HI = 0. Based on this evaluation, the COPCs in sediment do not present a significant risk to a current/future trespasser under the assumed exposure scenario.
- Current Off-Property Resident (Child, Adult, and Age-Adjusted) exposure to Groundwater: Age-Adjusted Total ILCR = 1E-03; Child Total HI = 24 (Total Liver HI = 24); Adult Total HI = 11 (Total Liver HI = 11). Based on this evaluation, the COPCs in off-property groundwater may present a significant risk to a current resident under the assumed exposure scenario.
- Future On-Property Resident (Child, Adult, and Age-Adjusted) exposure to Sediment, Subslab Soil Gas and Groundwater: Age-Adjusted Total ILCR = 2E-03; Child Total HI = 34 (Total liver HI = 31); Adult Total HI = 16 (Total liver HI = 14). Based on this evaluation, the COPCs in sediment, subslab soil gas and groundwater may present a significant risk to a future resident under the assumed exposure conditions.

The HHRA indicates that the untreated Site conditions are not protective of human health for the current/future off-property resident and future on-property resident under an unrestricted land use scenario.

It should be noted that benzo(a)pyrene and benzo(b)fluoranthene were found to contribute 2E-05 and 2.E-06 excess carcinogenic risk, respectively, for the future on-site age-adjusted resident exposed to site sediment. There was only one sediment sample where these contaminants were detected, and the exposure point concentration was based on the concentrations from this one sample. This sampling location was adjacent to the railroad tracks

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and is suspected to be associated with typical emissions from coal or diesel powered locomotives. As a result, EPA does not plan to address these contaminants in this FS, but will assess and compare these sample results with background concentrations of these contaminants during the RD/RA.

Summarizing the results of the HHRA in terms of the primary contributors to non-cancer versus cancer risk, of those exposure scenarios that presented a significant risk at the source area (OU1) the primary contributors to non-cancer risk are carbon tetrachloride and TCE in groundwater and PCE in subslab soil gas. The primary chemical contributors to cancer risk at OU1 are chloroform and PCE in the subslab soil gas, and carbon tetrachloride and chloroform in groundwater. For OU2, the primary contributors to both cancer and non-cancer risk are carbon tetrachloride, chloroform, and 1,2-dichloroethane in groundwater.

2.8 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

The screening level ecological risk assessment (SLERA) was developed to analyze the potential effects of Site contaminants on plants, soil invertebrates, mammals, and birds. Detected concentrations and, for nondetected analytes, sample quantitation limits (SQLs) were compared to benchmark values and were used to estimate daily doses via the food web. The initial, conservative screening indicated that polynuclear aromatic hydrocarbons (PAHs) and various other organic compounds required a more thorough evaluation with respect to exposure via the food web. To address the uncertainty generated through the conservatism associated with the initial screening, a refined exposure assessment was completed. This latter evaluation considered the mean normalized food ingestion and mean soil ingestion rates. Based on this refined assessment, current Site conditions do not pose a threat to ecological receptors.

2.9 LEACHING POTENTIAL OF CONTAMINANTS IN OU1 SOILS

The primary contaminants released to OU1 soils from facility operations are TCE, PCE, carbon tetrachloride and chloroform. Carbon tetrachloride was released directly to the ground surface from the former liquid fumigant AST located at the grain storage facility. When spilled on the ground, much of it would have evaporated to the air, but the remainder would have leached into the soil. It is likely that the carbon tetrachloride, when initially released into the soil, partitioned into soil-air (vapor phase), soil-matrix, and non-aqueous phase liquid (NAPL). TCE and PCE are likely associated with incidental solvent or degreaser usage during maintenance operations. These two compounds were detected in the soil gas samples collected from below the office/shop building and the maintenance building, and TCE was detected in the 124 to 128 feet bgs and the 130 to 134 feet bgs groundwater samples collected from boring SB-38. When a chlorinated solvent is released at the ground surface, it migrates both vertically and laterally in the subsurface. It typically will not migrate downward uniformly through unconsolidated media, but instead will migrate along multiple pathways. The bedding structure of the porous media often determines the specific migration pathway. Lateral spreading is greatest in horizontally bedded media and may occur in directions other than with groundwater flow. While migrating, the chlorinated VOCs will also tend to volatilize and occupy soil pore space in the vapor phase (EPA, 2003).

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Carbon tetrachloride and its degradation compounds are VOCs, specifically halogenated VOCs. These compounds are denser than water, and therefore have the potential to migrate vertically to significant depths below the water table. A release at the ground surface, as has occurred at this Site, can therefore lead to long-term contamination of both the unsaturated and saturated zones. Chlorinated solvents are volatile, indicating that they will produce vapor phase contamination in unsaturated media. In addition, they are characterized by a relatively rapid rate of migration and a relatively low degree of sorption in subsurface media. Carbon tetrachloride and chloroform released into the site soils easily move from the soils into the groundwater and soil pore spaces as vapor. The potential of these two compounds to leach from the soils into groundwater is high.

2.10 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

Based on the results of the RI, background investigation, and risk assessments (HHRA and SLERA), the COPCs for each OU and media are as follows:

- OU1 Soils – Carbon tetrachloride and chloroform
- OU1 Groundwater – Carbon tetrachloride, TCE and chloroform
- OU1 Soil Gas – Chloroform, TCE and PCE
- OU2 Groundwater – Carbon tetrachloride, chloroform, and 1,2-dichloroethane

The elevated PCE detections in the groundwater samples collected east of and cross-gradient from the grain storage facility are related to the West Highway 6 & Highway 281 Site and not attributable to the Site.

2.11 EXISTING SOURCE CONTROLS

An SVE and GET system were installed at the Site while it was under NDEQ oversight. These systems were installed in 1998, and began operation in 1999. The locations of the SVE and GET system wells are shown on Figure 2.22.

2.11.1 Groundwater Recovery

Garvey Elevators, Inc. installed the GET system in 1998, which commenced operation in 1999. The objective of the GET system was to prevent contaminated groundwater from migrating off site that return treated water to the aquifer. The system includes eight groundwater recovery wells, a packed tower air stripper, and two injection wells. Since this system came on-line in 1999, it operated only sporadically due to various system malfunctions and mechanical problems through March 2008. EPA assumed operation of the system and it has operated continuously since November 2008. As shown on Figure 2.22, except for RW-05, the recovery wells are located in a rough north-south trending line downgradient to the east of the source areas. RW-05 is located in proximity to the location of the former carbon tetrachloride AST.

2.11.1.1 Recovery Wells

Five of the recovery wells (RW-01, RW-02, RW-03, RW-04, and RW-05) are screened in the upper aquifer (A and B zones) between approximately 116 feet to 130 feet bgs. Each of these

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shallow recovery wells has 10-foot screens (EMCON, 1998). The remaining three recovery wells (RW-06, RW-07, and RW-08) are completed in the medial aquifer (C zone) from approximately 135 feet to 150 feet bgs. These deeper recovery wells have 15-foot screens. All eight wells have 0.040-inch slot, stainless steel screens (EMCON, 1998). Table 2.1 summarizes the depths of the screened intervals for each of the recovery wells.

2.11.1.2 Injection Wells

The injection wells are located west and upgradient of the contaminant source areas in the agricultural field on the western portion of the site property. Treated groundwater is discharged through two injection wells (IW-01 and IW-02) screened in the lower aquifer (D and E zones) between 175 feet to 230 feet bgs (ENSR/AECOM, 2006). The injection wells accept the full discharge from the GET system. The treatment system has a rate maximum capacity of approximately 500 gallons per minute. Table 2.1 summarizes the depths of the screened intervals for each of the recovery wells.

2.11.1.3 Submersible Pumps

Grundfos®, 460 volt (V), three-phase, submersible pumps are installed in each recovery well. Pump speeds are controlled by variable-frequency drives (VFDs) located in the control panel. Originally, the 5 wells screened in the upper aquifer had 5 horsepower (hp) pumps capable of pumping approximately 40 gallons per minute (gpm) at 245 feet of head, and the medial aquifer wells had 10 hp pumps capable of pumping approximately 100 gpm, at 260 feet of head. Due to malfunctioning equipment, all submersible pumps have been replaced with a new model. Table 2.2 presents current pump information for each recovery well.

2.11.1.4 Pressure Transmitters (Submersible)

Water levels in the recovery wells are monitored by Instrumentation Northwest, Inc. (INW), absolute pressure transmitters, Model PS9000, with 4-20 milliamp output. Transmitters in shallow wells have a range of 0 to 30 pounds per square inch absolute (psia) while transmitters in medial wells have a range of 0 to 50 psia. The two injection wells are equipped with 0 to 100 psia pressure transmitters.

2.11.1.5 Barometric Pressure Transmitter

To compensate for fluctuating barometric pressure without the use of vented tubing and desiccant chambers, an INW barometric pressure transmitter, Model BV-9000, with 4-20 milliamp output was mounted on the outside of the GET system control panel. This device provides a relative difference between pressure measured at the submersed pressure transmitters and barometric pressure, to provide an accurate pressure difference that is used to maintain proper well drawdown.

2.11.1.6 Flow Meters

Flow meters are located in the groundwater treatment room. The flow meters were placed at the influent into the treatment room ahead of the common header pipe. Existing flow meters

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are Signet Rotor or Signet paddlewheel type flow meters and Signet flow rate transmitters. Flow sensors were installed in schedule 80 polyvinyl chloride (PVC) saddles provided by Signet and mounted using Signet 8010 integral mounting kits, which allow for reading water velocities from 1.0 to 20.0 feet per second. The transmitters internally totalize and record total flow. The units can either display the current flow rate or total flow. In addition, the flow rate from each meter is transmitted to the PLC, which allows for logging and remote monitoring via the Human Machine Interface (HMI) software.

As outlined in the Interim RD, existing rotor and paddlewheel flow meters will be replaced with magnetic flow meters to provide greater accuracy in flow measurement, particularly at lower flow rates. Flow rate transmitters will be replaced to be compatible with the new magnetic flow meters.

2.11.2 Groundwater Treatment System

Groundwater treatment is accomplished by aeration in a packed column air stripper. The treated groundwater is discharged into two upgradient groundwater injection wells under a permit with the NDEQ. A Carbonair® Model OS-500 packed tower air stripper is used to remove VOCs from the groundwater. A 2.0 hp, 3-phase general purpose fan manufactured by The New York Blower Company® is used to force air through the packing located inside the air stripper. The blower moves approximately 2,000 cubic feet per minute (cfm) of air at 3 inches of water pressure (EMCON, 1999). A horizontal end suction pump is used to transfer the treated system effluent to the injection wells.

Treated groundwater is discharged through two injection wells (IW-01 and IW-02) screened in the lower aquifer (D and E zones) between 175 feet to 230 feet bgs (ENSR/AECOM, 2006). The injection wells accept the full discharge from the GET system. Table 2.1 summarizes the depths of the screened intervals for each recovery well.

2.11.3 SVE System

The SVE systems consist of eight vapor extraction wells and liquid knock-out tanks and blowers. Wells SVE-1, SVE-3, SVE-4, SVE-7, and SVE-8 are screened in the upper vadose zone (20 to 50 feet bgs), and wells SVE-9, SVE-10, and SVE-11 are screened in the lower vadose zone (60 to 110 feet bgs). Based on information obtained during a pilot test, the SVE wells have an expected radius of influence of 25 to 30 feet in the shallow vadose zone (predominantly silts and clays) and 150 to 180 feet in the deeper vadose zone (predominantly sand). Table 2.3 summarizes the depths of the screened intervals and total depth for each of the SVE wells.

The systems operate using two separate blowers, one for the set of shallow wells (SVE System 1), and one for the set of deeper wells (SVE System 2). Combined, the two blowers are capable of moving air at approximately 800 standard cubic feet per minute (scfm) at optimum vacuums. As originally operated, vapors from the eight wells were combined and passed through a catalytic oxidation unit and scrubber for treatment of the contaminated vapors. However, contaminant levels in the vapor stream have subsequently decreased such

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that treatment of the vapors is no longer required (in accordance with state air regulations) prior to discharge. The SVE systems are optimized to capture contamination from those wells which have consistently exhibited the highest concentrations of carbon tetrachloride. Of the shallow wells, only SVE-7 and SVE-8 are currently operating; SVE-1, SVE-3, and SVE-4 were closed in February 2011. Of the deep wells, only SVE-9 and SVE-11 are currently operating; SVE-10 was closed in February 2011.

2.11.4 Programmable Logic Controller

A PLC equipped with HMI computer software controls the groundwater treatment system equipment. The HMI software provides an interface with the PLC to monitor and control the groundwater treatment system remotely.

The system equipment is controlled by an Allen-Bradley CompactLogix Control System PLC, located in the control panel. The PLC uses Rockwell RSLinx OEM software to control a variety of system functions on the basis of equipment inputs, and to transfer system data to the HMI software. A proportional, integral, and derivative co-processor is included for groundwater elevation and air stripper sump setpoint control. This system and software were installed in August 2010 by the Superfund Technical Assessment & Response Team (START) contractor, TetraTech EM, Inc. (TetraTech), to update the existing PLC system.

2.11.5 Repairs and Modifications

The SVE and GET systems were installed in 1998 by Garvey Elevators, Inc., to prevent contaminated groundwater from migrating off Site. The consistency of system operation between 1999 and 2004 is unknown; however, between 2004 and 2008 operation was sporadic due to various system malfunctions and mechanical problems. Beginning in 2008, EPA START contractor TetraTech took over operation of the GET/SVE system and made numerous repairs and modifications. Major repairs and modifications were completed by START from August 2008 through May 2011 and are summarized below.

2008 - An initial assessment of the GET/SVE system revealed several malfunctioning or non-functioning components. New pumps were installed at three wells (RW-1, RW-3, and RW-4) due to inoperable pump motors. Four wells were redeveloped after it was determined that at least half of the screened interval was plugged. RW-5 was found to be partially collapsed and determined irreparable.

Minor repairs, such as rewiring the air stripper blower, installing new O-rings and filters in the particulate filter canisters, repairing cracks and leaks, and minor electrical repairs were made. A high-level alarm system was installed in the air stripper, along with emergency shut-off for the groundwater treatment system. An equipment room build out for the groundwater treatment room and the control panel room was constructed to prevent equipment from freezing during winter months and to protect electronic equipment from dust and extreme temperatures.

In the SVE System 2, the existing blower motor and a breaker in the control panel were replaced.

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2009 - Reported failures in RW-1 led to replacing existing wiring between RW-1 and RW-6 vaults. RW-6 and RW-7 exhibited reduced performance in 2009, prompting well screens being cleaned with acid wash and redeveloped. Routine maintenance to fix leaks and cracks in system pipes also occurred.

The low-level float switch in the SVE System 2 knockout tank was causing the transfer pump from the tank to run continuously; the malfunctioning float switch was replaced. Due to a rebuilding error in the past, the blower in SVE System 2 failed and was replaced with a 15 hp motor. The belt on the air stripper blower was replaced.

New VFDs were installed for the recovery wells and upgrades were made to the PLC and associated operational software. A larger cooling unit to provide better climate control in the equipment control room was installed to accommodate the new VFDs installed, which appeared to create more heat than the old VFDs. Transducers in RW-1 and RW-4, and flow sensors in RW-1 and RW-8 were replaced (TetraTech, 2011).

2.12 OTHER CONTAMINANT PLUMES IN THE HASTINGS AREA AND EXISTING INSTITUTIONAL CONTROLS

Groundwater is the source of municipal water in the city of Hastings and surrounding community. In addition to home and business use, groundwater is used for crop irrigation and livestock watering. The source of most groundwater used in the region encompassing the City of Hastings and surrounding communities is the unconsolidated Pleistocene aquifer that extends from the water table at approximately 115 feet bgs to bedrock at approximately 230 feet bgs.

In addition to the Garvey Elevator Superfund Site, there are two other NPL Sites within or adjacent to the City of Hastings. The Hastings Groundwater Contamination Site includes properties within the central industrial area of the City of Hastings and properties situated east of the city limits, including the former Naval Ammunition Depot (NAD). The Hastings Groundwater Contamination Site was placed on the NPL in 1986 and was split into six separate areas. Figure 2.15 shows five of the areas but does not include the former NAD and associated groundwater plumes. The other NPL Site in the vicinity is the West Highway 6 & Highway 281 Site, a former piston ring manufacturing facility that conducted chrome plating and operated vapor degreasers that was listed on the NPL in 2006.

The Hastings City Council recognized that “certain contaminants” existed in the groundwater underlying the City of Hastings, and that legislation was necessary and appropriate for the purpose of reducing or eliminating the possibility that humans would come into contact with the contaminants. Therefore, the Hastings City Council passed and approved Ordinance No. 3754 on November 13, 2000, to amend Chapter 32 Article VI, and Chapter 38, of the Hastings City Code, and established the Hastings Institutional Control Area (HICA). The effective date of the ordinance was January 1, 2001. This ordinance is a component of the selected remedy for the Area-Wide OU19 of the Hastings Groundwater Contamination Site (EPA, 2001).

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The ordinance established the policies and procedures for the registration of all new and existing water wells, and the requirements for permitting new domestic water wells within the HICA. The ordinance also established policies and procedures for submittal, review and evaluation of applications for new domestic water wells within the city's two mile extraterritorial jurisdiction. Only under certain conditions did the ordinance restrict the construction of new wells within the city's two mile extraterritorial jurisdiction. The ordinance did not place any requirements for existing domestic water wells. The geographic area of the HICA is shown on Figure 2.15. This figure also displays the property boundary of the Garvey Elevator grain storage facility. The Garvey Elevator grain storage facility and associated groundwater plume are located outside and to the southwest of the HICA.

Under the terms of the HICA, existing water wells located within the HICA, where groundwater contamination was known to exist, were allowed to remain in place provided that reasonable safeguards were implemented to prevent human contact with contaminated groundwater. Agricultural irrigation wells and wells for noncontact business use are permissible under the ordinance as long as adequate safeguards are in place to prevent human consumption of water from these wells. No new domestic water wells are allowed to be installed within the HICA.

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TABLE(S)

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Table 2.1 Recovery Well Screened Interval

Recovery Well	Screened Interval (feet bgs)
RW-01	115-125
RW-02	116-126
RW-03	114-124
RW-04	116-126
RW-05	117-127
RW-06	132-147
RW-07	135-150
RW-08	137-152
IW-01	175-230
IW-02	175-230

Table 2.2 Submersible Pumps Information

Recovery Well ID	Pump Type	Manufacturer	Model Number	Power (hp)	Rated Capacity (gpm)
RW-01	Submersible	Grundfos	10S07-12	0.75	5 to 12
RW-02	Submersible	Grundfos	10S07-12	0.75	5 to 12
RW-03	Submersible	Grundfos	10S07-12	0.75	5 to 12
RW-04	Submersible	Grundfos	10S07-12	0.75	5 to 12
RW-05	Submersible	Grundfos	Unknown	1.5	25
RW-06	Submersible	Grundfos	150S100-5	10	150
RW-07	Submersible	Grundfos	150S100-5	10	150
RW-08	Submersible	Grundfos	150S100-5	10	150

Table 2.3 SVE Well Total Depth and Screened Interval

Extraction Well	Screened Interval (feet bgs)
SVE-01	137-152
SVE-03	20-50
SVE-04	20-50
SVE-07	20-50
SVE-08	20-50
SVE-09	60-110
SVE-10	60-110
SVE-11	60-110

Notes: RW – recovery well; bgs – below ground surface; hp – horsepower; gpm – gallons per minute; SVE – soil vapor extraction.

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FIGURE(S)

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Filename: X:/EPA009/Garvey/FS/Site_Loc_Map.mxd
Project: EP9046.02.40.06.00.00
Revised: 01/11/12 RL
Source: ESRI StreetMap USA
Nebraska DNR

HGL HydroGeoLogic, Inc

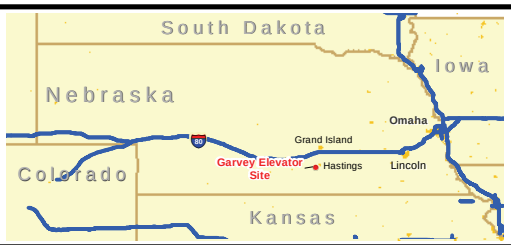

Figure 2.1
Site Location Map
Garvey Elevator
Superfund Site
Hastings, NE

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HGL—Feasibility Study,
Garvey Elevator Site—Hastings, NE

Figure 2.2
Current Site Features

Legend

- Former Garvey Elevators, Inc. Property Boundary
- Garvey Elevator Site, OU1 Boundary
- Concrete Paved Area
- Buildings
- Railroad

N

0 200 400 800

Feet

Filename: X:/EPA009/Garvey/FS/SiteMap.mxd
Project: EP9046.02.40.06.00.00
Revised: 1/11/12 RL
Source: ENSR GDB 2008, DNR

HGL HydroGeoLogic, Inc

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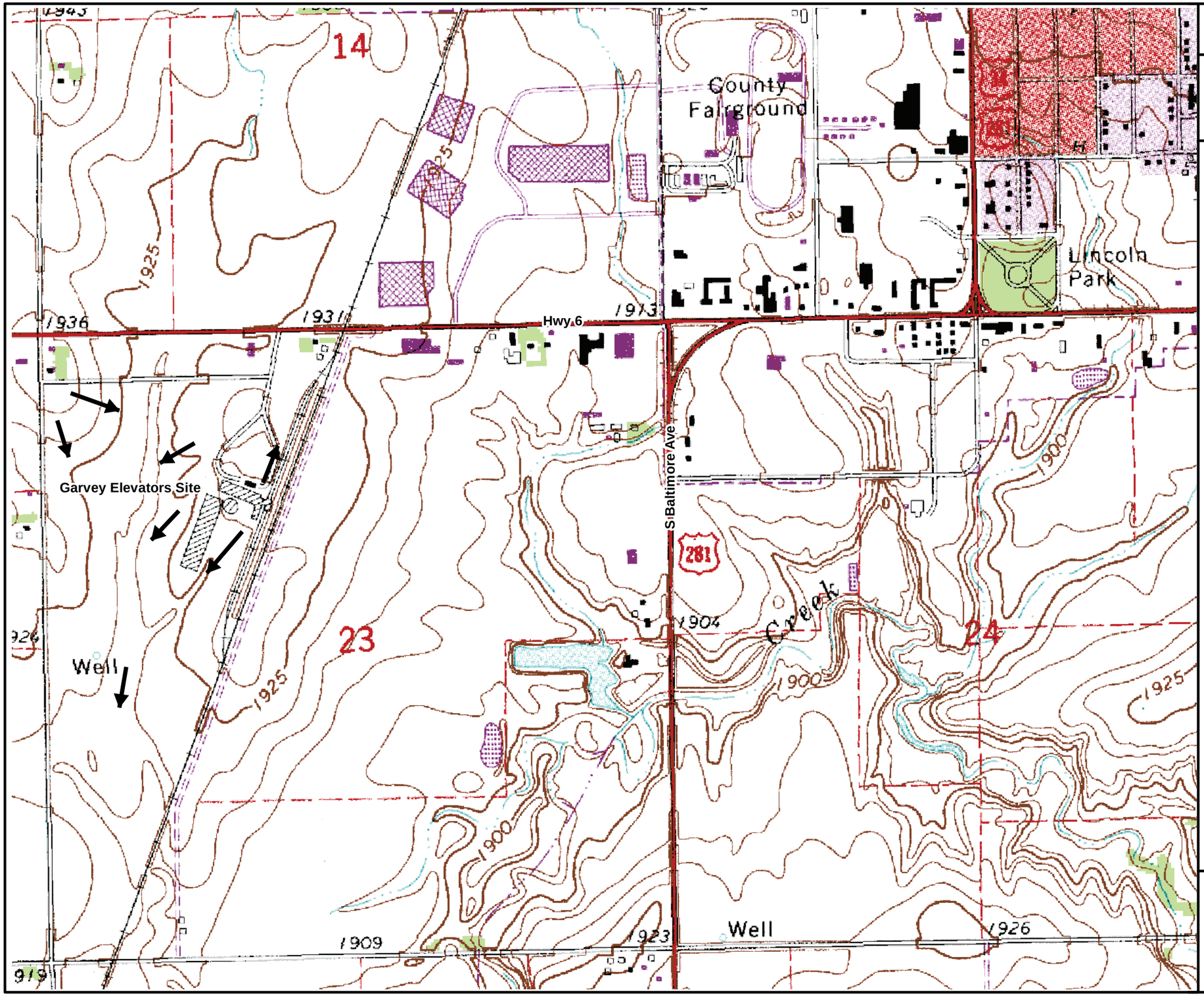


HGL—Feasibility Study,
Garvey Elevator Superfund Site—Hastings, NE

Figure 2.3
Site Topography/Hydrology

Legend

- Garvey Property Boundary
- OU1 Boundary
- Surface Water Flow

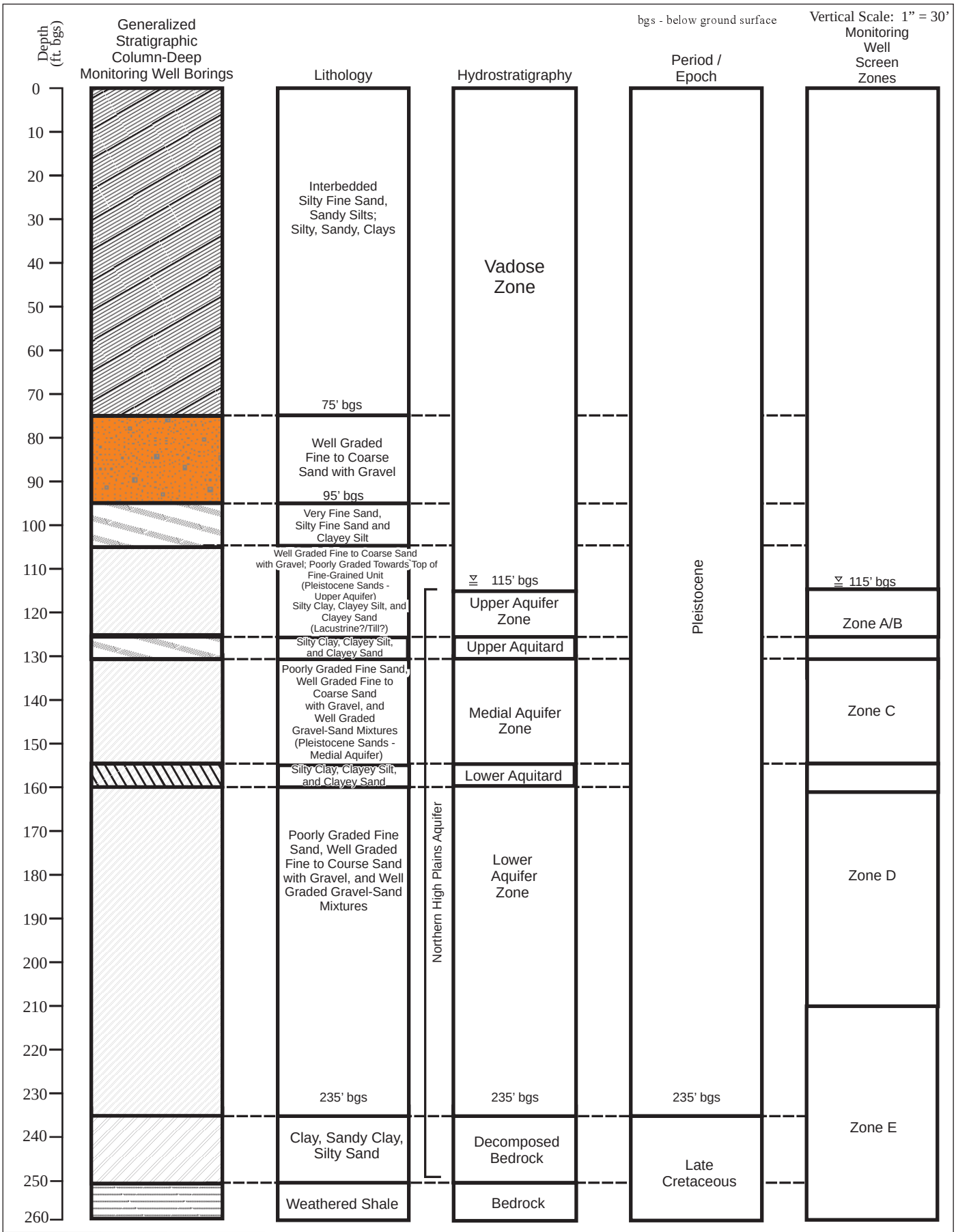
Contour interval 5 is feet

N

0 437.5 875 1,750
Feet

Filename: X:/EPA009/Garvey/FS/TopoMap.mxd
Project: EP9033.01.46.11
Revised: 01/11/12 RL
Source: USGS, 1983

HGL HydroGeoLogic, Inc



Filename: X:/EPA009/Garvey/MXDs/Superfund General_Geologic_Units.cdr
Project: EP9012.01.55.01
Revised: 01/11/12 RL
Source: HGL

HGL HydroGeoLogic, Inc

Figure 2.4
Generalized Stratigraphic Column

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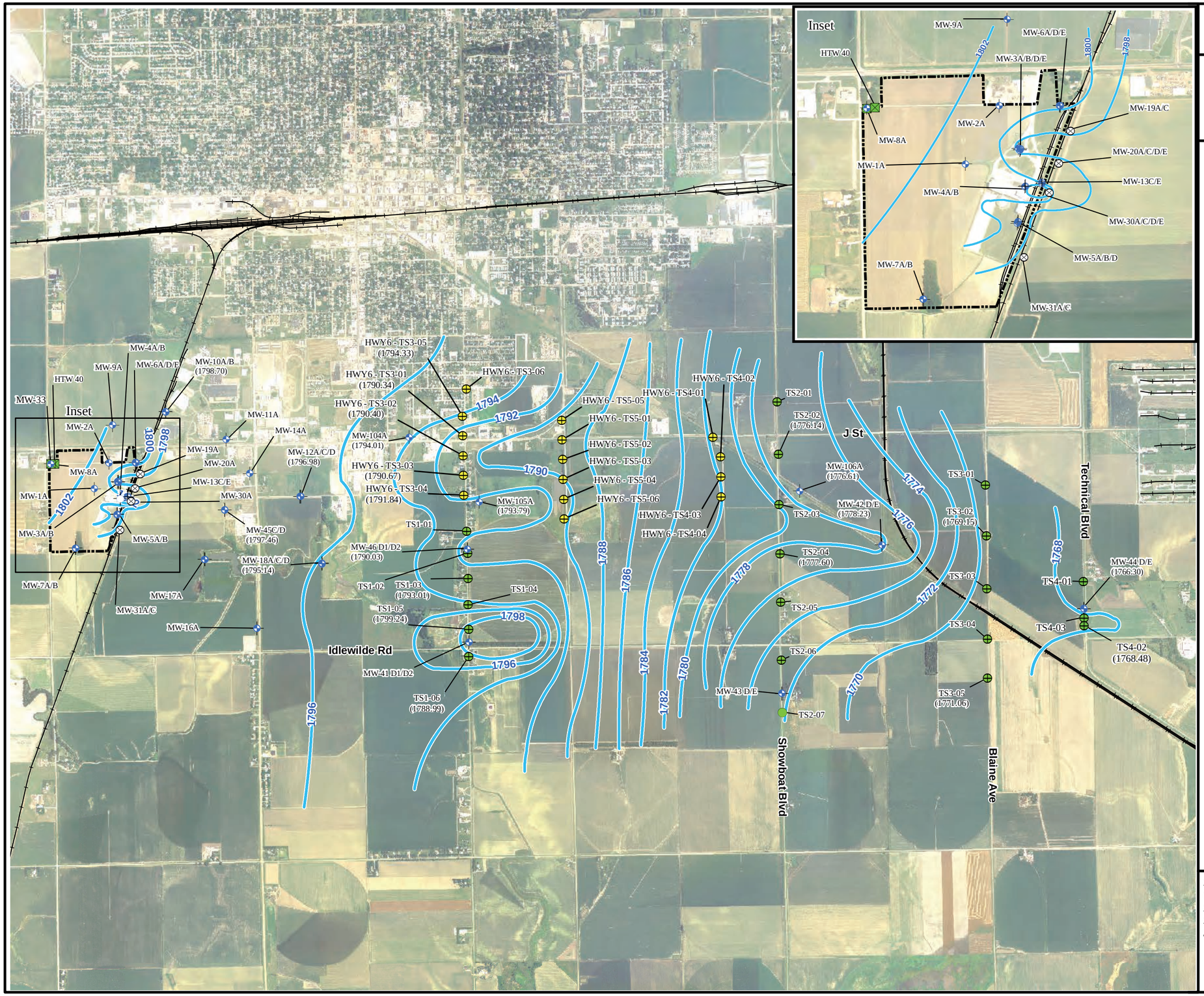

HGL—Feasibility Study,
Garvey Elevator Superfund Site—Hastings, NE

Figure 2.5
Upper Aquitard Surface Contours

Legend

- Garvey Property Boundary
- Railroad
- Monitoring Well
- Multilevel Well
- Hydraulic Conductivity Well
- Garvey Elevator Site Transect Boring
- West Highway 6 & Highway 281 Site Transect Boring
- 1778 — Upper Aquitard Surface Elevation (feet above mean sea level)

0 2,500 5,000
Feet

N

Filename: X:/EPA009/Garvey/FS/UpperAquitardContourMap.mxd
Project: EP9034.01.22.02.02
Revised: 01/11/12 RL
Source: ENSR GDB 2008, DNR

HGL HydroGeoLogic, Inc

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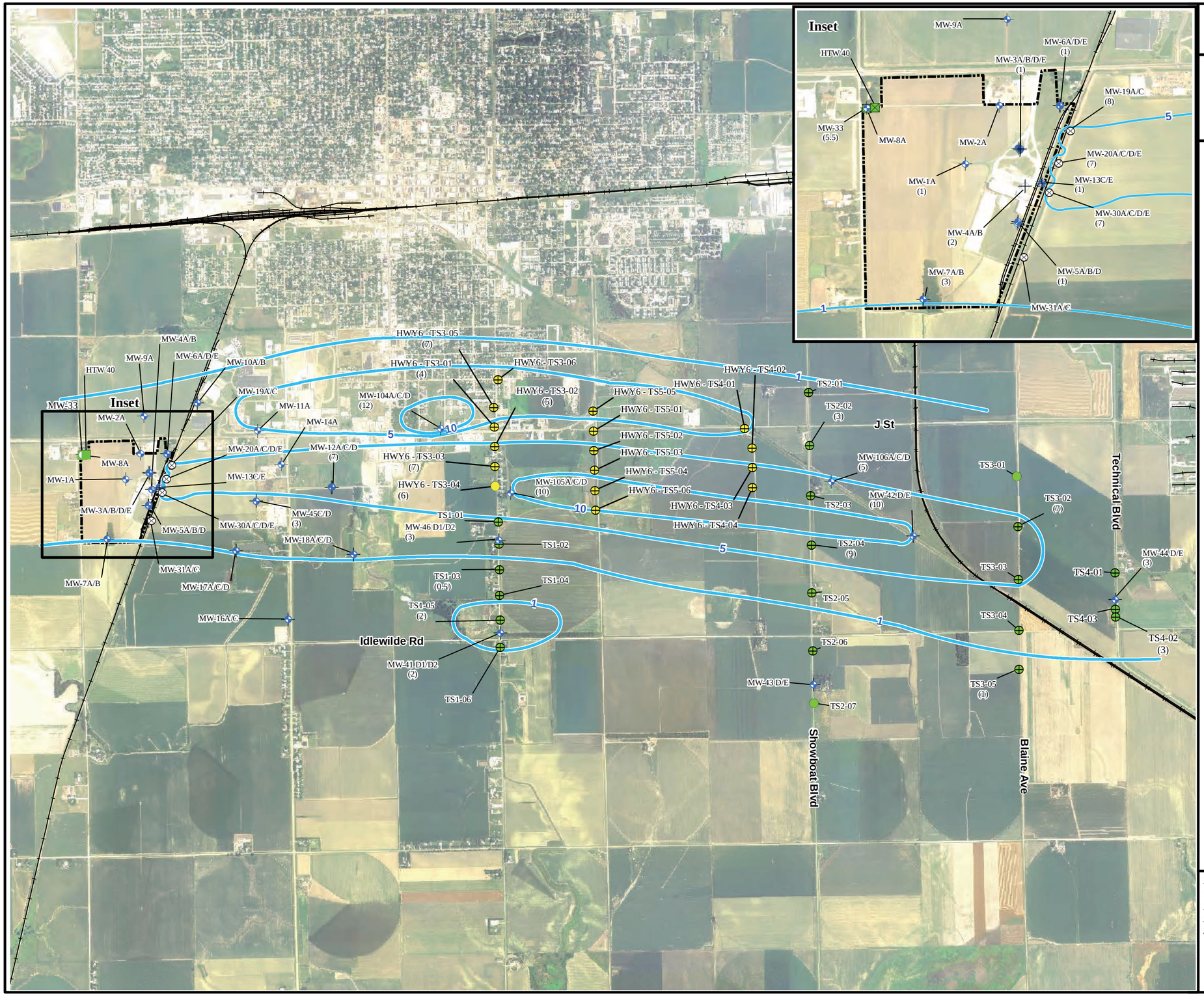

HGL—Feasibility Study,
Garvey Elevator Superfund Site—Hastings, NE

Figure 2.6
Upper Aquitard Thickness

Legend

- Garvey Property Boundary
- Railroad
- Monitoring Well
- Multilevel Well
- Hydraulic Conductivity Well
- Garvey Elevator Site Transect Boring
- West Highway 6 & Highway 281 Site Transect Boring
- 1 — Upper Aquitard Thickness (feet)

0 2,500 5,000
Feet

N

Filename: X:/EPA009/Garvey/FS/UpperAquitardThicknessMap.mxd
Project: EP9034.01.22.02.02
Revised: 01/11/12 RL
Source: ENSR GDB 2008, DNR

HGL HydroGeoLogic, Inc

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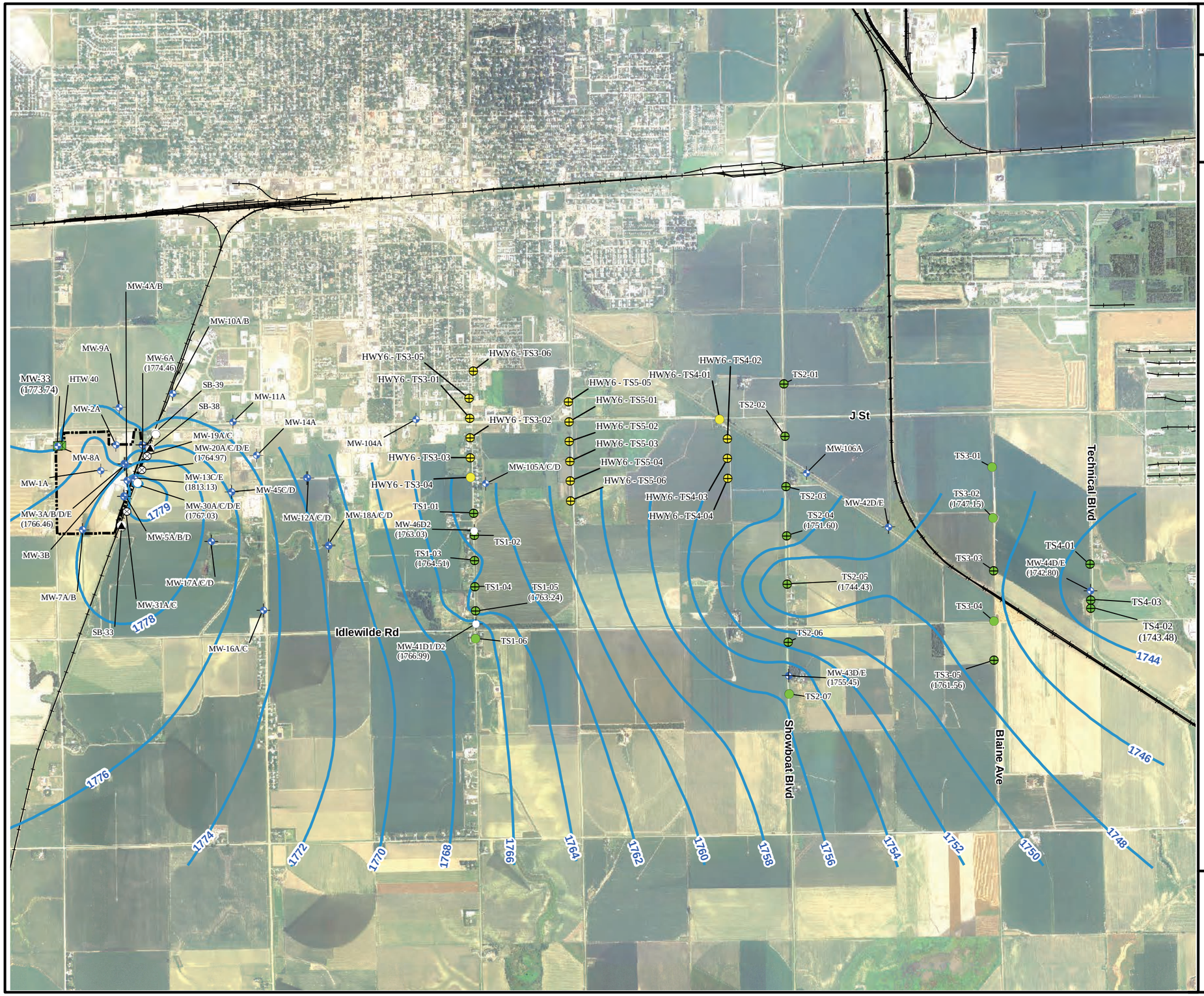


HGL—Feasibility Study,
Garvey Elevator Superfund Site—Hastings, NE

Figure 2.7
Lower Aquitard
Surface Contours

Legend

- Garvey Property Boundary
- Railroad
- Monitoring Well
- Multilevel Well
- Garvey Elevator Site Transect Boring
- West Highway 6 & Highway 281 Site Transect Boring
- Hydraulic Conductivity Well
- December 2009 DPT Groundwater Boring
- 1788 — Lower Aquitard Surface Elevation (feet above mean sea level)
- Inferred Contour

Note: Current data from West Highway 6 & Highway 281 site to the north does not indicate the presence of a lower aquitard.

0 2,500 5,000
Feet

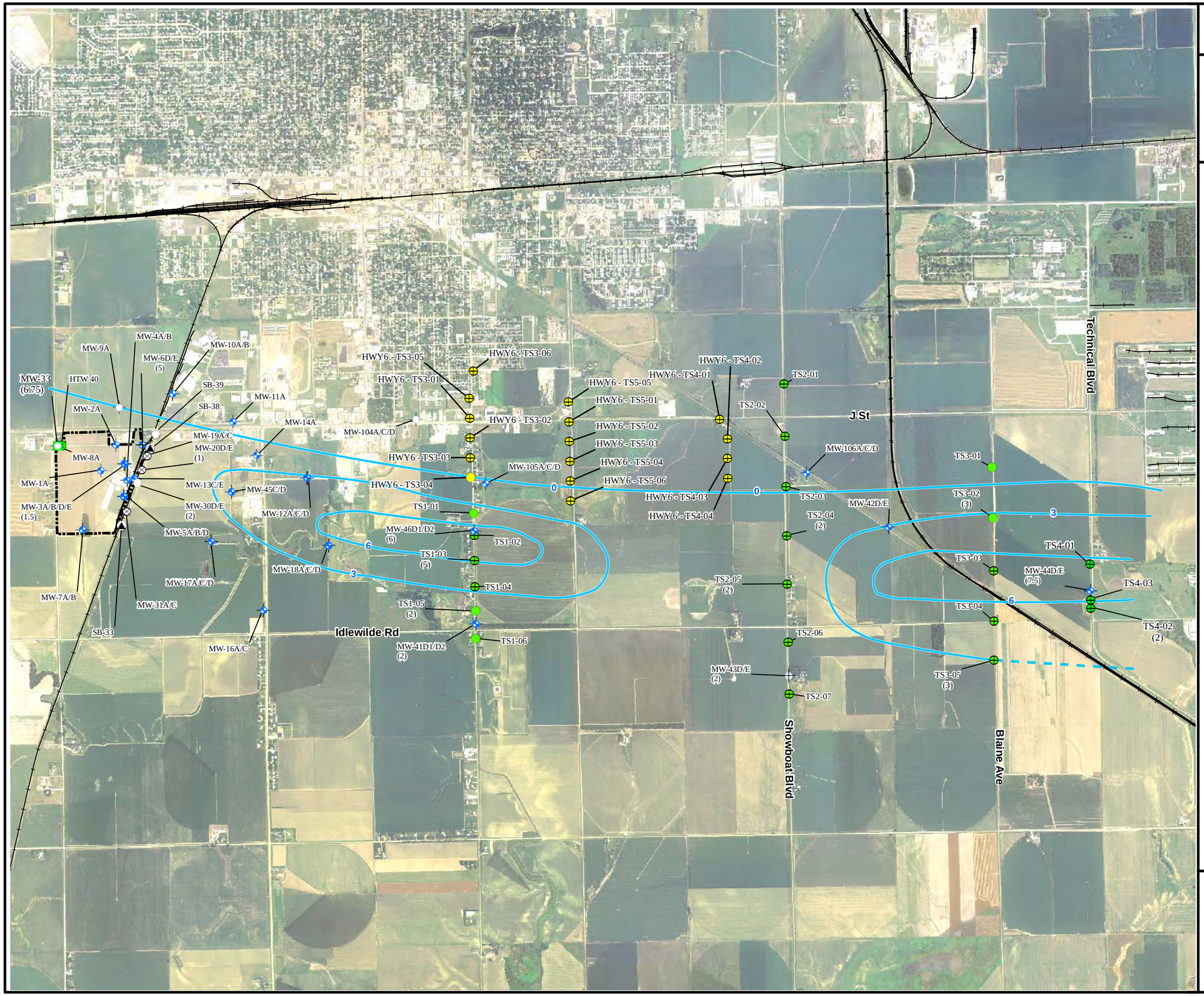
N

Filename: X:/EPA009/Garvey/MXDs/Feasibility_Study/Lower_Aquitard_Surface_Map.mxd
Project: EP9034.01.22.02.02
Revised: 01/12/12 ST
Source: ENSR GDB 2008, DNR

HGL HydroGeoLogic, Inc

US EPA ARCHIVE DOCUMENT

Figure 2.8
Lower Aquitard Thickness



Legend

- Garvey Property Boundary
- Railroad
- Monitoring Well
- Multilevel Well
- Garvey Elevator Site Transect Boring
- West Highway 6 & Highway 281 Site Transect Boring
- Hydraulic Conductivity Well
- December 2009 DPT Groundwater Boring
- 3 — Lower Aquitard Thickness (feet)
- Inferred Thickness

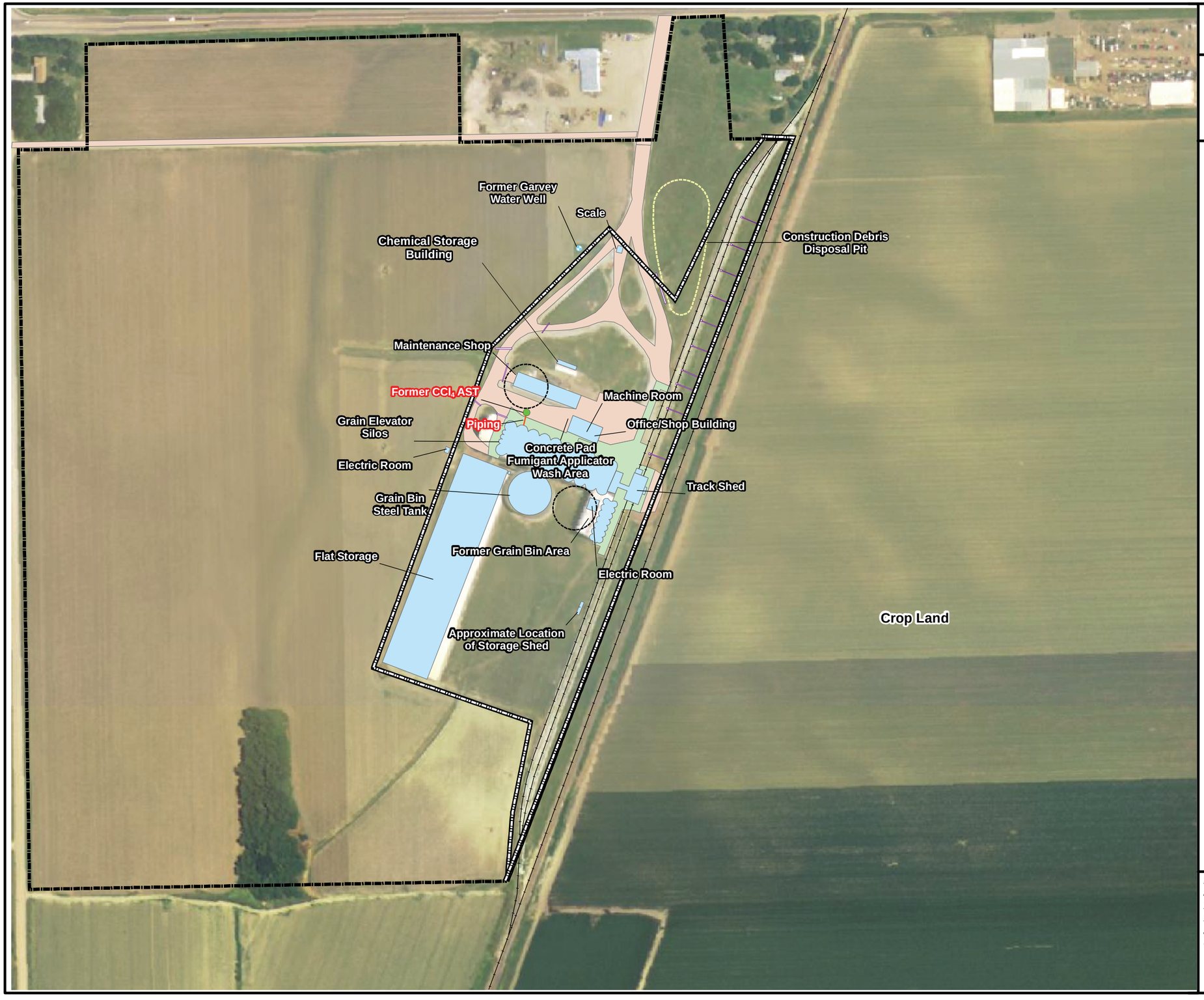
0 2,500 5,000
Feet

N

Filename: X:/EPA009/Garvey/MXDs/Feasibility_Study Lower_Aquitard_Surface_Map.mxd
Project: EP9034.01.22.02.02
Revised: 01/12/12 ST
Source: ENSR GDB 2008, DNR

HGL HydroGeoLogic, Inc

US EPA ARCHIVE DOCUMENT



HGL—Feasibility Study,
Garvey Elevator Superfund Site—Hastings, NE

Figure 2.9
Known and Potential Source Areas

Legend

- Garvey Property Boundary
- OU1 Boundary
- Culverts
- Buildings
- Former Steel Grain Bin
- Concrete Paved Area
- Gravel Road
- Railroad
- Former Garvey Water Well

Source Areas

- CCl_4 AST = Carbon Tetrachloride Above Ground Storage Tank
- Buried Piping

N

0 150 300

Feet

Filename: X:/EPA009/Garvey/FS/SourceArea.mxd
Project: EP9033.01.46.11
Revised: 05/23/12 RL
Source: ENSR GDB 2008; DNR; Garvey, 2003

HGL HydroGeoLogic, Inc

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HGL—Feasibility Study,
Garvey Elevator Superfund Site—Hastings, NE

Figure 2.10
Contaminants in Drainageway Sediments

Legend

- Garvey Property Boundary
- OU1 Boundary
- Culvert
- Building
- Former Steel Grain Bin
- Concrete Paved Area
- Gravel Road
- Railroad
- Drainageway
- Sediment Sample Location

Notes:
µg/kg - micrograms per kilogram

Shaded results indicate that the results exceed the Preliminary Remediation Goal (PRG).

SVOC = Semivolatile Organic Compound

All samples and the analytes they were sampled for are listed on Table 2.2.

0 125 250 500
Feet

N

Filename: X:/EPA009/Garvey/FS/
Pesticides_Drainageway_Sediments.mxd
Project: EP9033.01.46.11
Revised: 01/11/12 RL
Source: ENSR GDB 2008, DNR

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IA-6
SG-6
Overhead Door
Oil Barrel Racks
Locking Cage

IA-6	
Analyte	µg/m³
Methylene Chloride	4.4
Toluene	2

SG-5

SG-5	
Analyte	µg/m³
1,1,1-Trichloroethane	3.7
Methylene Chloride	2.5
Tetrachloroethene	420

Maintenance/Storage Room (Concrete Floor)

SG-6	
Analyte	µg/m³
Methylene Chloride	3.0
Tetrachloroethene	22.8

IA-5

IA-5	
Analyte	µg/m³
2-Hexanone	8.1 J
Methylene Chloride	3.8
m,p-Xylene	2.3

SG-4	
Analyte	µg/m³
1,1,1-Trichloroethane	74.6
Methylene Chloride	3.6
Tetrachloroethene	36.6

IA-4

IA-4	
Hexane	3.7
Methylene Chloride	26
Toluene	20.6

IA-3

IA-3 and Field Duplicate		
Analyte	µg/m³	
m,p-Xylene	4	3.5
Methylene Chloride	1.7 U	3.4
Toluene	3.7	3.4

SG-3
Bathroom
Vending Machines
Bathroom

SG-3	
Analyte	µg/m³
Ethylbenzene	4.2
m,p-Xylene	5.6
Methylene Chloride	7.5

IA-2	
Analyte	µg/m³
m,p-Xylene	3.5
Methylene Chloride	5.4
Toluene	3.5

IA-2
Office (Concrete Floor)

SG-2	
Analyte	µg/m³
Hexane	2.9
Methylene Chloride	17.4

IA-1	
Analyte	µg/m³
Hexane	2.5
m,p-Xylene	4.9
Methylene Chloride	13.7
Toluene	6.1

SG-2
Lockers
AGP Manager Office
HGL Field Office
IA-1
Break Area
SG-1

SG-1	
Analyte	µg/m³
Methylene Chloride	2.6

OA-1	
Analyte	µg/m³
Methylene chloride	15.8

OA-1
Not to Scale

Notes:
µg/m³ - micrograms per cubic meter
Shaded results indicate that results exceed the PreliminaryRemediation Goal (PRG).
Soil Gas - PRGs are taken from the subsurface vapor. Intrusion Guidance, November 2002.
Indoor Air PRGs are taken from the EPA Regional Screening Levels, Industrial Air, May 2010.

Filename: X:\EPA009\Garvey\FS\VOCs_SubSlab_SoilGas_IndoorAir_Samples.cdr
Project: EP9033.01.46.11
Revised: 01/11/12 RL
Source: HGL Database

HGL HydroGeoLogic, Inc.

Legend

- Subslab Soil Gas Sample Location
- Indoor Air Sample Location
- Background Air Sample Location

Figure 2.11
VOCs in Subslab Soil Gas and Indoor/Outdoor Air Sample Locations
Office / Shop Building

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OA-2

overhead door

(Dirt Floor)

OA-2	
Analyte	**µg/m³**
Methylene chloride	3

SG-9	
Analyte	**µg/m³**
Benzene	2.2
Carbon tetrachloride	3.7
Chloroform	93.3
Hexane	2.3
Methylene chloride	3.6
Tetrachloroethene	123
Toluene	1.9

IA-9	
Analyte	**µg/m³**
1,2,4-Trimethylbenzene	5.2
1,2-Dichloropropane	2.4
Benzene	7.4
Ethylbenzene	4.7
Heptane	2.7
Hexane	7.9
m,p-Xylene	14.5
Methylene chloride	43.3
o-Xylene	4.9
Toluene	23.8
Trichloroethene	3.8

Treatment Systems

IA-10	
Analyte	**µg/m³**
1,2,4-Trimethylbenzene	4.7
Benzene	7.5
Ethylbenzene	4.5
Heptane	2.2
Hexane	7.8
m,p-Xylene	13.8
Methylene chloride	35.5
o-Xylene	4.7
Toluene	24.5
Trichloroethene	3.7

IA-9

SG-9

IA-10

SG-10

Maintenance Shop

(Concrete Floor)

IA-8	
Analyte	**µg/m³**
1,2,4-Trimethylbenzene	5.8
Benzene	8.6
Ethylbenzene	5.3
Hexane	8.8
m,p-Xylene	16.4
Methylene chloride	34
o-Xylene	5.5
Toluene	28.1
Trichloroethene	3

SG-10	
Analyte	**µg/m³**
Chloroform	46.7
Methylene chloride	3.9
Tetrachloroethene	185

IA-7	
Analyte	**µg/m³**
1,2,4-Trimethylbenzene	4.5
Benzene	6.7
Ethylbenzene	4.2
Hexane	7.7
m,p-Xylene	13.1
Methylene chloride	32.8
o-Xylene	4.4
Toluene	23.1

SG-7	
Analyte	**µg/m³**
Carbon disulfide	3.2
Chloroform	6.3
Methylene chloride	3.1
Tetrachloroethene	1350
Trichloroethene	39.9

SG-8

IA-8

IA-7

SG-7

SG-8	
Analyte	**µg/m³**
Carbon disulfide	3.3
Methylene chloride	5.9
Naphthalene	5.4
Tetrachloroethene	6
Toluene	2.8

overhead door

Not to Scale

Notes:
µg/m³ - micrograms per cubic meter
Shaded results indicate that results exceed the PreliminaryRemediation Goal (PRG).
Soil Gas - PRGs are taken from the subsurface vapor. Intrusion Guidance, November 2002.
Indoor Air PRGs are taken from the EPA Regional Screening Levels, Industrial Air, May 2010.

Filename: X:\EPA009\Garvey\FS\ VOCs_MaintenanceShop_SubSlab_SoilGas_ IndoorAir_Samples.cdr
Project: EP9033.01.46.11
Revised: 01/11/12 RL
Source: HGL Database

HGL HydroGeoLogic, Inc.

Legend

- Subslab Soil Gas Sample Location
- Indoor Air Sample Location
- Background Air Sample Location

Figure 2.12
VOCs in Subslab Soil Gas and Indoor/Outdoor Air Sample Locations Maintenance Building

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Figure 2.13
Contaminants in Source Area Surface Soils

SB-31		
Depth (ft bgs)	**Analyte (µg/kg)**	
0-1	Methyl Acetate	7.3

SB-01		
Depth (ft bgs)	**Analyte (µg/kg)**	
0.5-1	Chloroform	13

SB-02		
Depth (ft bgs)	**Analyte (µg/kg)**	
0.5-1	Chloroform	7.5

SB-21		
Depth (ft bgs)	**Analyte (µg/kg)**	
0-0.5	Heptachlor Epoxide	3.1 J

SB-18		
Depth (ft bgs)	**Analyte (µg/kg)**	
0-0.5	Aroclor 1248	200

Legend

- Garvey Property Boundary
- OU1 Boundary
- Hydraulic Conductivity Well
- Multilevel Well
- Monitoring Well
- Irrigation Well
- DPT Soil Boring

Notes:
µg/kg - micrograms per kilogram

Shaded results indicate that the results exceed the Preliminary Remediation Goal (PRG).

ft bgs = feet below ground surface

All subsurface soil samples collected and the analytes they were sampled for are listed in Table 2.3

N

0 175 350 700
Feet

Filename: X:/EPA009/Garvey/FS/Source_Area_Soil_Sample_Locations.mxd
Project: EP9033.01.46.11
Revised: 01/11/12 RL
Source: ENSR GDB 2008, DNR

HGL HydroGeoLogic, Inc

US EPA ARCHIVE DOCUMENT

SB-29		
Depth (ft bgs)	Analyte (µg/kg)	
15-16 ft bgs	Naphthalene	230

SB-04		
Depth (ft bgs)	Analyte (µg/kg)	
18-20 ft bgs	Heptachlor Epoxide	2.1

SB-02		
Depth (ft bgs)	Analyte (µg/kg)	
7-7.5	Carbon Tetrachloride	14

SB-03		
Depth (ft bgs)	Analyte (µg/kg)	
4-5	Carbon Tetrachloride	77
11.5-12	Carbon Tetrachloride	41
11.5-12	Chloroform	10
16.5-17	Carbon Tetrachloride	73
16.5-17	Chloroform	11
19-20	Carbon Tetrachloride	7.7
19-20	Chloroform	10
19-20 (Duplicate)	Carbon Tetrachloride	15
19-20 (Duplicate)	Chloroform	18

HGL—Feasibility Study,
Garvey Elevator Superfund Site—Hastings, NE

Figure 2.14
Contaminants in Source Area Subsurface Soils

Legend

- Garvey Property Boundary
- OU1 Boundary
- Hydraulic Conductivity Well
- Multilevel Well
- Monitoring Well
- Irrigation Well
- DPT Soil Boring

Notes:
µg/kg - micrograms per kilogram

Only detections are shown.

Shaded results indicate that the results exceed the Preliminary Remediation Goal (PRG).

ft bgs = feet below ground surface

N

0 175 350 700
Feet

Filename: X:/EPA009/Garvey/FS/
Contaminants_Source_Area_Subsurface_Soils.mxd
Project: EP9033.01.46.11
Revised: 01/11/12 RL
Source: ENSR GDB 2008, DNR

HGL HydroGeoLogic, Inc

US EPA ARCHIVE DOCUMENT

HGL—Feasibility Study,
Garvey Elevator Superfund Site—Hastings, NE

Figure 2.15
Hastings Institutional Control Area and Areas of Groundwater Contamination

Legend

- Garvey Property Boundary
- OU1 Boundary
- Hastings Institutional Control Area (HICA)
- Approximate Carbon Tetrachloride/ Ethylene Dibromide Groundwater Contamination Plume
- Approximate Chlorinated Solvent Groundwater Contamination Plume
- Municipal Well Location

Note:
Groundwater plumes depicted are historic interpretations by the City of Hastings and are meant only to illustrate general relative locations of the plumes. The interpretations do not accurately illustrate the full extent of contamination of the plumes.

N

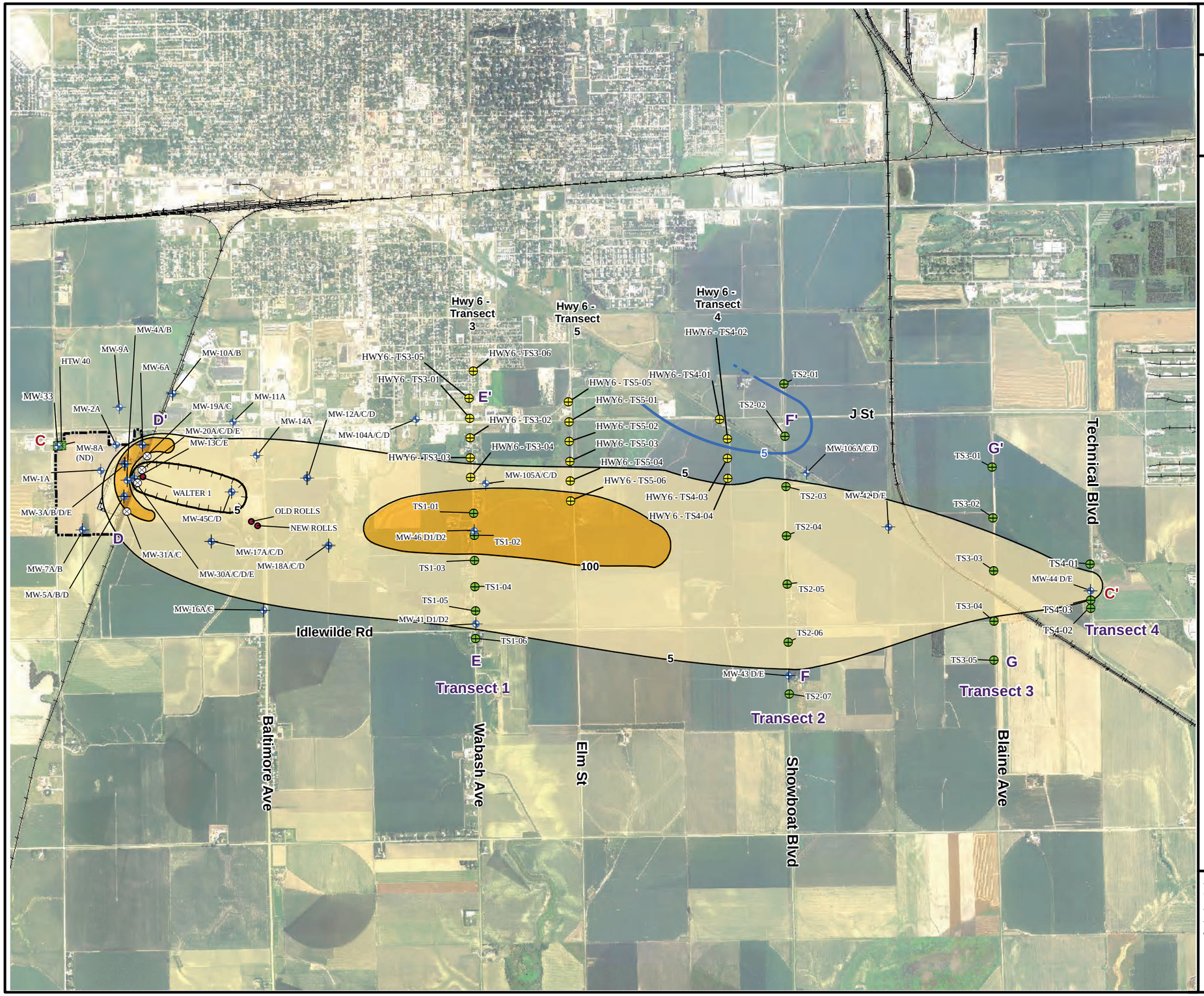
0 1,500 3,000 6,000
Feet

Filename: X:/EPA009/Garvey/FS/ Institutional_Control_Area_GW_Contamination.mxd
Project: EP9012.01.55.01
Revised: 01/11/12 RL
Source: Hastings Institutional Control Area Annual Report, 2008

HGL HydroGeoLogic, Inc

US EPA ARCHIVE DOCUMENT

Figure 2.16
Extent of Carbon Tetrachloride in Groundwater



Legend

- Garvey Property Boundary
- OU1 Boundary
- −5− Carbon Tetrachloride Contour (dashed where inferred)
- Railroad
- Monitoring Well Location
- Multilevel Well
- Hydraulic Conductivity Well
- West Highway 6 & Highway 281 Transect Sample Location (DPT sampled in January and February 2008)
- Garvery Elevator Transect Boring (DPT sampled in August, September, and December 2009)
- Domestic / Irrigation Well
- Carbon Tetrachloride Detected above 5 µg/L
- Carbon Tetrachloride Detected above 100 µg/L

Notes:
At DPT locations, samples were collected at multiple depths; the highest concentration was used to construct the isoconcentration contours.
This figure does not include the most recent groundwater data from September 2011.

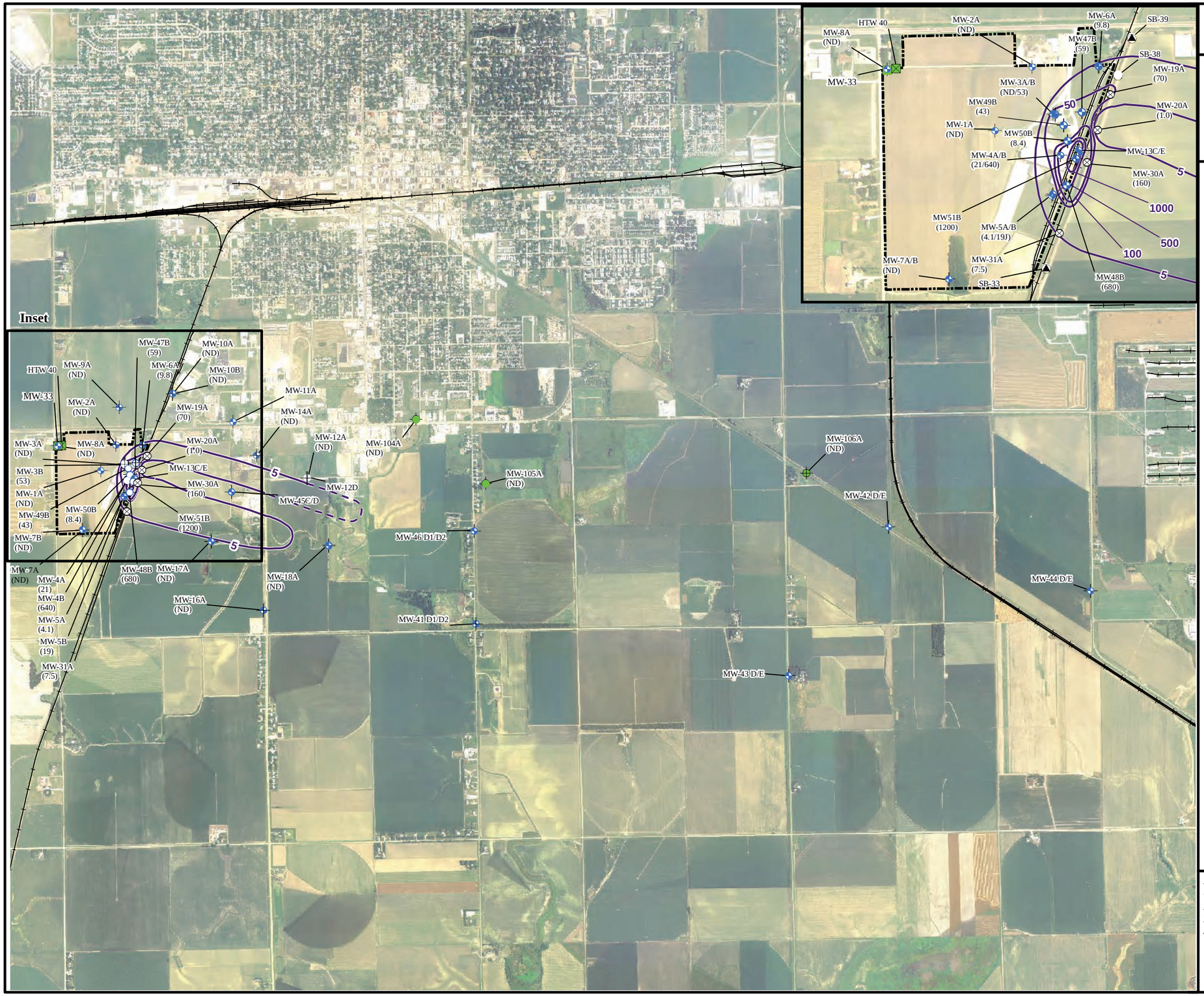
0 2,500 5,000
Feet

N

Filename: X:/EPA009/Garvey/FS/Cross_Section_CarbonTet_Plume.mxd
Project: EP9034.01.22.02.02
Revised: 01/11/12 RL
Source: ENSR GDB 2008, DNR

HGL HydroGeoLogic, Inc

US EPA ARCHIVE DOCUMENT



HGL—Feasibility Study,
Garvey Elevator Site—Hastings, NE

Figure 2.17
Carbon Tetrachloride in the Upper Aquifer Zone A/B September 2011 Sampling

Legend

- Garvey Property Boundary
- Railroad
- Monitoring Well Location
- Multilevel Well
- Hydraulic Conductivity
- West Highway 6 & Highway 281 Site Monitoring Well
- (190) Carbon Tetrachloride Concentration in micrograms per liter (µg/L)
- —(5)— Carbon Tetrachloride Isoconcentration Contour (µg/L) (Dashed Lines are Estimated)

Notes:

(ND) Nondetect

The plume interpretation is based on September 2011 data, which is different from data presented on Figure 2.16.

0 2,500 5,000
Feet

N

Filename: X:/EPA009/Garvey/FS/Carbon_TetChl_UpperAquifer_AB.mxd
Project: EP9034.01.22.02.02
Revised: 01/11/12 RL
Source: ENSR GDB 2008, DNR

HGL HydroGeoLogic, Inc

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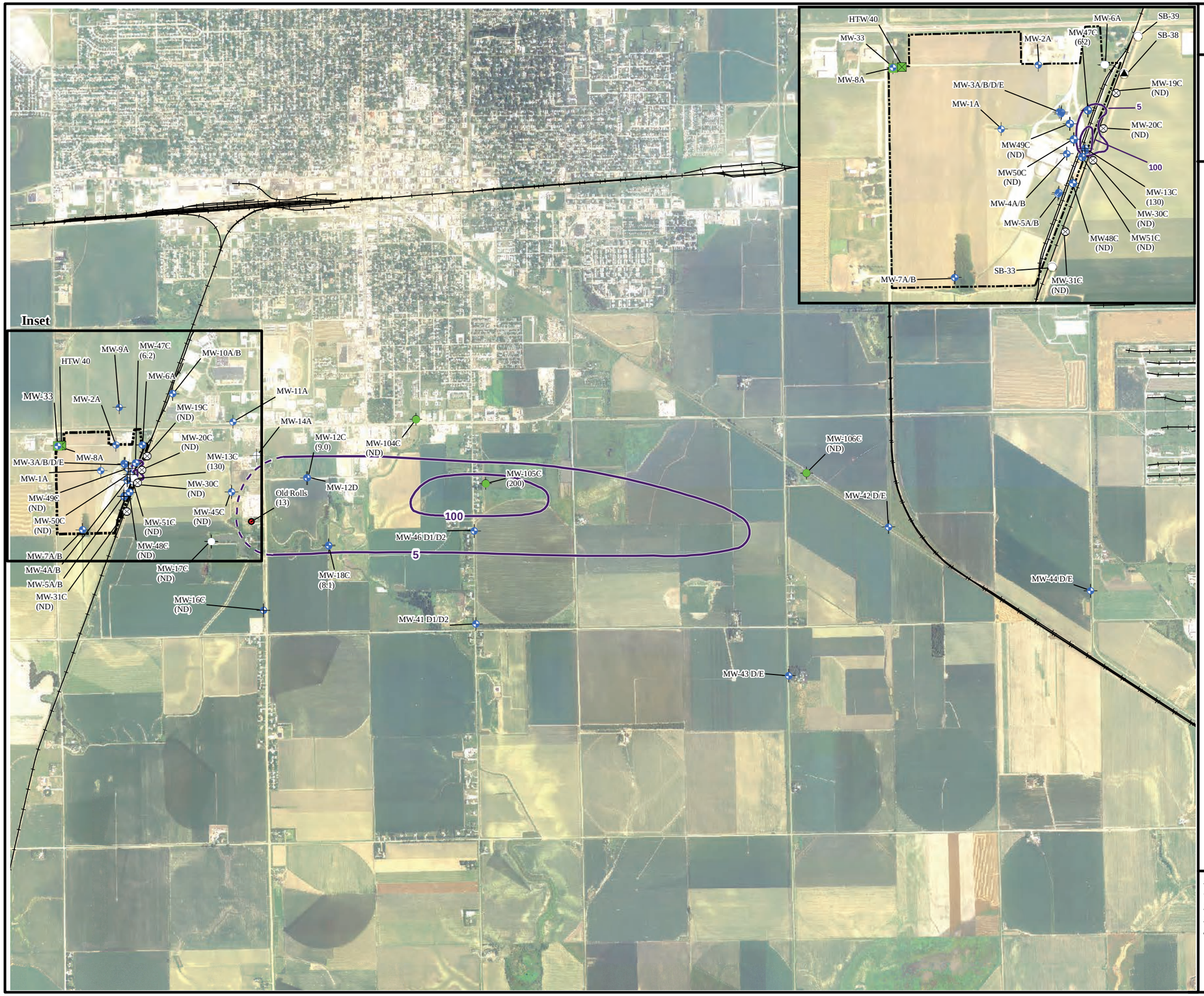

HGL—Feasibility Study,
Garvey Elevator Site—Hastings, NE

Figure 2.18
Carbon Tetrachloride in the Medial Aquifer Zone C
September 2011 Sampling

Legend

- Garvey Property Boundary
- Railroad
- Monitoring Well Location
- Multilevel Well
- Hydraulic Conductivity Well
- West Highway 6 & Highway 281 Site Monitoring Well
- (190) Carbon Tetrachloride Concentration in micrograms per liter (µg/L)
- —(5)— Carbon Tetrachloride Isoconcentration Contour (µg/L) (Dashed Lines are Estimated)
- Domestic / Irrigation Water Wells

Notes:

(ND) Nondetect

The plume interpretation is based on September 2011 data, which is different from data presented on Figure 2.16.

0 2,500 5,000
Feet

N

Filename:X:/EPA009/Garvey/FS/
Carbon_TetChl_Medial_Aquifer_C.mxd
Project: EP9034.01.22.02.02
Revised: 01/11/12 RL
Source: ENSR GDB 2008, DNR

HGL HydroGeoLogic, Inc

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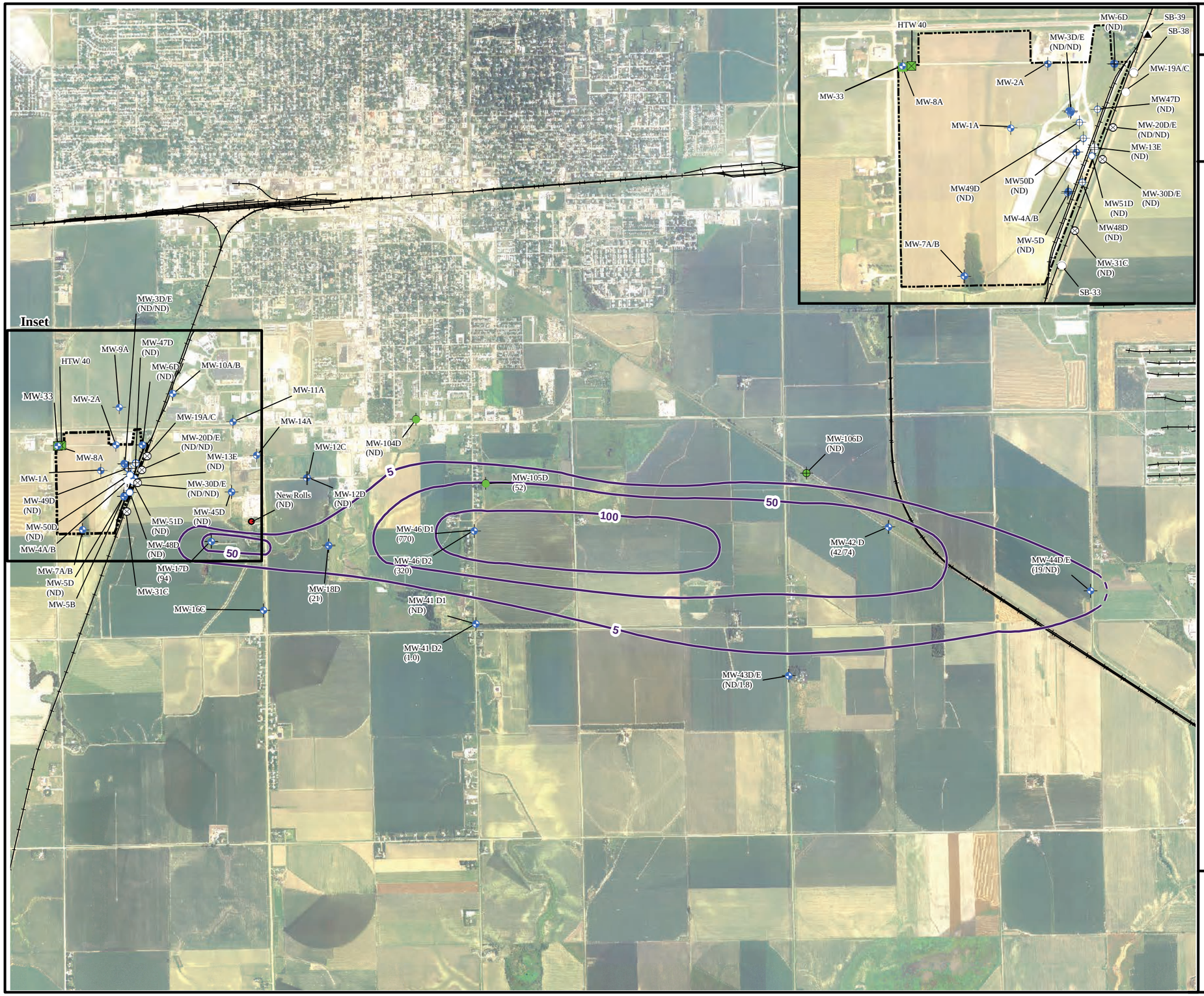

HGL—Feasibility Study,
Garvey Elevator Site—Hastings, NE

Figure 2.19
Carbon Tetrachloride in the Lower Aquifer Zone D/E
September 2011 Sampling

Legend

- Garvey Property Boundary
- Railroad
- Monitoring Well Location
- Multilevel
- Hydraulic Conductivity Well
- West Highway 6 & Highway 281 Site Monitoring Well
- (190) Carbon Tetrachloride Concentration in micrograms per liter (µg/L)
- —(5)— Carbon Tetrachloride Isoconcentration Contour (µg/L) (Dashed Lines are Estimated)
- Domestic / Irrigation Water Wells

Notes:

(ND) Nondetect

The plume interpretation is based on September 2011 data, which is different from data presented on Figure 2.16.

0 2,500 5,000
Feet

N

Filename: X:/EPA009/Garvey/FS/
Carbon_TetChl_LoweR_Aquifer_D.mxd
Project: EP9034.01.22.02.02
Revised: 01/11/12 ST
Source: ENSR GDB 2008, DNR

HGL HydroGeoLogic, Inc

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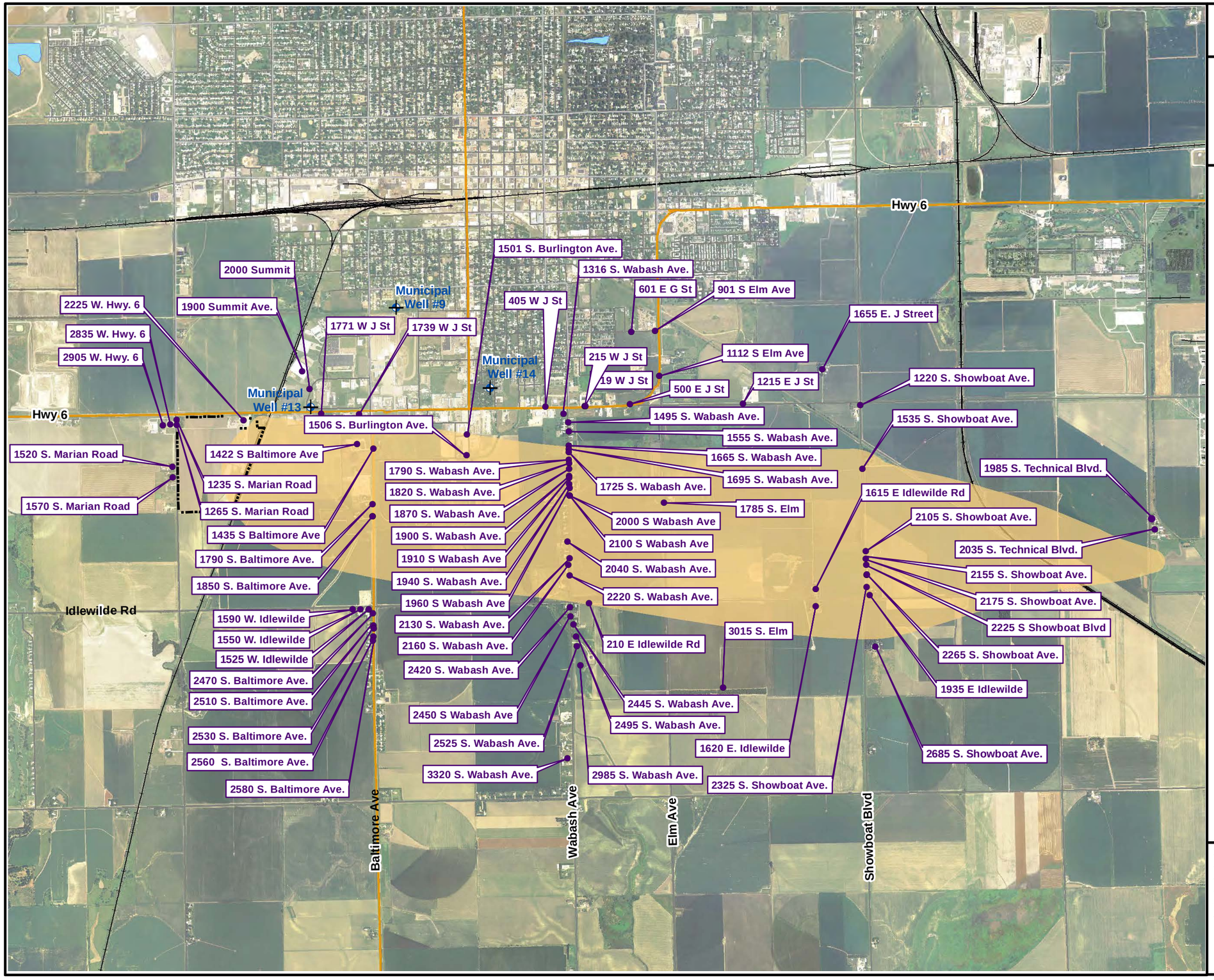
Figure 2.20
Private Well Locations



Legend

- Private Well
- Municipal Well
- Garvey Property Boundary
- Carbon Tetrachloride in Groundwater Detected Above 5 µg/L*
- Railroad

Notes:

* Based on samples collected January 2008 through June 2010.

Ave. - Avenue
Blvd. - Boulevard
E - East
S - South
St. - Street
W - West

N

0 0.5 1
Miles

Filename: X:\EPA009\Garvey\FS Private_Well_Locations.mxd
Project: EP9012.01.55.01
Revised: 01/11/12 RL
Source: Hasting Utility Department, Nebraska DNR, HGL Database 2008

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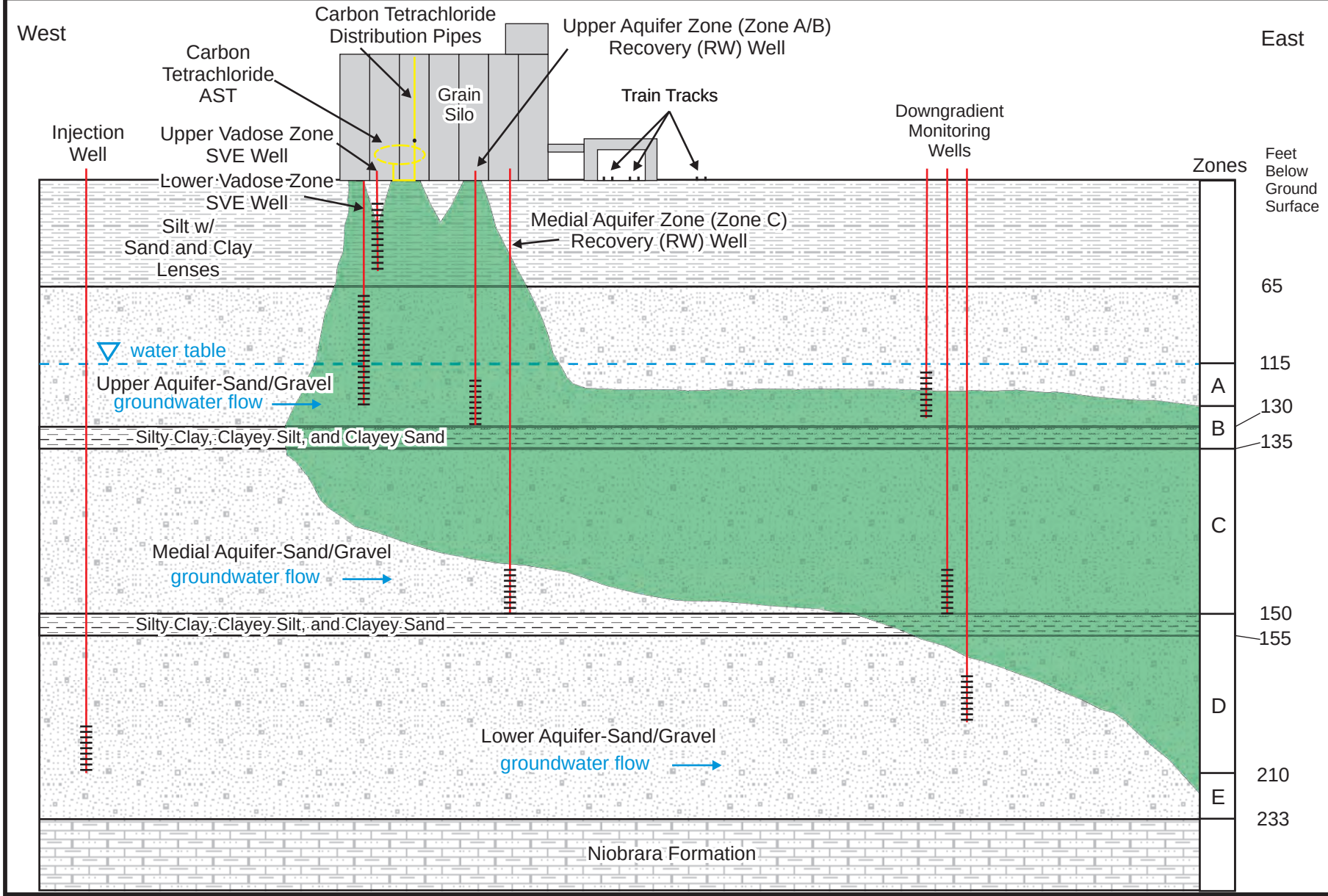

Filename: X:/EPA009/Garvey/FS/ Conceptualized_FateTransport_Liquid_Fumigant.cdr
Project: EP9033.01.55.01
Revised: 01/11/12 RL
Source: Hasting Utility Department, Nebraska DNR, HGL Database

HGL HydroGeoLogic, Inc

Figure 2.21
Conceptualized Physical Fate and Transport for Liquid Fumigant Contamination

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HGL—Feasibility Study,
Garvey Elevator Superfund Site—Hastings, NE

Figure 2.22
Existing GET and SVE Systems

Legend

- Garvey Elevator Property Boundary
- OU1 Boundary
- Pack Tower Stripper
- GET and SVE System Piping
- Recovery Wells
- Hydraulic Conductivity Well
- Multilevel Well
- Injection Well
- Soil Vapor Extraction Well
- Monitoring Well
- Irrigation Well

N

0 185 370 740

Feet

Filename: X:/EPA009/Garvey/FS/
GET_SVE.mxd
Project: EP9033.01.46.11
Revised: 01/11/12 RL
Source: ENSR GDB 2008, DNR

HGL HydroGeoLogic, Inc

3.0 REMEDIAL ACTION OBJECTIVES

According to the NCP [40 CFR 300.430(a)(1)(i)], the goal of the remedy selection process is "…to select remedies that are protective of human health and the environment, maintain protection over time, and minimize untreated waste." Preliminary RAOs are media-specific and source-specific goals to be achieved through completion of an RA that is protective of human health and the environment. These objectives are typically expressed in terms of the contaminant, the concentration of the contaminant, and the exposure route and receptor.

Preliminary RAOs are typically developed by evaluating several sources of information, including results of the groundwater monitoring reports, source area investigations, and tentatively identified ARARs. These inputs provide the basis for determination of whether protection of human health and the environment is achieved for a remedial alternative. During development of the preliminary RAOs, other RGs and preferences for Site outcomes that have been expressed by stakeholders may be considered. Although these goals are not considered requirements pursuant to the NCP (40 CFR 300), they may serve to guide the process for developing remedial alternatives. The following subsections present the ARARs, preliminary RAOs, and the preliminary RGs that have been identified for the Site.

3.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requires that the selected RAs must attain or exceed the ARARs in environmental and public health laws. The NCP also requires removal actions to attain ARARs to the greatest extent practicable. The distinction between applicable and relevant and appropriate is critical to understanding the constraints imposed on remedial alternatives by environmental regulations other than CERCLA.

Identification of ARARs must be done on a site-specific basis and involves a two-part analysis: first, determining if a given requirement is applicable and second, determining whether a requirement that is not applicable is both relevant and appropriate.

EPA and NDEQ have conducted an initial discussion concerning potential federal and state ARARs and have tentatively identified regulations that may be applicable or relevant and appropriate to the Site. Appendix A constitutes the initial identification and detailed description of ARARs for the implementation of a RA at the Site. Final ARARs will be set forth in the ROD amendment or Explanation of Significant Differences (ESD), as applicable, as performance standards for any and all remedial design and subsequent RAs.

Implementation of OU1 and OU2 RAs for the Site would not require federal, state, or local permits in accordance with Section 121(e) of CERCLA. The RA must comply with all substantive requirements that are "applicable" or "relevant and appropriate." OU1 and OU2 RAs could include not only the areas defined by the aerial extent of contamination but also

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areas in very close proximity to the contamination necessary for implementation of the response action. A summary of the scope and intent of ARARs with regard to on-site and off-site actions is presented below.

	Extent to Which Other Laws Apply	Scope of Requirements
On -site Compliance (OU1)	Applicable or Relevant and Appropriate	Substantive
Off -site Compliance (OU2)	Applicable Requirements	Substantive and Administrative

3.1.1 Definition of Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA, 42 (U.S.C.) § 9621(d), the NCP, 40 CFR 300 (1990), and guidance and policy issued by EPA require that RAs implemented under CERCLA comply with substantive provisions of ARARs derived from state and federal environmental laws, and state 1facility siting laws during and at the completion of the RA. ARARs are designated as either "applicable" or "relevant and appropriate," according to EPA guidance. If a state or federal environmental law is determined to be either "applicable" or "relevant and appropriate", compliance with the substantive requirements of that ARAR are mandatory under CERCLA and the NCP. Compliance with ARARs is a threshold criteria that any selected remedy must meet unless a legal waiver as provided by CERCLA Section 121(d) (4) is invoked.

3.1.1.1 Applicable Requirements

The NCP final rule for CERCLA defines applicable requirements as:

> *"…those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable."*

State requirements are more stringent than federal requirements if the state program has federal authorization and the state requirements are at least as stringent as the federal standard. Applicable requirements must be met to the full extent required by law or waived by EPA.

3.1.1.2 Relevant and Appropriate Requirements

If it is determined that a requirement is not applicable to a specific release, the requirement may still be relevant and appropriate to the circumstances of the release. The NCP final rule for CERCLA defines relevant and appropriate requirements as:

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> *"…those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location or circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be relevant and appropriate."*

The determination that a requirement is relevant and appropriate is a two-step process consisting of 1) the determination if a requirement is relevant; and, 2) the determination of whether a requirement is appropriate. In general, this process involves comparing a number of site-specific factors, including:

- The purpose of the requirement and the purpose of the proposed CERCLA action
- The medium and substances regulated by the requirement and the proposed RA
- The actions or activities regulated by the requirement and the RA
- The potential use of resources addressed in the requirement and the RA

In some cases, a requirement may be relevant but not appropriate because of a site-specific circumstance. Such a requirement is therefore not an ARAR for the Site. When a determination is made that a requirement is both relevant and appropriate, such a requirement must be complied with to the same degree as if it were applicable (EPA, 1988).

3.1.1.3 Other Requirements to be Considered

In addition to ARARs, to be considered (TBC) criteria are evaluated and utilized to determine the necessary level of cleanup for protection of human health or the environment. The TBCs are non-promulgated advisories, regulations, or guidance issued by federal or state government that are not legally binding and are not generally enforceable, but may have specific bearing on all or part of the action. TBCs can be used to determine the necessary level of cleanup for protection of human health or the environment where no specific ARARs exist for a chemical or situation or where such ARARs are not sufficient to be protective.

Many state requirements listed as ARARs are promulgated with identical or nearly identical requirements to federal law pursuant to delegated environmental programs administered by EPA and the state. The preamble to the NCP provides that such a situation results in citation to the state provision and treatment of the provision as a federal requirement. Examples of TBC sources of information are: *Institutional Controls: A Site Manager's Guide to Identifying, Evaluating, and Selecting Institutional Controls at Superfund and Resource Conservation and Recovery Act (RCRA) Corrective Action Cleanups*, USEPA 540-F-00-005, OSWER 9355.0-74FS-P, September 29, 2000 (EPA, 2000b).

3.1.1.4 Waivers of Specific Applicable or Relevant and Appropriate Requirements

CERCLA Section 121(d)(4) authorizes that any ARAR may be waived under one of the following six conditions if the protection of human health and the environment is assured:

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1. It is part of a total RA that will attain such level or standard of control when completed (i.e. interim action waiver).
2. Compliance with the ARAR at a given Site will result in greater risk to human health and the environment than alternative options that do not comply with the ARAR.
3. Compliance with such a requirement is technically impracticable from an engineering perspective.
4. The RA will attain a standard or performance equivalent to that required by the ARARs through use of another method or approach.
5. The ARAR in question is a state standard and the state has not consistently applied (or demonstrated the intention to consistently apply) the ARAR in similar circumstances at other sites.
6. In meeting the ARAR, the selected RA will not provide a balance between the need for protection of public health and welfare and the environment at the Site and the availability of Superfund monies to respond to other facilities.

3.1.1.5 Identification of Applicable or Relevant and Appropriate Requirements

ARARs are defined as chemical-, location-, or action-specific. An ARAR can be one or a combination of all three types of ARARs.

1. Chemical-specific requirements address chemical or physical characteristics of compounds or substances. These values establish acceptable amounts or concentrations of chemicals that may be found in or discharged to the ambient environment.
2. Location-specific requirements are restrictions placed upon the concentrations of hazardous substances or the conduct of cleanup activities because they are in specific locations. Location-specific ARARs relate to the geographical or physical positions of sites, rather than to the nature of contaminants at sites.
3. Action-specific requirements are usually technology-based or activity-based requirements or limitations on actions taken with respect to hazardous substances, pollutants, or contaminants. A given cleanup activity will trigger an action-specific requirement. Such requirements do not themselves determine the cleanup alternative but define how chosen cleanup methods should be performed.

Summaries of chemical-specific, action-specific, and location-specific ARARs and TBCs are included in Appendix A.

3.2 IDENTIFICATION OF PRELIMINARY REMEDIAL ACTION OBJECTIVES AND PRELIMINARY CLEANUP LEVELS

A central component of EPA's remedial alternatives development and evaluation process is the development of RAOs or PCLs for the response action(s) that addresses site-specific risk. Numerical PCLs can be based on existing environmental standards or risk calculations, thus providing crucial targets for successful remedial alternatives to meet.

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3.2.1 Preliminary Remedial Action Objectives

According to the NCP [40 CFR 300.430(a)(1)(i)], the goal of the remedy selection process is "to select remedies that are protective of human health and the environment, maintain protection over time, and minimize untreated waste." RAOs are medium-specific or operable unit-specific goals to be achieved through completion of a RA that is protective of human health and the environment. These objectives are typically expressed in terms of the contaminant, the exposure route and receptor, and the acceptable contaminant level for each exposure route. They provide the basis for determining whether protection of human health and the environment is achieved for a remedial alternative.

Preliminary RAOs are typically developed by evaluating several sources of information, including results of the HHRA and preliminarily identified ARARs. During development of the preliminary RAOs, other PCLs and desires may be considered that have been expressed by various Site stakeholders. Although these goals are not considered requirements pursuant to the NCP (40 CFR 300), they may serve to guide the remedial development process.

In determining what constitutes beneficial uses for a particular groundwater, preliminary RAOs and preliminary PCLs should reflect current and future uses of groundwater and exposure scenarios that are consistent with these uses. Preliminary PCLs, therefore, should be set based on a clear understanding of current groundwater uses as well as a clear determination of future groundwater uses. The PCLs developed for the Site are discussed in Section 3.2.2.

How quickly preliminary RAOs need to be achieved can have a significant impact on the selection of a remedy. If groundwater is not currently used as a drinking water source but is considered a future source of drinking water, then the timing for future use must be taken into account. Consideration needs to be given to alternatives that are available to restore groundwater by the time it is expected to be used as a drinking water supply. EPA guidance states that:

> *"Where the contaminated groundwater is not currently used or an alternative water source is readily available, and there is no near-term future need for the resource, it will likely be appropriate to consider a longer time frame for achieving restoration cleanup levels. Where longer remediation time frames are appropriate, less aggressive remediation methods and/or more passive remediation approaches (such as source control combined with monitored natural attenuation) should be considered."* (EPA, 1997)

EPA guidance recognizes that groundwater response actions are often implemented in several steps or in a phased approach.

The baseline HHRA was prepared as part of the RI to evaluate whether chemical concentrations detected in media at the Site pose a significant threat to human health. A summary of exposure scenarios and media evaluated in the HHRA are as follows:

- Current/Future Indoor Industrial Worker exposure to sediment and subslab soil gas via vapor intrusion.
- Current/Future Outdoor Industrial Worker exposure to sediment.

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- Future Construction Worker exposure to sediment.
- Current/Future Trespasser exposure to sediment.
- Current Off-Site Resident (Child and Age-Adjusted) exposure to groundwater.
- Future On-Site Resident (Child and Age-Adjusted) exposure to sediment, subslab soil gas, and groundwater.

Based on the HHRA, site conditions are protective of the current and future outdoor industrial worker, current and future indoor industrial worker, future construction worker, and the current and future trespasser, but are not protective of the following combinations of receptor groups and exposure routes:

- Current off-site resident exposure to carbon tetrachloride, chloroform, and 1,2-dichloroethane contaminated groundwater used for domestic purposes.
- Future on-site resident exposure to carbon tetrachloride, chloroform and trichloroethene contaminated groundwater used for domestic purposes.
- Future on-site resident exposure to chloroform, tetrachloroethene, and trichloroethene contaminated soil gas via vapor intrusion.

Based on the SLERA, current Site conditions do not pose a threat to ecological receptors.

Preliminary RAOs were developed for protection of human health to mitigate those exposure scenarios and media identified in the HHRA that exceed the total ILCR = 1E-04 and/or the total HI = 1.

The following preliminary RAOs were identified:

- Prevent or minimize the release of carbon tetrachloride, chloroform, tetrachloroethene, and trichloroethene from the unsaturated OU1 source area soils to groundwater at concentrations that would exceed their respective preliminary cleanup levels in groundwater.
- Prevent further migration of benzene, carbon tetrachloride, chloroform and trichloroethene contaminated groundwater in excess of their respective preliminary cleanup levels from the OU1 source area.
- Prevent further migration of carbon tetrachloride, chloroform, and 1,2-dichloroethane contaminated groundwater in excess of their respective preliminary cleanup levels from the OU2 area.
- Reduce the concentrations of benzene, carbon tetrachloride, chloroform and trichloroethene in groundwater beneath the OU1 source area to concentrations less than or equal to their respective preliminary cleanup levels within a reasonable timeframe, so that the aquifer is restored to its beneficial use.
- Prevent exposure of future residents to concentrations of chloroform, tetrachloroethene and trichloroethene in indoor air, at or above levels of concern for long-term exposure, from the vapor intrusion pathway at the OU1 source area.
- Reduce the concentrations of carbon tetrachloride, chloroform and 1,2-dichloroethane in groundwater beneath the OU2 area to concentrations less than or equal to their respective preliminary cleanup levels within a reasonable timeframe, so that the aquifer is restored to its beneficial use.

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- Prevent exposure of current and future residents to concentrations of carbon tetrachloride, chloroform, and 1,2-dichloroethane, in groundwater beneath the OU2 area, at or above levels of concern for long-term exposure from its domestic use.

The basis and rationale for the preliminary RAOs is the current and reasonably anticipated future land use and potential beneficial groundwater use as a drinking water source.

3.2.2 Preliminary Cleanup Levels

PCLs are developed based on the site-specific risk assessment, ARARs and/or TBCs. Where ARARs are not available or are not sufficiently protective, EPA generally sets site-specific remediation levels for: (1) carcinogens at a level that represents an excess upper bound lifetime cancer risk to an individual of between 1E-04 to 1E-06; and (2) non-carcinogens such that the cumulative risks from exposure will not result in adverse effects to human populations (including sensitive sub-populations) that may be exposed during a lifetime or part of a lifetime, incorporating an adequate margin of safety (OSWER Directive 9283.1-33). Pursuant to CERCLA Section 121(d) and in consideration of the groundwater aquifer's current use as a drinking water source, the Safe Drinking Water Act is a relevant and appropriate standard, and therefore, preliminary cleanup levels for groundwater are based on the MCLs specified therein. PCLs for COCs are presented in Table B.1 and are based on MCLs in drinking water and on standard EPA screening criteria for protection of groundwater for soils and soil gas. Additional PCLs address vapor intrusion. Assumptions and calculation methodologies used to develop the PCLs are presented in the Appendix B tables.

3.3 VOLUMES AND AREAS OF IMPACTED MEDIA

The following subsections detail the estimated quantities of soil and groundwater in OU1 and groundwater at OU2 that have been impacted.

3.3.1 Soil

Figures 2.11 through 2.14 illustrate the distribution of soil gas and surface and subsurface soil contamination in OU1. Based on the results illustrated in these figures, it appears that soil contamination is confined to the area directly adjacent to or beneath the former liquid fumigant AST and near the buried piping between the AST and the elevator. Carbon tetrachloride concentrations exceeding the PCL of 45 μg/kg for migration to groundwater were limited to one subsurface soil location (Figures 2.13 and 2.14). Carbon tetrachloride above the PCL was detected at SB-03 at depths between 4 feet bgs and 17 feet bgs, approximately 13 feet. Assuming a 25 feet by 25 feet area and a 13 feet thickness, the approximate volume of soil that requires remediation is 300 bank cubic yards.

The soils directly beneath the subslab of the shop area of the office/shop building and the maintenance shop of the maintenance building appear to be contaminated with chloroform, PCE, and TCE, all of which were observed above their respective PCLs for vapor intrusion (Figures 2.11 and 2.12). Based on an assumed square footage of approximately 1000 square

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feet each, and a depth of 0.5 feet bgs (for vapor intrusion), approximately 18.5 bank cubic yards of soils beneath each structure is contaminated above PCLs for vapor intrusion.

As reported in the RI, historical soil gas results from a 2007 DPT Investigation showed high levels of carbon tetrachloride in the soil gas at depths between 10 and 115 feet bgs, primarily at depths greater than 50 feet bgs (ENSR, 2007). However, all concentrations observed during the investigation were below the PCL for soil gas migration to groundwater.

3.3.2 Groundwater

Carbon tetrachloride is the most widespread of the groundwater contaminants; therefore it was used to estimate the volume of groundwater associated with the site that is contaminated above the PCL. Given the length of the plume and the relatively small amount of data regarding actual plume thickness, any estimation of groundwater volumes should be considered gross estimates only.

Two methods were used to calculate the volume of contaminated groundwater, the average end area method and estimates based on the approximate area and thickness of the plume. Each method was based on the plume size, as shown on Figure 2.16, cross sections of the plume from the RI (showing approximate thicknesses of the plume), and an assumed porosity of 0.3.

Using these methods, the estimated volume of contaminated groundwater beneath the grain storage facility (OU1) is approximately 100 million gallons. The estimated volume of contaminated groundwater in OU2 is estimated to be between 5.6 billion to 7.1 billion gallons.

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4.0 IDENTIFICATION AND SCREENING OF GENERAL RESPONSE ACTIONS, REMEDIAL TECHNOLOGIES, AND PROCESS OPTIONS

This section identifies GRAs, remedial technologies, and process options that are potentially useful to address the preliminary RAOs identified in Section 3 for the contaminated media. Screening of the GRAs, remedial technologies, and process options is then performed in accordance with the NCP to retain representative technologies and process options that can be assembled into remedial alternatives.

4.1 OVERVIEW

The identification and screening process consists of the following general steps:

- Develop GRAs for the contaminated media that will satisfy the preliminary RAOs identified in Section 3.
- Compile remedial technologies and process options for each GRA that are potentially viable for remediation of the contaminated media.
- Screen the remedial technologies and process options with respect to technical implementability for the contaminated media at the Site. Technologies and process options that are not technically implementable relative to the contaminated media are eliminated from further consideration in this FS.
- Evaluate and screen the retained remedial technologies and process options with respect to effectiveness, ease of implementability, and relative cost. Technologies and process options that have low effectiveness, low implementability, or high cost relative to the contaminated media are eliminated from further consideration in this FS.
- Combine and assemble the retained technologies and process options for the contaminated media into site-wide remedial alternatives.

The remainder of this section categorizes the contaminated media and evaluates GRAs, technologies, and process options that are potentially viable for remediating the contaminated soil and groundwater to achieve the preliminary RAOs discussed in Section 3.

4.2 GENERAL RESPONSE ACTIONS

GRAs are initial, broad response actions considered during technology screening to achieve the preliminary RAOs for the contaminated media identified as a concern at the Site. GRAs include several remedial categories, such as containment, removal, disposal, and treatment of contamination within the media. Site-specific GRAs are first developed to satisfy the preliminary RAOs for the contaminated medium and then are evaluated as part of the identification and screening of remedial technologies and process options for the contaminated media. It should be noted that not all GRAs identified for the contaminated media are necessarily retained for inclusion within the remedial alternatives for the Site.

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The GRAs considered for remediation of the contaminated media (i.e. soil and groundwater) include the following:

- No action
- Monitoring
- Institutional controls
- Engineered controls
- Containment
- Removal, transport, and disposal
- Treatment
- Collection, treatment, and discharge

No action leaves contaminated media in their existing condition with no control or cleanup planned. In accordance with the NCP, this GRA must be considered to provide a baseline against which other options can be compared.

Monitoring involves physical measures applied to the Site to determine if there is contaminant migration. Monitoring is not intended to substitute any engineering aspect of a selected remedy and does not physically mitigate VOC- contaminated soil and groundwater.

Institutional controls are administrative and legal restrictions intended to control or prevent present and future use of contaminated media. Institutional controls are not intended to substitute for engineering aspects of a selected remedy.

Engineered controls are physical restrictions intended to control or prevent present and future access to contaminant media.

Containment involves physical measures applied to contaminant media materials to control the release of contaminants and/or prevent direct contact or exposure to the contaminants.

Removal, transport, and disposal involve a complete or partial removal of contaminant media materials followed by transportation and disposal of the media materials at an on-site/off-site location.

Treatment involves biological, chemical, thermal, and/or physical measures applied to the contaminant media materials that reduce toxicity, mobility, and/or volume of the contaminants present.

Collection, treatment, and discharge involves physical measures applied to contaminant media materials to extract the media from the site, followed by application of biological, chemical, thermal and/or physical treatment and subsequent discharge to control the migration of contaminants.

A wide range of potential remedial technologies and process options were reviewed and the following determinations were made:

- Remedial technologies/process options that should be eliminated and have no further consideration because they are unable to remediate the contaminated media due to site conditions or the lack of compatibility with the contaminated media
- Remedial technologies/process options that are technically implementable but that should be eliminated and have no further consideration based on low effectiveness, low administrative implementability, and/or high cost for the contaminated media

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- Remedial technologies/process options that have substantial potential and applicability as a stand-alone remedy and are being retained for further consideration
- Remedial technologies/process options that could provide remedial benefits in combination with other remedial technologies but would only have cost-effective application for specific Site elements and particular conditions

Table C.1 and Table C.2 in Appendix C provide a comprehensive overview of the screening and elimination process for remedial technologies and process options identified for contaminated soil and groundwater. Potentially feasible remedial technologies and associated process options for the contaminated media were primarily identified using the Federal Remediation Technologies Roundtable (FRTR) *Remediation Technologies Screening Matrix and Reference Guide*, Version 4.0 (FRTR, 2002), *User's Guide for the VOCs in Soil Presumptive Remedy* (EPA, 1996a), and *Presumptive Response Strategy and Ex-situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites* (EPA, 1996b). Innovative remedial technologies and process options were also considered in the screening and elimination process.

Remedial technologies and process options that are not deemed to be technically implementable relative to the contaminated media were eliminated from further consideration. A given technology or process option was eliminated from further consideration in this FS on the basis of technical implementability. If Site conditions or Site characterization data indicated that the technology or process option is incompatible with the contaminant or contaminated media or cannot be implemented effectively due to physical limitations or constraints at the Site, a given technology or process option was eliminated from further consideration in this FS.

Some of the process options may be technically implementable on a small-scale basis, for a specific location, or for conditions other than those for which it is being evaluated; however, the technical implementability screening and elimination were performed by evaluating use of the process options for the contaminated media based on existing Site conditions and the preliminary RAOs.

The process options for the contaminated medium eliminated from further consideration in this FS (with the rationale for elimination) are indicated on Table C.1 for soil contamination and Table C.2 for groundwater contamination, using grey shading. Retained technologies and process options were then carried forward to the second step of the evaluation process, as discussed in Section 4.3.

From this evaluation, it is apparent that there is no single remedial technology or process option that can address all of the Site's conditions and achieve the threshold evaluation criteria required by the NCP. The Site will require combinations of remedial technologies/process options to adequately protect human health and the environment, achieve compliance with ARARs, and meet preliminary RAOs for all contaminated media.

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4.3 EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR EFFECTIVENESS, IMPLEMENTABILITY, AND RELATIVE COST

Each of the technically implementable remedial technologies and process options retained from the preliminary screening process presented in Section 4.2 were further evaluated in the second step of the screening process to determine if they should be eliminated from further consideration in the FS or retained for assembly into remedial alternatives.

4.3.1 Evaluation Criteria

Each remedial technology or process option was qualitatively evaluated for effectiveness, implementability, and relative cost. The criteria used, as defined in this step of the FS process, are described below.

Effectiveness

This evaluation of the effectiveness of a remedial technology or process option focuses on:

- Potential effectiveness in handling the estimated volumes of contaminated media and meeting the goals identified in the preliminary RAOs.
- Potential impacts to human health and the environment during construction and implementation.
- How proven the remedial technology or process option is with respect to the contaminants and conditions at the Site.

Implementability

Technically implementable technologies and process options retained in Section 4.2 are evaluated with respect to both the technical and administrative feasibility of implementing a remedial technology or process option. Technical implementability was used as an initial screening step in Section 4.8 to eliminate remedial technologies and process options that were clearly ineffective or unworkable at the Site. This subsequent screening criterion places greater emphasis on the institutional aspects of implementability. This criterion focuses on:

- Ability to obtain permits for off-site actions
- Availability and capacity of treatment, storage, and disposal services
- Availability of necessary equipment and skilled workers

Relative Cost

Cost plays a limited role in the screening of remedial technologies and process options. Relative capital and O&M costs are used rather than detailed estimates. The cost analysis is evaluated based on engineering judgment and is ranked relative to other process options in the same technology type.

Qualitative Rating System

Each remedial technology or process option was qualitatively evaluated using these three criteria to determine whether they should be eliminated from further consideration in the FS or

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retained for assembly into remedial alternatives. The following qualitative rating system was used in conjunction with the stated rationale to provide a justification for the ratings with respect to each criterion:

Effectiveness and Implementability		Relative Cost	
⓿	None	⓿	None
❶	Low	$	Low
❷	Low to Moderate	$$	Low to Moderate
❸	Moderate	$$$	Moderate
❹	Moderate to High	$$$$	Moderate to High
❺	High	$$$$$	High

Remedial technologies or process options deemed to have low effectiveness, and/or low administrative implementability for the contaminated medium are eliminated from further consideration in the FS.

4.3.2 Evaluation of Retained GRAs, Process Options, and Technologies

Each of the process options retained from the first screening step presented in Section 4.2 for the contaminated media has been evaluated using effectiveness, implementability, and relative cost and is presented on Table C.3 for soil contamination and Table C.4 for groundwater contamination. This evaluation and screening process is inherently qualitative in nature. The evaluation criteria described in Section 4.3.1 are specified by EPA guidance; however the degree to which the criteria are weighted against each other is not specified. Determination of how the individual evaluation criteria should influence the overall rankings requires engineering judgment.

The factors considered for each of the three criterion that provide justification for retention or elimination are rated using the qualitative ratings system previously described and summarized on the tables. The process options for contaminant medium eliminated from further consideration in this FS (with the rationale for elimination) are indicated on the tables using grey shading.

4.4 RETAINED GRAS, REMEDIAL TECHNOLOGIES, AND PROCESS OPTIONS FOR ASSEMBLY INTO REMEDIAL ALTERNATIVES

Based on the results of the two-step screening process described in Section 4.2 and Section 4.3, a reduced number of remedial technologies and process options for the contaminated media were retained for further evaluation and the development of RA alternatives as discussed further in Section 5. These retained remedial technologies and process options are presented in Table 4.1 for contaminated soil and Table 4.2 for contaminated groundwater.

Retention of remedial technologies and process options to address the contaminated media are for the following reasons:

- Remedial technologies/process options that have substantial potential and applicability as a stand-alone remedy and are being retained for further consideration

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- Remedial technologies/process options that could provide remedial benefits in combination with other remedial technologies but would only have cost-effective application for specific Site elements and particular conditions

It is unlikely that using or applying a single remedial technology/process option to the contaminated medium will solely be able to achieve the preliminary RAOs or comply with ARARs. Thus, using remedial technologies/process options in combination is likely to be necessary. The retained remedial technologies and process options include conventional and new (innovative) remedial methods.

The process options would be implemented in combinations for the contaminated medium of concern that would:

- Achieve threshold evaluation criteria (protection of human health and the environment and compliance with ARARs)
- Achieve preliminary RAOs to the extent possible (tentatively identified within this technical memorandum)

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Table 4.1 Retained Remedial Technologies and Process Options for Contaminated Soil

General Response Action	Remedial Technology	Process Option
No Action	None	No Action
Institutional Controls	Land Use Restrictions	Existing Governmental and Proprietary Controls
		Additional Governmental and Proprietary Controls
Monitoring	Sampling and Analysis	Soil Vapor Monitoring
	Site Inspection	Five Year Site Review
Removal, Transport, Disposal	Removal	Mechanical Removal (Excavation)
	Transport	Mechanical Transport (Truck Hauling)
	Disposal	On-site and Off-site Disposal
Soil Treatment	Physical Treatment	Ex Situ Soil Vapor Extraction
		In Situ Soil Vapor Extraction

Table 4.2 Retained Remedial Technologies and Process Options for Contaminated Groundwater

General Response Action	Remedial Technology	Process Option
No Action	None	No Action
Institutional Controls	Groundwater Use Controls	Existing Governmental and Proprietary Controls within OU1
		Additional Governmental and Proprietary Controls
	Community Awareness	Informational and Educational Programs
Monitoring	Sampling and Analysis	Groundwater Monitoring
	Site Inspection	Five Year Site Review
Groundwater Removal	Collection	Recovery Well(s)
	Discharge	Aquifer Reinjection
Groundwater Treatment	Biological Treatment	Natural Attenuation
		In Situ Enhanced Bioremediation
	Chemical Treatment	In Situ Chemical Oxidation
		In Situ Chemical Reduction
	Physical Treatment	Air Stripping

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5.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

5.1 OVERVIEW

In this section, remedial action alternatives (herein referred to as remedial alternatives) are assembled by combining the retained remedial technologies/process options presented in Appendix C for the contaminated medium. Remedial alternatives are developed from either stand-alone process options or combinations of the retained process options.

These remedial alternatives are then screened using a qualitative process with standard evaluation to determine overall effectiveness, implementability, and cost. The purpose of alternative screening is to reduce the number of remedial alternatives retained for detailed analysis in Section 7.

The remedial alternatives for the Site span a range of categories defined by the NCP as follows:

- No action alternative
- Alternatives that address the principal threats but involve little or no treatment; protection would be by prevention or control of exposure through actions such as containment and/or engineering and institutional controls
- Alternatives that, as their principal element, employ treatment that reduces the toxicity, mobility, or volume of the contaminants
- Alternatives that remove or destroy contaminants to the maximum extent, eliminating or minimizing long-term management
- Alternatives that include innovative treatment technologies

5.2 ASSUMPTIONS AFFECTING DEVELOPMENT OF REMEDIAL ALTERNATIVES

Several fundamental assumptions affect the development of remedial alternatives evaluated in this FS (other than a "no action alternative"). These assumptions are driven by requirements of the preliminary RAOs identified in Appendix B and Site limitations and constraints that cannot be overcome by using one or more remedial technology/process options as described in Section 4. These fundamental assumptions were taken into consideration during development of remedial alternatives for this FS and include the items listed in Table 5.1.

Secondary factors and considerations have also been tentatively identified to aid development of remedial alternatives but are not fundamental controlling considerations. Since these considerations vary depending on the remedial approach used in each alternative, they are discussed in Section 7 for retained remedial alternatives.

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5.3 REMEDIAL ALTERNATIVES DEVELOPMENT

Remedial alternatives were assembled by combining the retained remedial technologies and process options. Tables 5.2, 5.3, and 5.4 provide a comprehensive list of the remedial technologies/process options that were used to develop each remedial alternative.

Site investigations have shown that groundwater contamination originates from two soil sources, the former fumigant AST, and an area in the northeastern corner of the grain storage facility. Carbon tetrachloride has migrated in groundwater up to 4.7 miles to the east-southeast from the source areas, and has migrated vertically through two aquitards as it migrates downgradient in the aquifer. Treatment is critical to providing a long-term solution to sitewide groundwater contamination and aquifer restoration. Alternatives are developed for OU1 residual soil contamination, OU1 groundwater contamination, and OU2 groundwater contamination. The following sections describe the initial remedial alternatives developed for each OU and media of concern. Because this is the preliminary list of remedial alternatives prior to screening, the alternatives will be designated with a "P" before the alternative naming convention. Once the alternatives are screened and the list of alternatives for detailed analysis is presented, the "P" will be dropped from the alternative designation.

The remedial alternatives evaluated are described below.

5.3.1 Description of Remedial Alternatives Scoped for OU1 Contaminated Soil

Alternatives to address OU1 residual soil contamination have been developed. With the exception of the No Action alternative, the alternatives to address soil contamination at each source area would have the following common elements:

- Continued operation of the existing SVE system
- Implementation/enforcement of the necessary institutional/engineered controls to protect human health and the environment

The following remedial alternatives were identified to address residual soil contamination at the source area:

- Alternative PS1: No Action
- Alternative PS2: Excavation, Treatment and Disposal of Contaminated Soil and Operation of Existing SVE System
- Alternative PS3: Expand SVE System
- Alternative PS4: Excavation, Treatment and Disposal of Contaminated Soil and Expand SVE System

5.3.1.1 Alternative PS1: No Action

No Action (Alternative PS1) would discontinue SVE system operation at the Site. No change in the soil contaminant concentrations would occur since no treatment, containment, or removal of contaminated soil is included in this alternative.

The No Action alternative is carried through the FS process to provide a baseline for comparisons of Site remedial alternatives as required by the NCP.

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5.3.1.2 Alternative PS2: Excavation, Treatment and Disposal of Contaminated Soil and Operation of Existing SVE System

Alternative PS2 would involve excavating and treating contaminated soil exceeding remedial goals on site and disposing treated material into an on-site borrow area within OU1. Expected area of existing contamination is approximately 40 feet by 10 feet surface area, approximately 6 feet depth. Clean fill from the borrow area would be used to backfill the excavated area to match the surrounding grade. Excavated soil would be treated with an ex situ SVE process. After soil contamination is reduced below remedial goal concentrations, the treated soil would be placed into the on-site borrow pit, compacted, and seeded. The existing SVE system would continue to be utilized, with no expansion or upgrades performed. For costing purposes it is assumed the SVE system would continue to operate for 5 years, however, five year reviews would continue to be conducted for a total of 30 years.

Alternative PS2 includes the implementation of the necessary land use controls/institutional controls (LUCs/ICs) and engineered controls to protect human health and the environment.

5.3.1.3 Alternative PS3: Expand Existing SVE System

Alternative PS3 expands the treatment area of the SVE system by installing a shallow and deep recovery well in the source area. Emissions from the existing SVE system do not currently require treatment because the emissions levels are below the NDEQ threshold of 2.5 tons per year for any combination of hazardous air pollutants. A catalytic oxidation unit and scrubber are located on site but are not currently used; this equipment could be re-activated if treatment prior to discharge is needed to comply with state air regulations after expanding the existing SVE system. For purposes of this FS, it is assumed that emissions treatment would not be needed because the concentrations are assumed to remain below the NDEQ threshold after the system expansion is implemented. For costing purposes it is assumed the SVE system would continue to operate for 10 years.

Alternative PS3 would include the implementation of the necessary LUCs/ICs to protect human health and the environment.

5.3.1.4 Alternative PS4: Excavation, Treatment and Disposal of Contaminated Soil and Expand SVE System

Alternative PS4 combines Alternatives PS2 and PS3 to minimize the timeframe that the SVE system would be required to operate by removing contaminated soils from the source area. This alternative protects the environment through removal, on-site treatment and on-site disposal within OU1 of residual contaminated soil from the source area as described in detail in Alternative PS2, and continues to remove VOCs from the vadose zone on-site as described in Alternative PS3.

For costing purposes it is assumed the SVE system would continue to operate for 5 years; however, with excavation of contaminated soil and expansion of the SVE system the remedial timeframe would likely be reduced.

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5.3.2 Description of Remedial Alternatives Scoped for OU1 Contaminated Groundwater

Alternatives to address source area groundwater contamination have been developed. With the exception of the No Action alternative, the alternatives to address source area groundwater contamination at each source area would have the following common elements:

- Continued operation of the existing GET system
- Implementation/enforcement of the necessary institutional/engineered controls to protect human health and the environment
- The remedial alternatives identified to address residual groundwater contamination at the source area are: Alternative PSG1: No Action
- Alternative PSG2: Maintain and Operate Existing GET System
- Alternative PSG3: In Situ Treatment via Groundwater Amendments
- Alternative PSG4: In Situ Treatment via Groundwater Amendments and Operation of Existing GET System

5.3.2.1 Alternative PSG1: No Action

The No Action alternative would involve discontinuing operation of the GET system at the Site. There would be no change in the groundwater contaminant concentrations because no treatment, containment, or removal of contaminated groundwater is included in this alternative. The cost estimate for this alternative includes monitoring and enforcement of the ICs that are already in place at the Site as part of the Interim Remedy.

The No Action alternative is carried through the FS process to provide a baseline for comparisons of Site remedial alternatives as required by the NCP.

5.3.2.2 Alternative PSG2: Maintain and Operate Existing GET System

Groundwater extraction and treatment was implemented at the Site under previous interim actions. The system consists of eight existing recovery wells pumping to the treatment building where they combine in a single header and flow through bag filters and are treated by an air stripping unit. . Treated water is discharged to two upgradient injection wells. Section 2.10 provides a description of the existing system and its performance.

Under Alternative PSG2, the current GET system would continue to be operated and maintained to remove contaminants in groundwater. The GET system would not be expanded or otherwise enhanced. A recent groundwater model developed by HGL showed that the current system is capturing the extent of the OU1 groundwater contamination effectively.

5.3.2.3 Alternative PSG3: In Situ Treatment via Groundwater Amendments

Alternative PSG3 would consist of injecting a compound (organic substrate, chemical oxidant, or reducing agent) or a variety of compounds through a series of injection points installed perpendicular to the core of the groundwater contaminant plume. Injections would be conducted using DPT because groundwater contamination at OU1 is primarily in the upper aquifer. A sufficient number of injection points would be completed to provide sufficient coverage and allow an outside to inside injection sequence. Several injections of the selected

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compound would likely be necessary to meet RAOs. Groundwater modeling and periodic groundwater monitoring would provide a framework for the length of time injections may be needed. Alternative PSG3 would include the implementation of the necessary LUCs/ICs, such as groundwater use controls, to protect human health and the environment. Under this alternative, the existing GET system would discontinue operation.

In Situ Enhanced Bioremediation

Injections of compounds that would promote enhanced bioremediation (EB) would be conducted in both the upper and lower aquifers. The organic substrate would be injected to stimulate the biological degradation of chlorinated VOCs downgradient of the source area by providing a sufficient supply of the organic substrate (such as, lactate) to serve as an electron donor and sustain low redox conditions.

This treatment is accomplished by introducing the appropriate electron donor (organic substrate), and microorganisms and/or nutrients to stimulate or enhance the biodegradation of COCs by creating a favorable environment for the proliferation of microorganisms, primarily *Dehalobacter* and *Dehalococcoides*. The biodegradability of organic contaminants and environmental factors such as pH, temperature, redox condition, and Site hydrogeology also affects the performance of bioremediation.

Pilot studies would determine the optimum substrate, injection mechanism (gravity feed or low pressure), and the injection point configuration required to obtain adequate distribution of substrate to promote treatment.

Additional nutrient substrate and bioaugmentation may be necessary to maintain biological activity. Several applications of organic substrate may also be necessary to meet RAOs.

In Situ Chemical Oxidation

Injection of a chemical oxidant into the source area through dedicated injection wells is a potential alternative for groundwater treatment. In situ chemical oxidation would be conducted in both the upper, medial, and lower aquifer zones. Complete oxidation of contaminants results in their breakdown into less toxic compounds such as carbon dioxide, water, and metal oxides. The type of oxidant used is largely determined by the contaminant type. Chemical oxidants include hydrogen peroxide, permanganate, ozone, and persulfate. In situ chemical oxidation (ISCO) has been used to substantially reduce concentrations of a variety of contaminants in diverse aquifer materials.

Activated persulfate generates the sulfate radical (SO_4^-), a strong oxidizing species. However, selection of an activation method will depend on the target contaminants, lithology, hydrogeology, and other specific Site conditions. Persulfate can be activated by an iron chelate, alkaline conditions, hydrogen peroxide, and heat. The iron chelate activation method is not recommended for oxidation of carbon tetrachloride.

Bench- and pilot-scale studies would be conducted before full-scale implementation to determine the optimum concentration of persulfate and what impacts would be incurred from

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chemical oxidant injection, particularly on concentrations of metals. Use of persulfate would also require the determination of existing sulfate and iron levels in groundwater at the source area prior to implementation.

In Situ Chemical Reduction

Reducing agents to be injected for in situ chemical reduction would include emulsified oil zero-valent iron (EZVI) and EHC®. EZVI consists of nanoscale ZVI particles in a surfactant-stabilized, biodegradable water-in-oil emulsion. EHC® is a controlled-release, integrated carbon and ZVI source. The selected product would be injected into the contaminated zones of the subsurface.

Reducing agents such as EZVI and EHC® added to groundwater would reductively dechlorinate the contaminants. Bench- and pilot-scale studies would be conducted prior to full-scale implementation to determine the optimum concentration of the reducing agent and what impacts would be incurred from reducing agent injection. Through a process known as reductive dehalogenation, the contaminant and its daughter products are degraded into ethane and other less toxic hydrocarbons. These by-products are finally broken down through other biological activities in the subsurface.

EZVI and EHC® have been shown to be effective in reductive dehalogenation of chlorinated ethenes and carbon tetrachloride. Bench- and pilot-scale studies would be conducted before full-scale implementation to determine the optimum concentration of EZVI or EHC® and what impacts would be incurred from injection of EZVI or EHC®. Several applications of EZVI or EHC® may also be necessary to meet RAOs.

5.3.2.4 Alternative PSG4: In Situ Treatment via Groundwater Amendments and Operation of Existing GET System

Alternative PSG4 combines components of Alternatives PSG2 and PSG3 to reduce total cleanup time and decrease operating costs of the GET system. The in situ groundwater treatment would target areas of the OU1 plume with concentrations greater than 500 μg/L in the upper and medial aquifers. Due to the shallower depths, injections would be accomplished by DPT. The other components of the in situ alternative would be as described in Alternative PSG3. The continued operation of the GET system would be adjusted so that only the peripheral extraction wells would pump at adjusted pumping rates so as not to extract injection materials into the treatment system from the area being treated.

5.3.3 Description of Remedial Alternatives Scoped for OU2 Contaminated Groundwater

The alternatives for treating downgradient groundwater focus on remediation of the contaminant plume downgradient of the former Garvey property. Though alternatives to address downgradient groundwater contamination have been developed, the alternatives are only conceptual. The extent of contamination downgradient of the Site and groundwater modeling will play a significant role in the refinement of remedial alternatives to address downgradient contamination. With the exception of the No Action alternative, the alternatives

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to address downgradient groundwater contamination would have the following common elements:

- Implementation/enforcement of the necessary institutional/engineered controls to protect human health and the environment

The remedial alternatives identified to address downgradient groundwater contamination are:

- Alternative PG1: No Action
- Alternative PG2: Monitored Natural Attenuation
- Alternative PG3: Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume
- Alternative PG4: Groundwater Recovery, Treatment, and Discharge at Mid-plume and Leading Edge of Plume
- Alternative PG5: In Situ Treatment via Groundwater Amendments
- Alternative PG6: In Situ Treatment at Core of Plume and Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume

5.3.3.1 Alternative PG1: No Action

Contaminated groundwater throughout OU2 would not be remediated under the No Action alternative. There would be no change in the groundwater contaminant concentrations because no treatment, containment, or removal of contaminated soil is included in this alternative. However, this alternative would include periodic monitoring of the contaminated groundwater as part of Five Year Reviews.

The No Action alternative is carried through the FS process to provide a baseline for comparisons of Site remedial alternatives as required by the NCP.

5.3.3.2 Alternative PG2: Monitored Natural Attenuation

Groundwater monitoring is used to evaluate the long-term performance of natural attenuation determined by "biodegradation, dispersion, dilution, and adsorption" of contaminants in groundwater as defined by the NCP (Federal Register 1990; Preamble at 8734). Natural attenuation may be a useful remedial approach if site-specific data indicate that these processes "will effectively reduce contaminants in the groundwater to concentrations protective of human health [and the environment] in a timeframe comparable to that which could be achieved through active restoration." Monitored natural attenuation (MNA) may be an appropriate remedial approach for portions of the contaminant plume when combined with other remedial measures needed to control sources and/or remediate areas with higher levels of contamination. Whether MNA is used alone or combined with other remediation methods, sufficient information is required to demonstrate that natural processes are capable of achieving the remediation objectives established for the Site.

Alternative PG2 would provide protection of human health through ICs (legal and administrative controls) to restrict access to VOC-contaminated groundwater.

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5.3.3.3 Alternative PG3: Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume

Under Alternative PG3, recovery wells would be installed on the leading edge (eastern-most, hydraulically downgradient portion) of the OU2 groundwater plume. Groundwater would be pumped to a treatment system, treated with a tray air stripper, and discharged into aquifer reinjection wells. Recovery wells at the leading edge would focus on containing the groundwater plume from further migration in the medial and lower aquifers beyond Technical Boulevard. There is no groundwater contamination in the upper aquifer at the leading edge of the plume; therefore, no recovery wells are anticipated in this zone.

The number of extraction wells and size of treatment system, and number of injection wells would be initially estimated based on results from preliminary groundwater modeling.

Extraction well(s) and piping would be installed and linked to one treatment system building. An air stripper, bag filters, and discharge pump would be installed in the treatment building.

Alternative PG3 would provide protection of human health through ICs to restrict access to VOC-contaminated groundwater.

5.3.3.4 Alternative PG4: Groundwater Recovery, Treatment, and Discharge at Mid-plume and Leading Edge of Plume

Under Alternative PG4, recovery wells would be installed on the leading edge (eastern-most, hydraulically downgradient portion) of the OU2 groundwater plume, similar to Alternative PG3. Recovery wells would also be installed at mid-plume locations to provide for additional treatment and hydraulic control. Mid-plume recovery wells would target areas of the plume with carbon tetrachloride concentrations greater than 100 μg/L in the medial aquifer (C zone), generally around S. Elm Ave. The lower aquifer (D/E zone) mid-plume recovery wells would target the plume transect along Showboat Boulevard, where carbon tetrachloride groundwater concentrations are present at up to 45 μg/L. The addition of recovery wells in the mid-plume area should reduce the timeframe for aquifer restoration.

Alternative PG4 would provide protection of human health through ICs to restrict access to VOC-contaminated groundwater.

5.3.3.5 Alternative PG5: In Situ Treatment via Groundwater Amendments

In situ EB, ISCO, or in situ chemical reduction of chlorinated VOCs would be stimulated throughout OU2. Bench- and pilot-scale studies would be conducted before full-scale implementation to determine the efficacy of EB, ISCO or reduction at the Site. DPT would be used to inject a quantity of chemical or organic substrate. Sufficient coverage, subsurface mixing with groundwater contamination and an outside to inside injection sequence would be implemented. Additional nutrient substrate and bioaugmentation may be necessary to maintain biological activity. Several applications of chemical or organic substrate may also be necessary to meet preliminary RAOs.

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A description of in situ biological and chemical remediation methods can be found in Alternative PSG3.

Alternative PG5 would provide protection of human health through ICs to restrict access to VOC-contaminated groundwater.

5.3.3.6 Alternative PG6: In Situ Treatment at Core of Plume and Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume

Alternative PG6 combines Alternatives PG3 and PG5. In situ treatment would be stimulated with injection of groundwater amendments in mid-plume areas with high contaminant concentrations in order to reduce the timeframe of aquifer restoration. Groundwater would be contained from migrating further through recovery wells installed on the leading edge of the plume.

Alternative PG6 would provide protection of human health through ICs to restrict access to VOC-contaminated groundwater.

5.4 SCREENING EVALUATION OF ALTERNATIVES

The purpose of this screening evaluation is to reduce the number of proposed remedial alternatives that undergo a more thorough and extensive analysis as presented in Section 7. Because of this purpose, these alternatives are qualitatively evaluated using a smaller set of screening evaluation criteria than what is used for detailed evaluation of retained alternatives after screening. Per the NCP guidance, each of these proposed alternatives is screened using the short- and long-term aspects (where applicable) of three broad criteria: effectiveness, implementability, and cost.

Effectiveness

Effectiveness relates to the ability of the remedial alternative to satisfy screening evaluation criteria detailed in Table 5.5.

Effectiveness of each of the proposed alternatives is judged against the five effectiveness screening criteria using the qualitative ratings system presented in Table 5.6.

Implementability

Implementability relates to the ability of the remedial alternative to satisfy screening evaluation criteria detailed in Table 5.7.

Implementability of each of the proposed alternatives is judged against the screening criteria using the qualitative ratings system presented in Table 5.8.

Determination that an alternative is not technically feasible will usually preclude it from further consideration. Negative factors affecting administrative feasibility will normally

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involve coordination steps to lessen the negative aspects of the alternative but will not necessarily eliminate an alternative from further consideration.

Cost

Cost estimates prepared for screening alternatives are typically comparative estimates with relative accuracy. This level of accuracy allows cost decisions among alternatives to sustained as the accuracy of cost estimates improve during detailed analysis of alternatives. The procedures used to develop cost estimates for alternative screening are similar to those used for detailed analysis; the differences are in the degree of alternative refinement and cost component development.

The focus of comparative screening estimates is to identify and include items that are essential to the alternatives that control the magnitude of the overall cost. Cost estimates at this step of the FS process are generally determined using cost curves, generic unit costs, vendor information, conventional cost-estimating guides, and prior similar estimates modified by site-specific information rather than detailed cost estimates. Both capital and operation and maintenance (O&M) costs are considered in these estimates. Present value analyses are performed to discount all costs to a common base year. This is performed to fairly evaluate expenditures occurring over different time frames.

Because uncertainties with the definition of alternatives may remain in this step of the FS process, the costs developed for the screening analysis of these proposed alternatives are not held to the accuracy required for the detailed analysis of alternatives (i.e. +50 percent to -30 percent of actual costs). Typical cost accuracy ranges for qualitative alternative screening are +100 percent to -50 percent of actual costs.

The cost of each proposed alternative is rated on a comparative basis with other alternatives using a scale determined from the range of costs for the screened alternatives. Due to the likely alternative costs for the Site, the cost ranges for the ratings categories are rather large. The cost rating categories are presented in Table 5.9.

The evaluation and screening of each alternative using the three screening criteria are presented in Appendix E. This evaluation and screening process is inherently qualitative in nature (with the exception of approximate cost). The evaluation criteria described in in this section are specified by EPA guidance; however, the degree to which the criteria are weighted against each other are not specified. Determination of how the individual evaluation criteria influence the overall rankings requires engineering judgment.

Generally, alternatives with similar scope and essential components would have overall rankings that are similar, unless other considerations such as large differences in waste volumes or differing construction durations exist between them. Factors that affect the threshold criteria (overall protection of human health and the environment and compliance with ARARs) are given considerable weight in the overall ranking for effectiveness since alternatives must fully meet these criteria to be viable as a selected remedy. The threshold criteria are described in further detail within Section 6.

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5.5 SUMMARY OF ALTERNATIVES SCREENING

Each alternative developed and described in Section 5.3 was evaluated to determine its overall effectiveness, implementability, and cost in Appendix E using the qualitative ratings system discussed in Section 5.4. Tables 5.10 and 5.11 summarize the results for the screening of alternatives for the Site. Generally, alternatives that have a low rating for effectiveness and/or implementability coupled with a high cost would be eliminated from further consideration. Remedial alternatives eliminated from further consideration in this FS are shaded grey on Table 5.10 and 5.11.

5.6 ALTERNATIVES RETAINED FOR DETAILED ANALYSIS

Based on the screening of the alternatives in Section 5.5, the following alternatives were retained and renumbered for detailed analysis as presented in Section 7. The "P" was dropped from the naming convention, and the alternatives were renumbered consecutively.

Remedial Alternatives to Address OU1 Contaminated Soil:

Screening Number	Detailed Analysis Number	Alternative Description
PS1	S1	No Action
PS2	S2	Excavation, Treatment, and Disposal of Contaminated Soil and Operation of Existing SVE System
PS3	S3	Expand Existing SVE System
PS4	S4	Excavation, Treatment and Disposal of Contaminated Soil and Expand SVE System

Remedial Alternatives to Address OU1 Contaminated Groundwater:

Screening Number	Detailed Analysis Number	Alternative Description
PSG1	SG1	No Action
PSG2	SG2	Maintain and Operate Existing GET System
PSG3	SG3	In Situ Treatment via Groundwater Amendments
PSG4	SG4	In Situ Treatment via Groundwater Amendments and Operation of Existing GET System

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Remedial Alternatives to Address OU2 Contaminated Groundwater:

Screening Number	Detailed Analysis Number	Alternative Description
PG1	G1	No Action
PG3	G2	Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume
PG4	G3	Groundwater Recovery, Treatment, and Discharge at Mid-plume and Leading Edge of Plume
PG6	G4	In Situ Treatment at Core of Plume and Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume

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Table 5.1 Fundamental Assumptions Considered for Development of Remedial Alternatives

Fundamental Assumption	Rationale
The GET system for OU1 is operating efficiently and no upgrades are necessary.	A groundwater model and monitoring data have shown the GET system installed at OU1 to be effective in containing source area contamination from migrating downgradient. A recent interim RD was completed to upgrade the system; no further upgrades or additional recovery wells for OU1 are anticipated.

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Table 5.2
Remedial Technologies/Process Options for Assembly into Remedial Alternatives for OU1 Contaminated Soil
Garvey Elevator Site
Hastings, NE

			Alternative PS1	Alternative PS2	Alternative PS3	Alternative PS4
General Response Action	Remedial Technology	Process Option	No Action	Excavation, Treatment and Disposal of Contaminated Soil and Operation of Existing SVE System		Excavation, Treatment and Disposal of Contaminated Soil and Expand SVE System
No Action	None	No Action	✓			
Institutional Controls	Land Use Controls	Existing Governmental and Proprietary Controls	✓	✓	✓	✓
		Additional Governmental and Proprietary Controls		✓	✓	✓
	Community Awareness	Information and Education Programs	✓	✓	✓	✓
Monitoring	Sampling and Analysis	Vapor Intrusion Monitoring	✓	✓	✓	✓
	Site Inspection	Five Year Review	✓	✓	✓	✓
Removal, Transport, Disposal	Removal	Mechanical Removal (Excavation)		✓		✓
	Transport	Mechanical Transport (Truck Hauling)		✓		✓
	Disposal	On-site Disposal		✓		✓
Soil Treatment	Physical Treatment	In Situ Soil Vapor Extraction		✓	✓	✓
		Ex Situ Soil Vapor Extraction		✓		✓

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Table 5.3
Remedial Technologies/Process Options Used to Develop
Remedial Alternatives for OU1 Contaminated Groundwater
Garvey Elevator Site
Hastings, NE

General Response Action	Remedial Technology	Process Option	Alternative PSG1 No Action	Alternative PSG2 Maintain and Operate Existing GET System	Alternative PSG3 In Situ Treatment via Groundwater Amendments	Alternative PSG4 In Situ Treatment via Groundwater Amendments and Operation of Existing GET System
No Action	None	No Action	✓			
Institutional Controls	Groundwater Use Controls	Existing Governmental and Proprietary Controls	✓	✓	✓	✓
		Additional Governmental and Proprietary Controls		✓	✓	✓
	Community Awareness	Information and Education Programs	✓	✓	✓	✓
Monitoring	Sampling and Analysis	Groundwater Monitoring	✓	✓	✓	✓
	Site Inspection	Five Year Review	✓	✓	✓	✓
Groundwater Removal	Collection	Vertical Recovery Well(s)		✓		✓
	Discharge	Aquifer Reinjection		✓		✓
Groundwater Treatment	Biological Treatment	Natural Attenuation		✓	✓	✓
		In Situ Enhanced Bioremediation			✓	✓
	Chemical Treatment	In Situ Chemical Oxidation			✓	✓
		In Situ Chemical Reduction			✓	✓
	Physical Treatment	Air Stripping		✓		✓

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Table 5.4
Remedial Technologies/Process Options Used to Develop
Remedial Alternatives for OU2 Contaminated Groundwater
Garvey Elevator Site
Hastings, NE

General Response Action	Remedial Technology	Process Option	Alternative PG1 No Action	Alternative PG2 Monitored Natural Attenuation	Alternative PG3 Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume	Alternative PG4 Groundwater Recovery, Treatment, and Discharge at Mid-plume and Leading Edge of Plume	Alternative PG5 In Situ Treatment via Groundwater Amendments	Alternative PG6 In Situ Treatment at Core of Plume and Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume
No Action	None	No Action	✓					
Institutional Controls	Groundwater Use Controls	Existing Governmental and Proprietary Controls	✓	✓	✓	✓	✓	✓
		Additional Governmental and Proprietary Controls		✓	✓	✓	✓	✓
	Community Awareness	Information and Education Programs	✓	✓	✓	✓	✓	✓
Monitoring	Sampling and Analysis	Groundwater Monitoring	✓	✓	✓	✓	✓	✓
	Site Inspection	Five Year Review	✓	✓	✓	✓	✓	✓
Groundwater Removal	Collection	Recovery Well(s)			✓	✓		✓
	Discharge	Aquifer Reinjection			✓	✓		✓
Groundwater Treatment	Biological Treatment	Natural Attenuation		✓	✓	✓	✓	✓
		In Situ Enhanced Bioremediation					✓	✓
	Chemical Treatment	In Situ Chemical Oxidation					✓	✓
		In Situ Chemical Reduction					✓	✓
	Physical Treatment	Air Stripping			✓	✓		✓

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Table 5.5 Effectiveness Criteria

Effectiveness Criteria
Overall protection of human health and the environment[1]
Compliance with ARARs[1]
Short-term effectiveness (during the remedial construction and implementation period)
Long-term effectiveness and permanence (following remedial construction)
Reduction of toxicity, mobility, or volume through treatment

[1] These criteria are referred to as "threshold criteria" that an alternative must meet to be viable (except the "no action" alternative); threshold criteria are described further in Section 6.0.

Table 5.6 Effectiveness Qualitative Ratings System

Effectiveness Ratings Categories	
⓿	None
❶	Low
❷	Low to moderate
❸	Moderate
❹	Moderate to high
❺	High

Table 5.7 Implementability Criteria

Implementability Criteria	
Technical feasibility	Ability to construct, reliably operate, and meet technology-specific regulations for process options until a RA is complete
	Ability to operate, maintain, replace, and monitor technical components after the RA is complete
Administrative feasibility	Ability to obtain approvals from other agencies
	Availability and capacity of treatment, storage, and disposal services
	Availability of property, specific materials and equipment, and technical specialists required for a RA

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Table 5.8 Implementability Qualitative Ratings System

Implementability Ratings Categories	
❶	None
❶	Low
❷	Low to moderate
❸	Moderate
❹	Moderate to high
❺	High

Table 5.9 Cost Qualitative Ratings System

Cost Ratings Categories		Cost Ranges (Present Value Dollars)
$	**Low Cost**	Less than 1 million dollars
$$	**Low to Moderate Cost**	Between 1 million and 5 million dollars
$$$	**Moderate Cost**	Between 5 million and 10 million dollars
$$$$	**Moderate to High Cost**	Between 10 million and15 million dollars
$$$$$	**High Cost**	Greater than 15 million dollars

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Table 5.10 Summary of Alternatives Screening for OU1

Alternative	Description	Effectiveness Rating	Implementability Rating	Approx. Cost (Present Value Dollars)	
Contaminated Soil					
PS1	No Action	⓿	⓿	$	$298,000
PS2	Excavation, Treatment and Disposal of Contaminated Soil and Operation of Existing SVE System	❹	❹	$	$929,000
PS3	Expand SVE System	❸	❹	$$	$1,168,000
PS4	Excavation, Treatment and Disposal of Contaminated Soil and Expand SVE System	❹	❹	$	$883,000
Contaminated Groundwater					
PSG1	No Action	⓿	⓿	$$	$1,061,000
PSG2	Maintain and Operate Existing GET System	❸	❺	$$$	$6,340,000
PSG3	In Situ Treatment via Groundwater Amendments	❸	❹	$$$$	$12,346,000
PSG4	In Situ Treatment via Groundwater Amendments and Operation of Existing GET System	❹	❹	$$$$	$10,143,000

Notes:

1. The alternatives screening process involves a qualitative assessment of the degree to which remedial alternatives address evaluation criteria presented in Appendix E. The numerical designations for the qualitative ratings system used in this table are not used to quantitatively assess remedial alternatives (for instance, rankings for an alternative are not additive).
2. Shading indicates alternative has been eliminated from further consideration based on lack of effectiveness, lack of implementability, and/or elevated costs. Remaining (unshaded) remedial alternatives have been retained for detailed analysis in Section 7.0.

Legend for Qualitative Ratings System:

Effectiveness and Implementability		Cost (Present Value Dollars)	
⓿	None	$	Low Cost ($0 through $1M)
❶	Low	$$	Low to Moderate Cost ($1M through $5M)
❷	Low to Moderate	$$$	Moderate ($5M through $10M)
❸	Moderate	$$$$	Moderate to High Cost ($10M through $15M)
❹	Moderate to High	$$$$$	High Cost (Greater than $15M)
❺	High		

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Table 5.11 Summary of Alternatives Screening for OU2

Alternative	Description	Effectiveness Rating	Implementability Rating	Approx. Cost (Present Value Dollars)	
Contaminated Groundwater					
PG1	No Action	⓿	⓿	$	$852,000
PG2	Monitored Natural Attenuation	❶	❺	$$$$	$10,800,000
PG3	Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume	❸	❸	$$$$	$11,485,000
PG4	Groundwater Recovery, Treatment, and Discharge at Mid-plume and Leading Edge of Plume	❹	❸	$$$$$	$15,550,000
PG5	In Situ Treatment via Groundwater Amendments	❸	❷	$$$$$	$33,600,000
PG6	In Situ Treatment at Core of Plume and Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume	❹	❸	$$$$$	$36,651,000

Notes:

1. The alternatives screening process involves a qualitative assessment of the degree to which remedial alternatives address evaluation criteria presented in Appendix E. The numerical designations for the qualitative ratings system used in this table are not used to quantitatively assess remedial alternatives (for instance, rankings for an alternative are not additive).
2. Shading indicates alternative has been eliminated from further consideration based on lack of effectiveness, lack of implementability, and/or elevated costs. Remaining (unshaded) remedial alternatives have been retained for detailed analysis in Section 7.0.

Legend for Qualitative Ratings System:

Effectiveness and Implementability		Cost (Present Value Dollars)	
⓿	None	$	Low Cost ($0 through $1M)
❶	Low	$$	Low to Moderate Cost ($1M through $5M)
❷	Low to Moderate	$$$	Moderate Cost ($5M through $10M)
❸	Moderate	$$$$	Moderate to High Cost ($10M through $15M)
❹	Moderate to High	$$$$$	High Cost (Greater than $15M)
❺	High		

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6.0 DEFINITION OF CRITERIA USED IN THE DETAILED ANALYSIS OF RETAINED ALTERNATIVES

The remedial alternatives retained after completion of the preliminary alternative screening step of the FS process (summarized in Section 5.0) are evaluated using nine evaluation criteria. These criteria were developed to address statutory requirements and considerations for remedial actions in accordance with the NCP and additional technical and policy considerations that have proven to be important for selecting among remedial alternatives (EPA, 1988). Alternatives are further developed and evaluated in Section 7.0. The following subsections describe the nine evaluation criteria used in the detailed analysis of remedial alternatives and the priority in which the criteria are considered.

6.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Each alternative is assessed to determine whether it can provide adequate protection of human health and the environment (short- and long-term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site. Evaluation of this criterion focuses on how Site risks are eliminated, reduced, or controlled through treatment, engineered controls, or institutional controls and whether an alternative poses any unacceptable cross-media impacts.

6.2 COMPLIANCE WITH ARARS

For this criterion, each alternative is evaluated to determine how chemical-, location-, and action-specific ARARs. If the assessment indicates an ARAR will not be met, then the basis for justifying one of the six ARAR waivers allowed under CERCLA is discussed. These ARAR waivers are detailed in Table 6.1.

Criteria Used to Evaluate Remedial Alternatives Address Multiple Areas

- Protection of Human Health and Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance

6.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Long-term effectiveness evaluates the likelihood that the remedy will be successful and the permanence that it affords. Factors to be considered, as appropriate, include the following:

- Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities. The characteristics of the residuals are considered to the degree that they remain hazardous, taking into account their toxicity, mobility, or volume and propensity to bioaccumulate.

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- Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site. This factor includes an assessment of containment systems and institutional controls to determine if they are sufficient to ensure that any exposure to human and ecological receptors is within protective levels. This factor also addresses the long-term reliability of management controls for providing continued protection from residuals, the assessment of the potential need to replace technical components of the alternative, and the potential exposure pathways and risks posed should the remedial action need replacement.

6.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Each alternative is assessed for the degree to which it employs technology to permanently and significantly reduce toxicity, mobility, or volume, including how treatment is used to address the principal threats posed by the Site. Factors to be considered, as appropriate, include the following:

- The treatment processes the alternatives use and materials they will treat
- The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated, including how the principal threat(s) will be addressed
- The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment
- The degree to which the treatment is irreversible
- The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous substances and their constituents
- Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action

6.5 SHORT-TERM EFFECTIVENESS

This criterion reviews the effects of each alternative during the construction and implementation phase of the remedial action until remedial response objectives are met. The short-term impacts of each alternative are assessed, considering the following factors, as appropriate:

- Short-term risks that might be posed to the community during implementation of an alternative.
- Potential impacts on workers during implementation of a remedial action and the effectiveness and reliability of protective measures.
- Potential adverse environmental impacts resulting from construction and implementation of an alternative and the reliability of the available mitigation measures during implementation in preventing or reducing the potential impacts.
- Time until protection is achieved.

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6.6 IMPLEMENTABILITY

The technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation is evaluated under this criterion. The ease or difficulty of implementing each alternative will be assessed by considering the following factors detailed in Table 6.2.

6.7 COST

Types of costs that are assessed for each alternative include the following:

- Capital costs
- Annual O&M costs
- Periodic costs
- Present value of capital and annual O&M costs

Cost estimates are developed according to *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA, 2000a). Flexibility is incorporated into each alternative for the location of remedial facilities, the selection of cleanup levels, and the period in which remedial action will be completed. Assumptions of the project scope and duration are defined for each alternative to provide cost estimates for the various remedial alternatives. Important assumptions specific to each alternative are summarized in the description of the alternative. Additional assumptions are included in the detailed cost estimates in Appendix G.

The levels of detail employed in making these estimates are conceptual but are considered appropriate for making choices between alternatives. The information provided in the cost estimate is based on the best available information regarding the anticipated scope of the remedial alternatives.

The costs are evaluated with respect to the following categories:

- Capital costs are those expenditures that are required to construct a remedial action. They are exclusive of costs required to operate or maintain the action throughout its lifetime. Capital costs consist primarily of expenditures initially incurred to build or install the remedial action (e.g., construction of a water treatment system and related Site work). Capital costs include all labor, equipment, and material costs (including contractor markups, such as overhead and profit) associated with activities, such as mobilization/demobilization; monitoring Site work; installation of extraction, containment, or treatment systems; and disposal. Capital costs also include expenditures for professional/technical services that are necessary to support construction of the remedial action.
- Annual costs are those post-construction costs necessary to ensure or verify the continued effectiveness of a remedial action. These costs are estimated mostly on an annual basis. Annual costs include all labor, equipment, and material costs associated with activities, such as monitoring; operating and maintaining extraction, containment, or treatment systems; and disposal. Annual costs also include expenditures for professional/technical services necessary to support O&M activities and monitoring and enforcement of ICs or environmental covenants.

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- Periodic costs are those costs that occur only once every few years (for example, 5-year reviews, equipment replacement) or expenditures that occur only once during the entire O&M period or remedial time frame, such as Site closeout, or remedy failure and replacement. These costs may be either capital or O&M costs but, because of their periodic nature, it is more practical to consider them separately from other capital or O&M costs in the estimating process.
- The present value of each alternative provides the basis for the cost comparison. The present value cost represents the amount of money that, if invested in the initial year of the remedial action at a given rate, would provide the funds required to make future payments to cover all costs associated with the remedial action over its planned life. Future O&M and periodic costs are included and reduced by a present value discount rate. The use of discount rates for present value cost analyses is stated in the preamble to the NCP (55 FR 8722) and in OSWER Directive 9355.3-20 (Revisions to Office of Management and Budget [OMB] Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis, 1993). As outlined in *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA, 2000a), a 7 percent real discount rate should be applied over the period of evaluation for each alternative. The real discount rate is defined as:

$$\text{real discount rate} = [(1+\text{nominal discount rate})/(1+\text{inflation rate})] - 1$$

The nominal discount rate is typically called the nominal interest rate (e.g., on bonds).

A seven percent real discount rate not considering inflation would yield a nominal discount rate of seven percent. In addition, a seven percent real discount rate considering inflation would result in a nominal discount rate greater than seven percent.

The 20-year nominal treasury interest rates for the last eight years (no data is available prior to 2004 for the 20-year interest rate) have generally been less than six percent and inflation over the same period has averaged around three percent per year. Thus, the seven percent real discount rate is not appropriate to use for alternative evaluation cost estimating within this FS at this time for the reasons cited. An inflation rate of 3.15 percent (average of 20 years of Engineering News Record [ENR] Construction Cost Indices rounded to nearest tenth of a percent) and a nominal discount (interest) rate of 5.0 percent (average of the last 20 years of nominal 30-year treasury interest rates rounded to the nearest quarter of a percent) will be applied separately in the determination of net present value.

6.8 STATE ACCEPTANCE

This criterion evaluates the technical and administrative issues and concerns the state may have regarding each of the alternatives. Assessment of state concerns will be completed after comments on the FS and proposed plan have been received by EPA and are addressed in the ROD. Thus, state acceptance is not considered in the detailed evaluation of alternatives presented in this FS.

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6.9 COMMUNITY ACCEPTANCE

Assessment of concerns from the public will be completed after comments on the FS and proposed plan have been received by EPA and are addressed in the ROD. Thus, community acceptance is not considered in the detailed evaluation of alternatives presented in this FS.

6.10 CRITERIA PRIORITIES

The nine evaluation criteria are separated into three groups to establish priority among these criteria during detailed evaluation of the remedial alternatives as detailed in Table 6.3.

For this FS, threshold and balancing criteria are evaluated for each alternative using a qualitative ratings system. The ratings system defines the ability of the alternative to satisfy each of the threshold and balancing criteria, with exception to cost. Cost is rated based on the actual cost provided in the cost estimate for each alternative. The qualitative ratings system definitions for the threshold and balancing criteria are provided in Table 6.4.

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TABLE(S)

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Table 6.1 ARAR Waivers

Waiver	Description
Interim Measures	The RA selected is only part of a total RA that will attain such level or standard of control when completed. (CERCLA §121(d)(4)(A).)
Greater Risk to Health and the Environment	Compliance with such requirement at the facility will result in greater risk to human health and the environment than alternative options. (CERCLA §121(d)(4)(B).)
Technical Impracticability	Compliance with such requirement is technically impracticable from an engineering perspective. (CERCLA §121(d)(4)(C).)
Equivalent Standard of Performance	The RA selected will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, criteria, or limitation through use of another method or approach. (CERCLA §121(d)(4)(D).)
Inconsistent Application of State Requirements	With respect to a state standard, requirement, criteria, or limitation, the state has not consistently applied (or demonstrated the intention to consistently apply) the standard, requirement, criteria, or limitation in similar circumstances at other RAs. (CERCLA §121(d)(4)(E).)
Fund Balancing	In the case of a RA to be undertaken solely under Section 104 using the fund, selection of an RA that attains such level or standard of control will not provide a balance between the need for protection of public health and welfare and the environment at the facility under consideration and the availability of amounts from the fund to respond to other sites which present or may present a threat to public health or welfare or the environment, taking into consideration the relative immediacy of such threats. (CERCLA §121(d)(4)(F).)

Table 6.2 Implementability Factors to be Considered during Alternative Evaluation

Criteria	Factors TBC
Technical Feasibility	• Technical difficulties and unknowns associated with the construction and operation of a technology. • Reliability of the technology, focusing on technical problems that will lead to schedule delays. • Ease of undertaking additional RAs, including what, if any, future RAs would be needed and the difficulty to implement additional RAs. • Ability to monitor the effectiveness of the remedy, including an evaluation of risks of exposure should monitoring be insufficient to detect a system failure.
Administrative Feasibility	• Activities needed to coordinate with other offices and agencies and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions).
Availability of Services and Materials	• Availability of adequate off-site treatment, storage capacity, and disposal capacity and services. • Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources. • Availability of services and materials plus the potential for obtaining competitive bids, which is particularly important for innovative technologies. • Availability of prospective technologies.

Table 6.3 Criteria Priorities

Group	Criteria	Definition
Threshold Criteria	• Overall Protection of Human Health and the Environment • Compliance with ARARs	Must be satisfied by the remedial alternative being considered as the preferred remedy.
Balancing Criteria	• Long-Term Effectiveness and Permanence • Reduction of Toxicity, Mobility, or Volume through Treatment • Short-Term Effectiveness • Implementability • Cost	Technical criteria evaluated among those alternatives satisfying the threshold criteria.
Modifying Criteria	• State Acceptance and Community Acceptance	Not evaluated in this FS; will be evaluated after comments are received on the FS and proposed plan.

Table 6.4 Ratings System for Evaluation of Alternatives

Ratings Categories for Threshold Criteria	Ratings Categories for Balancing Criteria
— Unacceptable	❶ None
+ Acceptable	❶ Low
	❷ Low to moderate
	❸ Moderate
	❹ Moderate to high
	❺ High

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7.0 DETAILED ANALYSIS OF RETAINED ALTERNATIVES

7.1 OVERVIEW

In this section, remedial alternatives retained in Section 5 undergo detailed analysis. During detailed analysis, each alternative is assessed using the two threshold criteria and five balancing criteria presented in Section 6. The results of the detailed analysis for each remedial alterative are then arrayed to perform a comparative analysis of the alternatives and identify the key tradeoffs between them. The following alternatives were retained and renumbered for detailed analysis:

Alternatives to Address OU1 Contaminated Soil

- Alternative S1: No Action
- Alternative S2: Excavation, Treatment and Disposal of Contaminated Soil and Operation of Existing SVE System
- Alternative S3: Expand SVE System
- Alternative S4: Excavation, Treatment and Disposal of Contaminated Soil and Expand SVE System

Remedial Alternatives to Address OU1 Contaminated Groundwater

- Alternative SG1: No Action
- Alternative SG2: Maintain and Operate Existing GET System
- Alternative SG3: In Situ Treatment via Groundwater Amendments
- Alternative SG4: In Situ Treatment via Groundwater Amendments and Operation of Existing GET System

Remedial Alternatives to Address OU2 Contaminated Groundwater

- Alternative G1: No Action
- Alternative G2: Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume
- Alternative G3: Groundwater Recovery, Treatment, and Discharge at Mid-plume and Leading Edge of Plume
- Alternative G4: In Situ Treatment at Core of Plume and Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume

7.2 SECONDARY ASSUMPTIONS AFFECTING DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

Fundamental assumptions for all remedial alternatives used during alternative development and screening were presented in Section 5. However, there are numerous secondary assumptions that affect the detailed analysis of alternatives but are not fundamental controlling considerations. These assumptions are driven mainly by site limitations and constraints that cannot be overcome by using one or more retained remedial technology/process options as

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described in Section 4. Some of these secondary assumptions are grouped into distinct categories and include the items listed in Table 7.1.

7.3 ALTERNATIVES FOR OU1 CONTAMINATED SOIL

7.3.1 Alternative S1: No Action

7.3.1.1 Remedial Alternative Description

Alternative S1 is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared. The No Action alternative would include discontinuing operation of the SVE system at the Site. The only actions that would be implemented for Alternative S1 are completion of Five Year Reviews as required by the NCP and periodic monitoring. There would be no change in the soil contaminant concentrations because no treatment, containment, or removal of contaminated soil is included in this alternative.

7.3.1.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative S1 is provided in Table E.1A using the evaluation criteria along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S1 is unacceptable. —

7.3.1.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative S1 is provided in Table E.1B using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative S1 is unacceptable. —

7.3.1.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative S1 is provided in Table E.1C using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S1 is none. O

7.3.1.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative S1 is provided in Table E.1D using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S1 is none. O

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7.3.1.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative S1 is provided in Table E.1E using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S1 is none. ⓿

7.3.1.7 Implementability

Evaluation of implementability for Alternative S1 is provided in Table E.1F using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S1 is none. ⓿

7.3.1.8 Cost

Evaluation of cost for Alternative S1 is provided in Table E.1G using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The present value cost for Alternative S1 is $298,000.

7.3.2 Alternative S2: Excavation, Treatment and Disposal of Contaminated Soil and Operation of Existing SVE System

7.3.2.1 Remedial Alternative Description

Alternative S2 protects the environment through removal, on-site treatment and on-site disposal of residual contaminated soil from the source area and continued operation of the existing SVE system. Soil with contaminant concentrations exceeding cleanup goals would be excavated and treated on site. Excavation adjacent to the silos would require temporary shoring or protection depending on the excavation depth. Additional safety measures would be required with working in proximity to an active grain storage facility. The volume of excavation is approximately 90 bank cubic yards (bcy), with an area of 40 feet by 10 feet, 6 feet deep, in the region just north of the silos in or near the known source area of the former liquid fumigant AST area. Confirmatory sampling of the excavation sidewalls and floor would be performed to determine whether COCs are present above the cleanup goals. If needed, additional excavation would be done in an iterative process until confirmatory sampling results indicate that cleanup goals have been met. Clean fill from an on-site borrow pit would be used to backfill the excavated area. For purposes of this FS, it is assumed that the soil obtained from an on-site borrow area would be suitable for use as backfill. Figure 7.1 illustrates the locations of the preliminary excavation and borrow areas.

Contaminated soil would be characterized and treated as needed on site. Soil would be placed in an on-site ex situ SVE treatment area to reduce concentrations to meet disposal requirements for on-site disposal. The ex-situ SVE treatment area would consist of contaminated soil placed on a polyethylene sheet, PVC pipe venting running through the contaminated soil. A blower would be used to remove contaminants and introduce oxygen to promote biological breakdown of contaminants. After soil contamination is reduced below cleanup goals, the treated soil would be placed into the on-site borrow pit, compacted, and seeded. Figure 7.1 shows the preliminary location of the treatment area.

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This alternative would make use of the existing in situ SVE system operation which was previously implemented at the site by the PRP. The five shallow and three deep SVE well system would continue to operate with no upgrades or expansions performed. Operations, maintenance, and system monitoring would continue to be performed.

For purposes of this FS, it is assumed that the treatment system would need to be operated an additional 5 years after excavation to achieve cleanup levels. Five year reviews would be performed for a total of 30 years.

7.3.2.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative S2 is provided in Table E.2A using the evaluation criteria along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S2 is acceptable. +

7.3.2.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative S2 is provided in Table E.2B using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative S2 is acceptable. +

7.3.2.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative S2 is provided in Table E.2C using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S2 is moderate to high. ❸

7.3.2.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative S2 is provided in Table E.2D using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S2 is moderate to high. ❸

7.3.2.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative S2 is provided in Table E.2E using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S2 is moderate. ❸

7.3.2.7 Implementability

Evaluation of implementability for Alternative S2 is provided in Table E.2F using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S2 is moderate. ❸

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7.3.2.8 Cost

Evaluation of cost for Alternative S2 is provided in Table E.2G using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The present value cost for Alternative S2 is $929,000.

7.3.3 Alternative S3: Expand SVE System

7.3.3.1 Remedial Alternative Description

Alternative S3 expands the treatment area of the SVE system by installing a shallow (20 to 50 feet bgs screen) and deep (60 to 110 feet bgs screen) SVE well in the source area. The current system at the site does not operate any emissions treatment process; however, a catalytic oxidation unit and scrubber exist and could be re-activated if treatment prior to discharge is needed to comply with state air regulations. Figure 7.2 shows the preliminary locations of the additional SVE wells and the pipeline connection to the existing system.

For purposes of this FS, it is assumed that the treatment system would need to be operated 10 years after installation of additional SVE wells to achieve cleanup levels.

Alternative S3 would include the implementation of the necessary LUCs/ICs to protect human health and the environment.

7.3.3.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative S3 is provided in Table E.3A using the evaluation criteria along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S3 is acceptable. +

7.3.3.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative S3 is provided in Table E.3B using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative S3 is acceptable. +

7.3.3.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative S3 is provided in Table E.3C using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S3 is moderate. ❹

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7.3.3.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative S3 is provided in Table E.3D using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S3 is moderate to high. ❹

7.3.3.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative S3 is provided in Table E.3E using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S3 is moderate to high. ❸

7.3.3.7 Implementability

Evaluation of implementability for Alternative S3 is provided in Table E.3F using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S3 is moderate to high. ❹

7.3.3.8 Cost

Evaluation of cost for Alternative S3 is provided in Table E.3G using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The present value cost for Alternative S3 is $1,168,000.

7.3.4 Alternative S4: Excavation, Treatment and Disposal of Contaminated Soil and Expand SVE System

7.3.4.1 Remedial Alternative Description

Alternative S4 combines Alternatives S2 and S3 to minimize the time frame that the SVE system would be required to operate. This alternative protects the environment through removal, treatment and on-site disposal of residual contaminated soil from the source area as described in detail in Alternative S2 and continues to remove VOCs from the vadose zone on site as described in Alternative S3.

For purposes of this FS, it is assumed that the treatment system would need to be operated an additional 5 years after excavation to achieve cleanup levels.

7.3.4.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative S4 is provided in Table E.4A using the evaluation criteria along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S4 is acceptable. +

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7.3.4.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative S4 is provided in Table E.4B using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative S4 is acceptable. +

7.3.4.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative S4 is provided in Table E.4C using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S4 is moderate to high. ❺

7.3.4.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative S4 is provided in Table E.4D using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S4 is moderate to high. ❹

7.3.4.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative S4 is provided in Table E.4E using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S4 is moderate. ❸

7.3.4.7 Implementability

Evaluation of implementability for Alternative S4 is provided in Table E.4F using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative S4 is moderate. ❸

7.3.4.8 Cost

Evaluation of cost for Alternative S4 is provided in Table E.4G using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The present value cost for Alternative S4 is $883,000.

7.4 ALTERNATIVES FOR OU1 CONTAMINATED GROUNDWATER

7.4.1 Alternative SG1: No Action

7.4.1.1 Remedial Alternative Description

Alternative SG1 is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared. The only actions that would be

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implemented for Alternative SG1 are completion of Five Year Reviews as required by the NCP, periodic groundwater monitoring in support of the Five Year Reviews, and dismantling of the existing GET system and abandonment of recovery wells. There would be no change in the groundwater contaminant concentrations because no treatment, containment, or removal of contaminated groundwater is included in this alternative.

7.4.1.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative SG1 is provided in Table E.5A using the evaluation criteria along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG1 is unacceptable. ▬

7.4.1.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative SG1 is provided in Table E.5B using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative SG1 is unacceptable. ▬

7.4.1.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative SG1 is provided in Table E.5C using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG1 is none. ⓪

7.4.1.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative SG1 is provided in Table E.5D using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG1 is none. ⓪

7.4.1.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative SG1 is provided in Table E.5E using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG1 is none. ⓪

7.4.1.7 Implementability

Evaluation of implementability for Alternative SG1 is provided in Table E.5F using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG1 is none. ⓪

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7.4.1.8 Cost

Evaluation of cost for Alternative SG1 is provided in Table E.5G using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The present value cost for Alternative SG1 is $1,061,000.

7.4.2 Alternative SG2: Maintain and Operate Existing GET System

7.4.2.1 Remedial Alternative Description

Under Alternative SG2, the GET system implemented at the Site under previous interim actions would continue to be maintained and operated as is. The system consists of eight existing recovery wells pumping extracted groundwater to the treatment building where it combines in a single header and flows through bag filters and is treated by an air stripping unit. Section 2.10 provides a detailed description of the existing system and its performance.

Under Alternative SG2, the current GET system would continue to be operated to remove contaminants in groundwater, and O&M would continue. The GET system would not be expanded or otherwise enhanced. A recent groundwater model developed by HGL showed the current system is capturing the extent of the OU1 contamination effectively and preventing further migration of contaminants.

For purposes of this FS, it is assumed that groundwater monitoring would be conducted at the site quarterly for the first year, semiannually for 4 years, and annually for 25 years. The overall remediation time period for Alternative SG2 is estimated to be approximately 30 years based on groundwater modeling.

7.4.2.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative SG2 is provided in Table E.6A using the evaluation criteria along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG2 is acceptable. +

7.4.2.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative SG2 is provided in Table E.6B using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative SG2 is acceptable. +

7.4.2.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative SG2 is provided in Table E.6C using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG2 is moderate. ❺

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7.4.2.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative SG2 is provided in Table E.6D using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG2 is moderate. ❹

7.4.2.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative SG2 is provided in Table E.6E using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG2 is high. ❹

7.4.2.7 Implementability

Evaluation of implementability for Alternative SG2 is provided in Table E.6F using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG2 is high. ❺

7.4.2.8 Cost

Evaluation of cost for Alternative SG2 is provided in Table E.6G using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The present value cost for Alternative SG2 is $6,340,000.

7.4.3 Alternative SG3: In Situ Treatment via Groundwater Amendments

7.4.3.1 Remedial Alternative Description

Under Alternative SG3, in situ EB, in situ chemical oxidation, or in situ chemical reduction of chlorinated VOCs would be stimulated at the contaminant source area. These technologies are described in Section 5. Figure 7.3 shows the areas of groundwater contamination that would be targeted by in situ treatment. It was assumed that injections would be accomplished with by DPT. Bench- and pilot-scale studies would be conducted before full-scale implementation to determine the efficacy of EB, in situ chemical oxidation or reduction at the site. These studies would also determine the need for bioaugmentation at the site.

The existing GET system would be shut down during injections to prevent injected materials from being extracted and entering the treatment system. If the injections are successful, the GET system would be dismantled, and the equipment removed from the existing treatment building. The extraction piping would be removed and the recovery wells would be abandoned.

For purposes of this FS, it is assumed that substrate injection would be conducted once a year for 5 years. Groundwater monitoring would be conducted at the site quarterly for the first year, semiannually for 14 years. The overall remediation time period for Alternative SG3 is estimated to be 15 years based on groundwater modeling.

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7.4.3.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative SG3 is provided in Table E.7A using the evaluation criteria along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG3 is acceptable. +

7.4.3.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative SG3 is provided in Table E.7B using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative SG3 is acceptable. +

7.4.3.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative SG3 is provided in Table E.7C using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG3 is moderate. ❹

7.4.3.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative SG3 is provided in Table E.7D using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG3 is moderate to high. ❸

7.4.3.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative SG3 is provided in Table E.7E using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG3 is moderate. ❸

7.4.3.7 Implementability

Evaluation of implementability for Alternative SG3 is provided in Table E.7F using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG3 is moderate. ❸

7.4.3.8 Cost

Evaluation of cost for Alternative SG3 is provided in Table E.7G using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The present value cost for Alternative SG3 is $12,346,000.

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7.4.4 Alternative SG4: In Situ Treatment via Groundwater Amendments and Expand SVE System

7.4.4.1 Remedial Alternative Description

Alternative SG4 will combine components of SG2 and SG3 to reduce total cleanup time and decrease operating costs of the GET system. The in situ treatment would target areas of the OU1 plume with concentrations greater than 500 μg/L in the upper and medial aquifers. Due to the shallower depths, it was assumed that injections would be accomplished with DPT. The other components of the in situ alternative would be as described in Alternative SG3. The continued operation of the GET system would be adjusted so that only the peripheral extraction wells would pump at adjusted pumping rates so as not to extract injection materials into the system from the area being treated via injection of amendments.

For purposes of this FS, it is assumed that groundwater monitoring would be conducted at the site quarterly in years 0 and 1, semiannually for 4 years, and annually for 5 years. The overall remediation time period for Alternative SG4 is estimated to be 10 years.

7.4.4.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative SG4 is provided in Table E.8A using the evaluation criteria along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG4 is acceptable. +

7.4.4.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative SG4 is provided in Table E.8B using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative SG4 is acceptable. +

7.4.4.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative SG4 is provided in Table E.8C using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG4 is moderate to high. ❺

7.4.4.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative SG4 is provided in Table E.8D using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG4 is moderate to high. ❹

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7.4.4.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative SG4 is provided in Table E.8E using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG4 is moderate to high. ❸

7.4.4.7 Implementability

Evaluation of implementability for Alternative SG4 is provided in Table E.8F using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative SG4 is moderate to high. ❸

7.4.4.8 Cost

Evaluation of cost for Alternative SG4 is provided in Table E.8G using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The present value cost for Alternative SG4 is $10,143,000.

7.5 ALTERNATIVES FOR OU2 CONTAMINATED GROUNDWATER

7.5.1 Alternative G1: No Action

7.5.1.1 Remedial Alternative Description

Alternative G1 is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared. The only actions that would be implemented for Alternative G1 are completion of Five Year Reviews as required by the NCP and periodic groundwater monitoring in support of Five Year Reviews. There would be no change in the groundwater contaminant concentrations because no treatment, containment, or removal of contaminated groundwater is included in this alternative.

7.5.1.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative G1 is provided in Table E.9A using the evaluation criteria along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G1 is unacceptable. ▬

7.5.1.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative G1 is provided in Table E.9B using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative G1 is unacceptable. ▬

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7.5.1.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative G1 is provided in Table E.9C using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G1 is none. ⓿

7.5.1.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative G1 is provided in Table E.9D using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G1 is none. ⓿

7.5.1.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative G1 is provided in Table E.9E using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G1 is none. ⓿

7.5.1.7 Implementability

Evaluation of implementability for Alternative G1 is provided in Table E.9F using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G1 is none. ⓿

7.5.1.8 Cost

Evaluation of cost for Alternative G1 is provided in Table E.9G using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The present value cost for Alternative G1 is $852,000.

7.5.2 Alternative G2: Groundwater Recovery, Treatment and Discharge at Leading Edge of Plume

7.5.2.1 Remedial Alternative Description

Recovery wells would be installed at the leading edge of the OU2 groundwater plume and would focus on containing the groundwater plume from further migration in the medial and lower aquifers beyond Technical Boulevard. Groundwater would be pumped to a newly constructed treatment system, located along Blaine Avenue. The number of recovery wells, the approximate locations, and groundwater extraction rates has been estimated by a sitewide groundwater model. There is no groundwater contamination in the upper aquifer at the leading edge of the plume, therefore no recovery wells would be needed in this zone. It is currently estimated that three medial-level and three deep-level recovery wells pumping at a combined rate of approximately 825 gpm would be needed to intercept the contaminant plume. Recovery wells and piping would be installed and piped to the treatment system. The treatment system

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would be constructed in a similar manner to the GET system for OU1. Bag filters and an air stripper (sized according to the expected flow) would provide treatment prior to reinjection into the aquifer. Operation of the treatment system would prevent further migration of contaminated groundwater and restore the aquifer to levels at or below the PCLs for the site. ICs would provide protection of human health through the restriction of access to VOC-contaminated groundwater. The proposed IC area is illustrated on Figure 7.4.

Figure 7.5 shows the preliminary locations of recovery wells and the location of pipelines and the treatment system. Final locations would be based on the availability of right-of-way and easement agreements with property owners. If right-of-way is not available or easements cannot be obtained, the locations of recovery wells may not be in an optimum location for effective groundwater interception. The number of recovery wells necessary may need to be increased to compensate for locations that are not optimum.

For purposes of this FS, it is assumed that groundwater monitoring would be conducted at the site quarterly for the first year, semiannually for 4 years, and annually for 95 years. The overall remediation time period for Alternative G2 is estimated to be more than 100 years.

7.5.2.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative G2 is provided in Table E.10A using the evaluation criteria along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G2 is acceptable. **+**

7.5.2.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative G2 is provided in Table E.10B using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative G2 is acceptable. **+**

7.5.2.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative G2 is provided in Table E.10C using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G2 is moderate. ❹

7.5.2.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative G2 is provided in Table E.10D using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G2 is moderate. ❹

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7.5.2.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative G2 is provided in Table E.10E using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G2 is moderate to high. ❸

7.5.2.7 Implementability

Evaluation of implementability for Alternative G2 is provided in Table E.10F using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G2 is moderate. ❹

7.5.2.8 Cost

Evaluation of cost for Alternative G2 is provided in Table E.10G using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The present value cost for Alternative G2 is $11,485,000.

7.5.3 Alternative G3: Groundwater Recovery, Treatment and Discharge at Mid-plume and Leading Edge of Plume

7.5.3.1 Remedial Alternative Description

Alternative G3 would have the same elements as Alternative G2, with the addition of recovery wells focused in the mid-plume area. Mid-plume recovery wells would target areas of the plume with carbon tetrachloride concentrations greater than 100 μg/L in the medial aquifer (C zone), generally around South Elm Avenue. The lower aquifer (D/E zone) mid-plume recovery wells would target the plume transect along Showboat Boulevard, where concentrations are found as high 45 μg/L. The presence of recovery wells in the mid-plume area should reduce the timeframe of aquifer restoration. The number of recovery wells, the approximate locations, and groundwater extraction rates has been estimated by a sitewide groundwater model. There is no groundwater contamination in the upper aquifer at the leading edge of the plume; therefore, no recovery wells would be needed in this zone. It is currently estimated that six medial-level and six deep-level recovery wells pumping at a combined rate of approximately 1,650 gpm would be needed to intercept the contaminant plume. Recovery wells and piping would be installed and piped to the treatment system. The treatment system would be constructed in a similar manner to the GET system for OU1. Bag filters and an air stripper (sized according to the expected flow) would provide treatment prior to reinjection into the aquifer. Operation of the treatment system would prevent further migration of contaminated groundwater and restore the aquifer to levels at or below the PCLs for the site. ICs would provide protection of human health through the restriction of access to VOC-contaminated groundwater.

Figure 7.6 shows the preliminary locations of recovery wells and the location of pipelines and the treatment system. Final locations would be based on the availability of right-of-way and easement agreements with property owners. If right-of-way is not available or easements cannot be obtained, the locations of recovery wells may not be in an optimum location for

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effective groundwater interception. The number of recovery wells necessary may need to be increased to compensate for locations that are not optimum.

For purposes of this FS, it is assumed that groundwater monitoring would be conducted at the site quarterly for the first year, semiannually for 4 years, and annually for 70 years. The overall remediation time period for Alternative G3 is estimated to be 75 years.

7.5.3.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative G3 is provided in Table E.11A using the evaluation criteria along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G3 is acceptable. +

7.5.3.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative G3 is provided in Table E.11B using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative G3 is acceptable. +

7.5.3.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative G3 is provided in Table E.11C using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G3 is moderate to high. ❹

7.5.3.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative G3 is provided in Table E.11D using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G3 is moderate to high. ❹

7.5.3.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative G3 is provided in Table E.11E using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G3 is moderate to high. ❹

7.5.3.7 Implementability

Evaluation of implementability for Alternative G3 is provided in Table E.11F using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G3 is moderate. ❸

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7.5.3.8 Cost

Evaluation of cost for Alternative G3 is provided in Table E.11G using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The present value cost for Alternative G3 is $15,550,000.

7.5.4 Alternative G4: In Situ Treatment at Core of Plume and Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume

7.5.4.1 Remedial Alternative Description

Alternative G4 combines Alternative G2 with in situ treatment through groundwater amendments in the core of the contaminant plume. Operation of the treatment system would prevent further migration of contaminated groundwater and restore the aquifer to levels at or below the PCLs for the site. In situ treatment would further reduce concentrations, reducing the time table for aquifer restoration and operation of the treatment system. In situ treatment options are described in Section 5. ICs would provide protection of human health through the restriction of access to VOC-contaminated groundwater.

The number of recovery wells, their approximate locations, and groundwater extraction rates has been estimated by a site-wide groundwater model. There is no groundwater contamination in the upper aquifer at the leading edge of the plume; therefore, no recovery wells would be needed in this zone. It is currently estimated that three medial-level and three deep-level recovery wells pumping at a combined rate of approximately 825 gpm would be needed to intercept the contaminant plume.

Injection wells would be installed in one transect perpendicular to the flow of groundwater. The injection wells would be located to treat groundwater with the highest concentrations of contaminants. It is likely that multiple injections would need to be conducted to achieve cleanup goals. For purposes of this FS, it is assumed that injections would be conducted annually for five years.

Figure 7.7 shows the preliminary locations of recovery wells, pipelines, and treatment system to address groundwater contamination in the core of the contaminant plume.

For purposes of this FS, it is assumed that groundwater monitoring would be conducted at the site quarterly for the first year, semiannually for 4 years, and annually for 70 years. The overall remediation time period for Alternative G4 is estimated to be 75 years.

7.5.4.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative G4 is provided in Table E.12A using the evaluation criteria along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G4 is acceptable. **+**

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7.5.4.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative G4 is provided in Table E.12B using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative G4 is acceptable. +

7.5.4.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative G4 is provided in Table E.12C using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G4 is moderate to high. ❹

7.5.4.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative G4 is provided in Table E.12D using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G4 is moderate to high. ❹

7.5.4.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative G4 is provided in Table E.12E using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G4 is moderate to high. ❸

7.5.4.7 Implementability

Evaluation of implementability for Alternative G4 is provided in Table E.12F using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative G4 is moderate. ❷

7.5.4.8 Cost

Evaluation of cost for Alternative G4 is provided in Table E.12G using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The present value cost for Alternative G4 is $36,651,000.

7.6 COMPARATIVE ANALYSIS OF ALTERNATIVES

This FS evaluated the 10 retained remedial alternatives discussed in this section against the 2 threshold criteria and 5 balancing criteria. The results of the detailed analysis for each remedial alterative are presented in Table 7.2 for OU1 soil and groundwater and Table 7.3 for OU2 groundwater to allow a comparative analysis of the alternatives and identify the key tradeoffs between them.

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Consistent with Table 7.2 and Table 7.3, a comparative analysis for the remedial alternatives using the threshold and balancing criteria is described in the following subsections. Only significant comparative differences between alternatives are presented; the full set of rationale for the qualitative ratings is provided in Appendix E.

7.6.1 OU1 Contaminated Soil

7.6.1.1 Overall Protection of Human Health and the Environment

Of the three retained alternatives, only the "no action" alternative (i.e. Alternative S1) fails to provide protection for human health and the environment and did not address the preliminary RAOs. Thus, this alternative was given a rating of unacceptable.

Alternatives S2, S3 and S4 were both given a rating of acceptable. These alternatives address contaminated soil through continued operation of the existing SVE system and address high concentration areas through excavation or additional SVE wells. Under Alternatives S2 and S4, removal of contaminated soil near the former liquid fumigant AST source area would significantly reduce the migration of contaminants to groundwater. Alternative S3 would address the high contamination area left from the liquid fumigant AST, but would address it on a longer time frame through SVE.

7.6.1.2 Compliance with ARARs

Alternative S1 fails to be compliant with the chemical-specific ARARs identified for the site since no action is taken. Thus, this alternative was given a rating of unacceptable.

Alternatives S2 and S4 were given acceptable ratings under the assumption that disposal of excavated material would be in compliance with ARARs. Alternative S3 was given an acceptable rating under the assumption that expansion and operation of the SVE system would be in compliance with ARARs.

7.6.1.3 Long-Term Effectiveness and Permanence

Alternative S1 fails to provide long-term effectiveness and permanence since no action is taken. Thus, this alternative was given a rating of none.

Alternative S2 was given a moderate rating for long-term effectiveness because excavation of contaminated soil would reduce the overall time frame for completion of remediation. Although Alternative S3 includes expansion of the existing system and was given a moderate to high rating; however it would not include excavation of contaminated soil. Alternative S4 was given a high rating because it would reduce the overall time frame for completion of remediation through both the excavation of the contaminated soil and the expansion of the SVE system.

7.6.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative S1 fails to provide a reduction of toxicity, mobility, or volume of contaminated groundwater since no action is taken. Thus, this alternative was given a rating of none.

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Alternatives S2 and S4 were given a rating of moderate and moderate to high, respectively, because highly contaminated material would be removed, effectively reducing migration of contaminants to groundwater. Contaminated material would be treated prior to on-site disposal. The SVE system would continue to be operated.

Alternative S3 provides reduction of toxicity, mobility, and volume of contamination through expansion of the SVE system and was given a rating of moderate to high.

7.6.1.5 Short-Term Effectiveness

Alternative S1 fails to provide short-term effectiveness since no action is taken. Thus, this alternative was given a rating of none.

Alternatives S2 and S4 were given a moderate rating because of the risks associated with excavating contaminated soil in proximity to the grain storage silos and the potential impact to an active business. Alternative S3 was given a rating of moderate because installation of additional SVE wells would not be as disruptive or pose as many risks as excavation of contamination soil.

7.6.1.6 Implementability

Alternative S1 has no action taken other than periodic groundwater monitoring and Five Year Reviews. Thus, this alternative was given a rating of high.

Alternatives S2 and S4 were given a rating of moderate because excavation in proximity to the grain storage silos would require shoring of structures and protection of utilities and coordination with AGP.

Alternative S3 was given a rating of moderate to high, since it is less intrusive, but would still require coordination with AGP only to drill SVE wells.

7.6.1.7 Cost

The total present worth of Alternative S1 is estimated to be $298,000. The total present worth of Alternative S2 is estimated to be $929,000. The total present worth of Alternative S3 is estimated to be $1,168,000. The total present value of Alternative S4 is estimated to be $883,000.

No capital costs would be associated with Alternative 1 because no remedial actions would be conducted. Alternatives S2 and S4 would include excavation of contaminated soil. Alternatives S2, S3, and S4 would include continued operation of the SVE system.

7.6.2 OU1 Contaminated Groundwater

7.6.2.1 Overall Protection of Human Health and the Environment

Of the three retained alternatives, only Alternative SG1 fails to provide protection for human health and the environment and did not address the preliminary RAOs. Thus, this alternative was given a rating of unacceptable.

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Alternatives SG2, SG3 and SG4 were given a rating of acceptable because contaminant levels in groundwater would be reduced to levels below clean up goals.

7.6.2.2 Compliance with ARARs

Alternative SG1 fails to be compliant with the chemical-specific ARARs identified for the site since no action is taken. Thus, this alternative was given a rating of unacceptable.

Alternatives SG2, SG3 and SG4 were given a rating of acceptable because contaminant levels in groundwater would be reduced to levels below clean up goals. Construction of wells would be compliant with location- and action-specific ARARs, and any injections would comply with action-specific ARARs.

7.6.2.3 Long-Term Effectiveness and Permanence

Alternative SG1 fails to provide long-term effectiveness and permanence since no action is taken. Thus, this alternative was given a rating of none.

Alternative SG2 was given a high rating; however, there is uncertainty regarding the timeframe of treatment to achieve aquifer restoration. Alternative SG3 was given a moderate to high rating because core groundwater contamination at the source area is addressed through in situ treatment; however, it is uncertain how well in situ treatment alone will address groundwater contamination at the site. Alternative SG4 was given a high rating because in situ treatment of the core groundwater contamination at the source area would be conducted and the GET system would be operated to the extent practicable to address contaminated groundwater that would not be addressed by the in situ treatment.

7.6.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative SG1 fails to provide a reduction of toxicity, mobility, or volume of contaminated groundwater since no action is taken. Thus, this alternative was given a rating of none.

Alternative SG2 was given a moderate to high rating because the GET system would contain the groundwater contamination and groundwater would be treated and reinjected; however, no other active remediation of groundwater is occurring. Alternative SG3 was given a moderate rating because core groundwater contamination at the source area is addressed through in situ treatment; however, it is uncertain how well in situ treatment alone will address groundwater contamination at the site. Alternative SG4 was given a moderate to high rating because this alternative would include both active treatment of the core of the contaminant plume through in situ treatment and the GET system which would contain the groundwater contamination.

7.6.2.5 Short-Term Effectiveness

Alternative SG1 fails to provide short-term effectiveness since no action is taken. Thus, this alternative was given a rating of none.

Alternative SG2 was given a moderate to high rating because no additional construction would be required to continue O&M of the GET system. Alternatives SG3 and SG4 were given a

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moderate rating because in situ treatment would require injection in an area of the site that would require coordination with AGP to minimize disruption to facility operations.

7.6.2.6 Implementability

Alternative SG1 has no action taken other than periodic groundwater monitoring and Five Year Reviews. Thus, this alternative was given a rating of high.

Alternatives SG2 was given a high rating because the GET system is already operable and would not require any additional construction. Alternatives SG3 and SG4 were given a rating of moderate because although injection should be relatively straightforward and few technical difficulties and unknowns should arise during DPT injections, locations of injection points may be hindered by grain facility operations, utilities or other infrastructure. Good subsurface distribution of chemicals and substrates is needed for in situ treatment to be effective.

7.6.2.7 Cost

The total present worth of Alternative SG1 is estimated to be $1,061,000. No O&M costs would be associated with Alternative 1 because no remedial actions would be conducted; however, Alternative SG1 includes decommissioning of the existing GET system and abandonment of the recovery and reinjection wells. Alternative SG1 includes Five Year Reviews and periodic groundwater monitoring in support of the Five Year Reviews.

The total present worth of Alternative SG2 is estimated to be $6,340,000. Alternative SG2 includes O&M of the existing GET system and groundwater monitoring.

The total present worth of Alternative SG3 is estimated to be $12,346,000. Alternative SG3 includes injection of treatment amendments and groundwater monitoring.

The total present worth of Alternative SG4 is estimated to be $10,143,000. Alternative SG4 includes injection of treatment amendments, continued operation of the GET system, and groundwater monitoring.

7.6.3 OU2 Contaminated Groundwater

7.6.3.1 Overall Protection of Human Health and the Environment

Alternative G1 is the only alternative which fails to provide protection for human health and the environment and did not address the preliminary RAOs. Thus, this alternative was given a rating of unacceptable.

Alternatives G2, G3, and G4 were given a rating of acceptable because contaminant levels in groundwater would be reduced to levels below clean up goals and ICs would provide protection of human health through the restriction of access to VOC-contaminated groundwater.

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7.6.3.2 Compliance with ARARs

Alternative G1 fails to be compliant with the chemical-specific ARARs identified for the site since no action is taken. Thus, this alternative was given a rating of unacceptable.

Alternatives G2, G3, and G4 were given a rating of acceptable because contaminant levels in groundwater would be reduced to levels below clean-up goals. Construction of wells would be compliant with location- and action-specific ARARs, and any injections would comply with action-specific ARARs.

7.6.3.3 Long-Term Effectiveness and Permanence

Alternative G1 fails to provide long-term effectiveness and permanence since no action is taken. Thus, this alternative was given a rating of none.

Alternatives G2, G3 and G4 were given a moderate to high rating because groundwater contamination is contained and areas of high contamination are targeted. However, in Alternative G2 there is uncertainty regarding the timeframe of treatment to achieve aquifer restoration.

7.6.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative G1 fails to provide a reduction of toxicity, mobility, or volume of contaminated groundwater since no action is taken. Thus, this alternative was given a rating of none.

Alternative G2 was given a moderate to high rating. However, while it limits further migration off site and groundwater extracted would be treated, it would leave high concentration areas untreated and any reduction of contaminant volume would largely be left to natural attenuation processes.

Alternatives G3 and G4 were given a moderate to high rating because these alternatives consist of active remediation of contaminated groundwater in higher concentration areas. Alternative G3 would capture the contaminant plume at both the leading edge and within the higher concentration areas. Alternative G4 would supplement Alternative by G2 by targeting high concentration areas with in situ treatment. However, Alternative G4 would not address contaminated groundwater outside of the treatment areas; these areas would be left to undergo natural attenuation processes or be captured by the leading edge recovery wells.

7.6.3.5 Short-Term Effectiveness

Alternative G1 fails to provide short-term effectiveness since no action is taken. Thus, this alternative was given a rating of none.

Alternatives G2 and G4 were given a rating of moderate. Alternative G3 was given a rating of moderate to high. Short-term risks would be primarily due to installation of monitoring, recovery, and/or injection wells and system piping. These risks can be mitigated through safe drilling and construction practices, proper handling of drill cuttings and chemicals.

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7.6.3.6 Implementability

Alternative G1 has no action taken other than periodic groundwater monitoring and Five Year Reviews. Thus, this alternative was given a rating of high.

For implementability, Alternative G2 was given a moderate to high rating and Alternative G3 was given a moderate rating. They involve recovery or monitoring well installation which is relatively straightforward; however, Alternative G3 would require the installation of more wells. Few technical difficulties and unknowns should arise during installation. However, implementation would require locating the wells, pipelines, and treatment system in existing right-of-way or easement agreements with property owners. Locating the wells, piping, and treatment system in areas optimum for remediation of the contaminated groundwater may be difficult. Alternative G4 was given a low to moderate rating because it would require the installation of injection wells in addition to the recovery and monitoring wells.

7.6.3.7 Cost

The total present worth of Alternative G1 is estimated to be $852,000. No O&M costs would be associated with Alternative 1 because no remedial actions would be conducted; however, Alternative G1 includes Five Year Reviews and periodic groundwater monitoring in support of the Five Year Reviews.

The total present worth of Alternatives G2 and G3 is estimated to be $11,485,000 and $15,550,000, respectively. Both alternatives include installation of recovery, reinjection and monitoring wells; pipelines; treatment system building; treatment system; O&M of the treatment system and groundwater monitoring. Alternative G2 focuses solely on the leading edge of the contaminant plume whereas Alternative G3 includes recovery wells in the mid-plume area.

The total present worth of Alternative G4 is estimated to be $36,651,000. Alternative G4 includes the same elements as Alternative G2; however, under this alternative, injections of groundwater amendments would be conducted at the mid-plume area.

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TABLE(S)

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Table 7.1 Secondary Assumptions Affecting Refinement and Detailed Analysis of Remedial Alternatives

Secondary Assumption Category	Secondary Assumption Description	Rationale
Work at an Active Business	Remedial activities adjacent to the active grain storage facility would be designed to minimize disturbances to business operations	To the extent practicable, the remedial alternatives would access existing portions of the site in the contaminant source area. The hours of construction would be adjusted as necessary to minimize the disturbance to adjacent grain storage operations.

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Table 7.2
Summary of OU1 Comparative Analysis of Alternatives
Garvey Elevator Site
Hastings, NE

Remedial Alternative	Description	Threshold Criteria		Balancing Criteria				
		Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Present Value Cost (Dollars)
OU1 Contaminated Soil								
S1	No Action	—	—	⓿	⓿	⓿	⓿	$298,000
S2	Excavation, Treatment and Disposal of Contaminated soil and Operate Existing SVE system	+	+	❸	❸	❸	❸	$929,000
S3	Expand SVE System	+	+	❹	❹	❸	❹	$1,168,000
S4	Excavation, Treatment and Disposal of Contaminated soil and Expand SVE System	+	+	❺	❹	❸	❸	$883,000
OU1 Contaminated Groundwater								
SG1	No Action	—	—	⓿	⓿	⓿	⓿	$1,061,000
SG2	Maintain and Operate Existing GET System	+	+	❺	❹	❹	❺	$6,340,000
SG3	In Situ Treatment via Groundwater Amendments	+	+	❹	❸	❸	❸	$12,346,000
SG4	In Situ Treatment via Groundwater Amendments and Operation of Existing GET System	+	+	❺	❹	❸	❸	$10,143,000

Notes:

1. The numerical designations for the qualitative ratings system used in this table are not used to quantitatively assess remedial alternatives (for instance, individual rankings for an alternative are not additive).
2. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.

Legend for Qualitative Ratings System:

Threshold Criteria

— **Unacceptable**

\+ **Acceptable**

Balancing Criteria (Excluding Cost)

⓿ **None** **The "No Action" alternatives do not meet threshold criteria, but are carried through to provide a baseline**

❶ **Low**

❷ **Low to Moderate**

❸ **Moderate**

❹ **Moderate to High**

❺ **igh**

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Table 7.3
Summary of OU2 Comparative Analysis of Alternatives
Garvey Elevator Site
Hastings, NE

Remedial Alternative	Description	Threshold Criteria		Balancing Criteria				
		Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Present Value Cost (Dollars)
OU2 Contaminated Groundwater								
G1	No Action	—	—	⓿	⓿	⓿	⓿	$852,000
G2	Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume	+	+	❹	❹	❸	❹	$11,485,000
G3	Groundwater Recovery, Treatment, and Discharge at Mid-plume and Leading Edge of Plume	+	+	❹	❹	❹	❸	$15,550,000
G4	In Situ Treatment at Core of Plume and Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume	+	+	❹	❹	❸	❷	$36,651,000

Notes:

1. The numerical designations for the qualitative ratings system used in this table are not used to quantitatively assess remedial alternatives (for instance, individual rankings for an alternative are not additive).
2. Detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative are presented in Appendix F.

Legend for Qualitative Ratings System:

Threshold Criteria

— **Unacceptable**

\+ **Acceptable**

Balancing Criteria (Excluding Cost)

⓿ **None** **The "No Action" alternatives do not meet threshold criteria, but are carried through to provide a baseline.**

❶ **Low**

❷ **Low to Moderate**

❸ **Moderate**

❹ **Moderate to High**

❺ **High**

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FIGURE(S)

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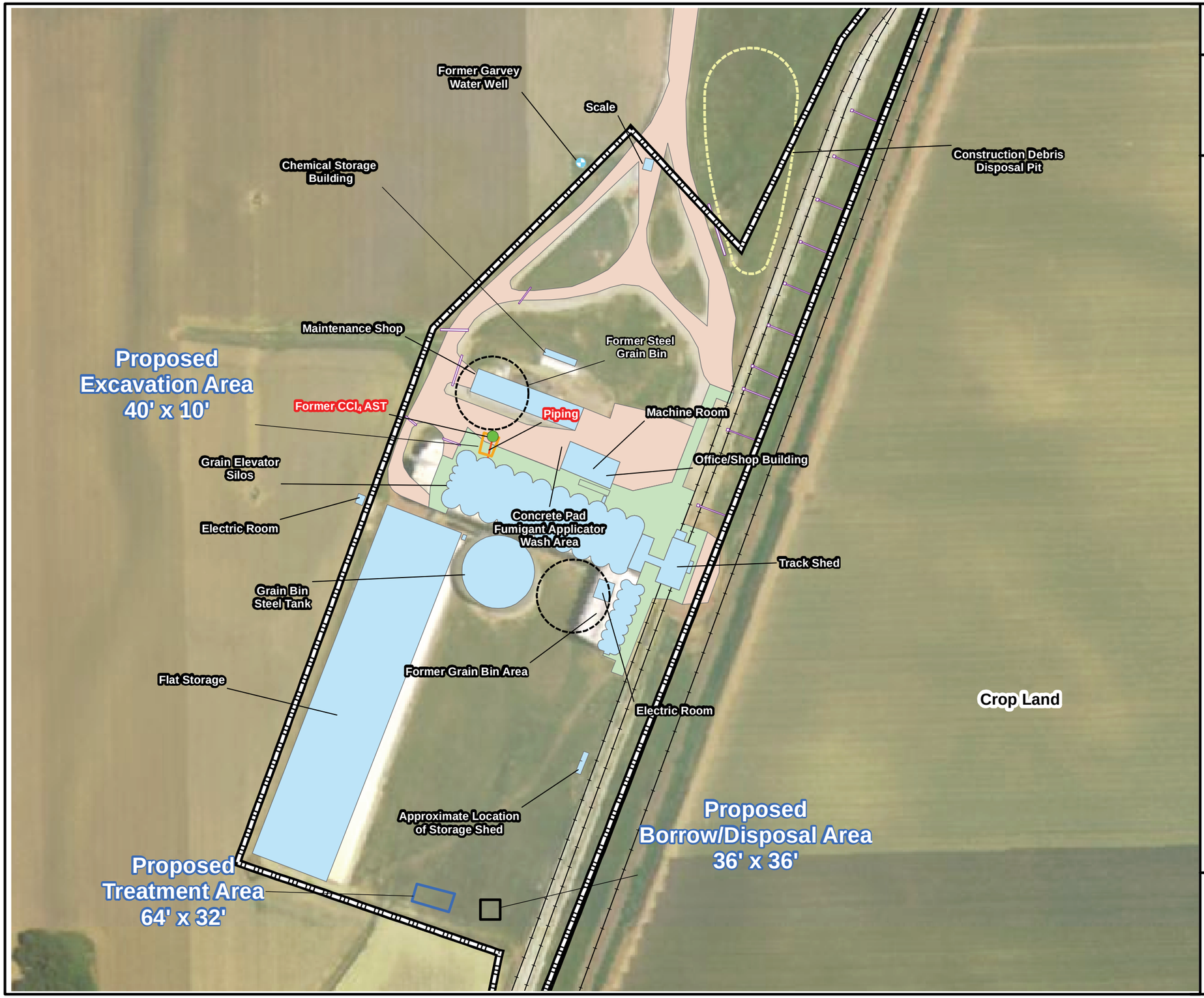

HGL—Feasibility Study,
Garvey Elevator Superfund Site—Hastings, NE

Figure 7.1
Preliminary Locations for Excavation Area, Treatment Area, and Borrow/Disposal Area-Alternative S2

Legend

- Garvey Property Boundary
- OU1 Boundary
- Culverts
- Buildings
- Former Steel Grain Bin
- Concrete Paved Area
- Gravel Road
- Railroad
- Former Garvey Water Well

Potential Source Areas

- CCl_4 AST = Carbon Tetrachloride Above Ground Storage Tank
- Buried Piping

N

0 180 360
Feet

Filename: X:/EPA009/Garvey/FS/SourceArea.mxd
Project: EP9033.01.46.11
Revised: 01/12/12 RL
Source: ENSR GDB 2008; DNR; Garvey, 2003

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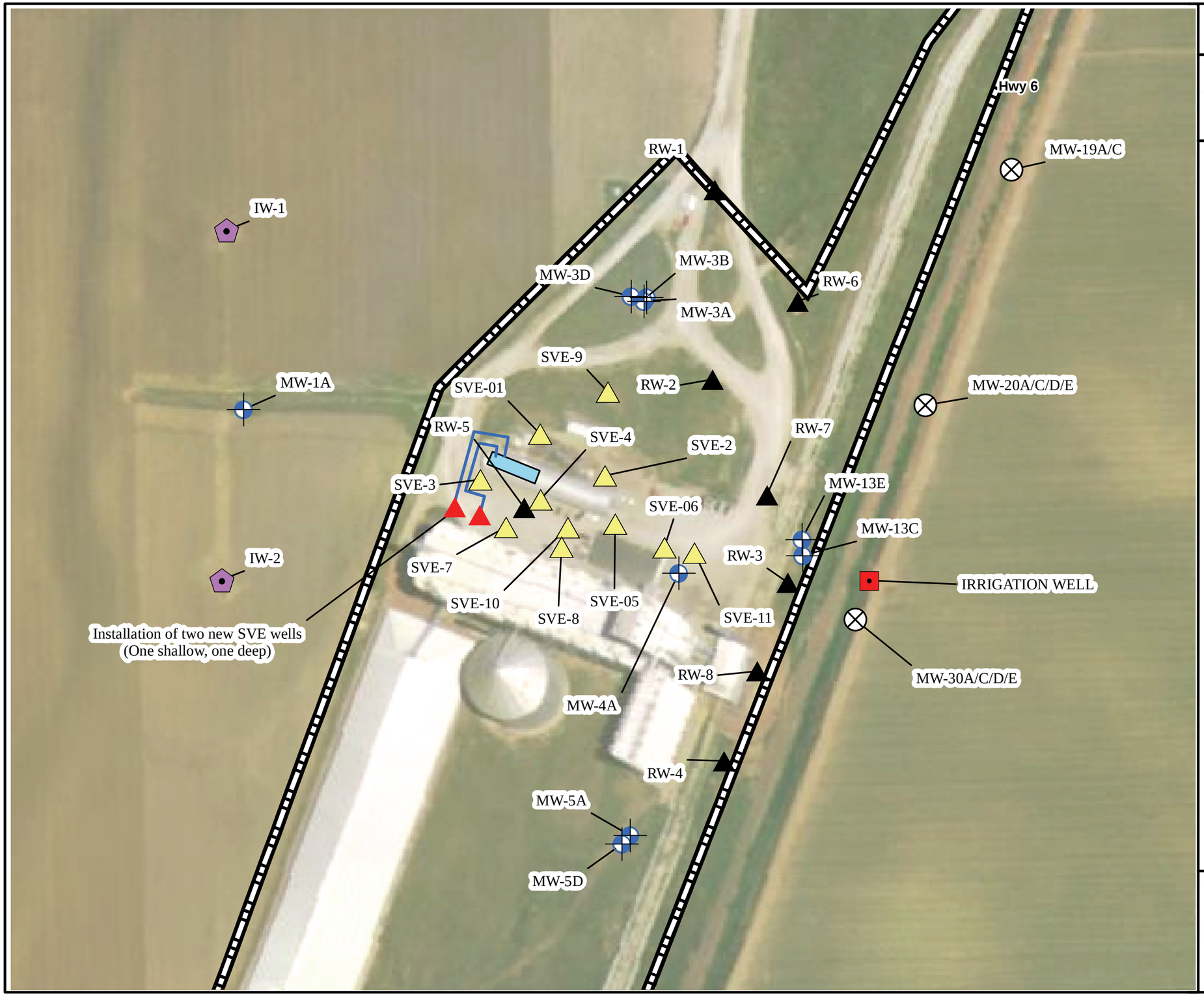

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Figure 7.2
Preliminary Locations for Additional SVE Wells-Alternative S3

Legend

- Garvey Elevator Property Boundary
- OU1 Boundary
- Treatment System
- Recovery Wells
- Multilevel Well
- Injection Well
- Soil Vapor Extraction Well
- Monitoring Well
- Irrigation Well
- Proposed SVE piping
- Proposed SVE Wells

0 75 150 300
Feet

N

Filename: X:/EPA009/Garvey/FS/GET_SVE.mxd
Project: EP9033.01.46.11
Revised: 01/12/12 RL
Source: ENSR GDB 2008, DNR

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Garvey Elevator Superfund Site—Hastings, NE

Figure 7.3
Preliminary DPT Injection Locations
for Alternatives SG3 and SG4

Legend

- Garvey Property Boundary
- Railroad
- Monitoring Well Location
- Multilevel Well
- (190) — Carbon Tetrachloride Concentration in micrograms per liter (µg/L) as measured in September 2011.
- —(5)— Carbon Tetrachloride Isoconcentration Contour (µg/L) (Dashed Lines are Estimated)
- Proposed DPT Injection Area

Notes:

(ND) Nondetect

0 125 250 500
Feet

N

Filename: X:/EPA009/Garvey/FS/
Perm_Inj_Wells.mxd
Project: EP9034.01.22.02.02
Revised: 01/12/12 RL
Source: ENSR GDB 2008, DNR

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Figure 7.4
Proposed Institiutional Control Area

Legend

- Garvey Property Boundary
- OU1 Boundary
- Carbon Tetrachloride Contour (dashed where inferred)
- Railroad
- Monitoring Well Location
- Multilevel Well
- Hydraulic Conductivity Well
- West Highway 6 & Highway 281 Transect Sample Location (DPT)
- Garvery Elevator Transect Boring (DPT)
- Domestic / Irrigation Well
- Carbon Tetrachloride Detected above 5 µg/L
- Carbon Tetrachloride Detected above 100 µg/L

Note: At DPT locations, samples were collected at multiple depths; the highest concentration was used to construct the isoconcentration contours.

0 2,500 5,000
Feet

N

Filename: X:/EPA009/Garvey/MXDs/Superfund Cross_Section_CarbonTet_Plume.mxd
Project: EP9034.01.22.02.02
Revised: 04/05/11 ST
Source: ENSR GDB 2008, DNR

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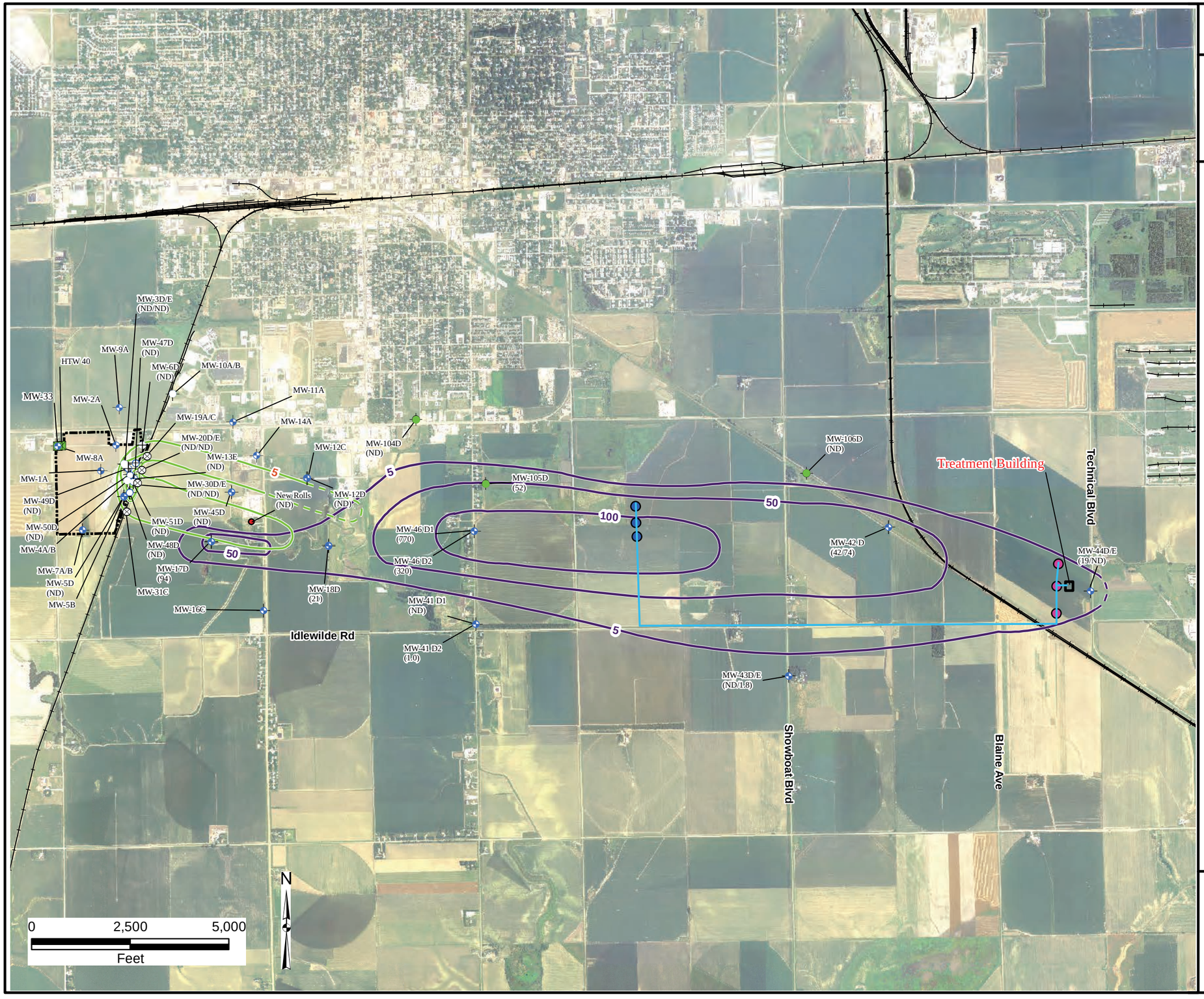
Figure 7.5
Preliminary Locations for Leading Edge Recovery Wells and Groundwater Treatment Building-Alternative G2



Legend

- Garvey Property Boundary
- Railroad
- Monitoring Well Location
- Multilevel
- Hydraulic Conductivity Well
- West Highway 6 & Highway 281 Site Monitoring Well
- (190) Carbon Tetrachloride Concentration in micrograms per liter (µg/L)
- (5) Carbon Tetrachloride Isoconcentration Contour (Lower Aquifer) (µg/L) (Dashed Lines are Estimated)
- Domestic / Irrigation Water Wells
- (5) Carbon Tetrachloride Isoconcentration Contour (Upper Aquifer) (µg/L) (Dashed Lines are Estimated)
- Recovery Wells (Medial)
- Recovery Wells (Deep)
- Recovery Well Piping
- Treatment Building

Notes:
(ND) Nondetect

Filename: X:/EPA009/Garvey/FS/Carbon_TetChl_LoweR_Aquifer_D.mxd
Project: EP9034.01.22.02.02
Revised: 01/11/12 ST
Source: ENSR GDB 2008, DNR

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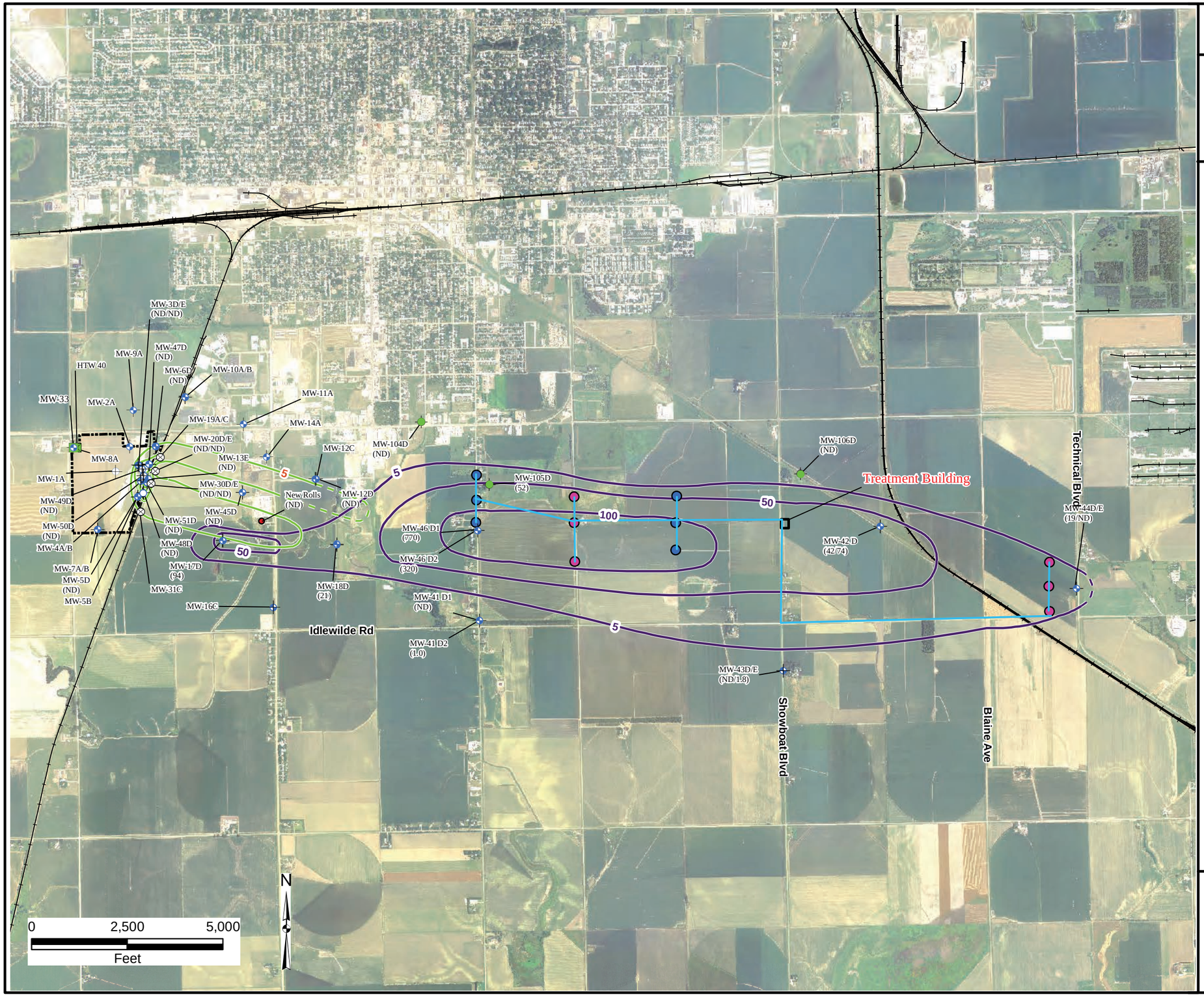
Figure 7.6
Preliminary Locations for Mid-Plume and Leading Edge Recovery Wells and Groundwater Treatment Building-Alternative G3



Legend

- Garvey Property Boundary
- Railroad
- Monitoring Well Location
- Multilevel
- Hydraulic Conductivity Well
- West Highway 6 & Highway 281 Site Monitoring Well
- (190) Carbon Tetrachloride Concentration in micrograms per liter (µg/L)
- (5) Carbon Tetrachloride Isoconcentration Contour (Lower Aquifer) (µg/L) (Dashed Lines are Estimated)
- Domestic / Irrigation Water Wells
- (5) Carbon Tetrachloride Isoconcentration Contour (Upper Aquifer) (µg/L) (Dashed Lines are Estimated)
- Recovery Wells (Medial)
- Recovery Wells (Deep)
- Recovery Well Piping
- Treatment Building

Notes:
(ND) Nondetect

Filename: X:/EPA009/Garvey/FS/
Mid-Plume_Prelim_Loc
Project: EP9034.01.22.02.02
Revised: 01/12/12 RL
Source: ENSR GDB 2008, DNR

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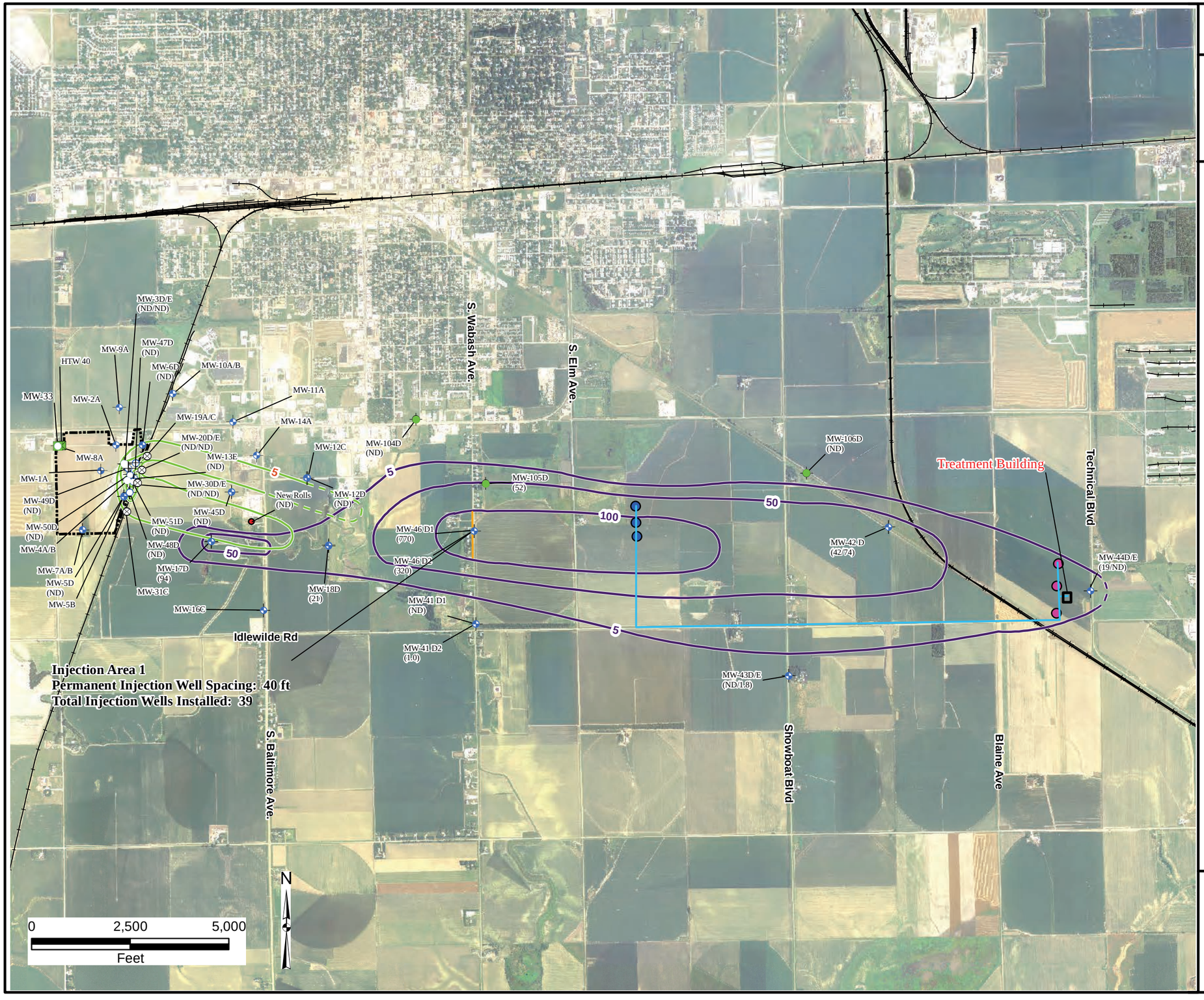

HGL—Feasibility Study,
Garvey Elevator Superfund Site—Hastings, NE

Figure 7.7
Preliminary Locations for Mid-Plume Injection Wells, Leading Edge Recovery Wells, and Groundwater Treatment Building -Alternative G4

Legend

- Garvey Property Boundary
- Railroad
- Monitoring Well Location
- Multilevel
- Hydraulic Conductivity Well
- West Highway 6 & Highway 281 Site Monitoring Well
- (190) Carbon Tetrachloride Concentration in micrograms per liter (µg/L)
- (5) Carbon Tetrachloride Isoconcentration Contour (Lower Aquifer) (µg/L) (Dashed Lines are Estimated)
- Domestic / Irrigation Water Wells
- (5) Carbon Tetrachloride Isoconcentration Contour (Upper Aquifer) (µg/L) (Dashed Lines are Estimated)
- Recovery Wells (Medial)
- Recovery Wells (Deep)
- Recovery Well Piping
- Injection Area (40 ft spacing between the wells)
- Treatment Building

Notes:
(ND) Nondetect

Filename: X:/EPA009/Garvey/FS/Inj_Area
Project: EP9034.01.22.02.02
Revised: 01/11/12 RL
Source: ENSR GDB 2008, DNR

HGL HydroGeoLogic, Inc

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APPENDIX A

SUMMARY OF FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

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Table A.1
Summary of Federal and State Applicable or Relevant and Appropriate Requirements
Garvey Elevator Site
Hastings, NE

Statue and Regulatory Citation	ARAR Determination	Description	Comments	Media of Concern		Type of ARAR		
				Soil	Groundwater	Chemical	Location	Action
FEDERAL ARARs								
Safe Drinking Water Act, 42 U.S.C § 300f, et seq., National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141 and 142	Relevant and Appropriate	The National Primary and Secondary Drinking Water Regulations (40 CFR Parts 141 and 143) establish MCLs for chemicals in drinking water distributed in public water systems. These are enforceable in Nebraska under Nebraska Revised Statutes (NRS) § 81-1505(1)(2), et seq., § 71-5301 to 71-5313 (Safe Drinking Water Act [SDWA]), NDHHS Title 179, and NDEQ Title 118, Chapter 4.	The Preamble to the NCP clearly states that MCLs are relevant and appropriate for groundwater that is a current source of drinking water. See 55 Federal Register 8750, March 8, 1990, and 40 CFR § 300.430(e)(2)(I)(B). MCLs developed under the SDWA generally are ARARs for current or potential drinking water sources. See EPA Guidance on Remedial Action for Contaminated Groundwater at Superfund Sites, OSWER Directive Number 9283.1-2, December 1988.			X		
Federal Surface Water Quality Requirements, Clean Water Act, 33 U.S.C. § 1251, et seq.	Applicable	As provided under Section 303 of the Clean Water Act, 33 U.S.C. § 1313, the State of Nebraska has promulgated water quality standards in NDEQ Title 117, Chapter 4.	None	X	X	X		
Air Emission Standards for Process Vents, 40 CFR 264, Subpart AA	Relevant and Appropriate	This provision establishes standards for air emissions of VOCs during air stripping operations.	None	X	X	X		
Air Emission Standards for Equipment Leaks, 40 CFR 264, Subpart BB	Relevant and Appropriate	This provision establishes standards for air emissions for equipment leaks.	None	X	X	X		
RCRA and regulations, 40 CFR § 264.18 (a) and (b)	Relevant and Appropriate	Regulations promulgated under NRS § 81-1505(13), et seq., specify requirements that apply to the location of any solid waste management facility.	None	X	X		X	
RCRA deed notice for hazardous wastes remaining on site after closure - 40 CFR 264.119 and 265.119	Relevant and Appropriate	Deed restrictions.	None	X	X		X	
Clean Water Act Point Source Discharges Requirements, 33 U.S.C. § 1342	Applicable	Section 402 of the Clean Water Act, 33 U.S.C. § 1342, et seq., authorizes the issuance of permits for the "discharge" of any "pollutant." This includes stormwater discharges associated with "industrial activity." See 40 CFR § 122.1 (b)(2)(iv). "Industrial activity" includes inactive mining operations that discharge stormwater contaminated by contact with, or that has come into contact with any overburden with, any over burden, raw material, intermediate products, finished products, byproducts, or waste products located on the site of such operations, see 40 CFR § 122.26 (b)(14)(iii); landfills, land application sites, and open dumps that receive or have received any industrial wastes including those subject to regulation under RCRA Subtitle D, see 40 CFR § 122.26(b)(14)(x)	Because the State of Nebraska has been delegated the authority to implement the Clean Water Act, these requirements are enforced in Nebraska through the National Pollutant Discharge Elimination (NPDES). The NPDES requirements are set forth below. EPA is not required to obtain permits from federal, state, or local entities but must still meet the substantive requirements of the permits.		X			X
Groundwater Monitoring 40 CFR Part 264 and Part 265 Subpart F and Part 270.14 (c)	Applicable	Sets forth requirements for groundwater monitoring.	The groundwater monitoring requirements found at 40 CFR Part 264 and Part 265 Subpart F and Part 270.14 (c) are incorporated in Nebraska Title 128 (hazardous waste regulations).		X			X

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Statue and Regulatory Citation	ARAR Determination	Description	Comments	Media of Concern		Type of ARAR		
				Soil	Groundwater	Chemical	Location	Action
FEDERAL ARARs (continued)								
On-Site Groundwater Treatment 40 CFR Part 264 and Part 265 Subparts I and J	Applicable	Sets forth requirements for on-site treatment of hazardous waste.	The treatment requirements found at 40 CFR Part 264 and Part 265 Subparts I and J are incorporated in Nebraska Title 128 (hazardous waste regulations).		X			X
Closure and Post-Closure/Disposal of Soils 40 CFR Part 264 and Part 265 Subpart G	Applicable	Sets forth requirements for closure and post-closure care (including disposal of soils) for hazardous waste treatment facilities.	The closure and post-closure requirements found at 40 CFR Part 264 and Part 265 Subparts I and J are incorporated in Nebraska Title 128 (hazardous waste regulations).	X	X			X
Financial Assurance Requirements 40 CFR Part 264 and 265	Applicable	Regulations promulgated under Title 123 and Title 132, Chapter 8 also specify requirements that apply to financial assurance.	The financial assurance requirements found in 40 C.F.R. Part 264 and Part 265 are incorporated by reference in Title 128, Chapters 21 and 22.				X	X
STATE OF NEBRASKA ARARs								
Regulations Governing Water Well Construction, Pump Installation and Water Well Abandonment Neb. Rev. Stat. §46-602, Title 178, Chapter 10, and Title 456, Chapter 12	Applicable	Groundwater wells must be registered with the Department of Natural Resources.	If the well is to be located in a groundwater management area, a permit is required from the local Natural Resources District prior to construction if it pumps more than 50 gpm. However, EPA is only required to meet the substantive requirements of said permit.		X		X	X
Regulations Governing Water Well Construction, Pump Installation and Water Well Abandonment Standards Neb. Rev. Stat. §46-602 and Title 178, Chapter 10	Applicable	Relates to the licensure of water well contractors and pump installation contractors and to the certification of water well drilling supervisors, pump installation supervisors, natural resources groundwater technicians and water well monitoring technicians.	None		X			X
Water Well Standards and Contractor's Practice Act, Neb. Rev. Stat. §46-1201 to §46-1241, Title 178, Chapter 10, and Title 456, Chapter 9	Applicable	The purposes of the Water Well Standards and Contractors' Practice Act are to: (1) Provide for the protection of groundwater through the licensing and regulation of water well contractors, pump installation contractors, water well drilling supervisors, pump installation supervisors, water well monitoring technicians, and natural resources groundwater technicians in the State of Nebraska; (2) protect the health and general welfare of the citizens of the state; (3) protect groundwater resources from potential pollution by providing for proper siting and construction of water wells and proper decommissioning of water wells; and (4) provide data on potential water supplies through well logs which will promote the economic and efficient utilization and management of the water resources of the state.	None		X			X

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Statue and Regulatory Citation	ARAR Determination	Description	Comments	Media of Concern		Type of ARAR		
				Soil	Groundwater	Chemical	Location	Action
STATE OF NEBRASKA ARARs (continued)								
Well Spacing Requirements Neb. Rev. Stat. §46-651 to §46-655	Relevant and Appropriate	Well spacing requirements.	None		X		X	X
The Industrial Ground Water Regulatory Act Neb. Rev. Stat. §46-675 through 46-690 and Title 456, Chapters 4 and 7	Relevant and Appropriate	Requires a permit for the withdrawal and transfer of groundwater for other than domestic or agricultural use. The permit must be obtained prior construction of the extraction well(s). The permit program is administered by the NDNR.	EPA is only required to meet the substantive requirements of the groundwater use permit.		X			X
Municipal and Rural Domestic Groundwater Transfers Permit Act Neb. Rev. Stat. §46-638 to §46-650	Relevant and Appropriate	Relates to protective permitting for public water supplies.	EPA is only required to meet the substantive requirements of protective permitting for public water supplies.		X		X	X
Institutional Controls Nebraska Hazardous Waste Regulations, Title 128, Chapter 21 and 22; Integrated Solid Waste Management Regulations, Title 132, Chapter 3; and Nebraska Uniform Covenants Act, Neb. Rev. Stat. §76-2601 to 76-2613	Applicable	1. A deed notice is required for hazardous wastes remaining on site after closure in accordance with 40 CFR 264.119 and 265.119 and Title 128 – Nebraska Hazardous Waste Regulations, Chapter 21 and 22. 2. A deed notice is required for closed solid waste disposal areas in accordance with Title 132 – Integrated Solid Waste Management Regulations, Chapter 3. Environmental Covenant 1. An environmental covenant pursuant to the Nebraska Uniform Covenants Act Neb. Rev. Stat. §76-2601 to 76-2613 may be used for a site, that upon completion of the cleanup action, is not suitable for unrestricted land use.	Institutional controls are generally land use restrictions designed to restrict access, future use, and interference with a selected remedy for a contaminated area. They are typically methods to manage risk during the implementation of a remedy and do not eliminate risk entirely. An institutional control enacted as a remedy should be compliant with the Uniform Environmental Covenants Act pursuant to The Nebraska Uniform Covenants Act, March 2005, Neb. Rev. Stat. §76-2601 to 76-2613. For groundwater, the goal of an institutional control would be to prevent situations from occurring in which humans or animals might inadvertently consume or otherwise be exposed to contaminated groundwater. Groundwater in Nebraska is considered to be publicly owned. Property owners only have the right to use the groundwater underlying their property. There is no ability under Nebraska State law to restrict the use of groundwater by prohibiting access. Public entities with zoning authority may be able to restrict access to groundwater from certain surface areas within the zoning jurisdiction of the entity, but groundwater use cannot be prohibited, and existing wells could still probably continue as non-conforming uses. Condemnation might be a possibility to remove these existing wells from use. Some limitations on use may be established by a local Natural Resource District to protect the quantity, and in certain circumstances preserve water quality, but only if a Groundwater Management Area has been established pursuant to Neb. Rev. Stat. §46-656 et seq. This authority, however, cannot be used to restrict the use of contaminated groundwater. Long-term effectiveness and enforcement concerns make this component much less reliable than other methods of active remediation.	X	X		X	X

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Statue and Regulatory Citation	ARAR Determination	Description	Comments	Media of Concern		Type of ARAR		
				Soil	Groundwater	Chemical	Location	Action
STATE OF NEBRASKA ARARs (continued)								
Air Quality Regulations Title 129 Chapter 17, Section 001	Applicable	Depending on the size of the unit and the potential to emit criteria pollutants and/or toxic or hazardous pollutants, a pre-construction review and permit may be required under Title 129 (Air Quality Regulations) specifically, Chapter 17, Section 001. Potential to emit is defined in Title 129, Chapter 1, as the maximum capacity of a stationary source to emit a pollutant under its physical and operational design	A risk analysis may be required on a case-by-case basis. Depending on the potential to emit, a Class I or Class II operating permit may be required. See specifically Title 129, Chapter 5 for determining applicability. If applicable, EPA would only be required to meet the substantive requirements of an operating permit. Best Available Control Technology (BACT) is required if the emissions unit has a potential to emit equal to or more than 2 1/2 tons/year of any hazardous air pollutant or an aggregate of 10 tons/year of hazardous air pollutants. See Title 129, Chapter 27, 002. It must be utilized continuously while the emissions unit is operating. If the emissions unit meets the threshold limits for construction/operating permits, annual emissions must be reported if requested by the Department. See Title 129, Chapter 6.	X	X	X	X	X
Disposal of Activated Carbon Used as Air Emission Control Title 128, Chapter 2	Relevant and Appropriate	If activated carbon is used as an air emission control, the spent carbon may be required to be handled as a hazardous waste in accordance with Title 128 requirements	The spent carbon meets the definition of solid waste in Title 128, Chapter 2. Air permits may also be required for carbon regeneration or reactivation depending on potential to emit (construction and/or operating permits - see Title 129). However, EPA would only be required to meet the substantive requirements of the construction and/or operating permit.	X	X	X		X
Integrated Solid Waste Management Regulations Title 132, Chapter 13	Relevant and Appropriate	If aerobic or anaerobic biological treatment is used for groundwater treatment, waste from the treatment process may be required to be handled and disposed of as special waste in accordance with Title 132 requirements.	None	X	X	X		X
Excavation of Contaminated Soil Title 128, Chapter 4	Relevant and Appropriate	Soil excavated and removed with the intent of disposal meets the definition of solid waste in Title 128, Chapter 4.	None	X				X
Disposal of Hazardous Waste Title 128, Chapter 4	Relevant and Appropriate	A hazardous waste determination must be made in accordance with Title 128, Chapter 4, 002. If material is a hazardous waste, it must be handled in accordance with all hazardous waste management requirements in Title 128, Chapters 8, 9, and 10.If material is hazardous waste, it must be disposed of in a permitted TSD facility as required under Title 128, Chapters 8, 9, and 10. However, generators subject to the requirements of Chapter 8 (conditionally exempt small quantity generator) have disposal options. The transporter must comply with the requirements of Title 128, Chapter 11.	If the material which caused the contamination was a hazardous waste then the closure and post-closure requirements of 40 CFR. Part 264 or Part 265, Subpart G, as incorporated by reference in Title 128, Chapters 21 and 22 are applicable. If the generator intends to store the hazardous waste for more than 90 days (more than 180 days for small quantity generators; or more than 270 days if a small quantity generator must transport the waste, or offer the waste for transportation over a distance of 200 miles or more) or intends to treat said waste on site, the requirements of Title 128, Chapters 12 through 15, 21, and 22 apply. If the generator is also acting as the transporter, then it must follow the transporter requirements found in Title 128, Chapter 11.	X	X	X	X	X

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Statue and Regulatory Citation	ARAR Determination	Description	Comments	Media of Concern		Type of ARAR		
				Soil	Groundwater	Chemical	Location	Action
STATE OF NEBRASKA ARARs (continued)								
Land Disposal Requirements (LDRs) Title 128, Chapter 20	Relevant and Appropriate	On-site treatment of those wastes that are determined to be hazardous would have to be conducted in a tank or container meeting requirements of 40 CFR 264, Subparts I and J.	Would apply to treatment residuals.	X				X
Disposal of Nonhazardous Waste Title 132, Chapter 1	Relevant and Appropriate	Nonhazardous waste may be a special waste as defined in Title 132, Chapter 1 and may only be disposed at a licensed landfill which is operated and maintained in compliance with NDEQ regulations and that is approved to accept special waste. Department and landfill approval required, and the generator must follow the requirements of Title 132, Chapter 12.	None	X				X
Disposal of Surface Water During Excavation	Relevant and Appropriate	If sumps are necessary during excavation to dewater, the water to be discharged either to the surface of the ground or a stream, then a permit and/or discharge limits must be obtained from the Department in accordance with Title 119 (NPDES regulations), Title 121 (NPDES effluent guidelines and standards), and Title 117 (Surface Water Quality Standards) or Title 127 (Publically owned treatment works (POTW) pretreatment rules and regulations). If the water is to be reinjected, it must be done in accordance with Title 122 (UIC regulations).	None	X		X		
Rules and Regulations for Underground Injection and Mineral Production Wells Title 122	Relevant and Appropriate	The Underground Injection Control (UIC) Program issues and reviews permits, conducts inspections, and performs compliance reviews for wells used to inject fluids into the subsurface.	Infiltration and/or reinjection of groundwater and injection of substances or nutrients would require a UIC permit or review under Title 122 or review of plans and specifications under Title 123. Underground injection may also require an NPDES permit under Titles 119 and 121 based on the potential impact to groundwater. However, EPA would only be required to meet the substantive requirements of the UIC and NPDES permits.	X	X			X
Nebraska Pollutant Discharge Elimination System	Relevant and Appropriate	Any surface discharge of contaminated or treated water is subject to the requirements of Title 119 - Rules and Regulations Pertaining to the Issuance of Discharge Elimination System Permits, Title 121 - Effluent Guidelines and Standards, Title 117 – Nebraska Surface Water Quality Standards. Any reinjection of contaminated water or treated water is subject to the requirements of Title 122 - Rules and Regulations for Underground Injections and Mineral Production Wells and Title 118 - Ground Water Quality and Use Classification (Department of Environmental Quality).	If applicable, EPA would only be required to meet the substantive requirements of the NPDES permit.		X	X		
Nebraska Surface Water Quality Standards Title 117	Applicable	Establishes the water quality standards applicable to surface waters in the State of Nebraska, including wetlands.	None		X	X		

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Statue and Regulatory Citation	ARAR Determination	Description	Comments	Media of Concern		Type of ARAR		
				Soil	Groundwater	Chemical	Location	Action
STATE OF NEBRASKA ARARs (continued)								
Groundwater Quality Standards Title 118	Relevant and Appropriate	Establishes narrative and numerical standards for contaminants introduced to groundwater either directly or indirectly by human activity. Provides that any groundwater whose existing quality is better than the MCLs must be maintained at the higher quality; however, the State may choose, after public notice and public hearing and based upon necessary economic or social development, to allow degradation that does not interfere with existing uses. Establishes a procedure for determining the needed action for groundwater pollution occurrences. This Protocol includes assessment of the degree and extent of the contamination, setting preliminary cleanup levels, and developing remedial actions.	The narrative and numerical requirements of Title 118 are relevant and appropriate to the groundwater at the Site. It is likely that any discharge limits would be based on groundwater quality standards because of the conjunctive relationship of groundwater and surface water. Under Title 118, a Remedial Action Classification (RAC) of "1" is assigned automatically any time a public or private drinking water supply has been contaminated. Minimum requirements imposed upon the responsible party in a RAC-1 area include the cleanup of readily removable contaminants. Mitigation may also be required. If additional cleanup is not required, the remaining contaminated groundwater will be managed and monitored to prevent any further damage. Preliminary cleanup levels in RAC-1 areas are typically MCLs. If an MCL has not been established for a particular contaminant, the Department can consider EPA's Ambient Water Quality Criteria, Health Advisories, and other documents in setting the preliminary cleanup level. The level will be set at the concentration which is estimated to result in a 1×10^{-6} excess cancer risk or the laboratory detection limit, if higher and within an acceptable range. The timeframe for any required corrective action is established, subject to appeal with adequate justification, as the period of potential exposure in the absence of any remedial action or 20 years, whichever time frame is less.		X	X		X
Flood Plain Management	Relevant and Appropriate	The Flood Plain Management Act, Neb. Rev. Stat. §31-1001 to §31-1031, and Title 258 – Rules Governing Flood Plain Management, govern certain activities occurring in flood plains.	None	X	X		X	X
Endangered and Threatened Species	Relevant and Appropriate	The Nebraska Nongame and Endangered Species Act, Neb. Rev. Stat. §37-801 to §37-811 (recodified in 1998), and Title 163, Chapter 4, 012, require consultation with the Nebraska Game and Parks Commission regarding actions which may affect threatened or endangered species and their critical habitat (Nebraska Game and Parks Commission).	None	X	X		X	X

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APPENDIX B

TENTATIVE LIST OF PRELIMINARY CLEANUP LEVELS

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Table B.1
Tentative List of Preliminary Cleanup Levels
Garvey Elevator Site, Hastings, Nebraska

Contaminant of Concern	Media					
	GW [a]	Soil	Soil Gas			Indoor Air [f]
		Migration to GW	Vapor Intrusion [d]	Migration to GW[e]		
		Fine-Grained Soils [c]		Fine-Grained Soils	Coarse-Grained Soils	
	ug/l	ug/kg	ug/m3	ug/m3	ug/m3	ug/m3
OU1						
Benzene	5	NA	NA	NA	NA	NA
Carbon Tetrachloride	5	45	NA	95,000	130,000	NA
Chloroform	80[b]	460	1	230,000	460,000	0.1
Tetrachloroethene	NA	NA	90	71,000	110,000	9
Trichloroethene	5	NA	4	39,000	66,000	0.4
OU2						
Carbon Tetrachloride	5	NA	NA	NA	NA	NA
Chloroform	80[b]	NA	NA	NA	NA	NA
1,2-Dichloroethane	5	NA	NA	NA	NA	NA

Notes:

GW = goundwater.
NA = Preliminary Cleanup Levels are not applicable for this media at designated OU.
[a] Groundwater PCLs are MCLs unless otherwise noted.

[b] PCL is the MCL for total trihalomethanes (bromodichloromethane, bromoform, chloroform, dibromochloromethane). The National Primary Drinking Water Regulations for disinfection byproducts assigns an MCL goal (MCLG) for chloroform of 70 ug/L (40 CFR 141.53).

[c] Values were calculated using site-specific soil information in SSL formula from USEPA Soil Screening Guidance, 1996. H' and Koc are from USEPA RSL April 2012 Tables. The resulting SSL was mulitplied by a DAF of 20.

[d] Values are 10 times the calculated site-specific risk-based levels for indoor air using formulas from App. D of the USEPA VI Guidance, 2002.

[e]Values for coarse- and fine-grained soils were calculated using the Method specified by Y. Rong, 1996. MCL-based SSL's were used in the calculation when available. SSLs, H', and Koc are from USEPA RSL April 2012 Tables.

[f] Values are calculated site-specific risk-based levels for indoor air using formulas from Appendix D of the USEPA VI Guidance, 2002. Toxicity values are from the USEPA RSL April 2012 Tables.

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Table B.2
Soil Migration to Groundwater Calculations
Garvey Elevator Site, Hastings, Nebraska

Calculate Soil Concentrations that will be Protective of Groundwater, Assuming Migration Into Groundwater:

SSL = Cw[Kd+((θw+θa*H')/Pb)] = Soil Screening Level Protective of Leaching to Groundwater
Formula from Page 29 of the USEPA Soil Screening Guidance, 1996

Chemical	Contaminant Conc. In Groundwater, Cw (MCL) ug/L	Distr. Coeff., Kd	Organic Carbon Part. Coeff., Koc	Organic Carbon Content, foc	Water-filled Soil Porosity, θw	Air-filled Soil Porosity, θa	Dry Soil Bulk Density, ρb	Total Soil Porosity, η	Henry's Law Constant,H'	Soil Screening Level, Protective of Groundwater, SSL (ug/kg), DAF 1	Soil Screening Level, Protective of Groundwater, SSL (ug/kg), DAF 20	Soil Screening Level, Protective of Groundwater, SSL (ug/kg) DAF 20, rounded
Carbon Tetrachloride	5	6.58E-02	4.39E+01	0.0015	0.3	0.2	1.36	0.5	1.13E+00	2.3	45	45
Chloroform	80	0.04773	3.18E+01	0.0015	0.3	0.2	1.36	0.5	1.50E-01	23.2	465	460

Fine Grained Soil
θw (water-filled soil porosity) 0.3 silt loam
η (total soil porosity) 0.5 windblown silt
ρb (dry soil bulk density) 1.36 g/cm3, windblown silt
Foc (fraction organic carbon) 0.0015 unitless, HWS, 1995; site specific , Foc 30 ft bgs = 0.11% and 50 ft bgs 0.19%
Kd (distribution coefficient)= Koc*foc
θa (air-filled soil porosity) = n - θw
Koc (organic carbon partition coefficient) - chemical specific, from USEPA April 2012 RSL table
H' (Henry's Law constant) - chemical specific, from USEPA April 2012 RSL table

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Table B.3
Soil Gas Calculations
Garvey Elevator Site, Hastings, Nebraska

Solve for soil gas concentration (Cg) given soil concentration (Cs) for MCL-based protection of groundwater:

Cs = Cg*[Sw+(n-Sw)*Kh+bd*Kd]/(bd*Kh)

rearranged to solve for Cg:

Cg=Cs/{[Sw+(n-Sw)*Kh+bd*Kd]/(bd*Kh)}

Chemical	Cs (SSL from RSL Table*20)	Kh (Henry's Law, unitless)	Organic Carbon Part. Coeff., Koc	Distribution Coeff., Kd	Cg (mg g/kg cm3), Fine Grained	Cg (ug/m3), Fine Grained	Cg rounded (ug/m3)	Distr. Coeff., Kd	Cg (mg g/kg cm3), Coarse Grained	Cg (ug/m3) for CoarseGrain	Cg rounded (ug/m3)
Carbon Tetrachloride	0.04	1.13E+00	4.39E+01	6.58E-02	9.48E-02	94,788	95,000	5.05E-02	0.132	132,403	130,000
Chloroform	0.44	1.50E-01	3.18E+01	4.77E-02	2.27E-01	227,348	230,000	3.66E-02	0.459	458,992	460,000
PCE	0.046	0.7236304	94.94	1.42E-01	7.09E-02	70,912	71,000	1.09E-01	0.106	106,069	110,000
TCE	0.036	0.4026983	60.7	9.11E-02	3.91E-02	39,091	39,000	6.98E-02	0.066	65,911	66,000

Notes:
SSLs from the USEPA RSL Tables (April 2012); MCL-based SSL used when available.
Henry's Law Constant (unitless) from the USEPA RSL Tables (April 2012).

Parameter	Fine Grained		Coarse Grained	
Sw (soil water content)	0.3	silt loam	0.13	sand
n (porosity)	0.5	windblown silt	0.4	sand
bd (bulk density)	1.36	g/cm3, windblown silt	1.59	g/cm3, sand
Foc (fraction organic carbon)	0.0015	site specific	0.00115	site specific

Table B.4
Indoor Air Calculations
Garvey Elevator Site, Hastings, Nebraska

Calculate Protective Indoor Air Concentrations (evaluate both carcinogenic, noncarcinogenic):

Ccancer (ug/m3) = [(TCR*Atc)/(EF*ED*IUR)] = Indoor Air Concentration Protective of Carcinogenic Affects
Cnc (ug/m3) = (THQ*RfC*1000ug/mg) = Indoor Air Concentration Protective of Non-carcinogenic Affects

Chemical	Inhalation Unit Risk, IUR (ug/m3)-1	Reference Concentration, RfC (mg/m3)	Ccancer (ug/m3)	Cnoncancer (ug/m3)	Lower of the Carcinogenic and Non-Carcinogenic Concentrations (ug/m3)
Chloroform	2.30E-05	9.80E-02	1.06E-01	9.80E+01	1.06E-01
Tetrachloroethene	2.60E-07	4.00E-02	9.36E+00	4.00E+01	9.36E+00
Trichloroethene	4.10E-06	2.00E-03	4.30E-01*	2.00E+00	4.30E-01

* = Chemical identified as a mutagen. Listed indoor air concentration incorporates the mutagenic component.

Total Carcinogenic Risk (TCR)	1.00E-06	
Total Hazard Quotient (THQ)	1	
Averaging Time (Atc)	25550	days
Exposure Frequency (EF)	350	days/year
Exposure Duration (ED)	30	years

Values are calculated site-specific risk-based levels for indoor air using formulas from Appendix D of the USEPA VI Guidance, 2002.
Toxicity values are from the USEPA RSL April 2012 Tables.

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APPENDIX C

DEVELOPMENT AND INITIAL SCREENING OF POTENTIALLY APPLICABLE REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

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Table C.1
Description and Initial Screening of Potentially Applicable Remedial Technologies and Process Options for Contaminated Soil (OU1)
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Description of Response Action	Screening Comments	Retained
No Action	None	No Action	No action would be taken. The source area soil contamination would remain in existing condition.	Required by NCP as stand-alone alternative.	Yes
Institutional Controls	Land Use Controls	Government and Proprietary Controls	Would prevent future site construction activities. Governmental controls include zoning restrictions, ordinances, statutes, codes or regulations, or other provisions that restrict land or resource use. Proprietary controls include instruments such as easements and covenants.	Potentially implementable response action.	Yes
	Community Awareness	Information and Education Programs	Community information and education programs would be undertaken to enhance awareness of potential hazards and remedies.	Potentially implementable response action.	Yes
Engineered Controls	Land Use Control	Fencing	Limit access to contaminated areas.	Implementation would not address any RAOs as there is no excess risk to trespassers.	No
Monitoring	Sampling and Analysis	Vapor Monitoring	Periodic monitoring of vapor intrusion would be conducted.	Technically feasible and potentially applicable.	Yes
	Site Inspection	Five-Year Review	Section 121 of CERCLA, as amended by SARA, requires that remedial actions which result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a Five Year Review.	Retained per CERCLA.	Yes
Containment of Source Areas	Surface Source Controls	Low Permeability Barrier	Contaminated soil would be covered to reduce or eliminate exposure risks to receptors as well as reduce or eliminate infiltration of precipitation and surface water into contaminated soil. Examples of cap construction materials include a soil and clay clap, asphaltic cap, concrete cap, and geosynthetic materials (such as a geomembrane or a geocomposite clay layer).	Not technically feasible because contaminated soil within the source areas are located near active facilities. Would not fully address existing subsurface contamination.	No
		Asphalt	An asphaltic cap would be constructed over the contaminated soil to reduce the amount of precipitation that infiltrates through the unsaturated zone.	Contaminated soil is located under and adjacent to an active facility. Would not address existing subsurface contamination.	No
		Concrete	Concrete would be used as cap material to reduce the amount of precipitation that infiltrates through the unsaturated zone.	Contaminated soil is located under and adjacent to an active facility. Would not address existing subsurface contamination.	No

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Table C.1
Description and Initial Screening of Potentially Applicable Remedial Technologies and Process Options for Contaminated Soil (OU1)
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Description of Response Action	Screening Comments	Retained
Containment of Source Areas (continued)	Surface Source Controls (continued)	Multilayer	A combination of clay, soil, and geomembranes would be used as cap construction material to reduce the amount of precipitation that infiltrates through the unsaturated zone.	Contaminated soil is located under and adjacent to an active facility. Would not address existing subsurface contamination.	No
Removal, Transport, Disposal	Removal	Mechanical Removal (Excavation)	Contaminated soil would be excavated to the extent possible.	Potentially implementable process option. No contamination has been found beneath the elevator; however, excavation adjacent to the silos would require shoring and may potentially leave residual contamination.	Yes
	Transport	Mechanical Transport (Truck Hauling)	Excavated soil would be transported by truck to a disposal site.	Potentially implementable process option. Primarily applicable if excavation and off-site disposal of contaminated soil is planned.	Yes
	Disposal	On-site Disposal	Excavated contaminated soil would be disposed of at an onsite borrow area. If combined with treatment technologies, treated soil could be used as onsite backfill.	Potentially implementable process option. Only applicable if treatment of excavated contaminant soil is planned.	Yes
		Off-site Disposal	Excavated contaminated soil would be disposed of at an offsite disposal facility authorized to receive the contaminated soil.	Potentially implementable process option.	Yes
Soil Treatment	Biological Treatment	Ex Situ Biological Degradation	Excavated soil would be mixed with water and nutrients. Microorganisms would degrade contaminants in the slurry mix.	Potentially implementable process option. May not be effective certain times of the year due to low temperatures during the operating period which would reduce microbial activity.	Yes
		In Situ Enhanced Bioremediation	Biological degradation of contaminants through reductive dechlorination by indigenous microorganisms would be stimulated through the addition of substrate and nutrients. Substrate could be a liquid or a gas.	Not technically feasible for site application because the soil contamination is in the vadose zone.	No
		Ex Situ Bioventing	Oxygen is delivered to excavated contaminated soils by forced air movement (either extraction or injection of air) to increase oxygen concentrations and stimulate biodegradation.	Potentially implementable process option.	Yes

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Table C.1
Description and Initial Screening of Potentially Applicable Remedial Technologies and Process Options for Contaminated Soil (OU1)
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Description of Response Action	Screening Comments	Retained
Soil Treatment (continued)	Biological Treatment (continued)	Phytoremediation		Not technically feasible for site application because of the need for available land to plant trees. Contaminated soil within the source areas is located near active facilities. Phytoremediation would only be effective during the vegetative growing season.	No
	Chemical Treatment	Ex Situ Chemical Oxidation	Excavated soil would be mixed with water and chemical oxidant. Contaminants in the slurry mix are degraded by the chemical oxidants.	Potentially implementable process option.	Yes
		In Situ Chemical Oxidation	Strong chemical oxidants (e.g., hydrogen peroxide, potassium permanganate, or sodium persulfate) would be injected into the vadose zone to oxidize chlorinated VOCs.	Not technically feasible for site application because the soil contamination is in the vadose zone.	No
		In Situ Chemical Reduction	Strong chemical reductants (e.g., zero-valent iron) would be injected into the vadose zone to achieve reductive dehalogenation of chlorinated VOCs.	Not technically feasible for site application because the soil contamination is in the vadose zone.	No
	Physical/ Chemical Treatment	Ex Situ Soil Washing	Contaminated soil would be mixed with a washing solution that removes the contaminants from the soil.	Not technically feasible for site application because technology is not proven effective with carbon tetrachloride. The target contaminant groups for soil washing are semivolatile organic compounds, fuels, and heavy metals. The technology can be used on pesticides and selected VOCs including benzene, toluene, ethylbenzene and xylenes.	No
		Ex Situ Solidification/ Stabilization	Contaminants would be either encased in a low-permeability matrix or stabilized chemically.	Technology is not effective against VOCs in soil.	No
		In Situ Soil Flushing	Water, or water containing an additive to enhance contaminant solubility, would be applied to the soil or injected into the ground water to raise the water table into the contaminated soil zone. Contaminants are leached into the ground water, which is then extracted and treated.	Not technically feasible due to active facility nearby, and contaminants in soil being a large distance from water table.	No

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Table C.1
Description and Initial Screening of Potentially Applicable Remedial Technologies and Process Options for Contaminated Soil (OU1)
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Description of Response Action	Screening Comments	Retained
Soil Treatment (continued)	Physical Treatment	Ex Situ Thermal Remediation	Excavated soil would be heated to a temperature of 200 to 1,000°C. A vacuum draws the contaminant vapors from the closed system to an off-gas treatment system. Considered a presumptive remedy for ex situ treatment of VOC-contaminated soil.	Potentially implementable process option.	Yes
		In Situ Thermal Remediation	Contaminated soil would be heated at high temperatures to volatilize or destroy the organic chemical compounds. The vaporized water, contaminants, and natural organic compounds are drawn by the vacuum to an off-gas treatment system. Types of in situ thermal treatments include steam enhanced extraction, electrical resistive heating and thermal conductive heating.	Technically feasible and potentially applicable; however, this technology was eliminated from consideration because relatively low concentrations at the Site would not be the most efficient use of the thermal technology.	No
		Incineration	Excavated soil would be heated to 870°C to 1,200°C volatilizing and destroying organic contaminants. Considered a presumptive remedy for ex situ treatment of VOC-contaminated soil.	Potentially implementable process option.	Yes
		In Situ Vitrification	An electrical current would be passed between electrodes inserted into soils to cause melting. Extremely high temperatures (1,600 to 2,000°C) melt soil into a glass-like substance with low permeability resulting in the destruction of organic contaminants.	Not technically feasible for site application because contaminated soil within the source areas are located under active facilities.	No
		Soil Vapor Extraction (SVE)	A vacuum would be applied to soil to promote airflow through the contaminated soil to remove VOCs. Considered the preferred presumptive remedy for treatment of VOC-contaminated soil. An SVE system was previously installed with 8 vapor extraction wells.	Potentially implementable process option. This technology was implemented at the site and has shown to be effective.	Yes
		Ex Situ Passive or Active Soil Venting	Excavated soil is stockpiled and contaminants volatilize passively or volatilization may be enhanced with a network of piping to which a vacuum is applied. Piles may be covered with a geomembrane.	Potentially implementable process option.	Yes

Notes:
1. Shading indicates remedial technologies/process options have been eliminated from further consideration based on lack of technical implementability. Remaining (unshaded) remedial technologies/process options have been retained for additional screening in Table C.3.

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Table C.2
Description and Initial Screening of Potentially Applicable Remedial Technologies and Process Options for Contaminated Groundwater (OU1, OU2)
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Operable Unit 1	Operable Unit 2	Description of Response Action	Screening Comments	Retained
No Action	None	No Action	✓	✓	No action would be taken. The source area and groundwater contamination would remain in their existing conditions.	Retained (Required by NCP as stand-alone alternative)	Yes
Institutional Controls	Groundwater Use Controls	Government and Proprietary Controls	✓	✓	Would prevent future Site construction activities and subsequent exposure to contaminated groundwater in source areas. Government controls include zoning and deed restrictions, ordinances, statutes, codes or regulations, or other provisions that restrict land or resource use. Proprietary controls include instruments such as easements and covenants.	Retained.	Yes
	Community Awareness	Information and Education Programs	✓	✓	Community information and education programs would be implemented to enhance awareness of potential hazards and remedies.	Technically feasible and potentially applicable.	Yes
Monitoring	Sampling and Analysis	Groundwater Monitoring	✓	✓	Periodic monitoring of groundwater contamination would be conducted.	Technically feasible and potentially applicable.	Yes
	Site Inspection	Five Year Site Review	✓	✓	Section 121 of CERCLA, as amended by SARA, requires that remedial actions which result in any hazardous substances, pollutants, or contaminants remaining at the Site be subject to a Five Year Review.	Retained per CERCLA.	Yes

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Table C.2
Description and Initial Screening of Potentially Applicable Remedial Technologies and Process Options for Contaminated Groundwater
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Operable Unit 1	Operable Unit 2	Description of Response Action	Screening Comments	Retained
Groundwater Containment	Hydraulic Control	Vertical Barrier	✓	✓	A slurry wall or grout curtain would be used to limit the direction and migration of contaminated groundwater flow. Depth of application is limited.	Not technically feasible for Site application due to the depth and width of groundwater contamination and the presence of the contaminated groundwater plume under active businesses both on Site and in the surrounding area.	No
Groundwater Removal	Collection	Recovery Well(s)	✓	✓	Extraction wells would be used to control the flow of groundwater and contaminated groundwater would be pumped to the surface for subsequent treatment.	Technically feasible and potentially applicable. This technology has been implemented at the Site. The current system consists of 8 extraction wells with treatment consisting of an air stripper.	Yes
		Interceptor Trench(es)		✓	Collection trenches would be installed perpendicular to groundwater flow in order to intercept and collect/divert groundwater for subsequent treatment. Trench depths of up to 70 feet can be achieved, but typical depth of installation is between 20 to 30 feet bgs.	Not technically feasible for Site application due to the depth of the interceptor trench required.	No

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Table C.2
Description and Initial Screening of Potentially Applicable Remedial Technologies and Process Options for Contaminated Groundwater
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Operable Unit 1	Operable Unit 2	Description of Response Action	Screening Comments	Retained
Groundwater Removal (continued)	Discharge	Discharge to Surface Water Body		✓	Discharge of extracted groundwater either directly to a surface water body or to a storm sewer that leads to a surface water body. Would require treatment prior to discharge.	Unlikely that treatment plant would be in proximity to a surface water body capable of handling the anticipated flow rates from an OU2 GET system.	No
		Discharge to Constructed Wetlands		✓	Constructed wetland would treat contaminants by a combination of three mechanisms: adsorption, biodegradation, and volatilization. Effluent would be discharged into Pawnee Creek.	Not technically feasible for Site application. Constructed wetland would require a large area to treat the anticipated flow rate and would not be effective during the colder winter months.	No
		Discharge to publicly owned treatment works (POTW)		✓	Discharge of extracted groundwater to POTW.	The OU 1 GET system discharges to two injection wells. It is not likely that the anticipated flow rates of a downgradient OU 2 GET system would be allowed to discharge to a POTW, due to POTW capacity restrictions.	No
	Discharge	Aquifer reinjection	✓	✓	Reinjection of treated groundwater into the contaminated aquifer or another aquifer.	Technically feasible for Site application and currently being used for discharge of treated groundwater from the OU1 GET system.	Yes

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Table C.2
Description and Initial Screening of Potentially Applicable Remedial Technologies and Process Options for Contaminated Groundwater
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Operable Unit 1	Operable Unit 2	Description of Response Action	Screening Comments	Retained
Groundwater Treatment	Biological Treatment	Ex Situ Biological Degradation		✓	Microorganisms adapted for degradation of the specific contaminants are applied to enhance the remediation process in extracted groundwater. Biological degradation would be enhanced by controlling the electron acceptor, nutrients, temperature and pH in an engineered reactor.	Not technically feasible for Site application. Air stripping or granular activated carbon adsorption would be more efficient and are considered presumptive treatment technologies for ex situ treatment of VOC-contaminated groundwater.	No
		Natural Attenuation		✓	A variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in the groundwater.	Technically feasible and potentially applicable as a long-term solution; however, need results of sampling to determine what types of microorganisms are present at the Site.	Yes
		In Situ Enhanced Bioremediation	✓	✓	Degradation of contaminants by naturally occurring microorganisms would be stimulated through the addition of substrate and nutrients to degrade contaminants.	Technically feasible and potentially applicable as a long-term solution; however, need results of sampling to determine what types of microorganisms are present at the Site and optimize injection details.	Yes
	Chemical/ Biological Treatment	Reactive Wall		✓	An in-ground trench would be excavated and backfilled with reactive media to provide passive treatment of contaminated groundwater passing through the trench. Depth of application is limited.	Not technically feasible for Site application because of the depth to which contamination is present at the Site.	No
Chemical	Treatment	Ex Situ UV/Oxidation		✓	Organic contaminants would be destroyed through chemical oxidation/reduction reactions. Used when destruction of contaminants is preferred or when contaminants cannot be removed with granular activated carbon or air stripping.	Technically feasible for Site application; however, preference given to using existing treatment system infrastructure - air stripping.	No

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Table C.2
Description and Initial Screening of Potentially Applicable Remedial Technologies and Process Options for Contaminated Groundwater
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Operable Unit 1	Operable Unit 2	Description of Response Action	Screening Comments	Retained
Groundwater Treatment (continued)	Chemical Treatment (continued)	In Situ Chemical Oxidation	✓	✓	Strong chemical oxidants (hydrogen peroxide, potassium permanganate, or ozone) would be injected into the contaminated aquifer to destroy organic contaminants.	Technically feasible and potentially applicable.	Yes
		In Situ Chemical Reduction	✓	✓	Strong chemical reducing agents (e.g., zero-valent iron) would be injected into the contaminated aquifer to achieve reductive dehalogenation of chlorinated contaminants.	Technically feasible and potentially applicable.	Yes
Chemical/	Physical Treatment	Surfactant Flushing	✓	✓	A mixture of water and solvents or surfactants would be injected or allowed to infiltrate into the contaminated aquifer to facilitate removal of contaminants through dissolution, displacement, and/or mobilization. The injected solution and contaminants would be extracted downgradient.	Not technically feasible for Site application because of the depth to which contamination is present at the Site.	No
		Electrokinetics	✓	✓	Electrokinetic remediation relies on application of a low-intensity direct current through the soil between ceramic electrodes that are divided into a cathode array and an anode array. This mobilizes charged species, causing ions and water to move toward the electrodes. Metal ions, ammonium ions, and positively charged organic compounds move toward the cathode. Most applicable in low permeability soils.	Not technically feasible for Site application because of the depth to which contamination is present at the Site. Also, soil permeability and geology are not suited for this technology.	No
		Precipitation/ Flocculation and Sedimentation	✓	✓	A precipitating agent is added to water in a rapid-mixing tank along with flocculating agents such as alum, lime, and/or various iron salts. This mixture then flows to a flocculation chamber that agglomerates particles, which are then separated from the liquid phase in a sedimentation chamber.	Not applicable for treatment of volatile organic compounds like carbon tetrachloride and chloroform.	No

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Table C.2
Description and Initial Screening of Potentially Applicable Remedial Technologies and Process Options for Contaminated Groundwater
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Operable Unit 1	Operable Unit 2	Description of Response Action	Screening Comments	Retained
Groundwater Treatment (continued)	Physical Treatment	Granular Activated Carbon	✓	✓	Organic contaminants would be removed from groundwater through adsorption onto activated carbon.	Technically feasible and potentially applicable; however, this technology was eliminated from consideration because of high GAC replacement costs and because the existing treatment system already uses air stripping.	No
		Reverse Osmosis	✓	✓	Water is forced through a membrane under pressure. The membrane(s), of which there are many types depending on the application, allows water free of contaminants to pass through. The water containing the contaminants (called supernatant) that were not able to pass through the membrane would require disposal or could be recirculated back to a pervaporation module for further treatment, where the organic vapors (called permeate) are extracted by vacuum, condensed and vented downstream of the condenser, thus minimizing air releases.	Technically feasible for Site application; however, this technology was eliminated from consideration based because of the disposal of the supernatant would be needed and air stripping has been shown to be an effective treatment technology for carbon tetrachloride and chloroform.	No
		Air Stripping	✓	✓	Contaminants would be removed from groundwater to the air through phase transfer mechanisms.	Technically feasible and potentially applicable. This technology has been implemented at the Site. The current system consists of a column air stripper.	Yes
		Dual Phase Extraction	✓	✓	Dual phase extraction (DPE), also known as multi-phase extraction, uses a high-vacuum system to remove both contaminated groundwater and soil vapor. Fluid/vapor extraction systems depress the water table and water flows faster to the extraction well. DPE removes contaminants from above and below the water table.	Technically feasible and potentially applicable; however, this technology was eliminated from consideration because of high GAC replacement costs and because the existing treatment system already uses air stripping.	No

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Table C.2
Description and Initial Screening of Potentially Applicable Remedial Technologies and Process Options for Contaminated Groundwater
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Operable Unit 1	Operable Unit 2	Description of Response Action	Screening Comments	Retained
Groundwater Treatment (continued)	Physical Treatment (continued)	In Situ Thermal Remediation	✓		Thermal treatment directly heats the subsurface soil, thereby increasing the contaminant's vapor pressure and diffusivity and decreasing its viscosity. As a result, the evaporation rate and mobility of the contaminant is increased, which ultimately decreases the removal time associated with SVE and/or DPE. Thermal treatment can be applied using electrical resistance heating (ERH), thermal conductive heating (TCH), or steam enhanced extraction (SEE).	Technically feasible and potentially applicable; however, this technology was eliminated from consideration because relatively low concentrations at the Site would not be the most efficient use of the thermal technology.	No
		Air Sparging	✓		Air would be injected through subsurface vertical and/or horizontal wells. VOCs partition into the air stream as it passes through the contaminated groundwater. Technology should be completed by utilizing the existing SVE system.	Technically feasible and potentially applicable; however, this technology was eliminated from consideration because of the depth to contaminated groundwater and the subsurface geology.	No
		In-well Air Stripping	✓	✓	Groundwater is pumped from the lower portion of an unconfined aquifer and then reinjected into the vadose zone. Pumping can be accomplished by a submersible pump and/or through air lift pumping. VOCs are removed through the physical process of pumping, thus creating turbulence in the well or through aeration in the well. VOCs are generally removed with a vacuum applied to the well or through an SVE system.	Not technically feasible for Site application due to the depth of the aquifers. Generally not used for confined aquifers.	No

Notes:
1. Shading indicates remedial technologies/process options have been eliminated from further consideration based on lack of technical implementability. Remaining (unshaded) remedial technologies/process options have been retained for additional screening in Table C.4.

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Table C.3
Effectiveness, Implementability and Relative Cost
Screening of Potentially Applicable Remedial Technologies/
Process Options for Contaminated Soil (OU1)
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Description of Response Action	Effectiveness		Implementability		Relative Cost		Reasons for Elimination of Process Option from Consideration
								Capital Cost	O&M Cost	
No Action	None	No Action	No action would be taken. The source area and groundwater contamination would remain in their existing conditions.	⓿	No protection of human health or the environment and no compliance with ARARs.	❺	Easily implemented but is not acceptable to regulatory agencies and does not meet ARARs.	⓿	⓿	Retained. Required by NCP as stand-alone alternative.
Institutional Controls	Land Use Controls	Government and Proprietary Controls	Legal instruments would prevent future site construction activities and subsequent exposure to contaminated soil in source areas. Examples of potential governmental controls include zoning restrictions, ordinances, statutes, codes or regulations, building permits, or other provisions that restrict land or resource use. Examples of proprietary controls could include instruments such as easements and covenants.	❷	Restricts future uses of the site that are not protective of human health and the environment but does not physically mitigate contaminants.	❺	Easily implemented using legal instruments and labor resources.	$	$	Retained. Previously implemented ICs prohibiting drilling of new private water supply wells and restricting the future site use. Feasible process option for combination with process options in which contaminated soil posing a threat to receptors are left onsite.
	Community Awareness	Information and Education Programs	Community information and education programs would be undertaken to enhance awareness of potential hazards and remedies.	❷	Potentially protects human receptors by enhancing awareness of potential site hazards and remedies. Does not directly affect ecological receptors and does not physically mitigate contamination.	❺	Easily implemented using available technical and community involvement labor resources.	$	$	Retained. Potentially feasible process option for combination with all other technologies.
Monitoring	Sampling and Analysis	Vapor Intrusion Monitoring	Periodic monitoring of vapor intrusion would be conducted.	⓿	Protects human receptors by monitoring contaminant concentrations and migration. Does not directly affect receptors and does not physically address contaminants.	❺	Easily implemented using available technical labor and equipment resources.	⓿	$	Retained.
	Site Inspection	Five-Year Site Review	Five-Year Reviews generally are required by CERCLA or program policy when hazardous substances remain on site above levels which permit unrestricted use and unlimited exposure.	⓿	Reviews effectiveness of site remediation measures, but does address contamination directly.	❺	Easily implemented using available technical labor and equipment resources. Dovetails with periodic monitoring of site.	⓿	$$	Section 121 of CERCLA, as amended by SARA, requires that remedial actions which result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a five-year review.
Removal, Transport, Disposal	Removal	Mechanical Removal (Excavation)	Contaminated soil would be excavated to the extent possible.	❹	Protects receptors by eliminating future exposure to contaminated material after implementation. Dust must be controlled during implementation to ensure protection to workers and the environment. Must be combined with containment, transport, disposal, and/or treatment technologies to ensure effectiveness.	❹	Implemented using available construction resources.	$$$$	⓿	Retained. Feasible as a long-term solution; must be combined with transport, disposal, and/or treatment technologies.

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Table C.3
Effectiveness, Implementability and Relative Cost
Screening of Potentially Applicable Remedial Technologies/
Process Options for Contaminated Soil (OU1)
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Description of Response Action	Effectiveness		Implementability		Relative Cost		Reasons for Elimination of Process Option from Consideration
								Capital Cost	O&M Cost	
Removal, Transport, Disposal (continued)	Transport	Mechanical Transport (Truck Hauling)	Excavated soil would be transported by truck to a treatment or disposal site.	❸	Potentially protects receptors by eliminating future exposure to contaminated soil after implementation. Onsite and offsite transport of materials and transportation of contaminated soil could negatively impact the community. Dust must be controlled during implementation to protect workers and the environment Must be combined with removal, containment, disposal, and/or treatment technologies to ensure effectiveness.	❺	Easily implemented using available construction resources; efficient for all sizes of materials. Permits and regulatory approval would be required for onsite and offsite transport of materials and contaminated soil.	$$$$	⓿	Retained. Feasible as a long-term solution; must be combined with removal, disposal, and/or treatment technologies.
	Disposal	Onsite Disposal	Excavated soil would be disposed on site.	❹	Protects receptors by eliminating surface exposure of contaminants within a permitted onsite disposal facility capable of accepting the wastes. Must be combined with removal, transport, and treatment technologies to ensure effectiveness.	❸	Implemented using a treatment technology to reduce contamination prior to disposal. Borrow location would need to be determined. Would require grading and necessary engineering controls.	$$	⓿	Retained. Feasible as a long-term solution; must be combined with removal, transport, and treatment technologies.
		Offsite Disposal	Excavated soil would be disposed of at an offsite disposal facility authorized to receive contaminated soil.	❹	Protects receptors by eliminating surface exposure of contaminants within a permitted offsite disposal facility capable of accepting the wastes. Must be combined with removal, transport, and/or treatment technologies to ensure effectiveness.	❹	Implemented using a permitted offsite disposal facility capable of accepting the wastes. Administrative feasibility is related mainly to obtaining regulatory approval and approval of the disposal facility.	$$$$	⓿	Retained as a future consideration; must be combined with removal and transport technologies.
Soil Treatment	Biological Treatment	Ex Situ Biological Degradation	Contaminated soil would be mixed with water and nutrients. Micro-organisms degrade contaminants in the slurry mix.	❸	Protects receptors by reducing contaminants through microbial activity. May require bench-scale testing in order to enhance biodegradation of contaminants. Must be combined with removal, transport, and disposal.	❸	Implemented by constructing a storage unit for contaminated soil, adding a slurry mix to enhance biodegradation, and sealing unit to provide anaerobic conditions.	$$$	$	Technically feasible but would require specialized equipment. Contaminants could be removed from soil with simpler technology.
		Ex Situ Bioventing	Contaminated soil would have oxygen delivered through it. Forcing air movement (either extraction or injection of air), oxygen would stimulate biodegradation.	❸	Protects receptors by reducing contaminants through microbial activity. Must be combined with removal, transport, and disposal.	❹	Implemented by constructing a storage unit for contaminated soil, providing an oxygen source, and vents.	$$	$	Technically feasible and similar to ex situ SVE.
	Chemical Treatment	Ex Situ Chemical Oxidation	Contaminated soil would be mixed with water and chemical oxidants. Contaminants in the slurry mix are degraded by the chemical oxidants.	❸	Protects receptors by destroying contaminants through chemical oxidation. May require bench-scale testing in order to optimize process. Must be combined with removal, transport, and disposal.	❸	Implemented by constructing a storage unit for contaminated soil and adding an oxidant slurry mix to promote oxidation of contaminants.	$$$	$	Technically feasible but would require specialized equipment. Contaminants could be removed from soil with simpler technology.

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Table C.3
Effectiveness, Implementability and Relative Cost
Screening of Potentially Applicable Remedial Technologies/
Process Options for Contaminated Soil (OU1)
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Description of Response Action	Effectiveness	Implementability	Relative Cost		Reasons for Elimination of Process Option from Consideration
						Capital Cost	O&M Cost	
Soil Treatment (continued)	Physical Treatment	Ex Situ Thermal Remediation	Excavated soil would be heated to a temperature of 200 to 1,000°C. A vacuum draws the contaminant vapors from the closed system to an off-gas treatment system. Considered a presumptive remedy for ex situ treatment of VOC-contaminated soil.	❸ Protects receptors by reducing concentration of contaminants in subsurface. Increased soil temperatures can cause the release of natural organic carbon from soil, which may help accelerate biological activity and biodegradation of residual contaminants may occur.	❷ Implemented using a patented, demonstrated, and commercialized technology. Additional treatment costs may be incurred for remediating soils with high clay or silt content, or in soils with high moisture content.	$$$$	$	Technically feasible, but would require mobilization of an ex situ thermal desorption unit and would be more costly than ex situ SVE.
		Incineration	Excavated soil would be heated to 870°C to 1,200°C volatilizing and destroying organic contaminants.	❺ Protects receptors by reducing concentration of contaminants in subsurface. Must be combined with removal, transport, and disposal technologies.	❸ Easily implemented using an available technology. Contaminated soil requiring incineration would be sent to an incineration facility such as the one in Kimball, Nebraska.	$$$$	$	Retained for potential future consideration. Technically feasible as a long-term solution; must be combined with removal, transport, and disposal technologies.
		Soil Vapor Extraction (SVE)	A vacuum would be applied to soil to promote airflow through the contaminated soil to remove VOCs.	❹ Protects receptors by reducing concentration of contaminants in subsurface. An SVE system with 11 vertical vapor extraction wells was previously installed. The system has shown effectiveness, but the current setup leaves areas untreated.	❺ Easily implemented using an available technology. A network of SVE wells was previously installed. May be able to use or expand the current treatment system.	$$	$$$	Retained. Technically feasible and potentially applicable. This technology has been implemented at the site.
		Ex Situ Passive or Active Soil Venting	Excavated soil is stockpiled and contaminants volatilize passively or volatilization may be enhanced with a network of piping to which a vacuum is applied. Piles may be covered with a geomembrane.	❸ Protects receptors by reducing concentration of contaminants in excavated soil.	❺ Easily implemented using an available technology. May be able to use the existing SVE system for an active soil venting system.	$	$	Technically feasible. However, active soil venting, or ex situ SVE, would be used to treat excavated contaminated soil.

Notes:
1. The screening process for effectiveness, implementability, and relative cost involves a qualitative assessment of the degree to which process options address evaluation criteria presented in Section 4.5. The numerical designations for the qualitative ratings system used in this table are not used to quantitatively assess process options (for instance, rankings for a process option are not additive).
2. **Shading** indicates remedial technologies/process options have been eliminated from further consideration based on lack of effectiveness, implementability, and/or cost. Remaining (unshaded) remedial technologies/process options have been retained for assembly into remedial action alternatives as discussed in Section 4.7.
Legend for Qualitative Ratings System: The following ratings were used for evaluation and presentation of effectiveness, implementability, and relative cost:

Effectiveness and Implementability

❶	**Low**
❷	**Low to Moderate**
❸	**Moderate**
❹	**Moderate to High**
❺	**High**

Relative Cost

$	**Low**
$$	**Low to Moderate**
$$$	**Moderate**
$$$$	**Moderate to High**
$$$$$	**High**

Table C.4
Effectiveness, Implementability and Relative Cost
Screening of Potentially Applicable Remedial Technologies/
Process Options for Contaminated Groundwater (OU1, OU2)
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Operable Unit 1	Operable Unit 2	Description of Response Action	Effectiveness		Implementability		Relative Cost: Capital Cost	Relative Cost: O&M Cost	Screening Comments
No Action	None	No Action	✓	✓	No action would be taken. The source area and groundwater contamination would remain in their existing conditions.	⓿	No protection of human health or the environment and no compliance with ARARs.	❺	Easily implementable – would require shutting down existing treatment system at OU1.	⓿	⓿	Retained (Required by NCP as stand-alone alternative)
Institutional Controls	Groundwater Use Controls	Government and Proprietary Controls	✓	✓	Legal instruments would restrict use of groundwater in the zone of contamination.	❷	Protects human receptors by restricting use of groundwater. Does not directly affect ecological receptors and does not physically address contamination.	❺	Easily implemented. using legal instruments and labor resources.	$	$	Technically feasible and potentially applicable.
	Community Awareness	Information and Education Programs	✓	✓	Community information and education programs would be undertaken to enhance awareness of potential hazards and remedies.	❷	Protects human receptors by enhancing awareness of potential site hazards and remedies. Does not physically address contamination.	❺	Easily implemented using available technical and community involvement labor resources.	$	$	Technically feasible and potentially applicable.
Monitoring	Sampling and Analysis	Groundwater Monitoring	✓	✓	Periodic monitoring of groundwater contamination would be conducted.	❷	Monitors contaminant concentrations and migration. Does not directly affect receptors and does not physically address contaminants.	❺	Easily implemented using available technical labor and equipment resources.	⓿	$$	Technically feasible and potentially applicable.
	Inspection Site	Five-Year Site Review	✓	✓	Five-Year Reviews generally are required by CERCLA or program policy when hazardous substances remain on site above levels which permit unrestricted use and unlimited exposure.	⓿	Reviews effectiveness of site remediation measures, but does not address contamination directly.	❺	Easily implemented using available technical labor and equipment resources. Dovetails with periodic monitoring of site.	⓿	$$	Section 121 of CERCLA, as amended by SARA, requires that remedial actions which result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a five-year review.
Groundwater Removal	Collection	Recovery Well(s)	✓	✓	Recovery wells would be used to control the flow of groundwater and pump contaminated groundwater to the surface for subsequent treatment.	❹	Protects human receptors by reducing migration of contaminated groundwater and capturing contaminants in groundwater. System design could fail to contain the contaminant plume as predicted, allowing the plume to migrate.	❹	Highly implementable – a system consisting of 8 recovery wells is currently operating at the site as a plume interception measure. System could be expanded if needed.	$$$	$$$$	Technically feasible and potentially applicable. This technology has been implemented at the site. The current system consists of 8 recovery wells with a treatment train consisting of an air stripper.
	Discharge	Aquifer Reinjection	✓	✓	Reinjection of treated groundwater into the contaminated aquifer or another aquifer.	❸	Used in conjunction with groundwater treatment. Treated water is discharged through one or more injection wells.	❹	Aquifer reinjection is already used at the site at OU 1. It is technically feasible and potentially applicable to expand the system by installing a new injection well.	$$	$	Technically feasible for site application. This technology has been implemented for the OU 1 GET system. Two injection wells upgradient from the site are currently used.
Groundwater Treatment (continued)	Biological Treatment	Natural Attenuation		✓	A variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in the groundwater.	❶	Monitors contaminant concentrations and migration. Does not directly affect receptors and does not physically address contaminants. Contaminants may migrate before they are degraded. Institutional controls may be required and the site may not be available for reuse until contaminant levels are reduced.	❺	Easily implemented using available technical labor and equipment resources.	$	$$	Technically feasible and potentially applicable as a long-term solution; however, sampling results do not indicate that significant natural attenuation processes are occurring.

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Table C.4
Effectiveness, Implementability and Relative Cost
Screening of Potentially Applicable Remedial Technologies/
Process Options for Contaminated Groundwater (OU1, OU2)
Garvey Elevator Site, Hastings, Nebraska

General Response Action	Remedial Technology	Process Option	Operable Unit 1	Operable Unit 2	Description of Response Action	Effectiveness	Implementability	Relative Cost: Capital Cost	Relative Cost: O&M Cost	Screening Comments
Chemical	Treatment	In Situ Enhanced Bioremediation	✓	✓	Degradation of contaminants by naturally occurring microorganisms would be stimulated through the addition of substrate and nutrients to degrade contaminants.	❸ Protects human receptors by reducing concentrations of contaminants in groundwater. Target contaminants for technology are chlorinated hydrocarbons. Higher permeability zones would be cleaned up much faster because groundwater flow rates are greater. Groundwater circulation can limit effectiveness if it allows contaminants to escape from zones of active biodegradation.	❹ Easily implemented using available technical labor and equipment resources. Limitations to implementability include delivery depth and method for nutrients, presence of nutrients in subsurface, carbon source, and type of microorganisms present in subsurface. The method of injection needs to ensure that contamination is not pushed away from the treatment area, but rather mixed with the contaminated groundwater through recirculation.	$$$	$$$	Technically feasible and potentially applicable as a long-term solution; however, need results of sampling to determine what types of microorganisms are present at the site and whether these need to be supplemented.
		In Situ Chemical Oxidation	✓	✓	Strong chemical oxidants (e.g., H_2O_2, $KMnO_4$, O_3, or NaS_2O_8) would be injected into the contaminated aquifer to destroy organic contaminants.	❹ Protects human receptors by reducing concentrations of contaminants in groundwater. Technology provides mass reduction in source areas as well as plume treatment.	❹ Easily implemented with relatively simple, readily available equipment. The method of injection needs to ensure that contamination is not pushed away from the treatment area, but rather mixed with the contaminated groundwater through recirculation.	$$$	$$$	Technically feasible and potentially applicable.
		In Situ Chemical Reduction	✓	✓	Strong chemical reducing agents (e.g., zero-valent iron) would be injected into the contaminated aquifer to achieve reductive dehalogenation of chlorinated contaminants.	❹ Protects human receptors by reducing concentrations of contaminants in groundwater. Technology provides mass reduction in source areas as well as plume treatment.	❹ Easily implemented with relatively simple, readily available equipment. The method of injection needs to ensure that contamination is not pushed away from the treatment area, but rather mixed with the contaminated groundwater through recirculation.	$$$	$$$	Technically feasible and potentially applicable.
Physical	Treatment	Air Stripping	✓	✓	Contaminants would be removed from groundwater to the air through phase transfer mechanisms.	❹ Protects human receptors by reducing concentrations of contaminants in groundwater. Generally, organic compounds with Henry's constant greater than 0.01 atmospheres - m^3/mol are considered amenable to stripping.	❹ Highly implementable – a 500 gpm column air stripper is currently being operated at OU1 for treatment of groundwater extracted from recovery wells.	$$$	$$$	Technically feasible and potentially applicable. This technology has been implemented at the site. The current system consists of 8 recovery wells being treated by a tray air stripper. Must be combined with groundwater recovery and discharge.

Notes:
1. The screening process for effectiveness, implementability, and relative cost involves a qualitative assessment of the degree to which process options address evaluation criteria presented in Section 4.5. The numerical designations for the qualitative ratings system used in this table are not used to quantitatively assess process options (for instance, rankings for a process option are not additive).
2. **Shading** indicates remedial technologies/process options have been eliminated from further consideration based on lack of effectiveness, implementability, and/or cost. Remaining (unshaded) remedial technologies/process options have been retained for assembly into remedial action alternatives as discussed in Section 4.7.

Legend for Qualitative Ratings System: The following ratings were used for evaluation and presentation of effectiveness, implementability, and relative cost:

Effectiveness and Implementability		Relative Cost	
❶	**None**	❶	**None**
❷	**Low**	$	**Low**
❸	**Low to Moderate**	$$	**Low to Moderate**
❹	**Moderate**	$$$	**Moderate**
❺	**Moderate to High**	$$$$	**Moderate to High**
❻	**High**	$$$$$	**High**

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APPENDIX D

PRELIMINARY SCREENING OF REMEDIAL ALTERNATIVES

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Ratings System for Screening of Alternatives

Effectiveness and Implementability		Cost (Present Value Dollars)	
❶	None	**$**	Low Cost ($0 through $1M)
❶	Low	**$$**	Low to Moderate Cost ($1M through $5M)
❷	Low to Moderate	**$$$**	Moderate Cost ($5M through $10M)
❸	Moderate	**$$$$**	Moderate to High Cost ($10M through $15M)
❹	Moderate to High	**$$$$$**	High Cost(Greater than $15M)
❺	High		

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OU1 Contaminated Soil Alternatives

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Alternative PS1
No Action

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ALTERNATIVE PS1 – NO ACTION

Alternative Description: The No Action alternative would involve discontinuing operation of the SVE system, and would result in no change in soil contaminant concentrations since no treatment, containment, or removal of contaminated soil is included in this alternative.

Table D.1A Effectiveness Screening - Alternative PS1

Effectiveness Criteria	Evaluation Summary
Overall protection of human health and the environment	Contaminated soil is left unaddressed. Contaminants would leach into the groundwater and increase the time to complete remediation of groundwater at the source area.
Compliance with ARARs	No further action is taken to address contaminated soil material. Contaminated soil with concentrations exceeding preliminary cleanup levels (PCLs) would remain on the site; thus this criterion is not met.
Short-term effectiveness (during the remedial construction and implementation period)	No further remedial action would be undertaken to address contaminated soil; thus, none of these criteria are met.
Long-term effectiveness and permanence (following remedial construction)	
Reduction of toxicity, mobility, or volume through treatment	
Overall Effectiveness Rating	⓪

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Table D.1B Implementability Screening - Alternative PS1

Implementability Criteria	Evaluation Summary
Ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete	No further remedial action would be undertaken to address contaminated soil; thus, ability to meet these criteria is high.
Ability to operate, maintain, replace, and monitor technical components after the remedial action is complete	
Ability to obtain approvals from other agencies	Contaminated soil would be left unaddressed. No remedial action would be undertaken to address the soil source material; thus, there is no need to obtain approvals from other regulatory agencies.
Availability and capacity of treatment, storage, and disposal services	Contaminated soil is left unaddressed. No remedial action would be undertaken to address contaminated soil; thus, this criterion is not applicable.
Availability of property, specific materials and equipment, and technical specialists required for a remedial action	No further remedial action would be undertaken to address contaminated soil; thus, ability to meet these criteria is high.
Overall Implementability Rating	❺

Table D.1C Cost Screening – Alternative PS1

Evaluation Factors for Cost	Overall Rating	Approx. Cost (Dollars)
Present Value Cost	$	$298,000

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Alternative PS2
Excavation, Treatment and Disposal of Contaminated Soil and Operation of Existing SVE System

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ALTERNATIVE PS2 – EXCAVATION, TREATMENT AND DISPOSAL OF CONTAMINATED SOIL AND OPERATION OF EXISTING SVE SYSTEM

Alternative Description: Alternative PS2 would involve excavating and treating contaminated soil exceeding PCLs on site and disposing treated material into an onsite borrow area. Clean fill from the borrow area would be used to backfill the excavated area to match the surrounding grade. Excavated soil would be treated with an ex situ SVE. After soil contamination is reduced below PCLs, the treated soil would be placed into the on-site borrow pit, compacted, and seeded. The existing SVE system consisting of the eight operational extraction wells would continue to be utilized for 5 years, with no expansion or upgrades performed.

Table D.2A Effectiveness Screening - Alternative PS2

Effectiveness Criteria	Evaluation Summary
Overall protection of human health and the environment	Contaminated soil with concentrations exceeding PCLs that can be removed by excavation would be excavated, treated on site, and disposed onsite. The volume of contaminated soils remaining on site would be reduced, and migration of contaminants to groundwater mitigated.
Compliance with ARARs	Contaminated soil with concentrations exceeding preliminary cleanup levels would be excavated, treated and disposed on site.
Short-term effectiveness (during the remedial construction and implementation period)	Dust must be controlled during implementation to ensure protection to workers and the environment. Construction workers would be subject to some exposure from excavation, but this pathway could be managed using standard H&S procedures and protocols.
Long-term effectiveness and permanence (following remedial construction)	The existing SVE system would continue to operate, reducing toxicity, mobility, and volume of residual soil contamination, ensuring that the long-term effectiveness and permanence criterion is met.
Reduction of toxicity, mobility, or volume through treatment	Contaminated soil with concentrations exceeding PCLs that can be removed by excavation would be excavated, treated on site, and disposed on site. The volume of contaminated soils remaining on site would be reduced, and migration of contaminants to groundwater mitigated.
Overall Effectiveness Rating	❹

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Table D.2B Implementability Screening - Alternative PS2

Implementability Criteria	Evaluation Summary
Ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete	The soil source material and contaminated soil would be removed; thus, ability to meet these criteria is high. Ex situ treatment system would be easily constructed, with soil gas concentrations monitored and soil sampled to ensure concentrations are reduced below PCLs before on-site disposal. Shoring of existing structures may be needed depending on the proximity of the excavation to the structures. There may be a concern with excavating soil in proximity of an operating grain storage facility. Operations and maintenance of the treatment area would be minimal, and would be deconstructed once treatment is complete.
Ability to operate, maintain, replace, and monitor technical components after the remedial action is complete	
Ability to obtain approvals from other agencies	Approvals for engineering controls should be obtainable. All regulatory approvals for the existing SVE system are already in place. There may be other approvals to construct and operate an ex situ SVE treatment system. However, these approvals should be obtainable.
Availability and capacity of treatment, storage, and disposal services	The contaminated soil would be excavated, treated on site and disposed of on site. Area and materials for ex situ treatment is anticipated to be available.
Availability of property, specific materials and equipment, and technical specialists required for a remedial action	Construction would be conducted using conventional equipment (e.g. backhoe) and services. A licensed contractor would need to perform soil excavation with special care taken near the existing structures. The subcontractor would need 40-hour OSHA training to excavate and handle contaminated soil. Clean fill would be obtained from an on-site borrow source and be used to backfill excavated areas. The excavated material would be treated on site by an ex situ SVE system. The borrow area would be used as the final disposal location of treated contaminant soil.
Overall Implementability Rating	❸

Table D.2C Cost Screening – Alternative PS2

Evaluation Factors for Cost	Overall Rating	Approx. Cost (Dollars)
Present Value Cost	$	$929,000

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Alternative PS3
Expand Existing SVE System

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ALTERNATIVE PS3 – EXPAND EXISTING SVE SYSTEM

Alternative Description: Alternative PS3 expands the treatment area of the SVE system by installing a shallow and deep recovery well in the source area. Emissions from the existing SVE system do not currently require treatment because the emissions levels are below the NDEQ threshold of 2.5 tons per year for any combination of hazardous air pollutants. A catalytic oxidation unit and scrubber are located on site but are not currently used; this equipment could be re-activated if treatment prior to discharge is needed to comply with state air regulations. For purposes of this FS, it is assumed that emissions treatment would not be needed because the concentrations would remain below the NDEQ threshold. It is assumed the SVE system would continue to operate for 10 years.

Table D.3A Effectiveness Screening - Alternative PS3

Effectiveness Criteria	Evaluation Summary
Overall protection of human health and the environment	Contaminated soil with concentrations exceeding PCLs residing near the existing facility building would be treated by expanding the SVE to include a shallow and deep SVE well.
Compliance with ARARs	Contaminated soil with concentrations exceeding PCLs would be treated through the use SVE; thus this criterion is met.
Short-term effectiveness (during the remedial construction and implementation period)	Safety measures such as dust suppression, use of PPE, and establishment of work zones would protect workers and the community during implementation which would consist primarily of the installation of SVE wells.
Long-term effectiveness and permanence (following remedial construction)	Continued O&M of the SVE system would ensure long-term effectiveness and permanence.
Reduction of toxicity, mobility, or volume through treatment	The SVE system removes VOCs in subsurface soil; however, there is uncertainty in the distribution of the contaminants in subsurface soils so optimization of the system may require significant adjustments. While not anticipated, off-gas treatment is available to reduce higher concentrations to comply with air emissions regulations.
Overall Effectiveness Rating	❸

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Table D.3B Implementability Screening - Alternative PS3

Implementability Criteria	Evaluation Summary
Ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete	Relatively easy to implement. The treatment system is already constructed and operational; additional SVE wells would be installed and manifolded to the existing system.
Ability to operate, maintain, replace, and monitor technical components after the remedial action is complete	Long-term O&M of the SVE system is already in place. Continued and expanded inspection, maintenance, and replacement of engineered controls and implementation of monitoring are easily implemented.
Ability to obtain approvals from other agencies	Regulatory approvals for engineered controls are already in place.
Availability and capacity of treatment, storage, and disposal services	All necessary components for treatment are already constructed and operational. Two blowers are currently operable, capable of approximately 800 standard cubic feet per minute (scfm) at optimum vacuums.
Availability of property, specific materials and equipment, and technical specialists required for a remedial action	The SVE system is already constructed and operational. Technical equipment and specialists are available for monitoring. Materials, equipment, and labor resources used for installation of recovery wells are readily available. Materials, equipment, and labor resources used for installation of the SVE well effluent piping and connection to the existing SVE system are readily available.
Overall Implementability Rating	❹

Table D.3C Cost Screening – Alternative PS3

Evaluation Factors for Cost	Overall Rating	Approx. Cost (Dollars)
Present Value Cost	$$	$1,168,000

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ALTERNATIVE PS4 – EXCAVATION, TREATMENT AND DISPOSAL OF CONTAMINATED SOIL AND EXPAND SVE SYSTEM

Alternative Description: Alternative PS4 combines Alternatives PS2 and PS3 to reduce the timeframe that the SVE system would be required to operate. This alternative protects the environment through removal, treatment and onsite disposal of residual contaminated soil from the source area as described in detail in Alternative PS2, and continues to remove VOCs from the vadose zone on site as described in Alternative PS3. It is assumed the SVE system would continue to operate for 5 years; however, with excavation of contaminated soil and expansion of the SVE system the remedial timeframe would likely be reduced.

Table D.4A Effectiveness Screening - Alternative PS4

Effectiveness Criteria	Evaluation Summary
Overall protection of human health and the environment	Contaminated soil with concentrations exceeding preliminary cleanup levels would be excavated, treated onsite, and disposed onsite; thus this criterion is met because contaminated soils would be eliminated and migration of contaminants to groundwater would be eliminated. Residual soils not excavated with concentrations exceeding PCLs residing near the existing facility building would be treated by expanding the SVE to include a shallow and deep SVE well.
Compliance with ARARs	Contaminated soil with concentrations exceeding preliminary cleanup levels would be excavated, treated and disposed on site and residual contaminated soils left in place would be treated through the use SVE; thus this criterion is met.
Short-term effectiveness (during the remedial construction and implementation period)	Safety measures such as dust suppression, use of PPE, and establishment of work zones would protect workers and the community during implementation which would consist of the installation of SVE wells and excavation. Construction workers would be subject to some exposure from excavation, but this pathway could be managed using standard H&S procedures and protocols.
Long-term effectiveness and permanence (following remedial construction) Reduction of toxicity, mobility, or volume through treatment	Contaminated soil with concentrations exceeding preliminary cleanup levels would be excavated, treated onsite and disposed onsite greatly reducing toxicity, mobility, and volume of contaminated soil. Expansion and continued O&M of the SVE system would further reduce toxicity, mobility and volume of residual soil contamination ensure long-term effectiveness and permanence.
Overall Effectiveness Rating	❹

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Table D.4B Implementability Screening - Alternative PS4

Implementability Criteria	Evaluation Summary
Ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete	The soil source material and contaminated soil would be removed; thus, ability to meet these criteria is high. An ex situ treatment system for the excavated soil would be easily constructed, with soil gas concentrations monitored and soil sampled to ensure concentrations are reduced below PCLs before onsite disposal. Shoring of existing structures may be needed depending on the proximity of the excavation to the structures. There may be a concern with excavating soil in proximity of an operating grain storage facility. The treatment system is already constructed and operational; additional SVE wells would be installed and manifolded to the existing system.
Ability to operate, maintain, replace, and monitor technical components after the remedial action is complete	
Ability to obtain approvals from other agencies	Approvals for engineering controls should be obtainable. All regulatory approvals and long-term O&M for the existing SVE system are already in place. Continued and expanded inspection, maintenance, and replacement of engineered controls and implementation of monitoring are easily implemented. There may be other approvals to construct and operate an ex situ SVE treatment system. However, these approvals should be obtainable.
Availability and capacity of treatment, storage, and disposal services	The contaminated soil would be excavated, treated on site and disposed of on site. Area and materials for ex situ treatment is anticipated to be available. All necessary components for SVE system are already constructed and operational. Two blowers are currently operable, capable of approximately 800 standard cubic feet per minute (scfm) at optimum vacuums.
Availability of property, specific materials and equipment, and technical specialists required for a remedial action	Excavation construction would be conducted using conventional equipment (e.g. backhoe) and services. A licensed contractor would need to perform soil excavation with special care taken near the existing structures. The subcontractor would need 40-hour OSHA training to excavate and handle contaminated soil. Clean fill would be obtained from an on-site borrow source and be used to backfill excavated areas. The excavated material would be treated on site by an ex situ SVE system. The borrow area would be used as the final disposal location of treated contaminant soil. The SVE system is already constructed and operational. Technical equipment and specialists are available for monitoring. Materials, equipment, and labor resources used for installation of recovery wells are readily available. Materials, equipment, and labor resources used for installation of the

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Implementability Criteria	Evaluation Summary
	SVE well effluent piping and connection to the existing SVE system are readily available.
Overall Implementability Rating	❸

Table D.4C Cost Screening – Alternative PS4

Evaluation Factors for Cost	Overall Rating	Approx. Cost (Dollars)
Present Value Cost	$	$883,000

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OU1 Contaminated Groundwater Alternatives

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Alternative PSG1
No Action

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ALTERNATIVE PSG1 – NO ACTION

Alternative Description: The No Action alternative would involve discontinuing operation of the GET system. There would be no change in the groundwater contaminant concentrations because no treatment, containment, or removal of contaminated groundwater is included in this alternative. However, this alternative would include periodic monitoring of the contaminated groundwater at the source area as part of a Five Year Review. Monitoring and enforcement of the institutional controls that are already in place at the Site as part of the Interim Remedy would be performed.

Table D.5A Effectiveness Screening - Alternative PSG1

Effectiveness Criteria	Evaluation Summary
Overall protection of human health and the environment	Contaminated groundwater is left unaddressed.
Compliance with ARARs	No further action is taken to address groundwater source material and contaminated groundwater exceeding chemical-specific ARARs; thus this criterion is not met.
Short-term effectiveness (during the remedial construction and implementation period)	No further remedial action would be undertaken to address contaminated groundwater source material; thus, none of these criteria are met.
Long-term effectiveness and permanence (following remedial construction)	
Reduction of toxicity, mobility, or volume through treatment	
Overall Effectiveness Rating	⓿

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Table D.5B Implementability Screening - Alternative PSG1

Implementability Criteria	Evaluation Summary
Ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete	No further remedial action would be undertaken to address contaminated groundwater; thus, ability to meet these criteria is high.
Ability to operate, maintain, replace, and monitor technical components after the remedial action is complete	
Ability to obtain approvals from other agencies	Groundwater source material and contaminated groundwater would be left unaddressed. No remedial action would be undertaken to address the groundwater source material; thus, there is no need to obtain approvals from other regulatory agencies.
Availability and capacity of treatment, storage, and disposal services	Contaminated groundwater is left unaddressed. No remedial action would be undertaken to address source areas or contaminated groundwater; thus, this criterion is not applicable.
Availability of property, specific materials and equipment, and technical specialists required for a remedial action	Technical equipment and specialists are available for monitoring; thus the ability to meet this criterion is high.
Overall Implementability Rating	❺

Table D.5C Cost Screening – Alternative PSG1

Evaluation Factors for Cost	Overall Rating	Approx. Cost (Dollars)
Present Value Cost	$$	$1,061,000

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Alternative PSG2
Maintain and Operate Existing GET System

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ALTERNATIVE PSG2 – MAINTAIN AND OPERATE EXISTING GET SYSTEM

Alternative Description: Groundwater recovery and treatment was implemented at the site by the PRP. The existing GET system consists of eight recovery wells and a packed column air stripper. Treated water is re-injected into the deep aquifer hydraulically upgradient of the source area. Under Alternative PSG2, the current GET system would continue to be operated to contain contaminated groundwater and remove contaminants. No further upgrades or expansions would occur. Alternative PSG2 includes the continued enforcement of the existing land use controls/institutional controls (LUCs/ICs) and engineered controls to protect human health and the environment.

Table D.6A Effectiveness Screening - Alternative PSG2

Effectiveness Criteria	Evaluation Summary
Overall protection of human health and the environment	The extraction system would provide hydraulic control of contaminated groundwater, preventing further downgradient migration. Groundwater is treated by an air stripper prior to aquifer injection, protecting human receptors by reducing concentrations of contaminants in groundwater.
Compliance with ARARs	Alternative would comply with location- and action- specific ARARs. It is uncertain whether chemical-specific ARARs within the aquifer would be met in a reasonable time frame.
Short-term effectiveness (during the remedial construction and implementation period)	No remedial construction or implementation would be necessary.
Long-term effectiveness and permanence (following remedial construction)	Long-term O&M of the extraction and treatment system would be required.
Reduction of toxicity, mobility, or volume through treatment	Mobility of groundwater contaminants would be reduced. Contaminants are removed from the extracted groundwater through air stripping. The contaminants removed are those dissolved in the groundwater originating from the unsaturated zone via leaching and back diffusion from finer grained units in the aquifer.
Overall Effectiveness Rating	❸

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Table D.6B Implementability Screening - Alternative PSG2

Implementability Criteria	Evaluation Summary
Ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete	All GET system components have been constructed and are reliably operating. Monitoring is straightforward. Additional monitoring wells may be needed for compliance.
Ability to operate, maintain, replace, and monitor technical components after the remedial action is complete	Long-term O&M of the extraction and treatment system would be required. Inspection, maintenance, and replacement of engineered controls and implementation of monitoring are easily implemented.
Ability to obtain approvals from other agencies	Regulatory approvals for engineered controls, and discharge permits have already been obtained.
Availability and capacity of treatment, storage, and disposal services	The GET system is already constructed. Treated water is re-injected into the deep aquifer through two hydraulically upgradient wells.
Availability of property, specific materials and equipment, and technical specialists required for a remedial action	The treatment building, necessary materials, and equipment are already in place. Labor resources used for installation of additional monitoring wells are readily available. Technical equipment and specialists are available for monitoring.
Overall Implementability Rating	❺

Table D.6C Cost Screening – Alternative PSG2

Evaluation Factors for Cost	Overall Rating	Approx. Cost (Dollars)
Present Value Cost	$$$$$	$6,340,000

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Alternative PSG3
In Situ Treatment via Groundwater Amendments

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ALTERNATIVE PSG3 – IN SITU TREATMENT VIA GROUNDWATER AMENDMENTS

Alternative Description: In situ enhanced bioremediation (EB), in situ chemical oxidation or in situ chemical reduction of chlorinated VOCs would be conducted at the source area. Injections would be conducted using DPT because groundwater contamination at OU1 is primarily in the upper aquifer. It is likely that several injection events of the chosen in situ treatment amendment would be required.

Table D.7A Effectiveness Screening - Alternative PSG3

Effectiveness Criteria	Evaluation Summary
Overall protection of human health and the environment	Monitoring would be performed to ensure protectiveness of the remedy. Bench- and pilot-scale studies would be conducted before full-scale implementation to determine the efficacy of EB, in situ chemical oxidation or reduction at the site. These studies would also determine the need for bioaugmentation at the site. For in situ EB to be a useful remedial approach, site-specific data should indicate that biological processes can be enhanced and would effectively reduce contaminants in groundwater to concentrations protective of human health. The presence of chloroform and methylene chloride could be indications that some biological degradation is occurring. Chemical oxidation and chemical reduction are expected to destroy groundwater contamination to achieve protection of human health and the environment. Contingency measures may be needed in the event that EB, chemical oxidation or chemical reduction does not reduce contaminant concentrations as expected. The existing GET system could be used if in situ treatment methods fail to reduce contaminants to below cleanup goals.
Compliance with ARARs	Chemical-specific ARARs would be addressed by the implementation of this alternative. Location- and action-specific ARARs for the remedy would be addressed during implementation.
Short-term effectiveness (during the remedial construction and implementation period)	Safety measures such as dust suppression, use of PPE, and established work zones would protect workers and the community during implementation which would consist primarily of the installation of wells and injection of substrate.

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Table D.7A Effectiveness Screening - Alternative PSG3 (continued)

Effectiveness Criteria	Evaluation Summary
Long-term effectiveness and permanence (following remedial construction)	Long-term effectiveness of biological remediation is not entirely ensured since this alternative may rely on biological processes to achieve preliminary cleanup levels. Anaerobic bioremediation would be more effective if source areas are contained. Long-term effectiveness of chemical oxidation or chemical reduction would be determined through good distribution of the oxidant/reducing agent in the subsurface. May require multiple injections to ensure that preliminary cleanup levels are achieved.
Reduction of toxicity, mobility, or volume through treatment	This alternative involves in situ treatment by enhancing biological degradation processes or chemical destruction of contaminants through oxidation or reduction processes. Bench- and pilot-scale studies would be conducted in order to optimize full-scale implementation..
Overall Effectiveness Rating	❸

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Table D.7B Implementability Screening - Alternative PSG3

Implementability Criteria	Evaluation Summary
Ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete	DPT and construction of monitoring wells would be relatively straightforward. Regulatory approvals for injection should be obtainable. Pilot-scale tests would be needed to determine the optimum substrate and if bioaugmentation is necessary. Providing adequate coverage of the substrate can only be determined through pilot-scale tests.
Ability to operate, maintain, replace, and monitor technical components after the remedial action is complete	Inspection, maintenance, and replacement of engineered controls and implementation of monitoring are easily implemented. Injections would be relatively straightforward. May require multiple injections to ensure that preliminary cleanup levels are achieved.
Ability to obtain approvals from other agencies	Regulatory approvals for engineered controls should be obtainable. Regulatory approvals for underground injection control (UIC) of materials through permanent injection wells should be obtainable.
Availability and capacity of treatment, storage, and disposal services	This alternative does not have associated treatment, storage or disposal services; thus, this criterion is not applicable.
Availability of property, specific materials and equipment, and technical specialists required for a remedial action	Materials, equipment, and labor resources used for institutional/engineered controls, DPT, installation of monitoring wells, and monitoring are easily obtainable. Technical equipment and specialists for the injection of nutrient substrate or chemicals are available. Biological substrate is available from a number of sources. Chemical oxidants are available from a number of sources; however, specific formulations may only be available from a few vendors. Because EHC and EZVI are generally considered proprietary technologies; only a few vendors have the necessary technical specialists and materials for implementation of this alternative.
Overall Implementability Rating	❸

Table D.7C Cost Screening – Alternative PSG3

Evaluation Factors for Cost	Overall Rating	Approx. Cost (Dollars)
Present Value Cost	$$$$	$12,346,000

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Alternative PSG4
In Situ Treatment via Groundwater Amendments and Operation of Existing GET System

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ALTERNATIVE PSG4 – IN SITU TREATMENT VIA GROUNDWATER AMENDMENTS AND OPERATION OF EXISTING GET SYSTEM

Alternative Description: Alternative PSG4 combines components of Alternatives PSG2 and PSG3 to reduce total cleanup time and decrease operating costs of the GET system. The in situ treatment would target areas of the OU1 plume with concentrations greater than 500 μg/L in the upper and medial aquifers. Due to the shallower depths, injections would be accomplished by DPT. The other components of the in situ alternative would be as described in Alternative PSG3. The continued operation of the GET system would be adjusted so that only the peripheral extraction wells would pump at adjusted pumping rates so as not to extract injection materials into the treatment system from the area being treated.

Table D.8A Effectiveness Screening - Alternative PSG4

Effectiveness Criteria	Evaluation Summary
Overall protection of human health and the environment	The groundwater extraction system would provide hydraulic control of contaminated groundwater, preventing further downgradient migration. Groundwater is treated by an air stripper prior to aquifer injection, protecting human receptors by reducing concentrations of contaminants in groundwater. Monitoring would be performed to ensure protectiveness of the remedy. Bench- and pilot-scale studies would be conducted before full-scale implementation to determine the efficacy of EB, in situ chemical oxidation or reduction at the site. These studies would also determine the need for bioaugmentation at the site. For in situ EB to be a useful remedial approach, site-specific data should indicate that biological processes can be enhanced and would effectively reduce contaminants in groundwater to concentrations protective of human health. The presence of chloroform and methylene chloride could be indications that some biological degradation is occurring. Chemical oxidation and chemical reduction are expected to destroy groundwater contamination to achieve protection of human health and the environment. Contingency measures may be needed in the event that EB, chemical oxidation or chemical reduction does not reduce contaminant concentrations as expected.
Compliance with ARARs	Chemical-specific ARARs would be addressed by the implementation of this alternative. Location- and action-specific ARARs for the remedy would be addressed during implementation.

Table D.8A Effectiveness Screening - Alternative PSG4 (continued)

Effectiveness Criteria	Evaluation Summary
Short-term effectiveness (during the remedial construction and implementation period)	Safety measures such as dust suppression, use of PPE, and established work zones would protect workers and the community during implementation which would consist primarily of the installation of wells and injection of substrate.
Long-term effectiveness and permanence (following remedial construction)	Long-term O&M of the extraction and treatment system would be required. Long-term effectiveness of biological remediation is not entirely ensured since this alternative may rely on biological processes to achieve preliminary cleanup levels. Anaerobic bioremediation would be more effective if source areas are contained. Long-term effectiveness of chemical oxidation or chemical reduction would be determined through good distribution of the oxidant/reducing agent in the subsurface. May require multiple injections to ensure that preliminary cleanup levels are achieved.
Reduction of toxicity, mobility, or volume through treatment	Mobility if groundwater contaminants would be reduced by the groundwater extraction system. Contaminants are removed from the extracted groundwater through air stripping. The contaminants removed are those dissolved in the groundwater originating from the unsaturated zone via leaching. This alternative involves in situ treatment by enhancing biological degradation processes or chemical destruction of contaminants through oxidation or reduction processes. Bench- and pilot-scale studies would be conducted in order to optimize full-scale implementation..
Overall Effectiveness Rating	❹

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Table D.8B Implementability Screening - Alternative PSG4

Implementability Criteria	Evaluation Summary
Ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete	All GET system components have been constructed and are reliably operating. DPT and construction of monitoring wells would be relatively straightforward. Monitoring is straightforward. Additional monitoring wells may be needed for compliance. Regulatory approvals for injection should be obtainable. Pilot-scale tests would be needed to determine the optimum substrate and if bioaugmentation is necessary. Providing adequate coverage of the substrate can only be determined through pilot-scale tests.
Ability to operate, maintain, replace, and monitor technical components after the remedial action is complete	Inspection, maintenance, and replacement of engineered controls and implementation of monitoring are easily implemented. Long-term O&M of the GET system would be required. Inspection, maintenance, and replacement of engineered controls and implementation of monitoring are easily implemented. Injections would be relatively straightforward. May require multiple injections to ensure that preliminary cleanup levels are achieved.
Ability to obtain approvals from other agencies	Regulatory approvals for engineered controls should be obtainable. Regulatory approvals for engineered controls and discharge permits have already been obtained. Regulatory approvals for underground injection control (UIC) of materials through permanent injection wells should be obtainable.
Availability and capacity of treatment, storage, and disposal services	The GET system is already constructed. Treated water is re-injected into the deep aquifer through two hydraulically upgradient wells.
Availability of property, specific materials and equipment, and technical specialists required for a remedial action	Materials, equipment, and labor resources used for institutional/engineered controls, DPT, installation of monitoring wells, and monitoring are easily obtainable. The treatment building, necessary materials, and equipment for the GET system are already in place. Technical equipment and specialists for the injection of nutrient substrate or chemicals are available. Biological substrate is available from a number of sources. Chemical oxidants are available from a number of sources; however, specific formulations may only be available from a few vendors. Because EHC and EZVI are generally considered proprietary technologies; only a few vendors have the necessary technical specialists and materials for implementation of this alternative.
Overall Implementability Rating	❸

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Table D.8C Cost Screening – Alternative PSG4

Evaluation Factors for Cost	Overall Rating	Approx. Cost (Dollars)
Present Value Cost	$$$$	$10,143,000

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OU2 Contaminated Groundwater Alternatives

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Alternative PG1
No Action

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ALTERNATIVE PG1 – NO ACTION

Alternative Description: The No Action alternative would provide no change in the groundwater contaminant concentrations because no treatment, containment, or removal of contaminated groundwater would be performed under this alternative. This alternative would include periodic monitoring of the contaminated groundwater at the source area as part of the Five Year Review.

Table D.9A Effectiveness Screening - Alternative PG1

Effectiveness Criteria	Evaluation Summary
Overall protection of human health and the environment	Contaminated groundwater is left unaddressed.
Compliance with ARARs	No further action is taken to address groundwater source material and contaminated groundwater exceeding chemical-specific ARARs; thus this criterion is not met.
Short-term effectiveness (during the remedial construction and implementation period)	No further remedial action would be undertaken to address contaminated groundwater; thus, none of these criteria are met.
Long-term effectiveness and permanence (following remedial construction)	
Reduction of toxicity, mobility, or volume through treatment	
Overall Effectiveness Rating	⓿

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Table D.9B Implementability Screening - Alternative PG1

Implementability Criteria	Evaluation Summary
Ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete	No further remedial action would be undertaken to address contaminated groundwater; thus, ability to meet these criteria is high.
Ability to operate, maintain, replace, and monitor technical components after the remedial action is complete	
Ability to obtain approvals from other agencies	Contaminated groundwater would be left unaddressed. No remedial action would be undertaken to address the groundwater source material; thus, there is no need to obtain approvals from other regulatory agencies.
Availability and capacity of treatment, storage, and disposal services	Contaminated groundwater is left unaddressed. No remedial action would be undertaken to address source areas or contaminated groundwater; thus, this criterion is not applicable.
Availability of property, specific materials and equipment, and technical specialists required for a remedial action	Technical equipment and specialists are available for monitoring; thus the ability to meet this criterion is high.
Overall Implementability Rating	❺

Table D.9C Cost Screening – Alternative PG1

Evaluation Factors for Cost	Overall Rating	Approx. Cost (Dollars)
Present Value Cost	$	$852,000

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Alternative PG2
Monitored Natural Attenuation

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ALTERNATIVE PG2 – MONITORED NATURAL ATTENUATION

Alternative Description: Groundwater monitoring would be used to evaluate the long-term performance of natural attenuation determined by "biodegradation, dispersion, dilution, and adsorption" of contaminants in groundwater as defined by the NCP (Federal Register 1990; Preamble at 8734). Monitored natural attenuation may be an appropriate remedial approach for portions of the contaminant plume when combined with other remedial measures needed to control sources and/or remediate areas with higher levels of contamination.

Table D.10A Effectiveness Screening - Alternative PG2

Effectiveness Criteria	Evaluation Summary
Overall protection of human health and the environment	This alternative relies on natural attenuation processes to reduce contaminant levels in groundwater. For natural attenuation to be a useful remedial approach, site-specific data should indicate that natural processes would effectively reduce contaminants in groundwater to concentrations protective of human health and the environment in a timeframe comparable to that which could be achieved through other active remedial approaches. There is little indication that natural processes would be effective in reducing contaminant concentrations in a reasonable timeframe. Contingency measures may be needed in the event that natural attenuation does not progress as expected. This alternative provides protection of human health through ICs to restrict access to VOC-contaminated groundwater.
Compliance with ARARs	Natural attenuation may be a useful remedial approach if site-specific data indicate that these processes "will effectively reduce contaminants in the groundwater to concentrations protective of human health [and the environment] in a time frame comparable to that which could be achieved through active restoration." It is uncertain whether chemical-specific ARARs within the aquifer would be met in a reasonable time frame. Location- and action-specific ARARs for the remedy would be addressed during implementation.
Short-term effectiveness (during the remedial construction and implementation period)	Safety measures such as dust suppression, use of PPE, and establishment of work zones would protect workers and the community during implementation which would consist primarily of the installation of additional monitoring wells, as needed.

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Table D.10A Effectiveness Screening - Alternative PG2 (continued)

Effectiveness Criteria	Evaluation Summary
Long-term effectiveness and permanence (following remedial construction)	Long-term effectiveness is not entirely ensured since this alternative relies on natural processes to achieve PCLs. Monitoring is the primary remedial component for ensuring protection of human health. If monitoring does not show natural processes are adequately addressing contamination, enhancement of natural processes may be needed or other treatment methods may be used. Natural attenuation would be more effective if source areas were continued to be contained.
Reduction of toxicity, mobility, or volume through treatment	This alternative relies on natural processes of biodegradation, dispersion, dilution, and adsorption to reduce toxicity, mobility, and volume of contaminated groundwater. Treatment may be variable depending on aquifer characteristics.
Overall Effectiveness Rating	❶

Table D.10B Implementability Screening - Alternative PG2

Implementability Criteria	Evaluation Summary
Ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete	No further remedial action would be undertaken to groundwater source material and contaminated groundwater; thus, ability to meet these criteria is high. Installation of additional monitoring wells would be relatively straightforward. Monitoring is straightforward.
Ability to operate, maintain, replace, and monitor technical components after the remedial action is complete	Inspection, maintenance, and replacement of engineered controls and implementation of monitoring are easily implemented.
Ability to obtain approvals from other agencies	Regulatory approvals for engineered controls should be obtainable.
Availability and capacity of treatment, storage, and disposal services	This alternative does not call for any treatment, storage and disposal services; thus, this criterion is not applicable.
Availability of property, specific materials and equipment, and technical specialists required for a remedial action	Materials, equipment, and labor resources used for institutional/engineered controls and monitoring are easily obtainable. Technical equipment and specialists are available for implementation of monitored natural attenuation.
Overall Implementability Rating	

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Table D.10C Cost Screening – Alternative PG2

Evaluation Factors for Cost	Overall Rating	Approx. Cost (Dollars)
Present Value Cost	$$$$	$10,800,000

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Alternative PG3
Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume

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ALTERNATIVE PG3 – GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE AT LEADING EDGE OF PLUME

Alternative Description: Recovery wells would be installed at the leading edge of the groundwater plume. Groundwater would be pumped to a newly constructed treatment building. A tray air stripper would provide treatment of chlorinated VOCs before discharge into deep aquifer injection wells.

For purposes of this FS, it is assumed that emissions treatment would not be needed because the concentrations would remain below the NDEQ threshold. Treatment of emissions prior to discharge would be required if emissions from the treatment system exceed the NDEQ threshold of 2.5 tons per year for any combination of hazardous air pollutants.

The number of recovery and injection wells, the approximate locations, and groundwater extraction rates would be initially estimated by a groundwater model. The final location of recovery and injection wells, the routing of pipelines, and the location of the treatment building would be determined by right-of-way access and potential to obtain easements.

Table D.11A Effectiveness Screening - Alternative PG3

Effectiveness Criteria	Evaluation Summary
Overall protection of human health and the environment	The GET system would provide hydraulic control. A well designed system would reduce groundwater concentrations below MCLs over time. This alternative provides protection of human health through ICs to restrict access to VOC-contaminated groundwater.
Compliance with ARARs	This alternative would comply with location- and action- specific ARARs. Treatment of extracted groundwater would meet chemical-specific ARARs. Over time, extraction of groundwater would reduce groundwater concentrations and meet chemical-specific ARARs.
Short-term effectiveness (during the remedial construction and implementation period)	Safety measures such as dust suppression, use of PPE, and establishment of work zones would protect workers and the community during implementation which would consist primarily of the installation of recovery and monitoring wells and pipeline from the recovery well(s) to the treatment building.
Long-term effectiveness and permanence (following remedial construction)	Long-term O&M of the extraction and treatment system would be required. The life of the treatment system may be reached before the cleanup goal is achieved. The extraction system would be designed to impact only the leading edge, preventing migration further downgradient. Mid-plume contamination would be left unaddressed.
Reduction of toxicity, mobility, or volume through treatment	Mobility of groundwater contaminants is reduced. However, only the mobile fraction of contaminants would be treated. The mobile fraction of contaminants would be removed from the extracted groundwater through air stripping.
Overall Effectiveness Rating	❸

Table D.11B Implementability Screening - Alternative PG3

Implementability Criteria	Evaluation Summary
Ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete	Relatively easy to implement; a treatment system has been implemented for OU 1. However, finding a suitable location for the treatment building may be difficult. The pipeline from recovery well(s) to treatment system would need to cross utility corridors and its locations would require construction in existing right-of-way or easement agreements with property owners. Recovery, injection and monitoring well installation is relatively straightforward. However, the locations of these wells would require construction in existing right-of-way or easement agreements with property owners. Monitoring is straightforward.
Ability to operate, maintain, replace, and monitor technical components after the remedial action is complete	Long-term O&M of the extraction and treatment system would be required. Inspection, maintenance, and replacement of engineered controls and implementation of monitoring are easily implemented.
Ability to obtain approvals from other agencies	Regulatory approvals for engineered controls should be obtainable. Meeting the substantive requirements of the state's UIC program should be obtainable to discharge to reinjection wells.
Availability and capacity of treatment, storage, and disposal services	The treatment system would be readily constructed. Contaminant concentrations would determine the need for treatment of emissions from the air stripper.
Availability of property, specific materials and equipment, and technical specialists required for a remedial action	The treatment system building would easily be constructed. Materials, equipment, and labor resources used for installation of recovery, injection and monitoring wells are readily available. Materials, equipment, and labor resources used for installation of recovery well piping and tray air stripper are readily available. Air strippers are available from a number of vendors. Technical equipment and specialists are available for monitoring.
Overall Implementability Rating	❹

Table D.11C Cost Screening – Alternative PG3

Evaluation Factors for Cost	Overall Rating	Approx. Cost (Dollars)
Present Value Cost	$$$$	$11,485,000

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Alternative PG4
Groundwater Recovery, Treatment, and Discharge at Mid-plume and Leading Edge of Plume

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ALTERNATIVE PG4 –GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE AT MID-PLUME AND LEADING EDGE OF PLUME

Alternative Description: This alternative is similar to Alternative PG3, except recovery wells would also be installed at mid-plume areas of high concentration. Groundwater would be pumped to a newly constructed treatment building. A tray air stripper would provide treatment of chlorinated VOCs before discharge into deep aquifer injection wells.

The number of recovery and injection wells, the approximate locations, and groundwater extraction rates would be initially estimated by a groundwater model. The final location of recovery and injection wells, the routing of pipelines, and the location of the treatment building would be determined by right-of-way access and potential to obtain easements.

Table D.12A Effectiveness Screening - Alternative PG4

Effectiveness Criteria	Evaluation Summary
Overall protection of human health and the environment	The GET system would provide hydraulic control. A well designed system would reduce groundwater concentrations below MCLs over time. This alternative provides protection of human health through ICs) to restrict access to VOC-contaminated groundwater.
Compliance with ARARs	This alternative would comply with location- and action- specific ARARs. Treatment of extracted groundwater would meet chemical-specific ARARs. Extraction of groundwater would reduce groundwater concentrations and meet chemical-specific ARARs over time.
Short-term effectiveness (during the remedial construction and implementation period)	Safety measures such as dust suppression, use of PPE, and establishment of work zones would protect workers and the community during implementation which would consist primarily of the installation of recovery and monitoring wells and pipeline from the recovery well(s) to the treatment building.
Long-term effectiveness and permanence (following remedial construction)	Long-term O&M of the extraction and treatment system would be required. The life of the treatment system may be reached before the cleanup goal is achieved. The extraction system would be designed to reduce groundwater concentrations in higher mid-plume concentration areas and prevent further migration downgradient of the contaminant plume.
Reduction of toxicity, mobility, or volume through treatment	Mobility of groundwater contaminants is reduced. However, only the mobile fraction of contaminants would be treated. The mobile fraction of contaminants would be removed from the extracted groundwater through air stripping.
Overall Effectiveness Rating	❹

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Table D.12B Implementability Screening - Alternative PG4

Implementability Criteria	Evaluation Summary
Ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete	Relatively easy to implement; a treatment system has been implemented for OU 1. However, finding a suitable location for the treatment building may be difficult. The pipeline from recovery well(s) to treatment system would need to cross utility corridors and its locations would require construction in existing right-of-way or easement agreements with property owners. Recovery, injection and monitoring well installation is relatively straightforward. However, the locations of these wells would require construction in existing right-of-way or easement agreements with property owners. Monitoring is straightforward.
Ability to operate, maintain, replace, and monitor technical components after the remedial action is complete	Long-term O&M of the extraction and treatment system would be required. Inspection, maintenance, and replacement of engineered controls and implementation of monitoring are easily implemented.
Ability to obtain approvals from other agencies	Regulatory approvals for engineered controls should be obtainable. Meeting the substantive requirements of the state's UIC program should be obtainable to discharge to reinjection wells.
Availability and capacity of treatment, storage, and disposal services	The treatment system would be readily constructed. Contaminant concentrations would determine the need for air stripper emissions treatment.
Availability of property, specific materials and equipment, and technical specialists required for a remedial action	The treatment system building would easily be constructed. Materials, equipment, and labor resources used for installation of recovery, injection and monitoring wells are readily available. Materials, equipment, and labor resources used for installation of recovery well piping are readily available. Air strippers are available from a number of vendors. Technical equipment and specialists are available for monitoring.
Overall Implementability Rating	❸

Table D.12C Cost Screening – Alternative PG4

Evaluation Factors for Cost	Overall Rating	Approx. Cost (Dollars)
Present Value Cost	$$$$$	$15,550,000

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Alternative PG5
In Situ Treatment via Groundwater Amendments

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ALTERNATIVE PG5 – IN SITU TREATMENT VIA GROUNDWATER AMENDMENTS

Alternative Description: In situ enhanced bioremediation (EB), in situ chemical oxidation or in situ chemical reduction of chlorinated VOCs would be conducted at OU 2. DPT would be used to inject a quantity of selected chemical or organic substrate. Sufficient coverage, subsurface mixing with groundwater contamination and an outside to inside injection sequence would be implemented. It is likely that several injection events of the chosen in situ treatment amendment would be required.

Table D.13A Effectiveness Screening - Alternative PG5

Effectiveness Criteria	Evaluation Summary
Overall protection of human health and the environment	Monitoring would ensure protectiveness of the remedy. Bench- and pilot-scale studies would be conducted before full-scale implementation to determine the efficacy of EB, in situ chemical oxidation or reduction at the site. These studies would also determine the need for bioaugmentation at the site. For in situ EB to be a useful remedial approach, site-specific data should indicate that biological processes can be enhanced and would effectively reduce groundwater contaminants to concentrations protective of human health. The presence of chloroform and methylene chloride indicates that some biological activity is occurring. Chemical oxidation and reduction would destroy groundwater contamination to achieve protection of human health and the environment. Contingency measures may be needed in the event that anaerobic bioremediation, chemical oxidation or chemical reduction does not reduce contaminant concentrations as expected. This alternative provides protection of human health through ICs to restrict access to VOC-contaminated groundwater.
Compliance with ARARs	Chemical-specific ARARs would be addressed by the implementation of this alternative. Location- and action-specific ARARs for the remedy would be addressed during implementation.
Short-term effectiveness (during the remedial construction and implementation period)	Safety measures such as dust suppression, use of PPE, and established of work zones would protect workers and the community during implementation which would consist of the installation of injection and monitoring wells and injection of substrate.
Long-term effectiveness and permanence (following remedial construction)	Long-term effectiveness of biological remediation is not entirely ensured since this alternative relies on biological processes to achieve preliminary cleanup levels. Anaerobic bioremediation would be more effective if source areas are contained. Long-term effectiveness would be determined through good distribution of chemical oxidant or chemical reducer in the subsurface. Multiple injections may be required to achieve preliminary cleanup levels.

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Table D.13A Effectiveness Screening - Alternative PG5 (continued)

Effectiveness Criteria	Evaluation Summary
Reduction of toxicity, mobility, or volume through treatment	This alternative involves in situ treatment by enhancing biological degradation processes or chemical destruction of contaminants through oxidation or reduction processes. Bench- and pilot-scale studies would be conducted to optimize full-scale implementation.
Overall Effectiveness Rating	❸

Table D.13B Implementability Screening - Alternative PG5

Implementability Criteria	Evaluation Summary
Ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete	Construction of injection and monitoring wells would be relatively straightforward. However, the locations of these wells would require construction in existing right-of-way or easement agreements with property owners. Under this alternative it is likely that many injection wells would be needed to provide sufficient coverage for the injected materials. Regulatory approvals for injection should be obtainable. Pilot-scale tests would be needed to determine the optimum substrate and if bioaugmentation is necessary. Providing adequate coverage of the substrate can only be determined through pilot-scale tests.
Ability to operate, maintain, replace, and monitor technical components after the remedial action is complete	Inspection, maintenance, and replacement of engineered controls and implementation of monitoring are easily implemented. Injections would be relatively straightforward. May require multiple injections to ensure that preliminary cleanup levels are achieved.
Ability to obtain approvals from other agencies	Regulatory approvals for engineered controls should be obtainable. Regulatory approvals for UIC of materials through permanent injection wells should be obtainable.
Availability and capacity of treatment, storage, and disposal services	This alternative does not call for any treatment, storage and disposal services; thus, this criterion is not applicable.

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Table D.13B Implementability Screening - Alternative PG5 (continued)

Availability of property, specific materials and equipment, and technical specialists required for a remedial action	Materials, equipment, and labor resources used for institutional/engineered controls, DPT, installation of monitoring wells, and monitoring are easily obtainable. Technical equipment and specialists for the injection of nutrient substrate and chemical oxidants are generally available. Biological substrate is available from a number of sources. Chemical oxidants are available from a number of sources; however, specific formulations may only be available from a few vendors. Because EHC and EZVI are generally considered proprietary technologies; only a few vendors have the necessary technical specialists and materials for implementation of this alternative.
Overall Implementability Rating	❷

Table D.13C Cost Screening – Alternative PG5

Evaluation Factors for Cost	Overall Rating	Approx. Cost (Dollars)
Present Value Cost	$$$$$	$33,600,000

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Alternative PG6
In Situ Treatment at Core of Plume and Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume

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ALTERNATIVE PG6 – IN SITU TREATMENT AT CORE OF PLUME AND GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE AT LEADING EDGE OF PLUME

Alternative Description: Alternative PG6 combines Alternative PG3 with in situ treatment via groundwater amendments in the core of the contaminant plume. Several injections of the chosen in situ treatment compound would occur.

Table D.14A Effectiveness Screening - Alternative PG6

Effectiveness Criteria	Evaluation Summary
Overall protection of human health and the environment	Monitoring would ensure protectiveness of the remedy. Bench- and pilot-scale studies would be conducted before full-scale implementation to determine the efficacy of EB, in situ chemical oxidation or reduction at the site. These studies would also determine the need for bioaugmentation at the site. For in situ EB to be a useful remedial approach, site-specific data should indicate that biological processes can be enhanced and would effectively reduce contaminants in groundwater to concentrations protective of human health. The presence of chloroform and methylene chloride indicates that some biological activity is occurring. Chemical oxidation and reduction would destroy groundwater contamination for protection of human health and the environment. The recovery and reinjection system would provide hydraulic control. Reinjection of treated water may decrease the time needed to operate the system. A well designed system may reduce groundwater concentrations below MCLs over time. This alternative provides protection of human health through ICs to restrict access to VOC-contaminated groundwater.
Compliance with ARARs	Chemical-specific ARARs would be addressed by the implementation of this alternative. Location- and action-specific ARARs for the remedy would be addressed during implementation.
Short-term effectiveness (during the remedial construction and implementation period)	Safety measures such as dust suppression, use of PPE, and established of work zones would protect workers and the community during implementation which would consist primarily of the installation of injection and monitoring wells, injection of substrate, and construction of treatment building.

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Table D.14A Effectiveness Screening - Alternative PG6 (continued)

Effectiveness Criteria	Evaluation Summary
Long-term effectiveness and permanence (following remedial construction)	Long-term effectiveness of biological remediation is not entirely ensured since this alternative relies on biological processes to achieve preliminary cleanup levels. Anaerobic bioremediation would be more effective if source areas are contained. Long-term effectiveness would be determined through good distribution of chemical oxidant or chemical reducer in the subsurface. Multiple injections may be required to achieve preliminary cleanup levels.
Reduction of toxicity, mobility, or volume through treatment	This alternative involves ex situ and in situ treatment processes. Enhancing biological and chemical degradation processes in situ leads to destruction of contaminants. Ex situ treatment of extracted groundwater through air stripping removes contaminants. Bench- and pilot-scale studies would be conducted in order to optimize full-scale implementation. Mobility of groundwater contaminants would be reduced. The mobile fraction of contaminants would be removed from the extracted groundwater through air stripping. Contaminants not treated through in situ treatment would be treated by the air stripper prior to discharge via injection.
Overall Effectiveness Rating	❹

Table D.14B Implementability Screening - Alternative PG6

Implementability Criteria	Evaluation Summary
Ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete	Relatively easy to implement; a treatment system has been implemented for OU 1. However, finding a suitable location for the treatment building may be difficult. The pipeline from recovery well(s) to treatment system would need to cross utility corridors and its locations would require construction in existing right-of-way or easement agreements with property owners. Recovery, injection and monitoring well installation is relatively straightforward. However, the locations of these wells would require construction in existing right-of-way or easement agreements with property owners. Monitoring is straightforward. Regulatory approvals for injection should be obtainable. Pilot-scale tests would be needed to determine the optimum substrate or if bioaugmentation is necessary. Providing adequate coverage of the substrate can only be determined through pilot-scale tests.

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Implementability Criteria	Evaluation Summary
	Monitoring is straightforward. Long-term O&M of the extraction and treatment system would be required.
Ability to operate, maintain, replace, and monitor technical components after the remedial action is complete	Inspection, maintenance, and replacement of engineered controls and implementation of monitoring are easily implemented. Injections would be relatively straightforward. May require multiple injections to ensure that preliminary cleanup levels are achieved.
Availability and capacity of treatment, storage, and disposal services	The treatment system would be readily constructed. Contaminant concentrations would determine the need for treatment of air stripper emissions.
Availability of property, specific materials and equipment, and technical specialists required for a remedial action	Materials, equipment, and labor resources used for installation of recovery, injection and monitoring wells are readily available. Materials, equipment, and labor resources used for installation of recovery and injection well piping and the tray air stripper are readily available. Technical equipment and specialists for the injection of nutrient substrate are generally available. Tray air strippers, substrate, and bioaugmentation material are available from a number of vendors. Technical equipment and specialists are available for monitoring.
Overall Implementability Rating	❷

Table D.14C Cost Screening – Alternative PG6

Evaluation Factors for Cost	Overall Rating	Approx. Cost (Dollars)
Present Value Cost	$$$$$	$36,651,000

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APPENDIX E

DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

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Ratings System for Evaluation of Alternatives

Ratings Categories for Threshold Criteria		Ratings Categories for Balancing Criteria	
−	Unacceptable	❶	None
+	Acceptable	❶	Low
		❷	Low to moderate
		❸	Moderate
		❹	Moderate to high
		❺	High

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OU1 Contaminated Soil Alternatives

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Alternative S1
No Action

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Table E.1A Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative S1

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long- term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	• No action is taken to address soil contamination; therefore, this alternative does not address unacceptable risks posed by hazardous substances in soil. • ICs prevent unacceptable risk by preventing future on-site residential development. • There is no reduction in risk for either vapor intrusion or leaching to groundwater.
Overall Protection of Human Health and the Environment Rating:	—

Table E.1B Evaluation Summary for Compliance with ARARs – Alternative S1

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with Chemical-Specific ARARs	• No chemical-specific ARARs
Compliance with Location-Specific ARARs	• No location-specific ARARs.
Compliance with Action-Specific ARARs	• Not applicable.
Compliance with ARARs Rating:	—

Table E.1C Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative S1

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	• Not applicable. No remedial action would be undertaken to address soil contamination. Therefore, this criterion is not met.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	• Not applicable. • No controls are put in place under this alternative. • Contaminated soil remains uncontained at the Site.
Long-Term Effectiveness and Permanence Rating:	O

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Table E.1D Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative S1

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment process, the alternative uses, and materials they will treat	• Not applicable. The no action alternative does not address contaminated soil; therefore, these criteria are not met.
The amount of contaminant destroyed or treated	
The degree of expected reduction in toxicity, mobility, or volume of contamination due to treatment	
The type and quantity of materials that will remain following treatment	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	
Irreversible treatment	
Reduction of Toxicity, Mobility, or Volume through Treatment:	⓿

Table E.1E Short-Term Effectiveness Evaluation Summary – Alternative S1

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	• Not applicable. The short-term risks to the community are unchanged by this activity. No impacts to workers during implementation would occur and no adverse environmental impacts would occur during implementation; however, since short term risks are not addressed and the time frame is open ended, the criterion is not met.
Potential impacts to workers during implementation and the reliability of protective measures taken to minimize these impacts	
Potential adverse environmental impacts resulting from implementation of an alternative and the reliability of the available mitigation measure during implementation	
Time until RAOs are achieved	RAOs are not estimated to be achieved.
Short-Term Effectiveness Rating:	⓿

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Table E.1F Implementability Evaluation Summary – Alternative S1

Evaluation Factors for Implementability		Evaluation Summary
Technical Feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	• Not applicable. The no action alternative has no technical component.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	
Administrative Feasibility	Coordination issues with other offices and agencies during construction or operations of the remedy.	• Not applicable. The no action alternative has no administrative component.
	The ability and time required to obtain necessary approvals and permits from other agencies for off-site actions or discharge scenarios	
Availability of Goods and Services	Availability of adequate off-site treatment, storage capacity, and disposal capacity and services	• Not applicable. The no action alternative would include limited periodic sampling in support of Five-Year Reviews.
	Availability of necessary equipment and specialists required to completed construction of remedy components	
	Availability of services and materials plus the potential for obtaining competitive bids	
	Availability of prospective technologies	
Implementability Rating:		⓿

Table E.1G Cost Evaluation Summary – Alternative S1

Evaluation Factors for Costs	Approximate Cost (Dollars)
Total Capital Costs	$53,000
Total Annual O&M Costs	$156,000
Total Periodic Cost	$372,000
Total Present Value Cost	$298,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 30). Costs are rounded to the nearest $1,000.

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Alternative S2
Excavation, Treatment and Disposal of Contaminated Soil and Operation of Existing SVE System

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Table E.2A Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative S2

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long- term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	• Contaminated soil would be addressed through excavation, on-site treatment and on-site disposal. • Removal of contaminated soil from the OU1 area is expected to reduce vapor intrusion risk to below acceptable levels ($1x10^{-6}$ risk level). • Risk of leaching to groundwater would be reduced to below acceptable levels in all OU 1 soils except soils deeper than the excavation depth beneath the buried transfer pipe. Slight possibility these soils would still impact groundwater. • Removal of contaminated soil from the OU1 area would facilitate unrestricted future land use.
Overall Protection of Human Health and the Environment Rating:	**+**

Table E.2B Evaluation Summary for Compliance with ARARs – Alternative S2

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with Chemical-Specific ARARs	• SVE emissions and ex situ treatment and disposal of excavated soil would be compliant with chemical-specific federal and state ARARs. SVE emissions would meet 40 CFR and NDEQ Title 129 standards.
Compliance with Location-Specific ARARs	• No location-specific ARARs.
Compliance with Action-Specific ARARs	• Both ex situ treatment and disposal of the excavated soil and SVE emissions would comply with federal and state action-specific ARARs, including RCRA and NDEQ Title 128/132 and 40 CFR 264 and NDEQ Title 129 standards..
Compliance with ARARs Rating:	**+**

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Table E.2C Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative S2

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	• This alternative has long-term effectiveness and permanence because most contaminated soil above PCLs would be removed, treated and disposed on site, and the in situ SVE system would continue to be operated to address residual soil contamination. • Would result in a significantly reduced risk to future residents via vapor intrusion and contaminant leaching to groundwater, but risk may remain above acceptable levels in the vicinity of the former AST and buried transfer pipe. Any residual risk would be controlled by continuing ICs.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	
Long-Term Effectiveness and Permanence Rating:	❸

Table E.2D Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative S2

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment process, the alternative uses, and materials they will treat	• In situ and ex situ SVE are treatment technologies that transfer VOCs from the soil to the atmosphere. Existing cat ox unit, which destroys contaminants, is not expected to be needed. Would satisfy statutory preference for soil treatment. • Excavation and treatment of contaminated material would be limited to a small area where contaminants are above PCLs. The entire volume of contaminated soils is expected to be treated, except the deeper soils beneath the former AST and buried pipe where residual contamination may remain. • In situ SVE would irreversibly treat soil and has been demonstrated to be an effective technology for removal of contaminants from the soil and would continue to operate as is, reducing toxicity, mobility, and volume. • Ex situ SVE treatment is expected to reduce toxicity to below cleanup goals prior to onsite disposal. • Any material above the cleanup goals that remain at the site following excavation will be treated via SVE. • This alternative would satisfy the statutory preference for treatment as a principal element of the remedial action.
The amount of contaminant destroyed or treated	
The degree of expected reduction in toxicity, mobility, or volume of contamination due to treatment	
The type and quantity of materials that will remain following treatment	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	
Irreversible treatment	• Yes
Reduction of Toxicity, Mobility, or Volume through Treatment:	❸

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Table E.2E Short-Term Effectiveness Evaluation Summary – Alternative S2

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	• A short-term risk is posed to the community and onsite workers during implementation of the alternative when excavating adjacent to the grain storage silos. Safety measures such as establishment of work zones (such as exclusion zones), dust suppression, and temporary shoring or protection would be implemented during construction to reduce short-term exposure risks to the community and onsite workers. • Security measures would be implemented to eliminate potential short-term risks posed to trespassers within the exclusion zone.
Potential impacts to workers during implementation and the reliability of protective measures taken to minimize these impacts	• The alternative involves excavation and transport of contaminated soil, which could pose short-term risks to workers. • Safety measures such as dust suppression, use of personal protective equipment (PPE), and establishment of work zones would be implemented during construction to reduce short-term exposure risks to the workers. • Other potential impacts could be from safety hazards such as falls, electrical and mechanical hazards, and hazards associated with working in proximity to an active grain storage facility. These potential impacts would be mitigated through adherence to safety requirements and standard operating procedures.
Potential adverse environmental impacts resulting from implementation of an alternative and the reliability of the available mitigation measure during implementation	• Protective measures such as dust suppression, silt fencing and other erosion prevention measures would be implemented to minimize the environmental impacts during construction. • Short-term environmental impacts could occur during implementation, especially if the dust and erosion controls during construction activities are ineffective. • Use of emissions reduction strategies and fuel conservation methods for removal and transport equipment could reduce short term impacts to the environment. • The application of emissions reduction strategies and fuel conservation methods for removal and transportation equipment during implementation can reduce short term impacts posed to the environment and promote technologies and practices that are sustainable.
Time until RAOs are achieved	• RAOs are estimated to be achieved in five years in all areas except deep soils beneath the area of the former AST and buried pipe.
Short-Term Effectiveness Rating:	❸

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Table E.2F Implementability Evaluation Summary – Alternative S2

Evaluation Factors for Implementability		Evaluation Summary
Technical Feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	• Excavation adjacent to the grain storage facility may require temporary shoring or protection. • Removal and onsite treatment and disposal of contaminated soil could be easily implemented; however, seasonal conditions such as freezing temperatures and significant snowfall could affect the ability to remove soil and could compromise construction in progress.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	• The hours of construction would be adjusted as necessary to minimize the disturbance to adjacent grain storage facility operations. • Ex situ SVE treatment may take longer than anticipated, delaying on-site disposal.
Administrative Feasibility	Coordination issues with other offices and agencies during construction or operations of the remedy	• Facility operations at the site may be impacted during construction; however, work would be conducted to minimize facility operations. • Regulatory approval for excavation, treatment, and disposal should be obtainable. • Regulatory approvals for the in situ SVE system are already in place.
	The ability and time required to obtain necessary approvals and permits from other agencies for off-site actions or discharge scenarios	
Availability of Goods and Services	Availability of adequate off-site treatment, storage capacity, and disposal capacity and services	• No off-site treatment, storage, or disposal is required for this alternative.
	Availability of necessary equipment and specialists required to completed construction of remedy components	• Technical specialists and equipment are available for implementation of this alternative. • Labor, equipment, and materials for contaminated soil removal and on-site treatment and disposal are available. • An ex situ SVE system should be easily constructed.
	Availability of services and materials plus the potential for obtaining competitive bids	
	Availability of prospective technologies	
Implementability Rating:		❸

Table E.2G Cost Evaluation Summary – Alternative S2

Evaluation Factors for Costs	Approximate Cost (Dollars)
Total Capital Costs	$345,000
Total Annual O&M Costs	$498,000
Total Periodic Cost	$372,000
Total Present Value Cost	$929,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 5). Costs are rounded to the nearest $1,000.

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Alternative S3
Expand Existing SVE System

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Table E.3A Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative S3

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long- term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	• Subsurface contaminants would be removed through soil vapor extraction in the vadose zone. • The majority of contaminated soil above cleanup goals would be targeted by the additional SVE wells installed, reducing the potential for migration of contaminants to groundwater and indoor air, and thereby reducing risk to below acceptable levels ($1x10^{-6}$ risk level) in all areas. • The pathway of contaminant migration to groundwater would remain. ICs would be implemented to manage future land use and minimize the exposure pathway to humans from untreated contaminated soil left onsite.
Overall Protection of Human Health and the Environment Rating:	**+**

Table E.3B Evaluation Summary for Compliance with ARARs – Alternative S3

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with Chemical-Specific ARARs	• SVE emissions and disposal of excavated soil during SVE construction would be compliant with federal and state chemical-specific air quality ARARs.
Compliance with Location-Specific ARARs	• No location-specific ARARs.
Compliance with Action-Specific ARARs	• Disposal of excavated soils and SVE emissions would be compliant with action-specific ARARs.
Compliance with ARARs Rating:	**+**

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Table E.3C Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative S3

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	• The majority of contaminated soil above cleanup goals would be treated. • The risk of exposure due to vapor intrusion is reduced to acceptable levels ($1x10^{-6}$ risk level). • The risk of leaching to groundwater and causing impact to groundwater above MCLs is reduced and possibly eliminated. • Although residual risk from contaminant migration to groundwater exists, ICs and continued groundwater containment would manage these risks.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	
Long-Term Effectiveness and Permanence Rating:	❹

Table E.3D Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative S3

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment process, the alternative uses, and materials they will treat	• Expanded in situ SVE is a treatment technology that transfers VOCs from soil to atmosphere. Existing cat ox unit, which destroys contaminants, is not expected to be necessary. • While not anticipated, emissions treatment is available to reduce higher concentrations to comply with air emission regulations. • SVE has been shown to be an effective method at the site for removal of contaminants from soil and is expected to irreversibly remove and treat contaminants from the entire contaminated soil volume. • The level of contamination in the SVE treatment area would eventually be reduced to below PCLs. No residual contamination would remain. • This alternative would satisfy the statutory preference for treatment as a principal element of the remedial action.
The amount of contaminant destroyed or treated	
The degree of expected reduction in toxicity, mobility, or volume of contamination due to treatment	
The type and quantity of materials that will remain following treatment	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	
Irreversible treatment	• Yes
Reduction of Toxicity, Mobility, or Volume through Treatment:	❹

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Table E.3E Short-Term Effectiveness Evaluation Summary – Alternative S3

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	• Short-term risks posed during implementation of the alternative could be mitigated with safety measures such as establishment of work zones (such as exclusion zones) and dust suppression. • Installation of SVE wells would be performed by a licensed contractor who would collect, manifest, and dispose of drill cuttings at a proper disposal facility.
Potential impacts to workers during implementation and the reliability of protective measures taken to minimize these impacts	• This alternative involves SVE well drilling and construction, which could pose short-term risk. Safety measures such as dust suppression, use of PPE, and establishment of work zones would be implemented during construction to reduce short-term exposure risks to the workers. • Other potential impacts could be from safety hazards such as trips, falls, electrical and mechanical hazards and hazards associated with working in proximity to an active grain storage facility. These potential impacts would be mitigated through adherence to safety requirements and standard operating procedures.
Potential adverse environmental impacts resulting from implementation of an alternative and the reliability of the available mitigation measure during implementation	• Short-term environmental impacts could occur during implementation, especially if the dust controls during construction activities are ineffective. • Use of standard procedures for transport and handling of contaminated soil cuttings would mitigate risks to the environment.
Time until RAOs are achieved	• RAOs are estimated to be achieved in ten years.
Short-Term Effectiveness Rating:	❸

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Table E.3F Implementability Evaluation Summary – Alternative S3

Evaluation Factors for Implementability		Evaluation Summary
Technical Feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	• The treatment system is already constructed and operational; additional SVE wells would be installed and connected to the existing system.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	• SVE is a reliable technology and presumptive remedy treatment technology for treating VOC-contaminated soil.
Administrative Feasibility	Coordination issues with other offices and agencies during construction or operations of the remedy	• Facility operations at the site may be impacted during construction; however, work would be conducted to minimize facility operations. • Regulatory approvals for SVE are already in place. No modification necessary for expansion.
	The ability and time required to obtain necessary approvals and permits from other agencies for off-site actions or discharge scenarios	
Availability of Goods and Services	Availability of adequate off-site treatment, storage capacity, and disposal capacity and services	• Off-site disposal facilities are available for disposal and have the capacity to accept the total volume of drill cuttings and other waste material generated.
	Availability of necessary equipment and specialists required to completed construction of remedy components	• Materials, equipment, and labor resources used for installation of SVE wells are readily available. • A licensed drilling contractor would perform SVE well installations. • Materials, equipment, and labor resources used for installation of the SVE well effluent piping and connection to the existing SVE system are readily available.
	Availability of services and materials plus the potential for obtaining competitive bids	
	Availability of prospective technologies	
Implementability Rating:		❹

Table E.3G Cost Evaluation Summary – Alternative S3

Evaluation Factors for Costs	Approximate Cost (Dollars)
Total Capital Costs	$336,000
Total Annual O&M Costs	$946,000
Total Periodic Cost	$186,000
Total Present Value Cost	$1,168,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 10). Costs are rounded to the nearest $1,000.

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Alternative S4
Excavation, Treatment and Disposal of Contaminated Soil and Expand Existing SVE System

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Table E.4A Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative S4

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long- term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	• Contaminated soil would be addressed through excavation, on-site treatment and on-site disposal and the expanded SVE system. • Removal of contaminated soil from the OU1 area would reduce risk of vapor intrusion and leaching from OU 1 soils to below acceptable levels ($1x10^{-6}$ risk level). • Removal of contaminated soil from the OU1 area would facilitate unrestricted future land use. • Subsurface contaminants that could not be excavated would be removed through SVE in the vadose zone. • The contaminated soil above cleanup goals remaining after excavation would be targeted by the additional SVE wells installed, reducing the potential for migration of contaminants to groundwater. • The pathway of contaminant migration to groundwater would remain. ICs would be implemented to manage future land use and minimize the exposure pathway to humans from untreated contaminated soil left onsite.
Overall Protection of Human Health and the Environment Rating:	**+**

Table E.4B Evaluation Summary for Compliance with ARARs – Alternative S4

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with Chemical-Specific ARARs	• SVE emissions and treatment/disposal of excavated soil would be compliant with federal and state chemical-specific ARARs.
Compliance with Location-Specific ARARs	• No location-specific ARARs.
Compliance with Action-Specific ARARs	• Disposal of excavated soil and SVE emissions would be compliant with federal and state action-specific ARARs.
Compliance with ARARs Rating:	**+**

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Table E.4C Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative S4

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	• This alternative has long-term effectiveness and permanence because most contaminated soil above PCLs would be removed, treated and disposed on site, and the in situ SVE system would continue to be operated to address residual soil contamination. • Risk of exposure to vapor intrusion would be reduced to acceptable levels ($1x10^{-6}$ risk level). • Risk of leaching to groundwater and causing impact to groundwater above MCLs is eliminated. • No residual risk would remain.
Long-Term Effectiveness and Permanence Rating:	❺

Table E.4D Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative S4

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment process, the alternative uses, and materials they will treat The amount of contaminant destroyed or treated The degree of expected reduction in toxicity, mobility, or volume of contamination due to treatment The type and quantity of materials that will remain following treatment Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	• In situ and ex situ SVE treatment technologies transfer VOCs from the soil to the atmosphere. Existing cat ox unit, which destroys contaminants, is not expected to be necessary. • While not anticipated, emissions treatment is available to reduce higher concentrations to comply with air emission regulations. • SVE has been shown to be an effective method at the site for removal of contaminants from soil. The entire volume of contaminated soils at the site would be irreversibly treated. • Ex situ SVE would reduce the contamination levels to below cleanup levels prior to on-site placement. • Excavation and treatment of contaminated material would be limited to a small area where contaminants are above PCLs. • The level of contamination in the SVE treatment area would eventually be reduced to below PCLs. No residual contamination would remain. • This alternative would satisfy the statutory preference for treatment as a principal element of the remedial action.
Irreversible technology	• Yes
Reduction of Toxicity, Mobility, or Volume through Treatment:	❹

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Table E.4E Short-Term Effectiveness Evaluation Summary – Alternative S4

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	• Short-term risks posed during implementation of the alternative could be mitigated with safety measures such as establishment of work zones (such as exclusion zones) and dust suppression. • Installation of SVE wells would be performed by a licensed contractor who would collect, manifest, and dispose of drill cuttings at a proper disposal facility. • Security measures would be implemented to eliminate potential short-term risks posed to trespassers within the exclusion zone.
Potential impacts to workers during implementation and the reliability of protective measures taken to minimize these impacts	• The alternative involves excavation and transport of contaminated soil and SVE well drilling, which could pose short-term risks to workers. • Safety measures such as dust suppression, use of PPE, and establishment of work zones would be implemented during construction to reduce short-term exposure risks to the workers. • Other potential impacts could be from safety hazards such as trips, falls, electrical and mechanical hazards and hazards associated with working in proximity to an active grain storage facility. These potential impacts would be mitigated through adherence to safety requirements and standard operating procedures.
Potential adverse environmental impacts resulting from implementation of an alternative and the reliability of the available mitigation measure during implementation	• Protective measures such as dust suppression, silt fencing and other erosion prevention measures would be implemented to minimize the environmental impacts during construction. • Short-term environmental impacts could occur during implementation, especially if the dust controls during construction activities are ineffective. • Use of standard procedures for transport and handling of contaminated soil cuttings would mitigate risks to the environment. • The application of emissions reduction strategies and fuel conservation methods for removal and transportation equipment during implementation can reduce short term impacts posed to the environment and promote technologies and practices that are sustainable.
Time until RAOs are achieved	• RAOs are estimated to be achieved in five years.
Short-Term Effectiveness Rating:	❸

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Table E.4F Implementability Evaluation Summary – Alternative S4

Evaluation Factors for Implementability		Evaluation Summary
Technical Feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	• Excavation adjacent to the grain storage facility may require temporary shoring or protection. • Removal and onsite treatment and disposal of contaminated soil could be easily implemented; however, seasonal conditions such as freezing temperatures and significant snowfall could affect the ability to remove soil and could compromise construction in progress. • The treatment system is already constructed and operational; additional SVE wells would be installed and connected to the existing system.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	• SVE is a reliable technology and presumptive remedy treatment technology for treating VOC-contaminated soil.
Administrative Feasibility	Coordination issues with other offices and agencies during construction or operations of the remedy	• Facility operations at the site may be impacted during construction; however, work would be conducted to minimize facility operations. • Regulatory approvals for engineered controls are already in place. • Regulatory approvals for the in situ SVE system are already in place. • Necessary regulatory approval for excavation, treatment and disposal should be readily obtainable.
	The ability and time required to obtain necessary approvals and permits from other agencies for off-site actions or discharge scenarios	
Availability of Goods and Services	Availability of adequate off-site treatment, storage capacity, and disposal capacity and services	• Off-site disposal facilities are available for disposal and have the capacity to accept the total volume of drill cuttings and other waste material generated. • Excavated contaminated material would be treated and disposed on-site.
	Availability of necessary equipment and specialists required to completed construction of remedy components	• Labor, equipment, and materials for contaminated soil removal and on-site treatment and disposal are available; SVE system is easily constructed. • Materials, equipment, and labor resources used for installation of SVE wells are readily available. • A licensed drilling contractor would perform SVE well installations. • Materials, equipment, and labor resources used for installation of the SVE well effluent piping and connection to the existing SVE system are readily available.
	Availability of services and materials plus the potential for obtaining competitive bids	
	Availability of prospective technologies	
Implementability Rating:		❸

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Table E.4G Cost Evaluation Summary – Alternative S4

Evaluation Factors for Costs	Approximate Cost (Dollars)
Total Capital Costs	$407,000
Total Annual O&M Costs	$516,000
Total Periodic Cost	$62,000
Total Present Value Cost	$883,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 5). Costs are rounded to the nearest $1,000.

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OU1 Contaminated Groundwater Alternatives

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Alternative SG1
No Action

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Table E.5A Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative SG1

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long- term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	• No action is taken to address groundwater contamination; therefore, this alternative does not address unacceptable risks posed by contaminants in groundwater. • No reduction in future risk with regards to human health. ICs prevent unacceptable risk by preventing future residential development. • Does not prevent migration of contamination.
Overall Protection of Human Health and the Environment Rating:	—

Table E.5B Evaluation Summary for Compliance with ARARs – Alternative SG1

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with Chemical-Specific ARARs	• No action is taken to address groundwater contamination; therefore, this criterion is not met. Does not address SDWA or NDEQ Title 118 standards.
Compliance with Location-Specific ARARs	• No location-specific ARARs .
Compliance with Action-Specific ARARs	• No remedial action would occur to address groundwater contamination; therefore, there are no action-specific ARARs to meet.
Compliance with ARARs Rating:	—

Table E.5C Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative SG1

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	• Not applicable. No further remedial action would be undertaken to address groundwater contamination. Therefore, this criterion is not met.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	• Not applicable. No controls are put in place under this alternative. • Contaminated groundwater remains uncontained at the Site.
Long-Term Effectiveness and Permanence Rating:	⓪

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Table E.5D Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative SG1

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment process, the alternative uses, and materials they will treat	• Not applicable. The no action alternative does not address contaminated groundwater; therefore, these criteria are not met.
The amount of contaminant destroyed or treated	
The degree of expected reduction in toxicity, mobility, or volume of contamination due to treatment	
The type and quantity of materials that will remain following treatment	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	
Irreversible treatment	
Reduction of Toxicity, Mobility, or Volume through Treatment:	**0**

Table E.5E Short-Term Effectiveness Evaluation Summary – Alternative SG1

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	• Not applicable. The short-term risks to the community are unchanged by this activity. No impacts to workers during implementation would occur and no adverse environmental impacts would occur during implementation; however, since short term risks are not addressed and the time frame is open ended, the criterion is not met.
Potential impacts to workers during implementation and the reliability of protective measures taken to minimize these impacts	
Potential adverse environmental impacts resulting from implementation of an alternative and the reliability of the available mitigation measure during implementation	
Time until RAO objectives are met	
Short-Term Effectiveness Rating:	**0**

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Table E.5F Implementability Evaluation Summary – Alternative SG1

Evaluation Factors for Implementability		Evaluation Summary
Technical Feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	• Not applicable. The no action alternative has no technical component.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	
Administrative Feasibility	Coordination issues with other offices and agencies during construction or operations of the remedy.	• Not applicable. The no action alternative has no administrative component.
	The ability and time required to obtain necessary approvals and permits from other agencies for off-site actions or discharge scenarios	
Availability of Goods and Services	Availability of adequate off-site treatment, storage capacity, and disposal capacity and services	• Not applicable. The no action alternative would include limited periodic groundwater sampling in support of Five Year Reviews.
	Availability of necessary equipment and specialists required to completed construction of remedy components	
	Availability of services and materials plus the potential for obtaining competitive bids	
	Availability of prospective technologies	
Implementability Rating:		⓿

Table E.5G Cost Evaluation Summary – Alternative SG1

Evaluation Factors for Costs	Approximate Cost (Dollars)
Total Capital Costs	$469,000
Total Annual O&M Costs	$1,128,000
Total Periodic Cost	$514,000
Total Present Value Cost	$1,061,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 100). Costs are rounded to the nearest $1,000.

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Alternative SG2
Maintain and Operate Existing GET System

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Table E.6A Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative SG2

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long- term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	• This alternative involves operating the existing (and recently upgraded) GET system. A recent groundwater model was developed showing it is providing adequate hydraulic control of the source area contamination and capturing the groundwater plume. • Ongoing application and enforcement of the existing ICs limiting private well installations for potable water would provide some protection of human health by reducing exposure to contaminated groundwater. • Monitoring of system performance would ensure continued groundwater containment. • Long-term risk eliminated after PCLs are achieved. • Continued operation of the existing GET system prevents groundwater migration from OU 1.
Overall Protection of Human Health and the Environment Rating:	**+**

Table E.6B Evaluation Summary for Compliance with ARARs – Alternative SG2

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with Chemical-Specific ARARs	• The existing GET system is containing and treating contaminated groundwater and reinjecting treated groundwater into the deep aquifer. • Addresses federal SDWA and state Title 118 standards by achieving ARARs at the conclusion of the remedial action.
Compliance with Location-Specific ARARs	• No location-specific ARARs.
Compliance with Action-Specific ARARs	• This alternative is compliant with all action-specific ARARs. • The existing GET system is containing and treating contaminated groundwater via air stripping. It is currently compliant with state and federal air emissions requirements. • The existing GET system reinjects treated effluent into the aquifer. It is currently compliant with the requirements of the state's Title 122 requirements for the Underground Injection Control (UIC) program.
Compliance with ARARs Rating:	**+**

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Table E.6C Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative SG2

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	• OU1 groundwater contamination in the upper and medial groundwater aquifers is contained by the GET system. Containment of source groundwater contamination could hasten downgradient remediation efforts (downgradient groundwater contamination associated with OU2 would be addressed separately). • At the conclusion of the remedial action, groundwater would achieve groundwater cleanup goals. • Controls would not be necessary to manage, because untreated residual contamination, if any, would not cause contamination above cleanup levels..
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	
Long-Term Effectiveness and Permanence Rating:	❺

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Table E.6D Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative SG2

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment process, the alternative uses, and materials they will treat	• This alternative provides treatment of VOCs using an air stripper. • Air stripping has been proven as a highly effective method for removal of COCs from the extracted groundwater at the site. An estimate of contaminant mass that would be treated by air stripping is not available. • Contaminated groundwater is hydraulically contained and prevented from migrating out of OU 1. The volume of groundwater that exceeds MCLs would be eliminated. • This alternative reduces contaminants in extracted groundwater below MCLs prior to discharge (aquifer reinjection). • Some contamination may be present beyond the horizontal radius of influence of the recovery wells, and/or below the screened depth of the recovery wells. In addition, residual contaminants may remain adsorbed to soil particles in the saturated zone, which may not be feasibly removed through groundwater extraction. The residual contamination would not impact groundwater causing contamination above groundwater MCLs.
The amount of contaminant destroyed or treated	
The degree of expected reduction in toxicity, mobility, or volume of contamination due to treatment	
The type and quantity of materials that will remain following treatment	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	• This alternative would satisfy the statutory preference for treatment as principal element of the remedial action.
Irreversible treatment	• Groundwater is irreversibly treated.
Reduction of Toxicity, Mobility, or Volume through Treatment:	❹

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Table E.6E Short-Term Effectiveness Evaluation Summary – Alternative SG2

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative Potential impacts to workers during implementation and the reliability of protective measures taken to minimize these impacts Potential adverse environmental impacts resulting from implementation of an alternative and the reliability of the available mitigation measure during implementation	• The GET system has been constructed and is operational; no additional construction is anticipated under this alternative. • Installation of additional monitoring wells (as needed) would be performed by a licensed contractor who would collect, manifest, and dispose of drill cuttings at proper disposal facilities. • All workers would be OSHA trained and would be required to wear appropriate personal protective equipment while drilling wells. • Emissions from the air stripper would be below state and local regulatory requirements. • No adverse impacts to the environment are expected from the installation of additional monitoring wells.
Time until RAOs are achieved	• ICs are in place which protect against any exposure from OU 1 groundwater. • RAOs are predicted to be achieved in 30 years.
Short-Term Effectiveness Rating:	❹

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Table E.6F Implementability Evaluation Summary – Alternative SG2

Evaluation Factors for Implementability		Evaluation Summary
Technical Feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	• The GET system consists of a column air stripper for treatment of VOCs in groundwater. Air stripping has been highly effective at removing VOCs from extracted groundwater. • Implementation of this alternative involves installation of monitoring wells using standard drilling equipment and installation techniques. • Inspection, maintenance and replacement of engineered controls are easily implemented.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	
Administrative Feasibility	Coordination issues with other offices and agencies during construction or operations of the remedy	• The required permitting for re-injection of treated groundwater has already been obtained. Air emission reporting is already being conducted.
	The ability and time required to obtain necessary approvals and permits from other agencies for off-site actions or discharge scenarios	• This alternative has administrative approvals and permits already in place.
Availability of Goods and Services	Availability of adequate off-site treatment, storage capacity, and disposal capacity and services	• This alternative requires no off-site treatment, storage or services.
	Availability of necessary equipment and specialists required to completed construction of remedy components	• The GET system has been constructed and is operational; no additional construction is anticipated under this alternative.
	Availability of services and materials plus the potential for obtaining competitive bids	
	Availability of prospective technologies	
Implementability Rating:		❺

Table E.6G Cost Evaluation Summary – Alternative SG2

Evaluation Factors for Costs	Approximate Cost (Dollars)
Total Capital Costs	$480,000
Total Annual O&M Costs	$10,034,000
Total Periodic Cost	$967,000
Total Present Value Cost	$6,340,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 100). Costs are rounded to the nearest $1,000.

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Alternative SG3
In Situ Treatment via Groundwater Amendments

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Table E.7A Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative SG3

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long- term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	• Contaminant levels in groundwater would be reduced to levels below clean up goals through in situ treatment methods such as chemical oxidation, chemical reduction, or enhanced bioremediation (EB). Long-term risk would be eliminated after cleanup levels are achieved. • Ongoing implementation, enforcement, and monitoringof the existing ICs limiting private well installations for potable water would provide some protection of human health by reducing exposure to contaminated groundwater. • Monitoring of performance would be performed to enhance protectiveness. • Does not prevent migration of groundwater during the remedial action, but amendments are expected to reduce contaminant levels at OU 1 in a short period of time so that migration would not be a concern.
Overall Protection of Human Health and the Environment Rating:	**+**

Table E.7B Evaluation Summary for Compliance with ARARs – Alternative SG3

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with Chemical-Specific ARARs	• This alternative would be compliant with federal SDWA and state Title 118 chemical-specific ARARs at the conclusion of the remedial action.
Compliance with Location-Specific ARARs	• No location-specific ARARs.
Compliance with Action-Specific ARARs	• This alternative would be compliant with action-specific ARARs. Injections would meet the requirements of the state's Title 122 UIC program.
Compliance with ARARs Rating:	**+**

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Table E.7C Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative SG3

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	• In situ treatment would decrease concentrations of contaminants to below PCLs at the conclusion of the remedial action. • The GET system would be operated to the extent practicable to address contaminated groundwater that would not be addressed by the in situ treatment. • Contamination outside of the source area would remain; however, remediation of source groundwater contamination could speed down gradient remediation efforts (downgradient groundwater contamination would be addressed separately). • Routine groundwater monitoring would be required as long as groundwater contamination exists. Routine monitoring would also assist in determining the effectiveness of the remedy. • Controls would not be necessary to manage, because untreated residual contamination, if any, would not cause contamination of groundwater above cleanup levels.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	
Long-Term Effectiveness and Permanence Rating:	❹

Table E.7D Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative SG3

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment process, the alternative uses, and materials they will treat	• This alternative provides treatment of contaminants by destroying contaminants through in situ treatment. • In situ treatment would result in complete, irreversible degradation/destruction of contaminants in those areas where contaminated groundwater that comes into contact with the chemical oxidants or reducing agents or an active bioremediation zone. • An estimate of contaminant mass that will undergo treatment is not available. • Contaminated groundwater outside of active treatment areas would not be addressed and would remain as residual contamination. • Groundwater would not be contained. • This alternative would satisfy the statutory preference for treatment as principal element of the remedial action.
The amount of contaminant destroyed or treated	
The degree of expected reduction in toxicity, mobility, or volume of contamination due to treatment	
The type and quantity of materials that will remain following treatment	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	
Irreversible treatment	• Contaminants are irreversibly treated.
Reduction of Toxicity, Mobility, or Volume through Treatment:	❸

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Table E.7E Short-Term Effectiveness Evaluation Summary – Alternative SG3

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	• DPT and installation of monitoring wells would be performed by licensed contractors who would collect, manifest, and dispose of drill cuttings at a proper disposal facility in compliance with federal and state regulations.
Potential impacts to workers during implementation and the reliability of protective measures taken to minimize these impacts	• Some risk to workers due to DPT and monitoring well construction. Chemical oxidants are highly corrosive/reactive and pose significant potential hazards during handling, including burns and explosive hazards. • All workers would be OSHA trained and would be required to wear appropriate personal protective equipment while drilling wells and performing injections. • Other potential impacts could be from safety hazards such as trips, falls, electrical and mechanical hazards and hazards associated with working in proximity to an active grain storage facility. These potential impacts would be mitigated through adherence to safety requirements and standard operating procedures. • Safety measures such as dust suppression, use of PPE, and establishment of work zones would be implemented during construction to reduce short-term exposure risks to the workers.
Potential adverse environmental impacts resulting from implementation of an alternative and the reliability of the available mitigation measure during implementation	• No adverse impacts to the environment are expected from DPT or the installation of monitoring wells. • Any adverse environmental impacts resulting from drilling monitoring wells would be mitigated through safe work practices and proper handling and disposal of drill cuttings. • A potential adverse environmental impact would result from a spill of chemicals. Potential adverse impacts would be mitigated through safe work practices and using materials compatible with injection work and the materials being injected.
Time until RAOs are achieved	• ICs are in place at OU 1 and protect against any exposure from OU 1 groundwater. • RAOs are predicted to be achieved in 15 years.
Short-Term Effectiveness Rating:	❸

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Table E.7F Implementability Evaluation Summary – Alternative SG3

Evaluation Factors for Implementability		Evaluation Summary
Technical Feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	• Bench- and pilot-scale studies would be conducted to optimize full scale implementation of in situ technologies. • Implementation of this alternative involves installation of monitoring wells using standard drilling equipment and installation techniques. • Injections would be conducted via DPT using an outside-in, downgradient to upgradient procedure to reduce the likelihood of mobilizing contaminants into uncontaminated areas. • Injections into the deep aquifer may be difficult and have low injection rates. • Inspection, maintenance and replacement of engineered controls are easily implemented.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	• Multiple injections would likely be necessary to achieve clean up goals.
Administrative Feasibility	Coordination issues with other offices and agencies during construction or operations of the remedy	• Injections would require meeting the requirements of the state's UIC program. • This alternative would require coordination with AGP in order to conduct periodic injections at an active grain storage facility.
	The ability and time required to obtain necessary approvals and permits from other agencies for off-site actions or discharge scenarios	• No off site actions or discharge scenarios are anticipated.
Availability of Goods and Services	Availability of adequate off-site treatment, storage capacity, and disposal capacity and services	• This alternative requires no off-site treatment, storage or services.
	Availability of necessary equipment and specialists required to completed construction of remedy components	• DPT and monitoring well installation would be performed by licensed drilling contractors. No specialized drilling equipment would be required. • There are numerous contractors that have the capability to perform injections into the subsurface using DPT. • There are numerous in situ treatment chemicals available to treat contaminants.
	Availability of services and materials plus the potential for obtaining competitive bids	
	Availability of prospective technologies	
	Implementability Rating:	❸

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Table E.7G Cost Evaluation Summary – Alternative SG3

Evaluation Factors for Costs	Approximate Cost (Dollars)
Total Capital Costs	$785,000
Total Annual O&M Costs	$3,555,000
Total Periodic Cost	$10,037,000
Total Present Value Cost	$12,346,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 4). Costs are rounded to the nearest $1,000.

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Alternative SG4
In Situ Treatment via Groundwater Amendments and Expand SVE System

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Table E.8A Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative SG4

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long- term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	• This alternative involves operating the existing (and recently upgraded) GET system. A recent groundwater model was developed showing it is providing adequate hydraulic control of the source area contamination and capturing the groundwater plume. • Ongoing implementation, enforcement, and monitoring of the existing ICs limiting private well installations for potable water would provide some protection of human health by reducing exposure to contaminated groundwater. • Monitoring of performance would be performed to enhance protectiveness. • High contaminant levels in groundwater would be reduced to levels below clean up goals through in situ treatment methods such as chemical oxidation, chemical reduction, or enhanced bioremediation (EB). • Long-term risk would be eliminated after cleanup goals are achieved. • Prevents groundwater migration from OU 1.
Overall Protection of Human Health and the Environment Rating:	**+**

Table E.8B Evaluation Summary for Compliance with ARARs – Alternative SG4

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with Chemical-Specific ARARs	• Chemical-specific federal SDWA and state NDEQ Title 118 ARARs would be achieved at the conclusion of the remedial action..
Compliance with Location-Specific ARARs	• No location-specific ARARs.
Compliance with Action-Specific ARARs	• This alternative is compliant with all action-specific ARARs. • The GET system is containing and treating contaminated groundwater via air stripping. It is currently compliant with state and federal emission requirements. • The GET system reinjects treated effluent into the aquifer. It is currently compliant with the requirements of the NDEQ Title 122 UIC program. • Injections of amendments would meet the requirements of the state's UIC program.
Compliance with ARARs Rating:	**+**

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Table E.8C Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative SG4

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	• In situ treatment would decrease concentrations of contaminants to below PCLs by the conclusion of the remedial action. • The GET system would be operated to the extent practicable to address contaminated groundwater that would not be addressed by the in situ treatment. • Contamination outside of the source area would remain; however, remediation of source groundwater contamination could speed down gradient remediation efforts (downgradient groundwater contamination would be addressed separately). • Routine groundwater monitoring would be required as long as groundwater contamination exists. Routine monitoring would also assist in determining the effectiveness of the remedy. • Controls would not be necessary to manage, because untreated residuals, if any, would not cause contamination above cleanup levels.
Long-Term Effectiveness and Permanence Rating:	❺

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Table E.8D Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative SG4

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment process, the alternative uses, and materials they will treat	• This alternative provides treatment of contaminants by destroying contaminants through in situ treatment. • Contaminated groundwater not addressed through in situ treatment would be extracted, treated and reinjected. • In situ treatment would result in complete degradation/destruction of contaminants in those areas where contaminated groundwater comes into contact with the chemical oxidants or reducing agents or an active bioremediation zone. • An estimate of the contaminant mass is unavailable. • Contaminated groundwater outside of active treatment areas would not be addressed; however, contaminated groundwater would be hydraulically contained and prevented from migrating out of OU 1 by the GET system. • Air stripping has been proven as a highly effective method for removal of COCs from the extracted groundwater at the site. The volume of groundwater in OU 1 that exceeds MCLs would be eliminated. • Any adsorbed residual contamination in the aquifer would not impact groundwater above MCLs. • This alternative would satisfy the statutory preference for treatment as principal element of the remedial action.
The amount of contaminant destroyed or treated	
The degree of expected reduction in toxicity, mobility, or volume of contamination due to treatment	
The type and quantity of materials that will remain following treatment	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	
Irreversible treatment	• Contaminants would be irreversibly treated.
Reduction of Toxicity, Mobility, or Volume through Treatment:	❹

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Table E.8E Short-Term Effectiveness Evaluation Summary – Alternative SG4

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	• The GET system has been constructed and is operational; no additional construction is anticipated under this alternative. • DPT and installation of additional monitoring wells (as needed) would be performed by licensed contractors who would collect, manifest, and dispose of drill cuttings at proper disposal facilities per federal and state regulations. • Emissions from the air stripper would be below state regulatory requirements. • Injection of amendments would be conducted by experienced contractors.
Potential impacts to workers during implementation and the reliability of protective measures taken to minimize these impacts	• Some risk to workers due to DPT and monitoring well construction. Chemical oxidants are highly corrosive/reactive and pose significant potential hazards, such as burns and explosion hazards. • All workers would be OSHA trained and would be required to wear appropriate personal protective equipment while drilling wells and performing injections. • Other potential impacts could be from safety hazards such as trips, falls, electrical and mechanical hazards and hazards associated with working in proximity to an active grain storage facility. These potential impacts would be mitigated through adherence to safety requirements and standard operating procedures. • Safety measures such as dust suppression, use of PPE, and establishment of work zones would be implemented during construction to reduce short-term exposure risks to the workers.
Potential adverse environmental impacts resulting from implementation of an alternative and the reliability of the available mitigation measure during implementation	• No adverse impacts to the environment are expected from the installation of monitoring wells. • Any adverse environmental impacts resulting from drilling monitoring wells would be mitigated through safe work practices and proper handling and disposal of drill cuttings. • A potential adverse environmental impact would result from a spill of chemicals. Potential adverse impacts would be mitigated through safe work practices and using materials compatible with injection work and the materials being injected. • Emissions from the air stripper would be below state and local regulatory requirements.
Time until RAOs are achieved	• ICs are in place at OU 1 that protect against any exposure from OU 1 groundwater. • RAOs are predicted to be achieved in 10 years.
Short-Term Effectiveness Rating:	❸

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Table E.8F Implementability Evaluation Summary – Alternative SG4

Evaluation Factors for Implementability		Evaluation Summary
Technical Feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	• The GET system consists of a column air stripper for treatment of VOCs in groundwater. Air stripping has been highly effective at removing VOCs from extracted groundwater. • Implementation of this alternative involves installation of monitoring wells using standard drilling equipment and installation techniques. • Inspection, maintenance and replacement of engineered controls are easily implemented. • Bench- and pilot-scale studies would be conducted to optimize full scale implementation of in situ technologies. • Injections would be conducted via DPT using an outside-in, downgradient to upgradient procedure to reduce the likelihood of mobilizing contaminants into uncontaminated areas. • Injections into the deep aquifer may be difficult and have low injection rates.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	• Multiple injections would likely be necessary to achieve clean up goals.
Administrative Feasibility	Coordination issues with other offices and agencies during construction or operations of the remedy	• Injections would require meeting the requirements of the state's UIC program. • This alternative would require coordination with AGP in order to conduct periodic injections at an active grain storage facility.
	The ability and time required to obtain necessary approvals and permits from other agencies for off-site actions or discharge scenarios	• No offsite actions or discharge scenarios are anticipated.
Availability of Goods and Services	Availability of adequate off-site treatment, storage capacity, and disposal capacity and services	• This alternative requires no off-site treatment, storage or services.
	Availability of necessary equipment and specialists required to completed construction of remedy components	• The GET system has been constructed and is operational. • Monitoring well installation would be performed by a licensed drilling contractor. No specialized drilling equipment would be required. • There are numerous contractors that have the capability to perform injections into the subsurface through DPT. • There are numerous in situ treatment chemicals available to treat contaminants.
	Availability of services and materials plus the potential for obtaining competitive bids	
	Availability of prospective technologies	
Implementability Rating:		❸

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Table E.8G Cost Evaluation Summary – Alternative SG4

Evaluation Factors for Costs	Approximate Cost (Dollars)
Total Capital Costs	$1,145,000
Total Annual O&M Costs	$4,313,000
Total Periodic Cost	$5,977,000
Total Present Value Cost	$10,143,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 2). Costs are rounded to the nearest $1,000.

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OU2 Contaminated Groundwater Alternatives

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Alternative G1
No Action

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Table E.9A Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative G1

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long- term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	• No action is taken to address groundwater contamination; therefore, this alternative does not address unacceptable risks posed by hazardous substances in groundwater. • ICs address risk by preventing exposure pathway. Continued enforcement of ICs prevents future exposures. • No reduction in future risk. • Does not prevent the migration of contaminated groundwater.
Overall Protection of Human Health and the Environment Rating:	—

Table E.9B Evaluation Summary for Compliance with ARARs – Alternative G1

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with Chemical-Specific ARARs	• Does not address federal and state requirements regarding contamination of a drinking water source.Therefore this criterion is not met.
Compliance with Location-Specific ARARs	• No location-specific ARARs.
Compliance with Action-Specific ARARs	• No remedial action would occur, therefore there are no action-specific ARARs to meet.
Compliance with ARARs Rating:	—

Table E.9C Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative G1

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	• Not applicable. No further remedial action would be undertaken to address groundwater contamination. Therefore, this criterion is not met.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	• Not applicable. No controls are put in place under this alternative. • Not applicable. Contaminated groundwater remains uncontained at the Site.
Long-Term Effectiveness and Permanence Rating:	O

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Table E.9D Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative G1

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment process, the alternative uses, and materials they will treat	• Not applicable. The no action alternative does not address contaminated groundwater; therefore, these criteria are not met.
The amount of contaminant destroyed or treated	
The degree of expected reduction in toxicity, mobility, or volume of contamination due to treatment	
The type and quantity of materials that will remain following treatment	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	
Irreversible technology	
Reduction of Toxicity, Mobility, or Volume through Treatment:	⓿

Table E.9E Short-Term Effectiveness Evaluation Summary – Alternative G1

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	• Not applicable. The short-term risks to the community are unchanged by this activity. No impacts to workers during implementation would occur and no adverse environmental impacts would occur during implementation; however, since short term risks are not addressed and the time frame is open ended, the criterion is not met.
Potential impacts to workers during implementation and the reliability of protective measures taken to minimize these impacts	
Potential adverse environmental impacts resulting from implementation of an alternative and the reliability of the available mitigation measure during implementation	
Time until RAOs are achieved	RAOs are not estimated to be achieved.
Short-Term Effectiveness Rating:	⓿

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Table E.9F Implementability Evaluation Summary – Alternative G1

Evaluation Factors for Implementability		Evaluation Summary
Technical Feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	• Not applicable. The no action alternative has no technical component.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	
Administrative Feasibility	Coordination issues with other offices and agencies during construction or operations of the remedy	• Not applicable. The no action alternative has no administrative component.
	The ability and time required to obtain necessary approvals and permits from other agencies for off-site actions or discharge scenarios	
Availability of Goods and Services	Availability of adequate off-site treatment, storage capacity, and disposal capacity and services	• Not applicable. The no action alternative would include limited periodic groundwater sampling in support of Five Year Reviews.
	Availability of necessary equipment and specialists required to completed construction of remedy components	
	Availability of services and materials plus the potential for obtaining competitive bids	
	Availability of prospective technologies	
Implementability Rating:		⓿

Table E.9G Cost Evaluation Summary – Alternative G1

Evaluation Factors for Costs	Approximate Cost (Dollars)
Total Capital Costs	$312,000
Total Annual O&M Costs	$924,000
Total Periodic Cost	$462,000
Total Present Value Cost	$852,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 100). Costs are rounded to the nearest $1,000.

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Alternative G2
Groundwater Recovery, Treatment and Discharge at Leading Edge of Plume

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Table E.10A Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative G2

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long- term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	• This alternative involves installing recovery wells along the leading edge of the groundwater plume, constructing a treatment system, and installing aquifer injection wells for discharge. • This alternative would provide hydraulic control, capture and treatment of contaminants to below MCL concentrations prior to reinjection of the OU2 contaminant plume. • Ongoing implementation, enforcement, and monitoring of the existing ICs limiting private well installations for potable water would provide some protection of human health by reducing exposure to contaminated groundwater. • Monitoring of performance of GET system ensure containment and would be used to assess achievement of cleanup levels. • Long-term risk is eliminated after cleanup levels are achieved. • The OU2 GET system would contain groundwater at the leading edge of the plume and prevent continued downgradient migration.
Overall Protection of Human Health and the Environment Rating:	**+**

Table E.10B Evaluation Summary for Compliance with ARARs – Alternative G2

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with Chemical-Specific ARARs	• This alternative would be compliant with federal SDWA and state Title 118 chemical-specific ARARs at the conclusion of the remedial action.
Compliance with Location-Specific ARARs	• No location-specific ARARs.
Compliance with Action-Specific ARARs	• The OU2 GET system would contain and treat contaminated groundwater via air stripping. It is anticipated that it would be compliant with state and federal emission requirements. • The GET system would reinject treated effluent into the aquifer. It is anticipated that it would be compliant with the requirements of the state's Title 122 UIC program.
Compliance with ARARs Rating:	**+**

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Table E.10C Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative G2

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	• The GET system would provide hydraulic control of the groundwater plume preventing further migration and remove contaminants from the leading edge of the plume area. However, groundwater contamination upgradient of the plume interception system would not be addressed. • Electrical and mechanical components (for example, well pumps, transfer pumps, valves, etc.) may require periodic replacement. Components of the treatment system should be easy to repair or replace. • Ongoing enforcement of the existing ICs limiting private well installations for potable water would provide some protection of human health by reducing exposure to contaminated groundwater. • Routine groundwater monitoring would be conducted so long as groundwater contamination exists. Routine monitoring would also assist in determining the effectiveness of the remedy. • At the conclusion of the remedial action, groundwater would achieve cleanup levels. Controls will not be necessary because any untreated residual contamination would not cause contamination above the cleanup levels.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	
Long-Term Effectiveness and Permanence Rating:	❹

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Table E.10D Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative G2

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment process, the alternative uses, and materials they will treat	• This alternative provides treatment of contaminants by removing contaminants through treatment of extracted groundwater by air stripping, which is a proven and reliable transfer technology and satisfies the regulatory preference for treatment • An estimate of contaminant mass that will be treated is not available, but Alternative G2, G3, and G4 would destroy approximately the same quantity. • Contaminated groundwater would be hydraulically contained and prevented from migrating downgradient of the GET system at the leading edge of the OU2 plume. • Levels of contaminants in extracted groundwater would be reduced to below cleanup goals by air stripping prior to discharge. The volume of groundwater that exceeds MCLs would be eliminated. • Leading edge recovery and treatment would not address contaminants in the groundwater upgradient of the plume interception system. • Any remaining adsorbed residual contamination in the aquifer would not impact groundwater above MCLs. • This alternative provides treatment by an air stripper. Treatment would only be applied to groundwater extracted through recovery wells.
The amount of contaminant destroyed or treated	
The degree of expected reduction in toxicity, mobility, or volume of contamination due to treatment	
The type and quantity of materials that will remain following treatment	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	
Irreversible treatment	• Contaminants are irreversibly treated.
Reduction of Toxicity, Mobility, or Volume through Treatment:	❹

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Table E.10E Short-Term Effectiveness Evaluation Summary – Alternative G2

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	• Installation of recovery, reinjection and monitoring wells would be performed by a licensed contractor who would collect, manifest, and dispose of drill cuttings in proper disposal areas. • The treatment system may pose short-term risks to the community during construction. Safety measures such as establishment of work zones (such as exclusion zones) would be implemented during construction to reduce short-term exposure risks to the community. A licensed contractor would be utilized to construct the system. • All workers would be OSHA trained and would be required to wear appropriate personal protective equipment during implementation.
Potential impacts to workers during implementation and the reliability of protective measures taken to minimize these impacts	• Some risk to workers during construction of monitoring, extraction, and injection wells, buried piping, and the treatment building. • All workers would be OSHA trained and would be required to wear appropriate personal protective equipment during implementation. • Other potential impacts could be from safety hazards such as trips, falls, electrical and mechanical hazards and hazards associated with working in proximity to an active grain storage facility. These potential impacts would be mitigated through adherence to safety requirements and standard operating procedures. • Safety measures such as dust suppression, use of PPE, and establishment of work zones would be implemented during construction to reduce short-term exposure risks to the workers.
Potential adverse environmental impacts resulting from implementation of an alternative and the reliability of the available mitigation measure during implementation	• No adverse impacts to the environment are expected from the construction of the treatment unit and installation of recovery, monitoring and reinjection wells and piping. • Any adverse environmental impacts resulting from drilling would be mitigated through safe work practices and proper handling and disposal of drill cuttings and other waste generated during construction. • Emissions from air stripper would be below state regulatory requirements.
Time until RAOs are achieved	• RAOs estimated to be achieved in 100 years.
Short-Term Effectiveness Rating:	❸

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Table E.10F Implementability Evaluation Summary – Alternative G2

Evaluation Factors for Implementability		Evaluation Summary
Technical Feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	• Implementation of this alternative involves installation of recovery, injection, and monitoring wells; and construction of pipelines, treatment building, and a treatment system using standard equipment and installation and construction techniques. • Pump and treat is a straightforward operation that is a presumptive remedy. • Inspection, maintenance, and replacement of engineered controls are easily implemented.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	• Operation of the GET system is easily implemented, although the system should be monitored closely to prevent system malfunctions and mechanical problems.
Administrative Feasibility	Coordination issues with other offices and agencies during construction or operations of the remedy	• Implementation would require locating the wells, pipelines, and treatment system in existing right-of-way or easement agreements with property owners.
	The ability and time required to obtain necessary approvals and permits from other agencies for off-site actions or discharge scenarios	• No off-site actions or discharge scenarios are anticipated.
Availability of Goods and Services	Availability of adequate off-site treatment, storage capacity, and disposal capacity and services	• This alternative requires no off-site treatment, storage, or services
	Availability of necessary equipment and specialists required to completed construction of remedy components	• Recovery, injection and monitoring well installation would be performed by a licensed drilling contractor. No specialized drilling equipment would be required.
	Availability of services and materials plus the potential for obtaining competitive bids Availability of prospective technologies	• The treatment system building, treatment system, and associated piping could easily be constructed by a licensed contractor. • No offsite treatment or storage required. • No specialized drilling equipment required. • Materials, equipment, and labor resources used for installation of recovery, injection and monitoring wells are readily available. • Materials, equipment, and labor resources used for installation of recovery well piping and tray air stripper are readily available. • Tray air strippers are available from a number of vendors.
	Implementability Rating:	❹

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Table E.10G Cost Evaluation Summary – Alternative G2

Evaluation Factors for Costs	Approximate Cost (Dollars)
Total Capital Costs	$4,715,000
Total Annual O&M Costs	$30,052,000
Total Periodic Cost	$4,539,000
Total Present Value Cost	$11,485,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 100). Costs are rounded to the nearest $1,000.

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Alternative G3
Groundwater Recovery, Treatment and Discharge at Mid-plume and Leading Edge of Plume

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Table E.11A Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative G3

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long- term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	• This alternative involves installing recovery wells in mid-plume areas of high concentration and along the leading edge of the groundwater plume. A treatment unit would be constructed, and an aquifer injection well for discharge would be installed. This would provide mid-plume treatment, along with hydraulic control and capture at the leading edge of the contamination plume. Extracted groundwater would undergo treatment prior to reinjection. • Ongoing implementation, enforcement, and monitoring of the existing ICs limiting private well installations for potable water would provide some protection of human health by reducing exposure to contaminated groundwater. • Monitoring would be performed ensure containment and assess achievement of cleanup levels. • Long-term risk is eliminated after cleanup levels are achieved. • The OU 2 GET system would contain groundwater at the leading edge of the plume and prevent continued downgradient migration. Mid-plume system would accelerate aquifer restoration.
Overall Protection of Human Health and the Environment Rating:	**+**

Table E.11B Evaluation Summary for Compliance with ARARs – Alternative G3

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with Chemical-Specific ARARs	• This alternative would be compliant with federal SDWA and state Title 118 chemical-specific ARARs at the conclusion of the remedial action.
Compliance with Location-Specific ARARs	• No location-specific ARARs.
Compliance with Action-Specific ARARs	• The OU2 GET system would contain and treat contaminated groundwater via air stripping. It is anticipated that it would be compliant with state and federal emission requirements. • The GET system would reinject treated effluent into the aquifer. It is anticipated that it would be compliant with the requirements of the state's Title 122 UIC program.
Compliance with ARARs Rating:	**+**

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Table E.11C Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative G3

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	• The GET system would remove contaminants from mid-plume and the leading edge of the plume area. Hydraulic control of the plume would prevent further migration. Residual contamination may exist outside recovery wells, outside the radius of influence or in different aquifer zones. • Electrical and mechanical components (e.g., well pumps, transfer pumps, valves, etc.) may require periodic replacement. Components of the treatment system should be easy to repair or replace. • Routine groundwater monitoring would be conducted so long as groundwater contamination exists. Routine monitoring would also assist in determining the effectiveness of the remedy. • At the conclusion of the remedial action, groundwater would achieve cleanup levels. • Controls will not be necessary because any untreated residual contamination would not cause contamination above the PCLs.
Long-Term Effectiveness and Permanence Rating:	❹

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Table E.11D Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative G3

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment process, the alternative uses, and materials they will treat	• This alternative provides treatment of contaminants by removing contaminants through treatment of extracted groundwater by air stripping, which is a proven and reliable transfer technology and satisfies the regulatory preference for treatment. • An estimate of contaminant mass that will be treated is not available, but Alternative G2, G3, and G4 would destroy approximately the same quantity.. • Contaminated groundwater would be hydraulically contained and prevented from migrating downgradient of the GET system at the leading edge of the OU2 plume. • Levels of contaminants in extracted groundwater would be reduced to below clean up goals prior to discharge. The volume of groundwater that exceeds MCLs in OU 2 would be eliminated. • Groundwater extraction would address the mobile fraction of contaminants at the mid-plume and leading edge recovery wells, and would rely on natural attenuation processes to reduce concentrations elsewhere. • Any remaining adsorbed residual contamination in the aquifer would not impact groundwater above MCLs. • This alternative provides a treatment component through a tray air stripper at the treatment system. Treatment would only be applied to groundwater extracted through recovery wells.
The amount of contaminant destroyed or treated	
The degree of expected reduction in toxicity, mobility, or volume of contamination due to treatment	
The type and quantity of materials that will remain following treatment	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	
Irreversible treatment	• Contaminants would be irreversibly treated.
Reduction of Toxicity, Mobility, or Volume through Treatment:	❹

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Table E.11E Short-Term Effectiveness Evaluation Summary – Alternative G3

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	• Installation of recovery, reinjection and monitoring wells would be performed by a licensed contractor who would collect, manifest, and dispose of drill cuttings in proper disposal areas. • The treatment system would pose short-term risks to the community during construction. Safety measures such as establishment of work zones (such as exclusion zones) would be implemented during construction to reduce short-term exposure risks to the community. A licensed contractor would be utilized to construct the unit. • All workers would be OSHA trained and would be required to wear appropriate personal protective equipment during implementation.
Potential impacts to workers during implementation and the reliability of protective measures taken to minimize these impacts	• Some risk to workers during construction of monitoring, extraction, and injection wells, buried piping, and the treatment building. • Other potential impacts could be from safety hazards such as trips, falls, electrical and mechanical hazards and hazards associated with working in proximity to an active grain storage facility. These potential impacts would be mitigated through adherence to safety requirements and standard operating procedures. • Safety measures such as dust suppression, use of PPE, and establishment of work zones would be implemented during construction to reduce short-term exposure risks to the workers. • All workers would be OSHA trained and would be required to wear appropriate personal protective equipment during implementation.
Potential adverse environmental impacts resulting from implementation of an alternative and the reliability of the available mitigation measure during implementation	• No adverse impacts to the environment are expected from the construction of the treatment unit and installation of extraction, monitoring and injection wells. • Any adverse environmental impacts resulting from drilling would be mitigated through safe work practices and proper handling and disposal of drill cuttings. • Emissions from air stripper would be anticipated to be below state regulatory requirements.
Time until RAOs are achieved	• RAOs are estimated to be achieved in 75 years.
Short-Term Effectiveness Rating:	❹

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Table E.11F Implementability Evaluation Summary – Alternative G3

Evaluation Factors for Implementability		Evaluation Summary
Technical Feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	• Implementation of this alternative involves installation of recovery, injection, and monitoring wells; and construction of pipelines, treatment building, and a treatment system using standard equipment and installation and construction techniques. Has twice the number of wells and 1.5 time the length of pipe relative to Alternative G2. • Pump and treat is a straightforward operation that is a presumptive remedy. • Groundwater would be extracted and reinjected to maintain hydraulic control of the groundwater plume. • Inspection, maintenance, and replacement of engineered controls are easily implemented.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	• Operation of the GET system is easily implemented, although the system should be monitored closely to prevent system malfunctions and mechanical problems.
Administrative Feasibility	Coordination issues with other offices and agencies during construction or operations of the remedy	• Implementation would require locating the wells, pipelines, and treatment system in existing right-of-way or easement agreements with property owners. Requires twice the number of easement agreements relative to Alternative G2.
	The ability and time required to obtain necessary approvals and permits from other agencies for off-site actions or discharge scenarios	• No off-site actions or discharge scenarios are anticipated.
Availability of Goods and Services	Availability of adequate off-site treatment, storage capacity, and disposal capacity and services	• This alternative requires no off-site treatment, storage, or services.
	Availability of necessary equipment and specialists required to completed construction of remedy components	• Recovery, reinjection and monitoring well installation would be performed by a licensed drilling contractor. No specialized drilling equipment would be required. • The treatment system building could easily be constructed a licensed contractor. • Materials, equipment, and labor resources used for installation of recovery, injection and monitoring wells are readily available. • Air strippers are available from a number of vendors.
	Availability of services and materials plus the potential for obtaining competitive bids	
	Availability of prospective technologies	
Implementability Rating:		❸

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Table E.11G Cost Evaluation Summary – Alternative G3

Evaluation Factors for Costs	Approximate Cost (Dollars)
Total Capital Costs	$7,199,000
Total Annual O&M Costs	$29,552,000
Total Periodic Cost	$3,541,000
Total Present Value Cost	$15,550,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 75). Costs are rounded to the nearest $1,000.

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Alternative G4
In Situ Treatment at Core of Plume and Groundwater Recovery, Treatment, and Discharge at Leading Edge of Plume

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Table E.12A Evaluation Summary for Overall Protection of Human Health and the Environment – Alternative G4

Evaluation Factors for Overall Protection of Human Health and the Environment	Evaluation Summary
Adequate protection of human health and the environment (short- and long- term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site	• This alternative involves installation of recovery wells to capture the groundwater contamination and in situ treatment methods such as chemical oxidation, chemical reduction, or enhanced bioremediation in the core of the contaminant plume. Extracted water would be pumped to a newly constructed treatment system and treated water would be reinjected into the deep aquifer. • Ongoing implementation, enforcement, and monitoring of the existing ICs limiting private well installations for potable water would provide some protection of human health by reducing exposure to contaminated groundwater. • Monitoring would ensure containment and be used to assess achievement of cleanup levels. • Long-term risk is eliminated after cleanup levels are achieved. • GET system would contain groundwater at the leading edge of the OU2 plume and prevent aquifer degradation in downgradient areas. • Chemical amendments would be used within areas of high concentration to accelerate aquifer restoration.
Overall Protection of Human Health and the Environment Rating:	**+**

Table E.12B Evaluation Summary for Compliance with ARARs – Alternative G4

Evaluation Factors for Compliance with ARARs	Evaluation Summary
Compliance with Chemical-Specific ARARs	• This alternative would be compliant with federal SDWA and state NDEQ Title 118 chemical-specific ARARs at the conclusion of the remedial action.
Compliance with Location-Specific ARARs	• No location-specific ARARs.
Compliance with Action-Specific ARARs	• The OU2 GET system would contain and treat contaminated groundwater via air stripping. It is anticipated that it would be compliant with state and federal emission requirements. • The GET system would reinject treated effluent into the aquifer. It is anticipated that it would be compliant with the requirements of the state's Title 122 UIC program. • Injection of groundwater amendments would meet the requirements of the state's UIC program.
Compliance with ARARs Rating:	**+**

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Table E.12C Evaluation Summary for Long-Term Effectiveness and Permanence – Alternative G4

Evaluation Factors for Long-Term Effectiveness and Permanence	Evaluation Summary
Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities	• Recovery wells would be placed to prevent further plume migration. Injection wells would be placed to target the core of the contaminant plume. • This alternative would decrease concentrations of contaminants to below cleanup goals at the conclusion of the remedial action. Controls would not be necessary to manage, because untreated residuals, if any, would not cause contamination above groundwater cleanup levels. • Electrical and mechanical components (e.g., well pumps, transfer pumps, valves, etc.) may require periodic replacement. Components of the treatment systems would be easy to repair or replace. • Routine groundwater monitoring would be required as long as groundwater contamination exists. Routine monitoring would also assist in determining the effectiveness of the remedy.
Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the Site	
Long-Term Effectiveness and Permanence Rating:	❹

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Table E.12D Evaluation Summary for Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative G4

Evaluation Factors for Reduction of Toxicity, Mobility, or Volume through Treatment	Evaluation Summary
The treatment process, the alternative uses, and materials they will treat	• This alternative provides treatment of contaminants by destroying contaminants through in situ treatment and removing contaminants from contaminated groundwater through air stripping of extracted groundwater not addressed by insitu treatment. • Air stripping has been proven as a highly effective method for removal of contaminants from groundwater at OU1. • In situ treatment would result in complete degradation/ destruction of contaminants in those areas where contaminated groundwater comes in contact with the chemical oxidants/reducing agents/active bioremediation zone. An estimate of the contaminated mass is not available, but Alternative G2, G3, and G4 would destroy approximately the same quantity. • The OU2 GET system at the leading edge of the plume would hydraulically contain and prevent contaminated groundwater from migrating downgradient of capture zone of extraction wells at the leading edge of the OU2 plume.. The volume of groundwater that exceeds the MCLs would be eliminated. • Any remaining adsorbed residual contamination in the aquifer would not impact groundwater above MCLs. • This alternative would satisfy the statutory preference for treatment as principal element of the remedial action.
The amount of contaminant destroyed or treated	
The degree of expected reduction in toxicity, mobility, or volume of contamination due to treatment	
The type and quantity of materials that will remain following treatment	
Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action	
Irreversible treatment	• Contaminants are irreversibly treated.
Reduction of Toxicity, Mobility, or Volume through Treatment:	❹

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Table E.12E Short-Term Effectiveness Evaluation Summary – Alternative G4

Evaluation Factors for Short-Term Effectiveness	Evaluation Summary
Short-term risks that might be posed to the community during implementation of an alternative	• The treatment system would pose short-term risks to the community during construction. Safety measures such as establishment of work zones (such as exclusion zones) would be implemented during construction to reduce short-term exposure risks to the community. A licensed contractor would be utilized to construct the unit. • DPT and installation of additional monitoring wells (as needed) would be performed by licensed contractors who would collect, manifest, and dispose of drill cuttings at proper disposal facilities. • Emissions from the air stripper would be below state regulatory requirements. • Injection of amendments would be conducted by experienced contractors. • All workers would be OSHA trained and would be required to wear appropriate personal protective equipment while drilling wells and performing injections. •
Potential impacts to workers during implementation and the reliability of protective measures taken to minimize these impacts	• Some risk to workers due to DPT and well construction, injections, piping installation, and treatment building construction. Chemical oxidants are highly corrosive/reactive and pose significant potential hazards such as burns and potential explosion hazards. • All workers would be OSHA trained and would be required to wear appropriate personal protective equipment while drilling wells and performing injections. • Other potential impacts could be from safety hazards such as trips, falls, electrical and mechanical hazards and hazards associated with working in proximity to an active grain storage facility. These potential impacts would be mitigated through adherence to safety requirements and standard operating procedures. • Safety measures such as dust suppression, use of PPE, and establishment of work zones would be implemented during construction to reduce short-term exposure risks to the workers.
Potential adverse environmental impacts resulting from implementation of an alternative and the reliability of the available mitigation measure during implementation	• No adverse impacts to the environment are expected from the installation of monitoring wells. • Any adverse environmental impacts resulting from drilling monitoring wells would be mitigated through safe work practices and proper handling and disposal of drill cuttings. • A potential adverse environmental impact would result from a spill of chemicals. Potential adverse impacts would be mitigated through safe work practices and using materials compatible with injection work and the materials being injected. • Emissions from the air stripper would be below state and local regulatory requirements.
Time until RAOs are achieved	• RAOs are estimated to be achieved in 75 years.
Short-Term Effectiveness Rating:	❸

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Table E.12F Implementability Evaluation Summary – Alternative G4

Evaluation Factors for Implementability		Evaluation Summary
Technical Feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	• Bench- and pilot-scale studies would be conducted to optimize full scale implementation of in situ technologies. • Implementation of this alternative involves installation of recovery, injection, and monitoring wells and treatment system using standard equipment and installation techniques. • Pump and treat is a straightforward operation and is a presumptive remedy. • Injections would be conducted working outside-in, downgradient to upgradient to reduce the likelihood of mobilizing contaminants into uncontaminated areas. Injections would be at approximately 78 permanent monitoring wells. • Inspection, maintenance and replacement of engineered controls are easily implemented.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	• Multiple injections would likely be necessary to achieve clean up goals. • Operation of the GET system is easily implemented.
Administrative Feasibility	Coordination issues with other offices and agencies during construction or operations of the remedy	• In situ injections would require meeting the requirements of the state's UIC program. • Implementation would require locating the wells, pipelines, and treatment system in existing right-of-way or easement agreements with property owners. Relative to Alternative G2, a greater number of easement agreements will be required, which may be difficult in the agricultural setting.
	The ability and time required to obtain necessary approvals and permits from other agencies for off-site actions or discharge scenarios	• No off-site actions or discharge scenarios are anticipated.
Availability of Goods and Services	Availability of adequate off-site treatment, storage capacity, and disposal capacity and services	• This alternative requires no off-site treatment, storage or services.
	Availability of necessary equipment and specialists required to completed construction of remedy components	• The treatment system building could easily be constructed by a licensed contractor • Materials, equipment, and labor resources used for all construction are readily available. • Air strippers are available from a number of vendors. • Recovery, reinjection, injection and monitoring well installation would be performed by a licensed drilling contractor. No specialized drilling equipment would be required. • There are numerous contractors that have the capability to perform injections into the subsurface through fixed injection wells. • There are numerous in situ treatment chemicals available to treat contaminants.
	Availability of services and materials plus the potential for obtaining competitive bids	
	Availability of prospective technologies	
Implementability Rating:		❷

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Table E.12G Cost Evaluation Summary – Alternative G4

Evaluation Factors for Costs	Approximate Cost (Dollars)
Total Capital Costs	$7,525,000
Total Annual O&M Costs	$27,607,000
Total Periodic Cost	$27,063,000
Total Present Value Cost	$36,651,000

Note: Total costs are for the assumed period of evaluation (Years 0 through 75). Costs are rounded to the nearest $1,000.

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APPENDIX F

DETAILED REMEDIAL ALTERNATIVE ANALYSIS COST INFORMATION

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The cost spreadsheets included in this appendix were developed in accordance with EPA 540-R-00-002 (OSWER 9355.0-75) July 2000.

These costs should be used to compare alternative relative costs. Costs for project management, remedial design, and construction management were determined as percentages of capital cost per the guidance. Costs for these work items may not reflect costs for implementation; these costs are determined based on specific client requirements during implementation.

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Alternative Cost Estimate and Present Value Summary

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COST SUMMARY INDEX

Sheet Name	Subtitle Name	Description
CS-S	Alternative Cost Summary	Summary of Alternative Costs for Contaminated Soil (Source Area) - OU 1
CS-S1	Cost Estimate Summary	Alternative S1 - No Action
PV-S1	Present Value Analysis	Alternative S1 - No Action
CS-S2	Cost Estimate Summary	Alternative S2 - Excavation, Treatment, and Disposal of Soil Contamination
PV-S2	Present Value Analysis	Alternative S2 - Excavation, Treatment, and Disposal of Soil Contamination
CS-S3	Cost Estimate Summary	Alternative S3 - Expand SVE System
PV-S3	Present Value Analysis	Alternative S3 - Expand SVE System
CS-S4	Cost Estimate Summary	Alternative S4 - Expand SVE System and Excavation, Treatment, and Disposal of Soil Contamination
PV-S4	Present Value Analysis	Alternative S4 - Expand SVE System and Excavation, Treatment, and Disposal of Soil Contamination
CS-SG	Alternative Cost Summary	Summary of Alternative Costs for Contaminated Groundwater (Source Area) - OU 1
CS-SG1	Cost Estimate Summary	AlternativeSG1 - No Action
PV-SG1	Present Value Analysis	Alternative SG1 - No Action
CS-SG2	Cost Estimate Summary	Alternative SG2 - Maintain and Operate Existing GET System
PV-SG2	Present Value Analysis	Alternative SG2 - Maintain and Operate Existing GET System
CS-SG3	Cost Estimate Summary	Alternative SG3 - In Situ Treatment via Groundwater Amendments
PV-SG3	Present Value Analysis	Alternative SG3 - In Situ Treatment via Groundwater Amendments
CS-SG4	Cost Estimate Summary	Alternative SG4 - Maintain and Operate Existing GET System and Situ Treatment via Groundwater Amendments
PV-SG4	Present Value Analysis	Alternative SG4 - Maintain and Operate Existing GET System and Situ Treatment via Groundwater Amendments
CS-G	Alternative Cost Summary	Summary of Alternative Costs for Contaminated Groundwater (Sitewide) - OU 2
CS-G1	Cost Estimate Summary	Alternative G1 - No Action
PV-G1	Present Value Analysis	Alternative G1 - No Action
CS-G2	Cost Estimate Summary	Alternative G2 - Groundwater Recovery, Treatment, and Discharge (Leading Edge)
PV-G2	Present Value Analysis	Alternative G2 - Groundwater Recovery, Treatment, and Discharge (Leading Edge)
CS-G3	Cost Estimate Summary	Alternative G3 - Groundwater Recovery, Treatment, and Discharge (Mid-Plume)
PV-G3	Present Value Analysis	Alternative G3 - Groundwater Recovery, Treatment, and Discharge (Mid-Plume)
CS-G4	Cost Estimate Summary	Alternative G4 - In Situ Treatment (Mid) and Groundwater Treatment and Discharge (Leading)
PV-G4	Present Value Analysis	Alternative G4 - In Situ Treatment (Mid) and Groundwater Treatment and Discharge (Leading)
PV-ADRFT	Annual Discount Rate Factors	Summary of Annual Discount Rate Factors Table
PV-OMB	OMB Nominal Interest Rates	Summary of OMB Nominal Interest Rates for Discount Rate Factor Determination

TABLE CS-S

ALTERNATIVE COST SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Alternative	Total Capital Cost	Total Annual Cost	Total Periodic Cost	Present Value Cost
S1	$53,000	$156,000	$372,000	$298,000
S2	$345,000	$498,000	$372,000	$929,000
S3	$336,000	$946,000	$186,000	$1,168,000
S4	$407,000	$516,000	$62,000	$883,000

Notes:

1 - Capital costs, annual costs, and periodic costs are presented on tables CS-S1 through CS-S4
2 - Estimated remedial timeframes and associated present value analysis for each remedial alternative are provided on tables PV-S1 through PV-S4.
3 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for feasibility study level evaluation purposes.

TABLE CS-S1

ALTERNATIVE S1
NO ACTION

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative S1 is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared. The No Action alternative would include discontinuing operation of the SVE system at the Site. The only actions that would be implemented for Alternative S1 are completion of five year site reviews as required by the NCP and periodic monitoring. There would be no change in the soil contaminant concentrations because no treatment, containment, or removal of contaminated soil is included in this alternative.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Institutional Controls	1	LS	$30,400	$30,400	
			SUBTOTAL	$30,400	
Contingency (Scope and Bid)	20%			$6,080	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$36,480	
Project Management	10%			$3,648	Percentage from Exhibit 5-8 was used.
Remedial Design	20%			$7,296	Percentage from Exhibit 5-8 was used.
Construction Management	15%			$5,472	Percentage from Exhibit 5-8 was used.
			TOTAL	$52,896	
			TOTAL CAPITAL COST	**$53,000**	Total capital cost is rounded to the nearest $1,000.

MONITORING COSTS: (Years 5, 10, 15, 20, 25, and 30)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Vapor Monitoring Sampling Event and Report Preparation	1	EA	$17,223	$17,223	
			SUBTOTAL	$17,223	
Contingency (Scope and Bid)	20%			$3,445	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$20,668	
Project Management	10%			$2,067	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$3,100	Middle value of the recommended range was used.
			TOTAL	$25,835	
			TOTAL ANNUAL MONITORING COST (Year 11 through 30)	**$26,000**	Total annual monitoring cost is rounded to the nearest $1,000.

TABLE CS-S1

ALTERNATIVE S1
NO ACTION

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative S1 is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared. The No Action alternative would include discontinuing operation of the SVE system at the Site. The only actions that would be implemented for Alternative S1 are completion of five year site reviews as required by the NCP and periodic monitoring. There would be no change in the soil contaminant concentrations because no treatment, containment, or removal of contaminated soil is included in this alternative.

FIVE-YEAR SITE REVIEW PERIODIC COSTS: (Years 5, 10, 15, 20, 25, and 30)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Five-Year Site Review	1	EA	$46,722	$46,722	
			SUBTOTAL	$46,722	
Contingency (Scope and Bid)	20%			$9,344	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$56,066	
Project Management	10%			$5,607	The high end of the recommended range was used.
			TOTAL	$61,673	
	TOTAL FIVE-YEAR SITE REVIEW PERIODIC COST			**$62,000**	Periodic cost is rounded to the nearest $1,000.

Notes:
Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000. Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

Abbreviations:

EA	Each
QTY	Quantity
LS	Lump sum

TABLE PV-S1

ALTERNATIVE S1
NO ACTION

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS			
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
0	$53,000	$0	$0	$0	$53,000	1.0000	$53,000
1	$0	$0	$0	$0	$0	0.9524	$0
2	$0	$0	$0	$0	$0	0.9070	$0
3	$0	$0	$0	$0	$0	0.8638	$0
4	$0	$0	$0	$0	$0	0.8227	$0
5	$0	$0	$26,000	$62,000	$88,000	0.7835	$68,948
6	$0	$0	$0	$0	$0	0.7462	$0
7	$0	$0	$0	$0	$0	0.7107	$0
8	$0	$0	$0	$0	$0	0.6768	$0
9	$0	$0	$0	$0	$0	0.6446	$0
10	$0	$0	$26,000	$62,000	$88,000	0.6139	$54,023
11	$0	$0	$0	$0	$0	0.5847	$0
12	$0	$0	$0	$0	$0	0.5568	$0
13	$0	$0	$0	$0	$0	0.5303	$0
14	$0	$0	$0	$0	$0	0.5051	$0
15	$0	$0	$26,000	$62,000	$88,000	0.4810	$42,328
16	$0	$0	$0	$0	$0	0.4581	$0
17	$0	$0	$0	$0	$0	0.4363	$0
18	$0	$0	$0	$0	$0	0.4155	$0
19	$0	$0	$0	$0	$0	0.3957	$0
20	$0	$0	$0	$26,000	$62,000	$88,000	0.3769	$33,167

TABLE PV-S1

ALTERNATIVE S1
NO ACTION

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

Year[1]	Capital Costs[2]	ANNUAL COSTS		PERIODIC COSTS	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
		O&M Costs	Monitoring Costs	Five-year Review Costs			
21	$0	$0	$0	$0	$0	0.3589	$0
22	$0	$0	$0	$0	$0	0.3418	$0
23	$0	$0	$0	$0	$0	0.3256	$0
24	$0	$0	$0	$0	$0	0.3101	$0
25	$0	$0	$26,000	$62,000	$88,000	0.2953	$25,986
26	$0	$0	$0	$0	$0	0.2812	$0
27	$0	$0	$0	$0	$0	0.2678	$0
28	$0	$0	$0	$0	$0	0.2551	$0
29	$0	$0	$0	$0	$0	0.2429	$0
30	$0	$0	$26,000	$62,000	$88,000	0.2314	$20,363
TOTALS:	**$53,000**	**$0**	**$156,000**	**$372,000**	**$581,000**		$297,815
TOTAL PRESENT VALUE OF ALTERNATIVE S1							**$298,000**

Notes:

1 - Duration is estimated for present value analysis. Estimated remedial timeframes are discussed within the FS report.

2 - Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-S1.

3 - Total annual expenditure is the total cost per year with no discounting.

4 - Present value is the total cost per year including a discount factor for that year. See Table PV-ADRFT for details.

5 - Total present value is rounded to the nearest $1,000. Depreciation is excluded from the present value cost.

6 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

TABLE CS-S2

ALTERNATIVE S2
EXCAVATION, TREATMENT, AND DISPOSAL OF SOIL CONTAMINATION

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative S2 protects the environment through removal, onsite treatment and onsite disposal of residual contaminated soil from the source area and continued operation of the existing SVE system. Soil with contaminant concentrations exceeding cleanup goals would be excavated and treated onsite. After soil contamination is reduced below remedial goal concentrations, the treated soil would be placed into the onsite borrow pit, compacted, and seeded. The existing SVE system would continue to be utilized, with no expansion or upgrades performed.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Mobilization and Demobilization	1	EA	$5,428	$5,428	
Institutional Controls	1	LS	$30,400	$26,385	
Earthwork					
Excavation of Contaminated Soils	297	BCY	$20	$5,884	
Treatment of Contaminated Soils	357	LCY	$72	$25,566	
Disposal of Treated Soils at Borrow Area	357	LCY	$4	$1,154	
Restoration of Excavated Areas	400	SF	$14	$5,557	
Confirmation Sampling	1	LS	$3,849	$3,849	
Miscellaneous Requirements for Sampling	1	LS	$53,300	$53,300	
			SUBTOTAL	$127,123	
Contingency (Scope and Bid)	20%			$25,425	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$152,548	
Project Management	8%			$12,204	Percentage from Exhibit 5-8 was used.
Remedial Design	15%			$22,882	Percentage from Exhibit 5-8 was used.
Construction Management	10%			$15,255	Percentage from Exhibit 5-8 was used.
			TOTAL	$202,889	
			TOTAL CAPITAL COST	**$203,000**	Total capital cost is rounded to the nearest $1,000.

FUTURE CAPITAL COSTS: (Assumed to be Incurred During Year 5)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
SVE Well Abandonment	11	EA	$2,856	$31,410	
Decommissioning Treatment System	1	LS	$50,000	$50,000	
			SUBTOTAL	$81,410	
Contingency (Scope and Bid)	20%			$16,282	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$97,692	
Project Management	10%			$9,769	Percentage from Exhibit 5-8 was used.
Remedial Design	20%			$19,538	Percentage from Exhibit 5-8 was used.
Construction Management	15%			$14,654	Percentage from Exhibit 5-8 was used.
			TOTAL	$141,653	
			TOTAL FUTURE CAPITAL COST	**$142,000**	Total future capital cost is rounded to the nearest $1,000.

TABLE CS-S2

ALTERNATIVE S2

EXCAVATION, TREATMENT, AND DISPOSAL OF SOIL CONTAMINATION

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative S2 protects the environment through removal, onsite treatment and onsite disposal of residual contaminated soil from the source area and continued operation of the existing SVE system. Soil with contaminant concentrations exceeding cleanup goals would be excavated and treated onsite. After soil contamination is reduced below remedial goal concentrations, the treated soil would be placed into the onsite borrow pit, compacted, and seeded. The existing SVE system would continue to be utilized, with no expansion or upgrades performed.

ANNUAL SVE O&M ANNUAL COSTS: (Assumed to be Incurred During Year 0 through 5)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
O&M of SVE Treatment System	1	EA	$40,141	$37,812	
			SUBTOTAL	$37,812	
Contingency (Scope and Bid)	20%			$7,562	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$45,374	
Project Management	10%			$4,537	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$6,806	Middle value of the recommended range was used.
			TOTAL	$56,717	
		TOTAL ANNUAL O&M COST		**$57,000**	Total annual O&M cost is rounded to the nearest $1,000.

ANNUAL MONITORING COSTS: (Assumed to be Incurred During Year 0 through 5)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Vapor Monitoring Sampling Event and Report Preparation	1	EA	$17,223	$17,223	
			SUBTOTAL	$17,223	
Contingency (Scope and Bid)	20%			$3,445	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$20,668	
Project Management	10%			$2,067	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$3,100	Middle value of the recommended range was used.
			TOTAL	$25,835	
		TOTAL ANNUAL MONITORING COST		**$26,000**	Total annual monitoring cost is rounded to the nearest $1,000.

TABLE CS-S2

ALTERNATIVE S2

EXCAVATION, TREATMENT, AND DISPOSAL OF SOIL CONTAMINATION

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative S2 protects the environment through removal, onsite treatment and onsite disposal of residual contaminated soil from the source area and continued operation of the existing SVE system. Soil with contaminant concentrations exceeding cleanup goals would be excavated and treated onsite. After soil contamination is reduced below remedial goal concentrations, the treated soil would be placed into the onsite borrow pit, compacted, and seeded. The existing SVE system would continue to be utilized, with no expansion or upgrades performed.

FIVE-YEAR SITE REVIEW PERIODIC COSTS: (Years 5, 10, 15, 20, 25, 30)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Five-Year Site Review	1	EA	$46,722	$46,722	
			SUBTOTAL	$46,722	
Contingency (Scope and Bid)	20%			$9,344	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$56,066	
Project Management	10%			$5,607	The high end of the recommended range was used.
			TOTAL	$61,673	
			TOTAL FIVE-YEAR SITE REVIEW PERIODIC COST	**$62,000**	Periodic cost is rounded to the nearest $1,000.

Notes:

Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000. Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

Abbreviations:

BCY	Bank cubic yards
EA	Each
LCY	Loose cubic yards
LS	Lump sum
QTY	Quantity
SF	Sqaure feet

TABLE PV-S2

ALTERNATIVE S2
EXCAVATION, TREATMENT, AND DISPOSAL OF SOIL CONTAMINATION

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS				
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Well Maintenance	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
0	$203,000	$57,000	$26,000	$0	$0	$286,000	1.0000	$286,000
1	$0	$57,000	$26,000	$0	$0	$83,000	0.9524	$79,049
2	$0	$57,000	$26,000	$0	$0	$83,000	0.9070	$75,281
3	$0	$57,000	$26,000	$0	$0	$83,000	0.8638	$71,695
4	$0	$57,000	$26,000	$0	$0	$83,000	0.8227	$68,284
5	$142,000	$57,000	$26,000	$0	$62,000	$287,000	0.7835	$224,865
6	$0	$0	$0	$0	$0	$0	0.7462	$0
7	$0	$0	$0	$0	$0	$0	0.7107	$0
8	$0	$0	$0	$0	$0	$0	0.6768	$0
9	$0	$0	$0	$0	$0	$0	0.6446	$0
10	$0	$0	$0	$0	$62,000	$62,000	0.6139	$38,062
11	$0	$0	$0	$0	$0	$0	0.5847	$0
12	$0	$0	$0	$0	$0	$0	0.5568	$0
13	$0	$0	$0	$0	$0	$0	0.5303	$0
14	$0	$0	$0	$0	$0	$0	0.5051	$0
15	$0	$0	$0	$0	$62,000	$62,000	0.4810	$29,822
16	$0	$0	$0	$0	$0	$0	0.4581	$0
17	$0	$0	$0	$0	$0	$0	0.4363	$0
18	$0	$0	$0	$0	$0	$0	0.4155	$0
19	$0	$0	$0	$0	$0	$0	0.3957	$0
20	$0	$0	$0	$0	$62,000	$62,000	0.3769	$23,368
21	$0	$0	$0	$0	$0	$0	0.3589	$0
22	$0	$0	$0	$0	$0	$0	0.3418	$0
23	$0	$0	$0	$0	$0	$0	0.3256	$0
24	$0	$0	$0	$0	$0	$0	0.3101	$0
25	$0	$0	$0	$0	$62,000	$62,000	0.2953	$18,309
26	$0	$0	$0	$0	$0	$0	0.2812	$0
27	$0	$0	$0	$0	$0	$0	0.2678	$0
28	$0	$0	$0	$0	$0	$0	0.2551	$0
29	$0	$0	$0	$0	$0	$0	0.2429	$0
30	$0	$0	$0	$0	$62,000	$62,000	0.2314	$14,347
TOTALS:	**$345,000**	**$342,000**	**$156,000**	**$0**	**$372,000**	**$1,215,000**		$929,082
TOTAL PRESENT VALUE OF ALTERNATIVE S2								**$929,000**

TABLE PV-S2

ALTERNATIVE S2
EXCAVATION, TREATMENT, AND DISPOSAL OF SOIL CONTAMINATION

PRESENT VALUE ANALYSIS

Site:	Garvey Elevator Site
Operable Unit:	OU1
Location:	Hastings, Nebraska
Phase:	Feasibility Study
Base Year:	2012

Discount Rate: 5.00%

Year[1]	Capital Costs[2]	ANNUAL COSTS		PERIODIC COSTS		Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
		O&M Costs	Monitoring Costs	Well Maintenance	Five-year Review Costs			

Notes:

1 - Duration is estimated for present value analysis. Estimated remedial timeframes are discussed within the FS report.

2 - Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-S2.

3 - Total annual expenditure is the total cost per year with no discounting.

4 - Present value is the total cost per year including a discount factor for that year. See Table PV-ADRFT for details.

5 - Total present value is rounded to the nearest $1,000. Depreciation is excluded from the present value cost.

6 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

TABLE CS-S3

ALTERNATIVE S3
EXPAND SVE SYSTEM

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative S3 expands the treatment area of the SVE system by installing a shallow (20 to 50 feet bgs screen) and deep (60 to 110 feet bgs screen) SVE well in the source area. The current system at the site does not operate any emissions treatment process; however, a catalytic oxidation unit and scrubber exist and could be re-activated if treatment prior to discharge is needed to comply with state air regulations.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Mobilization and Demobilization	1	EA	$5,428	$5,428	
Institutional Controls	1	LS	$30,400	$26,385	
Miscellaneous Requirements for Sampling	1	LS	$53,300	$53,300	
SVE Well Installation	2	EA	$17,121	$34,241	Includes installation of 1 new well at depth of 50 ft and 1 new well at depth of 110
Pipe Installation	310	LF	$16	$4,732	Piping for connecting 2 new SVE wells to existing treatment system
			SUBTOTAL	$124,086	
Contingency (Scope and Bid)	20%			$24,817	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$148,903	
Project Management	8%			$11,912	Percentage from Exhibit 5-8 was used.
Remedial Design	15%			$22,335	Percentage from Exhibit 5-8 was used.
Construction Management	10%			$14,890	Percentage from Exhibit 5-8 was used.
			TOTAL	$198,040	
			TOTAL CAPITAL COST	**$198,000**	Total capital cost is rounded to the nearest $1,000.

FUTURE CAPITAL COSTS: (Assumed to be Incurred During Year 10)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Soil Vapor Extraction Well Abandonment	13	EA	$2,805	$36,463	Includes abandonment of both existing SVE wells and newly installed wells
Decommissioning Treatment System	1	LS	$50,000	$50,000	
			SUBTOTAL	$86,463	
Contingency (Scope and Bid)	20%			$17,293	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$103,756	
Project Management	8%			$8,300	Percentage from Exhibit 5-8 was used.
Remedial Design	15%			$15,563	Percentage from Exhibit 5-8 was used.
Construction Management	10%			$10,376	Percentage from Exhibit 5-8 was used.
			TOTAL	$137,995	
			TOTAL FUTURE CAPITAL COST	**$138,000**	Total future capital cost is rounded to the nearest $1,000.

TABLE CS-S3

ALTERNATIVE S3
EXPAND SVE SYSTEM

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative S3 expands the treatment area of the SVE system by installing a shallow (20 to 50 feet bgs screen) and deep (60 to 110 feet bgs screen) SVE well in the source area. The current system at the site does not operate any emissions treatment process; however, a catalytic oxidation unit and scrubber exist and could be re-activated if treatment prior to discharge is needed to comply with state air regulations.

SOIL VAPOR EXTRACTION WELL MAINTENANCE PERIODIC COSTS: (Year 5)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Soil Vapor Extraction Well Maintenance	1	EA	$41,438	$41,438	
			SUBTOTAL	$41,438	
Contingency (Scope and Bid)	20%			$8,288	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$49,726	
Project Management	10%			$4,973	The high end of the recommended range was used.
Technical Support	15%			$7,459	Middle value of the recommended range was used.
			TOTAL	$62,158	
		TOTAL WELL MAINTENANCE PERIODIC COST		**$62,000**	Periodic cost is rounded to the nearest $1,000.

ANNUAL SVE O&M ANNUAL COSTS: (Assumed to be Incurred During Year 0 through 10)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
O&M of SVE Treatment System	1	EA	$40,141	$40,141	
			SUBTOTAL	$40,141	
Contingency (Scope and Bid)	20%			$8,028	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$48,169	
Project Management	10%			$4,817	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$7,225	Middle value of the recommended range was used.
			TOTAL	$60,211	
		TOTAL ANNUAL O&M COST		**$60,000**	Total annual O&M cost is rounded to the nearest $1,000.

ANNUAL MONITORING COSTS: (Assumed to be Incurred During Year 0 through 5)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Vapor Monitoring Sampling Event and Report Preparation	1	EA	$17,223	$17,223	
			SUBTOTAL	$17,223	
Contingency (Scope and Bid)	20%			$3,445	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$20,668	
Project Management	10%			$2,067	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$3,100	Middle value of the recommended range was used.
			TOTAL	$25,835	
		TOTAL ANNUAL MONITORING COST		**$26,000**	Total annual monitoring cost is rounded to the nearest $1,000.

TABLE CS-S3

ALTERNATIVE S3
EXPAND SVE SYSTEM

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative S3 expands the treatment area of the SVE system by installing a shallow (20 to 50 feet bgs screen) and deep (60 to 110 feet bgs screen) SVE well in the source area. The current system at the site does not operate any emissions treatment process; however, a catalytic oxidation unit and scrubber exist and could be re-activated if treatment prior to discharge is needed to comply with state air regulations.

FIVE-YEAR SITE REVIEW PERIODIC COSTS: (Years 5 and 10)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Five-Year Site Review	1	EA	$46,722	$46,722	
			SUBTOTAL	$46,722	
Contingency (Scope and Bid)	20%			$9,344	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$56,066	
Project Management	10%			$5,607	The high end of the recommended range was used.
			TOTAL	$61,673	
TOTAL FIVE-YEAR SITE REVIEW PERIODIC COST				**$62,000**	Periodic cost is rounded to the nearest $1,000.

Notes:
Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000. Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

Abbreviations:

EA	Each
LF	Linear feet
LS	Lump sum
QTY	Quantity

TABLE PV-S3

ALTERNATIVE S3
EXPAND SVE SYSTEM

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS				
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Well Maintenance	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
0	$198,000	$60,000	$26,000	$0	$0	$284,000	1.0000	$284,000
1	$0	$60,000	$26,000	$0	$0	$86,000	0.9524	$81,906
2	$0	$60,000	$26,000	$0	$0	$86,000	0.9070	$78,002
3	$0	$60,000	$26,000	$0	$0	$86,000	0.8638	$74,287
4	$0	$60,000	$26,000	$0	$0	$86,000	0.8227	$70,752
5	$0	$60,000	$26,000	$62,000	$62,000	$210,000	0.7835	$164,535
6	$0	$60,000	$26,000	$0	$0	$86,000	0.7462	$64,173
7	$0	$60,000	$26,000	$0	$0	$86,000	0.7107	$61,120
8	$0	$60,000	$26,000	$0	$0	$86,000	0.6768	$58,205
9	$0	$60,000	$26,000	$0	$0	$86,000	0.6446	$55,436
10	$138,000	$60,000	$26,000	$0	$62,000	$286,000	0.6139	$175,575
TOTALS:	**$336,000**	**$660,000**	**$286,000**	**$62,000**	**$124,000**	**$1,468,000**		$1,167,991
TOTAL PRESENT VALUE OF ALTERNATIVE S3								**$1,168,000**

Notes:

1 - Duration is estimated for present value analysis. Estimated remedial timeframes are discussed within the FS report.

2 - Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-S3.

3 - Total annual expenditure is the total cost per year with no discounting.

4 - Present value is the total cost per year including a discount factor for that year. See Table PV-ADRFT for details.

5 - Total present value is rounded to the nearest $1,000. Depreciation is excluded from the present value cost.

6 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

TABLE CS-S4

ALTERNATIVE S4

EXPAND SVE SYSTEM AND EXCAVATION, TREATMENT, AND DISPOSAL OF SOIL CONTAMINATION

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative S4 combines alternatives S2 and S3 to minimize the timeframe that the SVE system would be required to operate. This alternative protects the environment through removal, treatment and onsite disposal of residual contaminated soil from the source area as described in detail in Alternative S2 and continues to remove VOCs from the vadose zone on-site as described in Alternative S3.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Mobilization and Demobilization	1	EA	$5,428	$5,428	
Institutional Controls	1	LS	$30,400	$26,385	
Earthwork					
Excavation of Contaminated Soils	297	BCY	$20	$5,884	
Treatment of Contaminated Soils	357	LCY	$72	$25,566	
Disposal of Treated Soils at Borrow Area	357	LCY	$4	$1,154	
Restoration of Excavated Areas	400	SF	$14	$5,557	
Confirmation Sampling	1	LS	$3,849	$3,849	
Miscellaneous Requirements for Sampling	1	LS	$53,300	$53,300	
SVE Well Installation	2	EA	$17,121	$34,241	Includes installation of 1 new well at depth of 50 ft and 1 new well at depth of 110
Pipe Installation	310	LF	$16	$4,732	Piping for connecting 2 new SVE wells to existing treatment system
			SUBTOTAL	$166,096	
Contingency (Scope and Bid)	20%			$33,219	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$199,315	
Project Management	8%			$15,945	Percentage from Exhibit 5-8 was used.
Remedial Design	15%			$29,897	Percentage from Exhibit 5-8 was used.
Construction Management	10%			$19,932	Percentage from Exhibit 5-8 was used.
			TOTAL	$265,089	
			TOTAL CAPITAL COST	**$265,000**	Total capital cost is rounded to the nearest $1,000.

FUTURE CAPITAL COSTS: (Assumed to be Incurred During Year 5)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
SVE Well Abandonment	11	EA	$2,856	$31,410	
Decommissioning Treatment System	1	LS	$50,000	$50,000	
			SUBTOTAL	$81,410	
Contingency (Scope and Bid)	20%			$16,282	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$97,692	
Project Management	10%			$9,769	Percentage from Exhibit 5-8 was used.
Remedial Design	20%			$19,538	Percentage from Exhibit 5-8 was used.
Construction Management	15%			$14,654	Percentage from Exhibit 5-8 was used.
			TOTAL	$141,653	
			TOTAL FUTURE CAPITAL COST	**$142,000**	Total future capital cost is rounded to the nearest $1,000.

TABLE CS-S4

ALTERNATIVE S4

EXPAND SVE SYSTEM AND EXCAVATION, TREATMENT, AND DISPOSAL OF SOIL CONTAMINATION

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative S4 combines alternatives S2 and S3 to minimize the timeframe that the SVE system would be required to operate. This alternative protects the environment through removal, treatment and onsite disposal of residual contaminated soil from the source area as described in detail in Alternative S2 and continues to remove VOCs from the vadose zone on-site as described in Alternative S3.

ANNUAL SVE O&M ANNUAL COSTS: (Assumed to be Incurred During Year 0 through 5)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
O&M of SVE Treatment System	1	EA	$40,141	$40,141	
			SUBTOTAL	$40,141	
Contingency (Scope and Bid)	20%			$8,028	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$48,169	
Project Management	10%			$4,817	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$7,225	Middle value of the recommended range was used.
			TOTAL	$60,211	
		TOTAL ANNUAL O&M COST		**$60,000**	Total annual O&M cost is rounded to the nearest $1,000.

ANNUAL MONITORING COSTS: (Assumed to be Incurred During Year 0 through 5)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Vapor Monitoring Sampling Event and Report Preparation	1	EA	$17,223	$17,223	
			SUBTOTAL	$17,223	
Contingency (Scope and Bid)	20%			$3,445	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$20,668	
Project Management	10%			$2,067	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$3,100	Middle value of the recommended range was used.
			TOTAL	$25,835	
		TOTAL ANNUAL MONITORING COST		**$26,000**	Total annual monitoring cost is rounded to the nearest $1,000.

TABLE CS-S4

ALTERNATIVE S4

EXPAND SVE SYSTEM AND EXCAVATION, TREATMENT, AND DISPOSAL OF SOIL CONTAMINATION

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative S4 combines alternatives S2 and S3 to minimize the timeframe that the SVE system would be required to operate. This alternative protects the environment through removal, treatment and onsite disposal of residual contaminated soil from the source area as described in detail in Alternative S2 and continues to remove VOCs from the vadose zone on-site as described in Alternative S3.

FIVE-YEAR SITE REVIEW PERIODIC COSTS: (Year 5)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Five-Year Site Review	1	EA	$46,722	$46,722	
			SUBTOTAL	$46,722	
Contingency (Scope and Bid)	20%			$9,344	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$56,066	
Project Management	10%			$5,607	The high end of the recommended range was used.
			TOTAL	$61,673	
	TOTAL FIVE-YEAR SITE REVIEW PERIODIC COST			**$62,000**	Periodic cost is rounded to the nearest $1,000.

Notes:

Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000. Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

Abbreviations:

BCY	Bank cubic yards
EA	Each
LCY	Loose cubic yards
LF	Linear feet
LS	Lump sum
QTY	Quantity
SF	Sqaure feet

TABLE PV-S4

ALTERNATIVE S4

EXPAND SVE SYSTEM AND EXCAVATION, TREATMENT, AND DISPOSAL OF SOIL CONTAMINATION

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS				
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Well Maintenance	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
0	$265,000	$60,000	$26,000	$0	$0	$351,000	1.0000	$351,000
1	$0	$60,000	$26,000	$0	$0	$86,000	0.9524	$81,906
2	$0	$60,000	$26,000	$0	$0	$86,000	0.9070	$78,002
3	$0	$60,000	$26,000	$0	$0	$86,000	0.8638	$74,287
4	$0	$60,000	$26,000	$0	$0	$86,000	0.8227	$70,752
5	$142,000	$60,000	$26,000	$0	$62,000	$290,000	0.7835	$227,215
TOTALS:	**$407,000**	**$360,000**	**$156,000**	**$0**	**$62,000**	**$985,000**		$883,162
TOTAL PRESENT VALUE OF ALTERNATIVE S4								**$883,000**

Notes:

1 - Duration is estimated for present value analysis. Estimated remedial timeframes are discussed within the FS report.

2 - Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-S4.

3 - Total annual expenditure is the total cost per year with no discounting.

4 - Present value is the total cost per year including a discount factor for that year. See Table PV-ADRFT for details.

5 - Total present value is rounded to the nearest $1,000. Depreciation is excluded from the present value cost.

6 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

TABLE CS-SG

ALTERNATIVE COST SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Alternative	Total Capital Cost	Total Annual Cost	Total Periodic Cost	Present Value Cost
SG1	$469,000	$1,128,000	$514,000	$1,061,000
SG2	$480,000	$10,034,000	$967,000	$6,340,000
SG3	$785,000	$3,555,000	$10,037,000	$12,346,000
SG4	$1,145,000	$4,313,000	$5,977,000	$10,143,000

Notes:

1 - Capital costs, annual costs, and periodic costs are presented on tables CS-SG1 through CS-SG4

2 - Estimated remedial timeframes and associated present value analysis for each remedial alternative are provided on tables PV-SG1 through PV-SG4.

3 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for feasibility study level evaluation purposes.

TABLE CS-SG1

ALTERNATIVE SG1
NO ACTION

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative SG1 is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared. The only actions that would be implemented for Alternative SG1 are completion of Five Year Reviews as required by the NCP, periodic groundwater monitoring in support of the five year reviews, and dismantling of the existing GET system and abandonment of recovery wells. There would be no change in the groundwater contaminant concentrations because no treatment, containment, or removal of contaminated groundwater is included in this alternative.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Institutional Controls	1	LS	$30,400	$26,385	
Miscellaneous Requirements for Sampling	1	LS	$53,300	$53,300	
Decommissioning Treatment System	1	LS	$50,000	$50,000	
			SUBTOTAL	$129,685	
Contingency (Scope and Bid)	20%			$25,937	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$155,622	
Project Management	8%			$12,450	Percentage from Exhibit 5-8 was used.
Remedial Design	15%			$23,343	Percentage from Exhibit 5-8 was used.
Construction Management	10%			$15,562	Percentage from Exhibit 5-8 was used.
			TOTAL	$206,977	
			TOTAL CAPITAL COST	**$207,000**	Total capital cost is rounded to the nearest $1,000.

FUTURE CAPITAL COSTS: (Assumed to be Incurred During Year 100)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring Well Abandonment	47	EA	$3,487	$163,873	
			SUBTOTAL	$163,873	
Contingency (Scope and Bid)	20%			$32,775	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$196,648	
Project Management	8%			$15,732	Percentage from Exhibit 5-8 was used.
Remedial Design	15%			$29,497	Percentage from Exhibit 5-8 was used.
Construction Management	10%			$19,665	Percentage from Exhibit 5-8 was used.
			TOTAL	$261,542	
			TOTAL FUTURE CAPITAL COST	**$262,000**	Total future capital cost is rounded to the nearest $1,000.

TABLE CS-SG1

ALTERNATIVE SG1
NO ACTION

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative SG1 is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared. The only actions that would be implemented for Alternative SG1 are completion of Five Year Reviews as required by the NCP, periodic groundwater monitoring in support of the five year reviews, and dismantling of the existing GET system and abandonment of recovery wells. There would be no change in the groundwater contaminant concentrations because no treatment, containment, or removal of contaminated groundwater is included in this alternative.

ANNUAL MONITORING COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Groundwater Sampling Event	1	EA	$37,115	$37,115	
Groundwater Monitoring Event Report Preparation	1	EA	$25,005	$25,005	
			SUBTOTAL	$62,120	
Contingency (Scope and Bid)	20%			$12,424	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$74,544	
Project Management	10%			$7,454	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$11,182	Middle value of the recommended range was used.
			TOTAL	$93,180	
		TOTAL ANNUAL MONITORING COST		**$93,000**	Total annual monitoring cost is rounded to the nearest $1,000.

ANNUAL INSTITUTIONAL CONTROL ANNUAL COSTS: (Assumed to be Incurred During Year 1 through 100)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring and Enforcement of Institutional Controls	1	EA	$12,552	$12,552	
			SUBTOTAL	$12,552	
Contingency (Scope and Bid)	20%			$2,510	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$15,062	
Project Management	10%			$1,506	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$2,259	Middle value of the recommended range was used.
			TOTAL	$18,827	
		TOTAL ANNUAL O&M COST		**$19,000**	Total annual O&M cost is rounded to the nearest $1,000.

MONITORING WELL MAINTENANCE PERIODIC COSTS: (Every 10 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring Well Maintenance	1	EA	$47,070	$47,070	
			SUBTOTAL	$47,070	
Contingency (Scope and Bid)	20%			$9,414	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$56,484	
Project Management	10%			$5,648	The high end of the recommended range was used.
Technical Support	15%			$8,473	Middle value of the recommended range was used.
			TOTAL	$70,605	
		TOTAL MONITORING WELL MAINTENANCE PERIODIC COST		**$71,000**	Periodic cost is rounded to the nearest $1,000.

TABLE CS-SG1

ALTERNATIVE SG1
NO ACTION

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative SG1 is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared. The only actions that would be implemented for Alternative SG1 are completion of Five Year Reviews as required by the NCP, periodic groundwater monitoring in support of the five year reviews, and dismantling of the existing GET system and abandonment of recovery wells. There would be no change in the groundwater contaminant concentrations because no treatment, containment, or removal of contaminated groundwater is included in this alternative.

FIVE-YEAR SITE REVIEW PERIODIC COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Five-Year Site Review	1	EA	$46,722	$46,722	
			SUBTOTAL	$46,722	
Contingency (Scope and Bid)	20%			$9,344	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$56,066	
Project Management	10%			$5,607	The high end of the recommended range was used.
			TOTAL	$61,673	
	TOTAL FIVE-YEAR SITE REVIEW PERIODIC COST			**$62,000**	Periodic cost is rounded to the nearest $1,000.

Notes:
Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000. Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

Abbreviations:

EA	Each
LS	Lump sum
QTY	Quantity

TABLE PV-SG1

ALTERNATIVE SG1
NO ACTION

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS				
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Well Maintenance	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
0	$207,000	$0	$0	$0	$0	$207,000	1.0000	$207,000
1	$0	$19,000	$0	$0	$0	$19,000	0.9524	$18,096
2	$0	$19,000	$0	$0	$0	$19,000	0.9070	$17,233
3	$0	$19,000	$0	$0	$0	$19,000	0.8638	$16,412
4	$0	$19,000	$0	$0	$0	$19,000	0.8227	$15,631
5	$0	$19,000	$93,000	$0	$62,000	$174,000	0.7835	$136,329
6	$0	$19,000	$0	$0	$0	$19,000	0.7462	$14,178
7	$0	$19,000	$0	$0	$0	$19,000	0.7107	$13,503
8	$0	$19,000	$0	$0	$0	$19,000	0.6768	$12,859
9	$0	$19,000	$0	$0	$0	$19,000	0.6446	$12,247
10	$0	$19,000	$93,000	$71,000	$62,000	$245,000	0.6139	$150,406
11	$0	$19,000	$0	$0	$0	$19,000	0.5847	$11,109
12	$0	$19,000	$0	$0	$0	$19,000	0.5568	$10,579
13	$0	$19,000	$0	$0	$0	$19,000	0.5303	$10,076
14	$0	$19,000	$0	$0	$0	$19,000	0.5051	$9,597
15	$0	$19,000	$93,000	$0	$62,000	$174,000	0.4810	$83,694
16	$0	$19,000	$0	$0	$0	$19,000	0.4581	$8,704
17	$0	$19,000	$0	$0	$0	$19,000	0.4363	$8,290
18	$0	$19,000	$0	$0	$0	$19,000	0.4155	$7,895
19	$0	$19,000	$0	$0	$0	$19,000	0.3957	$7,518
20	$0	$19,000	$93,000	$71,000	$62,000	$245,000	0.3769	$92,341
21	$0	$19,000	$0	$0	$0	$19,000	0.3589	$6,819
22	$0	$19,000	$0	$0	$0	$19,000	0.3418	$6,494
23	$0	$19,000	$0	$0	$0	$19,000	0.3256	$6,186
24	$0	$19,000	$0	$0	$0	$19,000	0.3101	$5,892

TABLE PV-SG1

ALTERNATIVE SG1
NO ACTION

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: **5.00%**

Year[1]	Capital Costs[2]	ANNUAL COSTS		PERIODIC COSTS		Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
		O&M Costs	Monitoring Costs	Well Maintenance	Five-year Review Costs			
25	$0	$19,000	$93,000	$0	$62,000	$174,000	0.2953	$51,382
26	$0	$19,000	$0	$0	$0	$19,000	0.2812	$5,343
27	$0	$19,000	$0	$0	$0	$19,000	0.2678	$5,088
28	$0	$19,000	$0	$0	$0	$19,000	0.2551	$4,847
29	$0	$19,000	$0	$0	$0	$19,000	0.2429	$4,615
30	$262,000	$19,000	$93,000	$0	$62,000	$436,000	0.2314	$100,890
TOTALS:	**$469,000**	**$570,000**	**$558,000**	**$142,000**	**$372,000**	**$2,111,000**		$1,061,253
TOTAL PRESENT VALUE OF ALTERNATIVE SG1								**$1,061,000**

Notes:

1 - Duration is estimated for present value analysis. Estimated remedial timeframes are discussed within the FS report.

2 - Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-SG1.

3 - Total annual expenditure is the total cost per year with no discounting.

4 - Present value is the total cost per year including a discount factor for that year. See Table PV-ADRFT for details.

5 - Total present value is rounded to the nearest $1,000. Depreciation is excluded from the present value cost.

6 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

TABLE CS-SG2

ALTERNATIVE SG2
MAINTAIN AND OPERATE EXISTING GET SYSTEM

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Under Alternative SG2, the GET system implemented at the Site under previous interim actions would continue to be maintained and operated as is. The system consists of eight existing recovery wells pumping extracted groundwater to the treatment building where it combines in a single header and flows through bag filters and is treated by an air stripping unit.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Institutional Controls	1	LS	$30,400	$26,385	
Miscellaneous Requirements for Sampling	1	LS	$53,300	$53,300	
			SUBTOTAL	$79,685	
Contingency (Scope and Bid)	20%			$15,937	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$95,622	
Project Management	10%			$9,562	Percentage from Exhibit 5-8 was used.
Remedial Design	20%			$19,124	Percentage from Exhibit 5-8 was used.
Construction Management	15%			$14,343	Percentage from Exhibit 5-8 was used.
			TOTAL	$138,651	
			TOTAL CAPITAL COST	**$139,000**	Total capital cost is rounded to the nearest $1,000.

FUTURE CAPITAL COSTS: (Assumed to be Incurred During Year 30)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Well Abandonment	47	EA	$3,487	$163,873	
Decommissioning Treatment System	1	LS	$50,000	$50,000	
			SUBTOTAL	$213,873	
Contingency (Scope and Bid)	20%			$42,775	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$256,648	
Project Management	8%			$20,532	Percentage from Exhibit 5-8 was used.
Remedial Design	15%			$38,497	Percentage from Exhibit 5-8 was used.
Construction Management	10%			$25,665	Percentage from Exhibit 5-8 was used.
			TOTAL	$341,342	
			TOTAL FUTURE CAPITAL COST	**$341,000**	Total future capital cost is rounded to the nearest $1,000.

TABLE CS-SG2

ALTERNATIVE SG2
MAINTAIN AND OPERATE EXISTING GET SYSTEM

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Under Alternative SG2, the GET system implemented at the Site under previous interim actions would continue to be maintained and operated as is. The system consists of eight existing recovery wells pumping extracted groundwater to the treatment building where it combines in a single header and flows through bag filters and is treated by an air stripping unit.

QUARTERLY MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 1)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Groundwater Sampling Event	4	EA	$37,115	$148,460	
Groundwater Monitoring Event Report Preparation	4	EA	$25,005	$100,020	
			SUBTOTAL	$248,480	
Contingency (Scope and Bid)	20%			$49,696	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$298,176	
Project Management	8%			$23,854	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$44,726	Middle value of the recommended range was used.
			TOTAL	$366,756	
		TOTAL QUARTERLY MONITORING COST		**$367,000**	Total quarterly monitoring cost is rounded to the nearest $1,000.

SEMIANNUAL MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 2 through 5)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Groundwater Sampling Event	2	EA	$37,115	$74,230	
Groundwater Monitoring Event Report Preparation	2	EA	$25,005	$50,010	
			SUBTOTAL	$124,240	
Contingency (Scope and Bid)	20%			$24,848	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$149,088	
Project Management	8%			$11,927	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$22,363	Middle value of the recommended range was used.
			TOTAL	$183,378	
		TOTAL SEMIANNUAL MONITORING COST		**$183,000**	Total semiannual monitoring cost is rounded to the nearest $1,000.

ANNUAL MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 6 through 30)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Groundwater Sampling Event	1	EA	$37,115	$37,115	
Groundwater Monitoring Event Report Preparation	1	EA	$25,005	$25,005	
			SUBTOTAL	$62,120	
Contingency (Scope and Bid)	20%			$12,424	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$74,544	
Project Management	10%			$7,454	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$11,182	Middle value of the recommended range was used.
			TOTAL	$93,180	
		TOTAL ANNUAL MONITORING COST		**$93,000**	Total annual monitoring cost is rounded to the nearest $1,000.

TABLE CS-SG2

ALTERNATIVE SG2
MAINTAIN AND OPERATE EXISTING GET SYSTEM

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Under Alternative SG2, the GET system implemented at the Site under previous interim actions would continue to be maintained and operated as is. The system consists of eight existing recovery wells pumping extracted groundwater to the treatment building where it combines in a single header and flows through bag filters and is treated by an air stripping unit.

ANNUAL GET O&M ANNUAL COSTS: (Assumed to be Incurred During Year 0 through 30)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
O&M of GET Treatment System	1	EA	$124,020	$124,020	
			SUBTOTAL	$124,020	
Contingency (Scope and Bid)	20%			$24,804	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$148,824	
Project Management	8%			$11,906	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$22,324	Middle value of the recommended range was used.
			TOTAL	$183,054	
		TOTAL ANNUAL O&M COST		**$183,000**	Total annual O&M cost is rounded to the nearest $1,000.

ANNUAL INSTITUTIONAL CONTROL ANNUAL COSTS: (Assumed to be Incurred During Year 1 through 30)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring and Enforcement of Institutional Controls	1	EA	$12,552	$12,552	
			SUBTOTAL	$12,552	
Contingency (Scope and Bid)	20%			$2,510	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$15,062	
Project Management	10%			$1,506	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$2,259	Middle value of the recommended range was used.
			TOTAL	$18,827	
		TOTAL ANNUAL O&M COST		**$19,000**	Total annual O&M cost is rounded to the nearest $1,000.

WELL MAINTENANCE PERIODIC COSTS: (Every 10 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring Well Maintenance	1	EA	$47,070	$47,070	
Recovery Well Maintenance	1	EA	$20,014	$13,073	
Re-Injection Well Maintenance	1	EA	$10,988	$13,073	
			SUBTOTAL	$73,216	
Contingency (Scope and Bid)	20%			$14,643	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$87,859	
Project Management	10%			$8,786	The high end of the recommended range was used.
Technical Support	15%			$13,179	Middle value of the recommended range was used.
			TOTAL	$109,824	
		TOTAL WELL MAINTENANCE PERIODIC COST		**$110,000**	Periodic cost is rounded to the nearest $1,000.

TABLE CS-SG2

ALTERNATIVE SG2
MAINTAIN AND OPERATE EXISTING GET SYSTEM

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Under Alternative SG2, the GET system implemented at the Site under previous interim actions would continue to be maintained and operated as is. The system consists of eight existing recovery wells pumping extracted groundwater to the treatment building where it combines in a single header and flows through bag filters and is treated by an air stripping unit.

EQUIPMENT REPLACEMENT PERIODIC COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Equipment Replacement Allowance	1	EA	$50,000	$50,000	
			SUBTOTAL	$50,000	
Contingency (Scope and Bid)	20%			$10,000	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$60,000	
Project Management	10%			$6,000	The high end of the recommended range was used.
Technical Support	15%			$9,000	Middle value of the recommended range was used.
			TOTAL	$75,000	
			TOTAL WELL MAINTENANCE PERIODIC COST	**$75,000**	Periodic cost is rounded to the nearest $1,000.

FIVE-YEAR SITE REVIEW PERIODIC COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Five-Year Site Review	1	EA	$46,722	$46,722	
			SUBTOTAL	$46,722	
Contingency (Scope and Bid)	20%			$9,344	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$56,066	
Project Management	10%			$5,607	The high end of the recommended range was used.
			TOTAL	$61,673	
			TOTAL FIVE-YEAR SITE REVIEW PERIODIC COST	**$62,000**	Periodic cost is rounded to the nearest $1,000.

Notes:
Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000. Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

Abbreviations:

EA	Each
LS	Lump sum
QTY	Quantity

TABLE PV-SG2

ALTERNATIVE SG2
MAINTAIN AND OPERATE EXISTING GET SYSTEM

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS					
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Well Maintenance	Equipment Replacement Costs	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
0	$139,000	$183,000	$367,000	$0	$0	$0	$689,000	1.0000	$689,000
1	$0	$202,000	$367,000	$0	$0	$0	$569,000	0.9524	$541,916
2	$0	$202,000	$183,000	$0	$0	$0	$385,000	0.9070	$349,195
3	$0	$202,000	$183,000	$0	$0	$0	$385,000	0.8638	$332,563
4	$0	$202,000	$183,000	$0	$0	$0	$385,000	0.8227	$316,740
5	$0	$202,000	$183,000	$0	$75,000	$62,000	$522,000	0.7835	$408,987
6	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.7462	$220,129
7	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.7107	$209,657
8	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.6768	$199,656
9	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.6446	$190,157
10	$0	$202,000	$93,000	$110,000	$75,000	$62,000	$542,000	0.6139	$332,734
11	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.5847	$172,487
12	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.5568	$164,256
13	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.5303	$156,439
14	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.5051	$149,005
15	$0	$202,000	$93,000	$0	$75,000	$62,000	$432,000	0.4810	$207,792
16	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.4581	$135,140
17	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.4363	$128,709
18	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.4155	$122,573
19	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.3957	$116,732
20	$0	$202,000	$93,000	$110,000	$75,000	$62,000	$542,000	0.3769	$204,280
21	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.3589	$105,876
22	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.3418	$100,831
23	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.3256	$96,052
24	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.3101	$91,480

TABLE PV-SG2

ALTERNATIVE SG2
MAINTAIN AND OPERATE EXISTING GET SYSTEM

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS					
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Well Maintenance	Equipment Replacement Costs	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
25	$0	$202,000	$93,000	$0	$75,000	$62,000	$432,000	0.2953	$127,570
26	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.2812	$82,954
27	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.2678	$79,001
28	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.2551	$75,255
29	$0	$202,000	$93,000	$0	$0	$0	$295,000	0.2429	$71,656
30	$341,000	$202,000	$93,000	$0	$0	$62,000	$698,000	0.2314	$161,517
TOTALS:	**$480,000**	**$6,243,000**	**$3,791,000**	**$220,000**	**$375,000**	**$372,000**	**$11,481,000**		$6,340,339
TOTAL PRESENT VALUE OF ALTERNATIVE SG2									**$6,340,000**

Notes:

1 - Duration is estimated for present value analysis. Estimated remedial timeframes are discussed within the FS report.

2 - Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-SG2.

3 - Total annual expenditure is the total cost per year with no discounting.

4 - Present value is the total cost per year including a discount factor for that year. See Table PV-ADRFT for details.

5 - Total present value is rounded to the nearest $1,000. Depreciation is excluded from the present value cost.

6 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

TABLE CS-SG3

ALTERNATIVE SG3
IN SITU TREATMENT VIA GROUNDWATER AMENDMENTS

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Under Alternative SG3, in situ EB, in situ chemical oxidation, or in situ chemical reduction of chlorinated VOCs would be stimulated at the contaminant source area. Due to the shallower depths, it was assumed that injections would be accomplished with by DPT. Bench- and pilot-scale studies would be conducted before full-scale implementation to determine the efficacy of EB, in situ chemical oxidation or reduction at the site. The existing GET system would be shut down during injections to prevent injected materials from being extracted and entering the treatment system. If the injections are successful, the GET system would be dismantled, and the equipment removed from the existing treatment building. The extraction piping would be removed and the recovery wells would be abandoned.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Institutional Controls	1	LS	$30,400	$26,385	
Miscellaneous Requirements for Sampling	1	LS	$53,300	$53,300	
EB Injection Event - Equipment Purchase	1	LS	$23,851	$23,851	
Pilot Scale Injection	1	EA	$82,153	$82,153	Average cost of the three injection alternatives used
EB Injection			$125,941		
ISCO Injection			$50,738		
ISCR Injection			$69,778		
Pilot Scale Groundwater Monitoring Event	1	EA	$59,171	$58,646	
Pilot Scale Groundwater Monitoring Event Report Generation	1	EA	$14,580	$14,580	
			SUBTOTAL	$258,915	
Contingency (Scope and Bid)	20%			$51,783	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$310,698	
Project Management	8%			$24,856	Percentage from Exhibit 5-8 was used.
Remedial Design	15%			$46,605	Percentage from Exhibit 5-8 was used.
Construction Management	10%			$31,070	Percentage from Exhibit 5-8 was used.
Technical Support	10%			$31,070	
			TOTAL	$444,299	
			TOTAL CAPITAL COST	**$444,000**	Total capital cost is rounded to the nearest $1,000.

FUTURE CAPITAL COSTS: (Assumed to be Incurred During Year 15)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring Well Abandonment	47	EA	$3,487	$163,873	
Decommissioning Treatment System	1	LS	$50,000	$50,000	
			SUBTOTAL	$213,873	
Contingency (Scope and Bid)	20%			$42,775	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$256,648	
Project Management	8%			$20,532	Percentage from Exhibit 5-8 was used.
Remedial Design	15%			$38,497	Percentage from Exhibit 5-8 was used.
Construction Management	10%			$25,665	Percentage from Exhibit 5-8 was used.
			TOTAL	$341,342	
			TOTAL FUTURE CAPITAL COST	**$341,000**	Total future capital cost is rounded to the nearest $1,000.

TABLE CS-SG3

ALTERNATIVE SG3
IN SITU TREATMENT VIA GROUNDWATER AMENDMENTS

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Under Alternative SG3, in situ EB, in situ chemical oxidation, or in situ chemical reduction of chlorinated VOCs would be stimulated at the contaminant source area. Due to the shallower depths, it was assumed that injections would be accomplished with by DPT. Bench- and pilot-scale studies would be conducted before full-scale implementation to determine the efficacy of EB, in situ chemical oxidation or reduction at the site. The existing GET system would be shut down during injections to prevent injected materials from being extracted and entering the treatment system. If the injections are successful, the GET system would be dismantled, and the equipment removed from the existing treatment building. The extraction piping would be removed and the recovery wells would be abandoned.

INJECTION PERIODIC COSTS: (Assumed to be Incurred During Year 0 through 4)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Injection Event - Area 1	1	EA	$1,326,330	$1,326,330	Average cost of the three injection alternatives used
EB Injection			$1,540,051		
ISCO Injection			$1,067,905		
ISCR Injection			$1,371,034		
			SUBTOTAL	$1,326,330	
Contingency (Scope and Bid)	20%			$265,266	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$1,591,596	
Project Management	6%			$95,496	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$238,739	Middle value of the recommended range was used.
			TOTAL	$1,925,831	
			TOTAL INJECTION COST	**$1,926,000**	Total periodic injection cost is rounded to the nearest $1,000.

QUARTERLY MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 0,1)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
EB Groundwater Sampling Event	1	EA	$74,651	$74,651	
VOC-Only Groundwater Sampling Event	3	EA	$37,115	$111,345	
Groundwater Monitoring Event Report Preparation	4	EA	$25,005	$100,020	
			SUBTOTAL	$286,016	
Contingency (Scope and Bid)	20%			$57,203	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$343,219	
Project Management	8%			$27,458	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$51,483	Middle value of the recommended range was used.
			TOTAL	$422,160	
			TOTAL QUARTERLY MONITORING COST	**$422,000**	Total quarterly monitoring cost is rounded to the nearest $1,000.

SEMIANNUAL MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 2 through 5)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
EB Groundwater Sampling Event	1	EA	$74,651	$74,651	
VOC-Only Groundwater Sampling Event	1	EA	$37,115	$37,115	
Groundwater Monitoring Event Report Preparation	2	EA	$25,005	$50,010	
			SUBTOTAL	$161,776	
Contingency (Scope and Bid)	20%			$32,355	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$194,131	
Project Management	8%			$15,530	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$29,120	Middle value of the recommended range was used.
			TOTAL	$238,781	
			TOTAL SEMIANNUAL MONITORING COST	**$239,000**	Total semiannual monitoring cost is rounded to the nearest $1,000.

TABLE CS-SG3

ALTERNATIVE SG3
IN SITU TREATMENT VIA GROUNDWATER AMENDMENTS

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Under Alternative SG3, in situ EB, in situ chemical oxidation, or in situ chemical reduction of chlorinated VOCs would be stimulated at the contaminant source area. Due to the shallower depths, it was assumed that injections would be accomplished with by DPT. Bench- and pilot-scale studies would be conducted before full-scale implementation to determine the efficacy of EB, in situ chemical oxidation or reduction at the site. The existing GET system would be shut down during injections to prevent injected materials from being extracted and entering the treatment system. If the injections are successful, the GET system would be dismantled, and the equipment removed from the existing treatment building. The extraction piping would be removed and the recovery wells would be abandoned.

ANNUAL INSTITUTIONAL CONTROL ANNUAL COSTS: (Assumed to be Incurred During Year 1 through 15)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring and Enforcement of Institutional Controls	1	EA	$12,552	$12,552	
			SUBTOTAL	$12,552	
Contingency (Scope and Bid)	20%			$2,510	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$15,062	
Project Management	10%			$1,506	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$2,259	Middle value of the recommended range was used.
			TOTAL	$18,827	
		TOTAL ANNUAL O&M COST		**$19,000**	Total annual O&M cost is rounded to the nearest $1,000.

MONITORING WELL MAINTENANCE PERIODIC COSTS: (Every 10 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring Well Maintenance	1	EA	$47,070	$47,070	
			SUBTOTAL	$47,070	
Contingency (Scope and Bid)	20%			$9,414	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$56,484	
Project Management	10%			$5,648	The high end of the recommended range was used.
Technical Support	15%			$8,473	Middle value of the recommended range was used.
			TOTAL	$70,605	
		TOTAL MONITORING WELL MAINTENANCE PERIODIC COST		**$71,000**	Periodic cost is rounded to the nearest $1,000.

EQUIPMENT REPLACEMENT PERIODIC COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Equipment Replacement Allowance	1	EA	$50,000	$50,000	
			SUBTOTAL	$50,000	
Contingency (Scope and Bid)	20%			$10,000	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$60,000	
Project Management	10%			$6,000	The high end of the recommended range was used.
Technical Support	15%			$9,000	Middle value of the recommended range was used.
			TOTAL	$75,000	
		TOTAL WELL MAINTENANCE PERIODIC COST		**$75,000**	Periodic cost is rounded to the nearest $1,000.

TABLE CS-SG3

ALTERNATIVE SG3
IN SITU TREATMENT VIA GROUNDWATER AMENDMENTS

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Under Alternative SG3, in situ EB, in situ chemical oxidation, or in situ chemical reduction of chlorinated VOCs would be stimulated at the contaminant source area. Due to the shallower depths, it was assumed that injections would be accomplished with by DPT. Bench- and pilot-scale studies would be conducted before full-scale implementation to determine the efficacy of EB, in situ chemical oxidation or reduction at the site. The existing GET system would be shut down during injections to prevent injected materials from being extracted and entering the treatment system. If the injections are successful, the GET system would be dismantled, and the equipment removed from the existing treatment building. The extraction piping would be removed and the recovery wells would be abandoned.

FIVE-YEAR SITE REVIEW PERIODIC COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Five-Year Site Review	1	EA	$46,722	$46,722	
			SUBTOTAL	$46,722	
Contingency (Scope and Bid)	20%			$9,344	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$56,066	
Project Management	10%			$5,607	The high end of the recommended range was used.
			TOTAL	$61,673	
			TOTAL FIVE-YEAR SITE REVIEW PERIODIC COST	**$62,000**	Periodic cost is rounded to the nearest $1,000.

Notes:
Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000. Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

Abbreviations:

EA	Each
LS	Lump sum
QTY	Quantity

TABLE PV-SG3

ALTERNATIVE SG3
IN SITU TREATMENT VIA GROUNDWATER AMENDMENTS

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS						
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Injection Costs	Well Maintenance	Equipment Replacement Costs	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
0	$444,000	$0	$422,000	$1,926,000	$0	$0	$0	$2,792,000	1.0000	$2,792,000
1	$0	$19,000	$422,000	$1,926,000	$0	$0	$0	$2,367,000	0.9524	$2,254,331
2	$0	$19,000	$239,000	$1,926,000	$0	$0	$0	$2,184,000	0.9070	$1,980,888
3	$0	$19,000	$239,000	$1,926,000	$0	$0	$0	$2,184,000	0.8638	$1,886,539
4	$0	$19,000	$239,000	$1,926,000	$0	$0	$0	$2,184,000	0.8227	$1,796,777
5	$0	$19,000	$239,000	$0	$0	$75,000	$62,000	$395,000	0.7835	$309,483
6	$0	$19,000	$147,000	$0	$0	$0	$0	$166,000	0.7462	$123,869
7	$0	$19,000	$147,000	$0	$0	$0	$0	$166,000	0.7107	$117,976
8	$0	$19,000	$147,000	$0	$0	$0	$0	$166,000	0.6768	$112,349
9	$0	$19,000	$147,000	$0	$0	$0	$0	$166,000	0.6446	$107,004
10	$0	$19,000	$147,000	$0	$71,000	$75,000	$62,000	$374,000	0.6139	$229,599
11	$0	$19,000	$147,000	$0	$0	$0	$0	$166,000	0.5847	$97,060
12	$0	$19,000	$147,000	$0	$0	$0	$0	$166,000	0.5568	$92,429
13	$0	$19,000	$147,000	$0	$0	$0	$0	$166,000	0.5303	$88,030
14	$0	$19,000	$147,000	$0	$0	$0	$0	$166,000	0.5051	$83,847
15	$341,000	$19,000	$147,000	$0	$0	$0	$62,000	$569,000	0.4810	$273,689
TOTALS:	**$785,000**	**$285,000**	**$3,270,000**	**$9,630,000**	**$71,000**	**$150,000**	**$186,000**	**$14,377,000**		$12,345,870
TOTAL PRESENT VALUE OF ALTERNATIVE SG3										**$12,346,000**

Notes:

1 - Duration is estimated for present value analysis. Estimated remedial timeframes are discussed within the FS report.

2 - Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-SG3.

3 - Total annual expenditure is the total cost per year with no discounting.

4 - Present value is the total cost per year including a discount factor for that year. See Table PV-ADRFT for details.

5 - Total present value is rounded to the nearest $1,000. Depreciation is excluded from the present value cost.

6 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

TABLE CS-SG4

ALTERNATIVE SG4

MAINTAIN AND OPERATE EXISTING GET SYSTEM AND IN SITU TREATMENT VIA GROUNDWATER AMENDMENTS

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative SG4 will combine components of SG2 and SG3 to reduce total cleanup time and decrease operating costs of the GET system. The in situ treatment would target areas of the OU1 plume with concentrations greater than 500 µg/L in the upper and medial aquifers. Due to the shallower depths, it was assumed that injections would be accomplished with DPT. The other components of the in situ alternative would be as described in Alternative SG3. The continued operation of the GET system would be adjusted so that only the peripheral extraction wells would pump at adjusted pumping rates so as not to extract injection materials into the system from the area being treated via injection of amendments.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Institutional Controls	1	LS	$30,400	$26,385	
Miscellaneous Requirements for Sampling	1	LS	$53,300	$53,300	
Injection Well Installation	18	EA	$8,265	$148,759	
EB Injection Event - Equipment Purchase	1	LS	$23,851	$23,851	
Pilot Scale Injection	1	EA	$80,304	$80,304	Average cost of the three injection alternatives used
EB Injection			$125,941		
ISCO Injection			$50,738		
ISCR Injection			$64,231		
Pilot Scale Groundwater Monitoring Event	1	EA	$59,171	$58,646	
Pilot Scale Groundwater Monitoring Event Report Generation	1	EA	$14,580	$14,580	
			SUBTOTAL	$405,825	
Contingency (Scope and Bid)	20%			$81,165	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$486,990	
Project Management	8%			$38,959	Percentage from Exhibit 5-8 was used.
Remedial Design	15%			$73,049	Percentage from Exhibit 5-8 was used.
Construction Management	10%			$48,699	Percentage from Exhibit 5-8 was used.
Technical Support	10%			$48,699	
			TOTAL	$696,396	
			TOTAL CAPITAL COST	**$696,000**	Total capital cost is rounded to the nearest $1,000.

FUTURE CAPITAL COSTS: (Assumed to be Incurred During Year 10)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring Well Abandonment	47	EA	$3,487	$163,873	
Injection Well Abandonment	18	EA	$3,747	$67,437	
Decommissioning Treatment System	1	LS	$50,000	$50,000	
			SUBTOTAL	$281,310	
Contingency (Scope and Bid)	20%			$56,262	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$337,572	
Project Management	8%			$27,006	Percentage from Exhibit 5-8 was used.
Remedial Design	15%			$50,636	Percentage from Exhibit 5-8 was used.
Construction Management	10%			$33,757	Percentage from Exhibit 5-8 was used.
			TOTAL	$448,971	
			TOTAL FUTURE CAPITAL COST	**$449,000**	Total future capital cost is rounded to the nearest $1,000.

TABLE CS-SG4

ALTERNATIVE SG4

MAINTAIN AND OPERATE EXISTING GET SYSTEM AND IN SITU TREATMENT VIA GROUNDWATER AMENDMENTS

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative SG4 will combine components of SG2 and SG3 to reduce total cleanup time and decrease operating costs of the GET system. The in situ treatment would target areas of the OU1 plume with concentrations greater than 500 µg/L in the upper and medial aquifers. Due to the shallower depths, it was assumed that injections would be accomplished with DPT. The other components of the in situ alternative would be as described in Alternative SG3. The continued operation of the GET system would be adjusted so that only the peripheral extraction wells would pump at adjusted pumping rates so as not to extract injection materials into the system from the area being treated via injection of amendments.

INJECTION PERIODIC COSTS: (Assumed to be Incurred During Year 0 through 2)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Injection Event - Area 1	1	EA	$1,326,330	$1,326,330	Average cost of the three injection alternatives used
EB Injection			$1,540,051		
ISCO Injection			$1,067,905		
ISCR Injection			$1,371,034		
			SUBTOTAL	$1,326,330	
Contingency (Scope and Bid)	20%			$265,266	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$1,591,596	
Project Management	6%			$95,496	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$238,739	Middle value of the recommended range was used.
			TOTAL	$1,925,831	
			TOTAL INJECTION COST	**$1,926,000**	Total periodic injection cost is rounded to the nearest $1,000.

QUARTERLY MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 0 through 1)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
EB Groundwater Sampling Event	1	EA	$74,651	$74,651	
VOC-Only Groundwater Sampling Event	3	EA	$37,115	$111,345	
Groundwater Monitoring Event Report Preparation	4	EA	$25,005	$100,020	
			SUBTOTAL	$286,016	
Contingency (Scope and Bid)	20%			$57,203	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$343,219	
Project Management	8%			$27,458	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$51,483	Middle value of the recommended range was used.
			TOTAL	$422,160	
			TOTAL QUARTERLY MONITORING COST	**$422,000**	Total quarterly monitoring cost is rounded to the nearest $1,000.

SEMIANNUAL MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 2 through 5)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
EB Groundwater Sampling Event	1	EA	$74,651	$74,651	
VOC-Only Groundwater Sampling Event	1	EA	$37,115	$37,115	
Groundwater Monitoring Event Report Preparation	2	EA	$25,005	$50,010	
			SUBTOTAL	$161,776	
Contingency (Scope and Bid)	20%			$32,355	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$194,131	
Project Management	8%			$15,530	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$29,120	Middle value of the recommended range was used.
			TOTAL	$238,781	
			TOTAL SEMIANNUAL MONITORING COST	**$239,000**	Total semiannual monitoring cost is rounded to the nearest $1,000.

TABLE CS-SG4

ALTERNATIVE SG4

MAINTAIN AND OPERATE EXISTING GET SYSTEM AND IN SITU TREATMENT VIA GROUNDWATER AMENDMENTS

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative SG4 will combine components of SG2 and SG3 to reduce total cleanup time and decrease operating costs of the GET system. The in situ treatment would target areas of the OU1 plume with concentrations greater than 500 µg/L in the upper and medial aquifers. Due to the shallower depths, it was assumed that injections would be accomplished with DPT. The other components of the in situ alternative would be as described in Alternative SG3. The continued operation of the GET system would be adjusted so that only the peripheral extraction wells would pump at adjusted pumping rates so as not to extract injection materials into the system from the area being treated via injection of amendments.

ANNUAL MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 6 through 10)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
EB Groundwater Sampling Event	1	EA	$74,651	$74,651	
Groundwater Monitoring Event Report Preparation	1	EA	$25,005	$25,005	
			SUBTOTAL	$99,656	
Contingency (Scope and Bid)	20%			$19,931	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$119,587	
Project Management	8%			$9,567	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$17,938	Middle value of the recommended range was used.
			TOTAL	$147,092	
		TOTAL ANNUAL MONITORING COST		**$147,000**	Total annual monitoring cost is rounded to the nearest $1,000.

ANNUAL GET O&M ANNUAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
O&M of GET Treatment System	1	EA	$92,153	$92,153	
			SUBTOTAL	$92,153	
Contingency (Scope and Bid)	20%			$18,431	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$110,584	
Project Management	8%			$8,847	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$16,588	Middle value of the recommended range was used.
			TOTAL	$136,019	
		TOTAL ANNUAL O&M COST		**$136,000**	Total annual O&M cost is rounded to the nearest $1,000.

ANNUAL INSTITUTIONAL CONTROL ANNUAL COSTS: (Assumed to be Incurred During Year 1 through 10)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring and Enforcement of Institutional Controls	1	EA	$12,552	$12,552	
			SUBTOTAL	$12,552	
Contingency (Scope and Bid)	20%			$2,510	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$15,062	
Project Management	10%			$1,506	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$2,259	Middle value of the recommended range was used.
			TOTAL	$18,827	
		TOTAL ANNUAL O&M COST		**$19,000**	Total annual O&M cost is rounded to the nearest $1,000.

MONITORING WELL MAINTENANCE PERIODIC COSTS: (Every 10 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring Well Maintenance	1	EA	$47,070	$47,070	
			SUBTOTAL	$47,070	
Contingency (Scope and Bid)	20%			$9,414	10% Scope, 10% Bid (Low end of the recommended range).

TABLE CS-SG4

ALTERNATIVE SG4

MAINTAIN AND OPERATE EXISTING GET SYSTEM AND IN SITU TREATMENT VIA GROUNDWATER AMENDMENTS

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative SG4 will combine components of SG2 and SG3 to reduce total cleanup time and decrease operating costs of the GET system. The in situ treatment would target areas of the OU1 plume with concentrations greater than 500 µg/L in the upper and medial aquifers. Due to the shallower depths, it was assumed that injections would be accomplished with DPT. The other components of the in situ alternative would be as described in Alternative SG3. The continued operation of the GET system would be adjusted so that only the peripheral extraction wells would pump at adjusted pumping rates so as not to extract injection materials into the system from the area being treated via injection of amendments.

		SUBTOTAL	$56,484	
Project Management	10%		$5,648	The high end of the recommended range was used.
Technical Support	15%		$8,473	Middle value of the recommended range was used.
		TOTAL	$70,605	
		TOTAL MONITORING WELL MAINTENANCE PERIODIC COST	**$71,000**	Periodic cost is rounded to the nearest $1,000.

TABLE CS-SG4

ALTERNATIVE SG4

MAINTAIN AND OPERATE EXISTING GET SYSTEM AND IN SITU TREATMENT VIA GROUNDWATER AMENDMENTS

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative SG4 will combine components of SG2 and SG3 to reduce total cleanup time and decrease operating costs of the GET system. The in situ treatment would target areas of the OU1 plume with concentrations greater than 500 µg/L in the upper and medial aquifers. Due to the shallower depths, it was assumed that injections would be accomplished with DPT. The other components of the in situ alternative would be as described in Alternative SG3. The continued operation of the GET system would be adjusted so that only the peripheral extraction wells would pump at adjusted pumping rates so as not to extract injection materials into the system from the area being treated via injection of amendments.

EQUIPMENT REPLACEMENT PERIODIC COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Equipment Replacement Allowance	1	EA	$50,000	$50,000	
			SUBTOTAL	$50,000	
Contingency (Scope and Bid)	20%			$10,000	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$60,000	
Project Management	10%			$6,000	The high end of the recommended range was used.
Technical Support	15%			$9,000	Middle value of the recommended range was used.
			TOTAL	$75,000	
			TOTAL WELL MAINTENANCE PERIODIC COST	**$75,000**	Periodic cost is rounded to the nearest $1,000.

FIVE-YEAR SITE REVIEW PERIODIC COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Five-Year Site Review	1	EA	$46,722	$46,722	
			SUBTOTAL	$46,722	
Contingency (Scope and Bid)	20%			$9,344	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$56,066	
Project Management	10%			$5,607	The high end of the recommended range was used.
			TOTAL	$61,673	
			TOTAL FIVE-YEAR SITE REVIEW PERIODIC COST	**$62,000**	Periodic cost is rounded to the nearest $1,000.

Notes:

Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000. Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

Abbreviations:

EA Each
LS Lump sum
QTY Quantity

TABLE PV-SG4

ALTERNATIVE SG4

MAINTAIN AND OPERATE EXISTING GET SYSTEM AND IN SITU TREATMENT VIA GROUNDWATER AMENDMENTS

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site

Operable Unit: OU1

Location: Hastings, Nebraska

Phase: Feasibility Study

Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS						
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Injection Costs	Well Maintenance	Equipment Replacement Costs	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
0	$696,000	$136,000	$422,000	$1,926,000	$0	$0	$0	$3,180,000	1.0000	$3,180,000
1	$0	$155,000	$422,000	$1,926,000	$0	$0	$0	$2,503,000	0.9524	$2,383,857
2	$0	$155,000	$239,000	$1,926,000	$0	$0	$0	$2,320,000	0.9070	$2,104,240
3	$0	$155,000	$239,000	$0	$0	$0	$0	$394,000	0.8638	$340,337
4	$0	$155,000	$239,000	$0	$0	$0	$0	$394,000	0.8227	$324,144
5	$0	$155,000	$239,000	$0	$0	$75,000	$62,000	$531,000	0.7835	$416,039
6	$0	$155,000	$147,000	$0	$0	$0	$0	$302,000	0.7462	$225,352
7	$0	$155,000	$147,000	$0	$0	$0	$0	$302,000	0.7107	$214,631
8	$0	$155,000	$147,000	$0	$0	$0	$0	$302,000	0.6768	$204,394
9	$0	$155,000	$147,000	$0	$0	$0	$0	$302,000	0.6446	$194,669
10	$449,000	$155,000	$239,000	$0	$0	$0	$62,000	$905,000	0.6139	$555,580
TOTALS:	**$1,145,000**	**$1,686,000**	**$2,627,000**	**$5,778,000**	**$0**	**$75,000**	**$124,000**	**$11,435,000**		$10,143,243
TOTAL PRESENT VALUE OF ALTERNATIVE SG4										**$10,143,000**

Notes:

1 - Duration is estimated for present value analysis. Estimated remedial timeframes are discussed within the FS report.

2 - Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-SG4.

3 - Total annual expenditure is the total cost per year with no discounting.

4 - Present value is the total cost per year including a discount factor for that year. See Table PV-ADRFT for details.

5 - Total present value is rounded to the nearest $1,000. Depreciation is excluded from the present value cost.

6 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

TABLE CS-G

ALTERNATIVE COST SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Alternative	Total Capital Cost	Total Annual Cost	Total Periodic Cost	Present Value Cost
G1	$312,000	$924,000	$462,000	$852,000
G2	$4,715,000	$30,052,000	$4,539,000	$11,485,000
G3	$7,199,000	$29,552,000	$3,541,000	$15,550,000
G4	$7,525,000	$27,607,000	$27,063,000	$36,651,000

Notes:

1 - Capital costs, annual costs, and periodic costs are presented on tables CS-G1 through CS-G4

2 - Estimated remedial timeframes and associated present value analysis for each remedial alternative are provided on tables PV-G1 through PV-G4.

3 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for feasibility study level evaluation purposes.

TABLE CS G1

ALTERNATIVE G1
NO ACTION

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative G1 is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared. The only actions that would be implemented for Alternative G1 are completion of five year site reviews as required by the NCP and periodic groundwater monitoring in support of Five Year Reviews. There would be no change in the groundwater contaminant concentrations because no treatment, containment, or removal of contaminated groundwater is included in this alternative.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Institutional Controls	1	LS	$30,400	$26,385	
Miscellaneous Requirements for Sampling	1	LS	$53,300	$53,300	
			SUBTOTAL	$79,685	
Contingency (Scope and Bid)	20%			$15,937	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$95,622	
Project Management	10%			$9,562	Percentage from Exhibit 5-8 was used.
Remedial Design	20%			$19,124	Percentage from Exhibit 5-8 was used.
Construction Management	15%			$14,343	Percentage from Exhibit 5-8 was used.
			TOTAL	$138,651	
			TOTAL CAPITAL COST	**$139,000**	Total capital cost is rounded to the nearest $1,000.

FUTURE CAPITAL COSTS: (Assumed to be Incurred During Year 100)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring Well Abandonment	27	EA	$4,023	$108,621	
			SUBTOTAL	$108,621	
Contingency (Scope and Bid)	20%			$21,724	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$130,345	
Project Management	8%			$10,428	Percentage from Exhibit 5-8 was used.
Remedial Design	15%			$19,552	Percentage from Exhibit 5-8 was used.
Construction Management	10%			$13,035	Percentage from Exhibit 5-8 was used.
			TOTAL	$173,360	
			TOTAL FUTURE CAPITAL COST	**$173,000**	Total future capital cost is rounded to the nearest $1,000.

TABLE CS G1

ALTERNATIVE G1
NO ACTION

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative G1 is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared. The only actions that would be implemented for Alternative G1 are completion of five year site reviews as required by the NCP and periodic groundwater monitoring in support of Five Year Reviews. There would be no change in the groundwater contaminant concentrations because no treatment, containment, or removal of contaminated groundwater is included in this alternative.

MONITORING COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Groundwater Sampling Event	1	EA	$23,610	$23,610	
Groundwater Monitoring Event Report Preparation	1	EA	$15,500	$15,500	
			SUBTOTAL	$39,110	
Contingency (Scope and Bid)	20%			$7,822	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$46,932	
Project Management	10%			$4,693	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$7,040	Middle value of the recommended range was used.
			TOTAL	$58,665	
			TOTAL ANNUAL MONITORING COST	**$59,000**	Total annual monitoring cost is rounded to the nearest $1,000.

ANNUAL INSTITUTIONAL CONTROL ANNUAL COSTS: (Assumed to be Incurred During Year 1 through 100)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring and Enforcement of Institutional Controls	1	EA	$12,552	$12,552	
			SUBTOTAL	$12,552	
Contingency (Scope and Bid)	20%			$2,510	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$15,062	
Project Management	10%			$1,506	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$2,259	Middle value of the recommended range was used.
			TOTAL	$18,827	
			TOTAL ANNUAL O&M COST	**$19,000**	Total annual O&M cost is rounded to the nearest $1,000.

MONITORING WELL MAINTENANCE PERIODIC COSTS: (Every 10 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring Well Maintenance	1	EA	$30,219	$30,219	
			SUBTOTAL	$30,219	
Contingency (Scope and Bid)	20%			$6,044	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$36,263	
Project Management	10%			$3,626	The high end of the recommended range was used.
Technical Support	15%			$5,439	Middle value of the recommended range was used.
			TOTAL	$45,328	
			TOTAL MONITORING WELL MAINTENANCE PERIODIC COST	**$45,000**	Periodic cost is rounded to the nearest $1,000.

TABLE CS G1

ALTERNATIVE G1
NO ACTION

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative G1 is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared. The only actions that would be implemented for Alternative G1 are completion of five year site reviews as required by the NCP and periodic groundwater monitoring in support of Five Year Reviews. There would be no change in the groundwater contaminant concentrations because no treatment, containment, or removal of contaminated groundwater is included in this alternative.

FIVE-YEAR SITE REVIEW PERIODIC COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Five-Year Site Review	1	EA	$46,722	$46,722	
			SUBTOTAL	$46,722	
Contingency (Scope and Bid)	20%			$9,344	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$56,066	
Project Management	10%			$5,607	The high end of the recommended range was used.
			TOTAL	$61,673	
			TOTAL FIVE-YEAR SITE REVIEW PERIODIC COST	**$62,000**	Periodic cost is rounded to the nearest $1,000.

Notes:
Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000. Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

Abbreviations:

EA	Each
LS	Lump sum
QTY	Quantity

TABLE PV-G1

ALTERNATIVE G1
NO ACTION

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS				
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Well Maintenance	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
0	$139,000	$0	$0	$0	$0	$139,000	1.0000	$139,000
1	$0	$19,000	$0	$0	$0	$19,000	0.9524	$18,096
2	$0	$19,000	$0	$0	$0	$19,000	0.9070	$17,233
3	$0	$19,000	$0	$0	$0	$19,000	0.8638	$16,412
4	$0	$19,000	$0	$0	$0	$19,000	0.8227	$15,631
5	$0	$19,000	$59,000	$0	$62,000	$140,000	0.7835	$109,690
6	$0	$19,000	$0	$0	$0	$19,000	0.7462	$14,178
7	$0	$19,000	$0	$0	$0	$19,000	0.7107	$13,503
8	$0	$19,000	$0	$0	$0	$19,000	0.6768	$12,859
9	$0	$19,000	$0	$0	$0	$19,000	0.6446	$12,247
10	$0	$19,000	$59,000	$45,000	$62,000	$185,000	0.6139	$113,572
11	$0	$19,000	$0	$0	$0	$19,000	0.5847	$11,109
12	$0	$19,000	$0	$0	$0	$19,000	0.5568	$10,579
13	$0	$19,000	$0	$0	$0	$19,000	0.5303	$10,076
14	$0	$19,000	$0	$0	$0	$19,000	0.5051	$9,597
15	$0	$19,000	$59,000	$0	$62,000	$140,000	0.4810	$67,340
16	$0	$19,000	$0	$0	$0	$19,000	0.4581	$8,704
17	$0	$19,000	$0	$0	$0	$19,000	0.4363	$8,290
18	$0	$19,000	$0	$0	$0	$19,000	0.4155	$7,895
19	$0	$19,000	$0	$0	$0	$19,000	0.3957	$7,518
20	$0	$19,000	$59,000	$45,000	$62,000	$185,000	0.3769	$69,727
21	$0	$19,000	$0	$0	$0	$19,000	0.3589	$6,819
22	$0	$19,000	$0	$0	$0	$19,000	0.3418	$6,494
23	$0	$19,000	$0	$0	$0	$19,000	0.3256	$6,186
24	$0	$19,000	$0	$0	$0	$19,000	0.3101	$5,892
25	$0	$19,000	$59,000	$0	$62,000	$140,000	0.2953	$41,342
26	$0	$19,000	$0	$0	$0	$19,000	0.2812	$5,343
27	$0	$19,000	$0	$0	$0	$19,000	0.2678	$5,088
28	$0	$19,000	$0	$0	$0	$19,000	0.2551	$4,847
29	$0	$19,000	$0	$0	$0	$19,000	0.2429	$4,615
30	$173,000	$19,000	$59,000	$0	$62,000	$313,000	0.2314	$72,428
TOTALS:	**$312,000**	**$570,000**	**$354,000**	**$90,000**	**$372,000**	**$1,698,000**		$852,310

TABLE PV-G1

ALTERNATIVE G1
NO ACTION

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

Year[1]	Capital Costs[2]	ANNUAL COSTS		PERIODIC COSTS		Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
		O&M Costs	Monitoring Costs	Well Maintenance	Five-year Review Costs			
TOTAL PRESENT VALUE OF ALTERNATIVE G1								**$852,000**

Notes:

1 - Duration is estimated for present value analysis. Estimated remedial timeframes are discussed within the FS report.

2 - Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-G1.

3 - Total annual expenditure is the total cost per year with no discounting.

4 - Present value is the total cost per year including a discount factor for that year. See Table PV-ADRFT for details.

5 - Total present value is rounded to the nearest $1,000. Depreciation is excluded from the present value cost.

6 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

TABLE CS G2

ALTERNATIVE G2
GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (LEADING EDGE)

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Recovery wells would be installed at the leading edge of the OU2 groundwater plume and would focus on containing the groundwater plume from further migration in the medial and lower aquifers beyond Technical Boulevard. Groundwater would be pumped to a newly constructed treatment system, located along Blaine Avenue. The number of recovery wells, the approximate locations, and groundwater extraction rates has been estimated by a sitewide groundwater model.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Land Acquisition/Easement Requirements	1	LS	$14,464	$14,464	
Institutional Controls	1	LS	$30,400	$26,385	
Miscellaneous Requirements for Sampling	1	LS	$53,300	$53,300	
Monitoring Well Installation	30	EA	$10,969	$329,045	
Recovery Well Installation	6	EA	$106,924	$641,543	
Re-Injection Well Installation	3	EA	$111,850	$335,548	
Well Vault Installation	9	EA	$48,941	$440,466	
Pipe Installation	13,480	LF	$62	$828,916	
Treatment System Building	1	EA	$98,469	$98,469	
Treatment System	1	EA	$135,871	$135,871	
Treatment System Startup Testing	1	EA	$13,947	$13,947	
			SUBTOTAL	$2,917,954	
Contingency (Scope and Bid)	20%			$583,591	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$3,501,545	
Project Management	5%			$175,077	Percentage from Exhibit 5-8 was used.
Remedial Design	8%			$280,124	Percentage from Exhibit 5-8 was used.
Construction Management	6%			$210,093	Percentage from Exhibit 5-8 was used.
			TOTAL	$4,166,839	
			TOTAL CAPITAL COST	**$4,167,000**	Total capital cost is rounded to the nearest $1,000.

FUTURE CAPITAL COSTS: (Assumed to be Incurred During Year 100)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring Well Abandonment	57	EA	$3,634	$207,088	
Recovery Well Abandonment	6	EA	$8,922	$53,532	
Re-Injection Well Abandonment	3	EA	$10,860	$32,578	
Decommissioning Treatment System	1	LS	$50,000	$50,000	
			SUBTOTAL	$343,198	
Contingency (Scope and Bid)	20%			$68,640	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$411,838	
Project Management	8%			$32,947	Percentage from Exhibit 5-8 was used.
Remedial Design	15%			$61,776	Percentage from Exhibit 5-8 was used.
Construction Management	10%			$41,184	Percentage from Exhibit 5-8 was used.
			TOTAL	$547,745	
			TOTAL FUTURE CAPITAL COST	**$548,000**	Total future capital cost is rounded to the nearest $1,000.

TABLE CS G2

ALTERNATIVE G2

GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (LEADING EDGE)

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Recovery wells would be installed at the leading edge of the OU2 groundwater plume and would focus on containing the groundwater plume from further migration in the medial and lower aquifers beyond Technical Boulevard. Groundwater would be pumped to a newly constructed treatment system, located along Blaine Avenue. The number of recovery wells, the approximate locations, and groundwater extraction rates has been estimated by a sitewide groundwater model.

QUARTERLY MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 1)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Groundwater Sampling Event	4	EA	$43,720	$174,880	
Groundwater Monitoring Event Report Preparation	4	EA	$29,788	$119,152	
			SUBTOTAL	$294,032	
Contingency (Scope and Bid)	20%			$58,806	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$352,838	
Project Management	8%			$28,227	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$52,926	Middle value of the recommended range was used.
			TOTAL	$433,991	
		TOTAL QUARTERLY MONITORING COST		**$434,000**	Total quarterly monitoring cost is rounded to the nearest $1,000.

SEMIANNUAL MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 2 through 5)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Groundwater Sampling Event	2	EA	$43,720	$87,440	
Groundwater Monitoring Event Report Preparation	2	EA	$29,788	$59,576	
			SUBTOTAL	$147,016	
Contingency (Scope and Bid)	20%			$29,403	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$176,419	
Project Management	8%			$14,114	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$26,463	Middle value of the recommended range was used.
			TOTAL	$216,996	
		TOTAL SEMIANNUAL MONITORING COST		**$217,000**	Total semiannual monitoring cost is rounded to the nearest $1,000.

ANNUAL MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 6 through 100)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Groundwater Sampling Event	1	EA	$43,720	$43,720	
Groundwater Monitoring Event Report Preparation	1	EA	$29,788	$29,788	
			SUBTOTAL	$73,508	
Contingency (Scope and Bid)	20%			$14,702	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$88,210	
Project Management	10%			$8,821	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$13,232	Middle value of the recommended range was used.
			TOTAL	$110,263	
		TOTAL ANNUAL MONITORING COST		**$110,000**	Total annual monitoring cost is rounded to the nearest $1,000.

TABLE CS G2

ALTERNATIVE G2

GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (LEADING EDGE)

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Recovery wells would be installed at the leading edge of the OU2 groundwater plume and would focus on containing the groundwater plume from further migration in the medial and lower aquifers beyond Technical Boulevard. Groundwater would be pumped to a newly constructed treatment system, located along Blaine Avenue. The number of recovery wells, the approximate locations, and groundwater extraction rates has been estimated by a sitewide groundwater model.

ANNUAL GET O&M ANNUAL COSTS: (Assumed to be Incurred During Year 1 through 100)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
O&M of GET Treatment System	1	EA	$110,833	$110,833	
			SUBTOTAL	$110,833	
Contingency (Scope and Bid)	20%			$22,167	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$133,000	
Project Management	8%			$10,640	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$19,950	Middle value of the recommended range was used.
			TOTAL	$163,590	
		TOTAL ANNUAL O&M COST		**$164,000**	Total annual O&M cost is rounded to the nearest $1,000.

ANNUAL INSTITUTIONAL CONTROL ANNUAL COSTS: (Assumed to be Incurred During Year 1 through 100)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring and Enforcement of Institutional Controls	1	EA	$12,552	$12,552	
			SUBTOTAL	$12,552	
Contingency (Scope and Bid)	20%			$2,510	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$15,062	
Project Management	10%			$1,506	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$2,259	Middle value of the recommended range was used.
			TOTAL	$18,827	
		TOTAL ANNUAL O&M COST		**$19,000**	Total annual O&M cost is rounded to the nearest $1,000.

WELL MAINTENANCE PERIODIC COSTS: (Every 10 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring Well Maintenance	1	EA	$55,496	$55,496	
Recovery Well Maintenance	1	EA	$17,005	$17,005	
Re-Injection Well Maintenance	1	EA	$12,637	$12,637	
			SUBTOTAL	$85,138	
Contingency (Scope and Bid)	20%			$17,028	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$102,166	
Project Management	10%			$10,217	The high end of the recommended range was used.
Technical Support	15%			$15,325	Middle value of the recommended range was used.
			TOTAL	$127,708	
		TOTAL WELL MAINTENANCE PERIODIC COST		**$128,000**	Periodic cost is rounded to the nearest $1,000.

TABLE CS G2

ALTERNATIVE G2

GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (LEADING EDGE)

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Recovery wells would be installed at the leading edge of the OU2 groundwater plume and would focus on containing the groundwater plume from further migration in the medial and lower aquifers beyond Technical Boulevard. Groundwater would be pumped to a newly constructed treatment system, located along Blaine Avenue. The number of recovery wells, the approximate locations, and groundwater extraction rates has been estimated by a sitewide groundwater model.

EQUIPMENT REPLACEMENT PERIODIC COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Equipment Replacement Allowance	1	EA	$75,000	$75,000	
			SUBTOTAL	$75,000	
Contingency (Scope and Bid)	20%			$15,000	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$90,000	
Project Management	10%			$9,000	The high end of the recommended range was used.
Technical Support	15%			$13,500	Middle value of the recommended range was used.
			TOTAL	$112,500	
		TOTAL WELL MAINTENANCE PERIODIC COST		**$113,000**	Periodic cost is rounded to the nearest $1,000.

FIVE-YEAR SITE REVIEW PERIODIC COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Five-Year Site Review	1	EA	$46,722	$46,722	
			SUBTOTAL	$46,722	
Contingency (Scope and Bid)	20%			$9,344	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$56,066	
Project Management	10%			$5,607	The high end of the recommended range was used.
			TOTAL	$61,673	
		TOTAL FIVE-YEAR SITE REVIEW PERIODIC COST		**$62,000**	Periodic cost is rounded to the nearest $1,000.

Notes:

Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000. Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

Abbreviations:

EA	Each
LF	Linear feet
LS	Lump sum
QTY	Quantity

TABLE PV-G2

ALTERNATIVE G2
GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (LEADING EDGE)

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS					
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Well Maintenance	Equipment Replacement Costs	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
0	$4,167,000	$0	$0	$0	$0	$0	$4,167,000	1.0000	$4,167,000
1	$0	$183,000	$434,000	$0	$0	$0	$617,000	0.9524	$587,631
2	$0	$183,000	$217,000	$0	$0	$0	$400,000	0.9070	$362,800
3	$0	$183,000	$217,000	$0	$0	$0	$400,000	0.8638	$345,520
4	$0	$183,000	$217,000	$0	$0	$0	$400,000	0.8227	$329,080
5	$0	$183,000	$217,000	$0	$113,000	$62,000	$575,000	0.7835	$450,513
6	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.7462	$218,637
7	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.7107	$208,235
8	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.6768	$198,302
9	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.6446	$188,868
10	$0	$183,000	$110,000	$128,000	$113,000	$62,000	$596,000	0.6139	$365,884
11	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.5847	$171,317
12	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.5568	$163,142
13	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.5303	$155,378
14	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.5051	$147,994
15	$0	$183,000	$110,000	$0	$113,000	$62,000	$468,000	0.4810	$225,108
16	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.4581	$134,223
17	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.4363	$127,836
18	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.4155	$121,742
19	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.3957	$115,940
20	$0	$183,000	$110,000	$128,000	$113,000	$62,000	$596,000	0.3769	$224,632
21	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.3589	$105,158
22	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.3418	$100,147
23	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.3256	$95,401
24	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.3101	$90,859
25	$0	$183,000	$110,000	$0	$113,000	$62,000	$468,000	0.2953	$138,200
26	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.2812	$82,392
27	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.2678	$78,465
28	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.2551	$74,744
29	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.2429	$71,170

TABLE PV-G2

ALTERNATIVE G2
GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (LEADING EDGE)

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS					
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Well Maintenance	Equipment Replacement Costs	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
30	$0	$183,000	$110,000	$128,000	$113,000	$62,000	$596,000	0.2314	$137,914
31	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.2204	$64,577
32	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.2099	$61,501
33	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.1999	$58,571
34	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.1904	$55,787
35	$0	$183,000	$110,000	$0	$113,000	$62,000	$468,000	0.1813	$84,848
36	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.1727	$50,601
37	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.1644	$48,169
38	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.1566	$45,884
39	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.1491	$43,686
40	$0	$183,000	$110,000	$128,000	$113,000	$62,000	$596,000	0.1420	$84,632
41	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.1353	$39,643
42	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.1288	$37,738
43	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.1227	$35,951
44	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.1169	$34,252
45	$0	$183,000	$110,000	$0	$113,000	$62,000	$468,000	0.1113	$52,088
46	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.1060	$31,058
47	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.1009	$29,564
48	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0961	$28,157
49	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0916	$26,839
50	$0	$183,000	$110,000	$128,000	$113,000	$62,000	$596,000	0.0872	$51,971
51	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0831	$24,348
52	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0791	$23,176
53	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0753	$22,063
54	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0717	$21,008
55	$0	$183,000	$110,000	$0	$113,000	$62,000	$468,000	0.0683	$31,964
56	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0651	$19,074
57	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0620	$18,166
58	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0590	$17,287
59	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0562	$16,467

TABLE PV-G2

ALTERNATIVE G2
GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (LEADING EDGE)

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS					
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Well Maintenance	Equipment Replacement Costs	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
60	$0	$183,000	$110,000	$128,000	$113,000	$62,000	$596,000	0.0535	$31,886
61	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0510	$14,943
62	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0486	$14,240
63	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0462	$13,537
64	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0440	$12,892
65	$0	$183,000	$110,000	$0	$113,000	$62,000	$468,000	0.0419	$19,609
66	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0399	$11,691
67	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0380	$11,134
68	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0362	$10,607
69	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0345	$10,109
70	$0	$183,000	$110,000	$128,000	$113,000	$62,000	$596,000	0.0329	$19,608
71	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0313	$9,171
72	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0298	$8,731
73	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0284	$8,321
74	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0270	$7,911
75	$0	$183,000	$110,000	$0	$113,000	$62,000	$468,000	0.0258	$12,074
76	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0245	$7,179
77	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0234	$6,856
78	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0222	$6,505
79	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0212	$6,212
80	$0	$183,000	$110,000	$128,000	$113,000	$62,000	$596,000	0.0202	$12,039
81	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0192	$5,626
82	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0183	$5,362
83	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0174	$5,098
84	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0166	$4,864
85	$0	$183,000	$110,000	$0	$113,000	$62,000	$468,000	0.0158	$7,394
86	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0151	$4,424
87	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0143	$4,190
88	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0137	$4,014
89	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0130	$3,809

TABLE PV-G2

ALTERNATIVE G2
GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (LEADING EDGE)

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS					
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Well Maintenance	Equipment Replacement Costs	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
90	$0	$183,000	$110,000	$128,000	$113,000	$62,000	$596,000	0.0124	$7,390
91	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0118	$3,457
92	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0112	$3,282
93	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0107	$3,135
94	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0102	$2,989
95	$0	$183,000	$110,000	$0	$113,000	$62,000	$468,000	0.0097	$4,540
96	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0092	$2,696
97	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0088	$2,578
98	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0084	$2,461
99	$0	$183,000	$110,000	$0	$0	$0	$293,000	0.0080	$2,344
100	$548,000	$183,000	$110,000	$0	$0	$62,000	$903,000	0.0076	$6,863
TOTALS:	**$4,715,000**	**$18,300,000**	**$11,752,000**	**$1,152,000**	**$2,147,000**	**$1,240,000**	**$39,306,000**		$11,485,073
TOTAL PRESENT VALUE OF ALTERNATIVE G2									**$11,485,000**

Notes:

1 - Duration is estimated for present value analysis. Estimated remedial timeframes are discussed within the FS report.

2 - Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-G2.

3 - Total annual expenditure is the total cost per year with no discounting.

4 - Present value is the total cost per year including a discount factor for that year. See Table PV-ADRFT for details.

5 - Total present value is rounded to the nearest $1,000. Depreciation is excluded from the present value cost.

6 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

TABLE CS G3

ALTERNATIVE G3
GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (MID-PLUME)

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative G3 would have the same elements as Alternative G2, with the addition of recovery wells focused in the mid-plume area. Mid-plume recovery wells would target areas of the plume with carbon tetrachloride concentrations greater than 100 µg/L in the medial aquifer (C zone), generally around South Elm Avenue. The lower aquifer (D/E zone) mid-plume recovery wells would target the plume transect along Showboat Boulevard, where concentrations are found as high 45 µg/L. The presence of recovery wells in the mid-plume area should reduce the timeframe of aquifer restoration. The number of recovery wells, the approximate locations, and groundwater extraction rates has been estimated by a sitewide groundwater model.

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Land Acquisition/Easement Requirements	1	LS	$14,464	$14,464	
Institutional Controls	1	LS	$30,400	$26,385	
Miscellaneous Requirements for Sampling	1	LS	$53,300	$53,300	
Monitoring Well Installation	30	EA	$10,969	$329,045	
Recovery Well Installation	12	EA	$106,439	$1,277,257	
Re-Injection Well Installation	6	EA	$101,355	$608,129	
Well Vault Installation	18	EA	$48,941	$880,931	
Pipe Installation	18,250	LF	$58	$1,047,130	
Treatment System Building	1	EA	$98,469	$98,469	
Treatment System	1	EA	$231,425	$231,425	
Treatment System Startup Testing	1	EA	$13,947	$13,947	
			SUBTOTAL	$4,580,482	
Contingency (Scope and Bid)	20%			$916,096	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$5,496,578	
Project Management	5%			$274,829	Percentage from Exhibit 5-8 was used.
Remedial Design	8%			$439,726	Percentage from Exhibit 5-8 was used.
Construction Management	6%			$329,795	Percentage from Exhibit 5-8 was used.
			TOTAL	$6,540,928	
			TOTAL CAPITAL COST	**$6,541,000**	Total capital cost is rounded to the nearest $1,000.

FUTURE CAPITAL COSTS: (Assumed to be Incurred During Year 75)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring Well Abandonment	57	EA	$3,634	$207,088	
Recovery Well Abandonment	12	EA	$8,233	$98,793	
Re-Injection Well Abandonment	6	EA	$9,433	$56,597	
Decommissioning Treatment System	1	LS	$50,000	$50,000	
			SUBTOTAL	$412,478	
Contingency (Scope and Bid)	20%			$82,496	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$494,974	
Project Management	8%			$39,598	Percentage from Exhibit 5-8 was used.
Remedial Design	15%			$74,246	Percentage from Exhibit 5-8 was used.
Construction Management	10%			$49,497	Percentage from Exhibit 5-8 was used.
			TOTAL	$658,315	
			TOTAL FUTURE CAPITAL COST	**$658,000**	Total future capital cost is rounded to the nearest $1,000.

TABLE CS G3

ALTERNATIVE G3

GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (MID-PLUME)

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative G3 would have the same elements as Alternative G2, with the addition of recovery wells focused in the mid-plume area. Mid-plume recovery wells would target areas of the plume with carbon tetrachloride concentrations greater than 100 µg/L in the medial aquifer (C zone), generally around South Elm Avenue. The lower aquifer (D/E zone) mid-plume recovery wells would target the plume transect along Showboat Boulevard, where concentrations are found as high 45 µg/L. The presence of recovery wells in the mid-plume area should reduce the timeframe of aquifer restoration. The number of recovery wells, the approximate locations, and groundwater extraction rates has been estimated by a sitewide groundwater model.

QUARTERLY MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 1)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Groundwater Sampling Event	4	EA	$43,720	$174,880	
Groundwater Monitoring Event Report Preparation	4	EA	$29,788	$119,152	
			SUBTOTAL	$294,032	
Contingency (Scope and Bid)	20%			$58,806	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$352,838	
Project Management	8%			$28,227	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$52,926	Middle value of the recommended range was used.
			TOTAL	$433,991	
		TOTAL QUARTERLY MONITORING COST		**$434,000**	Total quarterly monitoring cost is rounded to the nearest $1,000.

SEMIANNUAL MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 2 through 5)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Groundwater Sampling Event	2	EA	$43,720	$87,440	
Groundwater Monitoring Event Report Preparation	2	EA	$29,788	$59,576	
			SUBTOTAL	$147,016	
Contingency (Scope and Bid)	20%			$29,403	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$176,419	
Project Management	8%			$14,114	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$26,463	Middle value of the recommended range was used.
			TOTAL	$216,996	
		TOTAL SEMIANNUAL MONITORING COST		**$217,000**	Total semiannual monitoring cost is rounded to the nearest $1,000.

ANNUAL MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 6 through 75)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Groundwater Sampling Event	1	EA	$43,720	$43,720	
Groundwater Monitoring Event Report Preparation	1	EA	$29,788	$29,788	
			SUBTOTAL	$73,508	
Contingency (Scope and Bid)	20%			$14,702	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$88,210	
Project Management	10%			$8,821	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$13,232	Middle value of the recommended range was used.
			TOTAL	$110,263	
		TOTAL ANNUAL MONITORING COST		**$110,000**	Total annual monitoring cost is rounded to the nearest $1,000.

TABLE CS G3

ALTERNATIVE G3

GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (MID-PLUME)

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative G3 would have the same elements as Alternative G2, with the addition of recovery wells focused in the mid-plume area. Mid-plume recovery wells would target areas of the plume with carbon tetrachloride concentrations greater than 100 µg/L in the medial aquifer (C zone), generally around South Elm Avenue. The lower aquifer (D/E zone) mid-plume recovery wells would target the plume transect along Showboat Boulevard, where concentrations are found as high 45 µg/L. The presence of recovery wells in the mid-plume area should reduce the timeframe of aquifer restoration. The number of recovery wells, the approximate locations, and groundwater extraction rates has been estimated by a sitewide groundwater model.

ANNUAL GET O&M ANNUAL COSTS: (Assumed to be Incurred During Year 1 through 75)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
O&M of GET Treatment System	1	EA	$172,891	$172,891	
			SUBTOTAL	$172,891	
Contingency (Scope and Bid)	20%			$34,578	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$207,469	
Project Management	8%			$16,598	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$31,120	Middle value of the recommended range was used.
			TOTAL	$255,187	
		TOTAL ANNUAL O&M COST		**$255,000**	Total annual O&M cost is rounded to the nearest $1,000.

ANNUAL INSTITUTIONAL CONTROL ANNUAL COSTS: (Assumed to be Incurred During Year 1 through 75)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring and Enforcement of Institutional Controls	1	EA	$12,552	$12,552	
			SUBTOTAL	$12,552	
Contingency (Scope and Bid)	20%			$2,510	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$15,062	
Project Management	10%			$1,506	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$2,259	Middle value of the recommended range was used.
			TOTAL	$18,827	
		TOTAL ANNUAL O&M COST		**$19,000**	Total annual O&M cost is rounded to the nearest $1,000.

WELL MAINTENANCE PERIODIC COSTS: (Every 10 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring Well Maintenance	1	EA	$55,496	$55,496	
Recovery Well Maintenance	1	EA	$25,743	$25,743	
Re-Injection Well Maintenance	1	EA	$17,005	$17,005	
			SUBTOTAL	$98,244	
Contingency (Scope and Bid)	20%			$19,649	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$117,893	
Project Management	10%			$11,789	The high end of the recommended range was used.
Technical Support	15%			$17,684	Middle value of the recommended range was used.
			TOTAL	$147,366	
		TOTAL WELL MAINTENANCE PERIODIC COST		**$147,000**	Periodic cost is rounded to the nearest $1,000.

TABLE CS G3

ALTERNATIVE G3

GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (MID-PLUME)

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative G3 would have the same elements as Alternative G2, with the addition of recovery wells focused in the mid-plume area. Mid-plume recovery wells would target areas of the plume with carbon tetrachloride concentrations greater than 100 µg/L in the medial aquifer (C zone), generally around South Elm Avenue. The lower aquifer (D/E zone) mid-plume recovery wells would target the plume transect along Showboat Boulevard, where concentrations are found as high 45 µg/L. The presence of recovery wells in the mid-plume area should reduce the timeframe of aquifer restoration. The number of recovery wells, the approximate locations, and groundwater extraction rates has been estimated by a sitewide groundwater model.

EQUIPMENT REPLACEMENT PERIODIC COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Equipment Replacement Allowance	1	EA	$75,000	$75,000	
			SUBTOTAL	$75,000	
Contingency (Scope and Bid)	20%			$15,000	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$90,000	
Project Management	10%			$9,000	The high end of the recommended range was used.
Technical Support	15%			$13,500	Middle value of the recommended range was used.
			TOTAL	$112,500	
		TOTAL WELL MAINTENANCE PERIODIC COST		**$113,000**	Periodic cost is rounded to the nearest $1,000.

TABLE CS G3

ALTERNATIVE G3

GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (MID-PLUME)

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative G3 would have the same elements as Alternative G2, with the addition of recovery wells focused in the mid-plume area. Mid-plume recovery wells would target areas of the plume with carbon tetrachloride concentrations greater than 100 µg/L in the medial aquifer (C zone), generally around South Elm Avenue. The lower aquifer (D/E zone) mid-plume recovery wells would target the plume transect along Showboat Boulevard, where concentrations are found as high 45 µg/L. The presence of recovery wells in the mid-plume area should reduce the timeframe of aquifer restoration. The number of recovery wells, the approximate locations, and groundwater extraction rates has been estimated by a sitewide groundwater model.

FIVE-YEAR SITE REVIEW PERIODIC COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Five-Year Site Review	1	EA	$46,722	$46,722	
			SUBTOTAL	$46,722	
Contingency (Scope and Bid)	20%			$9,344	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$56,066	
Project Management	10%			$5,607	The high end of the recommended range was used.
			TOTAL	$61,673	
	TOTAL FIVE-YEAR SITE REVIEW PERIODIC COST			**$62,000**	Periodic cost is rounded to the nearest $1,000.

Notes:

Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000. Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

Abbreviations:

EA	Each
LF	Linear feet
LS	Lump sum
QTY	Quantity

TABLE PV-G3

ALTERNATIVE G3
GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (MID-PLUME)

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS					
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Well Maintenance	Equipment Replacement Costs	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
0	$6,541,000	$0	$0	$0	$0	$0	$6,541,000	1.0000	$6,541,000
1	$0	$274,000	$434,000	$0	$0	$0	$708,000	0.9524	$674,299
2	$0	$274,000	$217,000	$0	$0	$0	$491,000	0.9070	$445,337
3	$0	$274,000	$217,000	$0	$0	$0	$491,000	0.8638	$424,126
4	$0	$274,000	$217,000	$0	$0	$0	$491,000	0.8227	$403,946
5	$0	$274,000	$217,000	$0	$113,000	$62,000	$666,000	0.7835	$521,811
6	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.7462	$286,541
7	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.7107	$272,909
8	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.6768	$259,891
9	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.6446	$247,526
10	$0	$274,000	$110,000	$147,000	$113,000	$62,000	$706,000	0.6139	$433,413
11	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.5847	$224,525
12	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.5568	$213,811
13	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.5303	$203,635
14	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.5051	$193,958
15	$0	$274,000	$110,000	$0	$113,000	$62,000	$559,000	0.4810	$268,879
16	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.4581	$175,910
17	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.4363	$167,539
18	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.4155	$159,552
19	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.3957	$151,949
20	$0	$274,000	$110,000	$147,000	$113,000	$62,000	$706,000	0.3769	$266,091
21	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.3589	$137,818
22	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.3418	$131,251
23	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.3256	$125,030
24	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.3101	$119,078
25	$0	$274,000	$110,000	$0	$113,000	$62,000	$559,000	0.2953	$165,073
26	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.2812	$107,981
27	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.2678	$102,835
28	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.2551	$97,958
29	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.2429	$93,274

TABLE PV-G3

ALTERNATIVE G3
GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (MID-PLUME)

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS					
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Well Maintenance	Equipment Replacement Costs	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
30	$0	$274,000	$110,000	$147,000	$113,000	$62,000	$706,000	0.2314	$163,368
31	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.2204	$84,634
32	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.2099	$80,602
33	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.1999	$76,762
34	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.1904	$73,114
35	$0	$274,000	$110,000	$0	$113,000	$62,000	$559,000	0.1813	$101,347
36	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.1727	$66,317
37	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.1644	$63,130
38	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.1566	$60,134
39	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.1491	$57,254
40	$0	$274,000	$110,000	$147,000	$113,000	$62,000	$706,000	0.1420	$100,252
41	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.1353	$51,955
42	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.1288	$49,459
43	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.1227	$47,117
44	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.1169	$44,890
45	$0	$274,000	$110,000	$0	$113,000	$62,000	$559,000	0.1113	$62,217
46	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.1060	$40,704
47	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.1009	$38,746
48	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0961	$36,902
49	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0916	$35,174
50	$0	$274,000	$110,000	$147,000	$113,000	$62,000	$706,000	0.0872	$61,563
51	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0831	$31,910
52	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0791	$30,374
53	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0753	$28,915
54	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0717	$27,533
55	$0	$274,000	$110,000	$0	$113,000	$62,000	$559,000	0.0683	$38,180
56	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0651	$24,998
57	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0620	$23,808
58	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0590	$22,656
59	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0562	$21,581

TABLE PV-G3

ALTERNATIVE G3
GROUNDWATER RECOVERY, TREATMENT, AND DISCHARGE (MID-PLUME)

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS					
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Well Maintenance	Equipment Replacement Costs	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
60	$0	$274,000	$110,000	$147,000	$113,000	$62,000	$706,000	0.0535	$37,771
61	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0510	$19,584
62	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0486	$18,662
63	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0462	$17,741
64	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0440	$16,896
65	$0	$274,000	$110,000	$0	$113,000	$62,000	$559,000	0.0419	$23,422
66	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0399	$15,322
67	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0380	$14,592
68	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0362	$13,901
69	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0345	$13,248
70	$0	$274,000	$110,000	$147,000	$113,000	$62,000	$706,000	0.0329	$23,227
71	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0313	$12,019
72	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0298	$11,443
73	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0284	$10,906
74	$0	$274,000	$110,000	$0	$0	$0	$384,000	0.0270	$10,368
75	$658,000	$274,000	$110,000	$0	$0	$62,000	$1,104,000	0.0258	$28,483
TOTALS:	**$7,199,000**	**$20,550,000**	**$9,002,000**	**$1,029,000**	**$1,582,000**	**$930,000**	**$40,292,000**		$15,550,127
TOTAL PRESENT VALUE OF ALTERNATIVE G3									**$15,550,000**

Notes:

1 - Duration is estimated for present value analysis. Estimated remedial timeframes are discussed within the FS report.

2 - Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-G3.

3 - Total annual expenditure is the total cost per year with no discounting.

4 - Present value is the total cost per year including a discount factor for that year. See Table PV-ADRFT for details.

5 - Total present value is rounded to the nearest $1,000. Depreciation is excluded from the present value cost.

6 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

TABLE CS G4

ALTERNATIVE G4

IN SITU TREATMENT (MID) AND GROUNDWATER TREATMENT AND DISCHARGE (LEADING EDGE)

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative G4 combines Alternative G2 with in situ treatment through groundwater amendments in the core of the contaminant plume. Operation of the treatment system would prevent further migration of contaminated groundwater and restore the aquifer to levels at or below the PCLs for the site. In situ treatment would further reduce concentrations, reducing the time table for aquifer restoration and operation of the treatment system

CAPITAL COSTS: (Assumed to be Incurred During Year 0)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Land Acquisition/Easement Requirements	1	LS	$14,464	$14,464	
Institutional Controls	1	LS	$30,400	$26,385	
Miscellaneous Requirements for Sampling	1	LS	$53,300	$53,300	
Monitoring Well Installation	30	EA	$10,969	$329,045	
Injection Well Installation	78	EA	$11,332	$883,846	
Recovery Well Installation	6	EA	$106,924	$641,543	
Re-Injection Well Installation	3	EA	$111,850	$335,548	
EB Injection Event - Equipment Purchase	1	LS	$23,851	$23,851	
Pilot Scale Injection	1	EA	$383,607	$383,607	Average cost of the three injection alternatives
EB Injection			$523,845		
ISCO Injection			$257,693		
ISCR Injection			$369,281		
Pilot Scale Groundwater Monitoring Event	1	EA	$57,871	$57,871	
Pilot Scale Groundwater Monitoring Event Report Generation	1	EA	$14,580	$14,580	
Well Vault Installation	9	EA	$48,941	$440,466	
Pipe Installation	13,480	LF	$62	$828,916	
Treatment System Building	1	EA	$98,469	$98,469	
Treatment System	1	EA	$156,893	$156,893	
Treatment System Startup Testing	1	EA	$13,947	$13,947	
			SUBTOTAL	$4,302,731	
Contingency (Scope and Bid)	20%			$860,546	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$5,163,277	
Project Management	5%			$258,164	Percentage from Exhibit 5-8 was used.
Remedial Design	8%			$413,062	Percentage from Exhibit 5-8 was used.
Construction Management	6%			$309,797	Percentage from Exhibit 5-8 was used.
Technical Support	10%			$516,328	
			TOTAL	$6,660,628	
			TOTAL CAPITAL COST	**$6,661,000**	Total capital cost is rounded to the nearest $1,000.

TABLE CS G4

ALTERNATIVE G4
IN SITU TREATMENT (MID) AND GROUNDWATER TREATMENT AND DISCHARGE (LEADING EDGE)

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative G4 combines Alternative G2 with in situ treatment through groundwater amendments in the core of the contaminant plume. Operation of the treatment system would prevent further migration of contaminated groundwater and restore the aquifer to levels at or below the PCLs for the site. In situ treatment would further reduce concentrations, reducing the time table for aquifer restoration and operation of the treatment system

FUTURE CAPITAL COSTS: (Assumed to be Incurred During Year 75)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring Well Abandonment	57	EA	$3,634	$207,088	
Injection Well Abandonment	78	EA	$2,926	$228,164	
Recovery Well Abandonment	6	EA	$8,922	$53,532	
Re-Injection Well Abandonment	3	EA	$10,860	$32,578	
Decommissioning Treatment System	1	LS	$50,000	$50,000	
			SUBTOTAL	$571,362	
Contingency (Scope and Bid)	20%			$114,272	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$685,634	
Project Management	6%			$41,138	Percentage from Exhibit 5-8 was used.
Remedial Design	12%			$82,276	Percentage from Exhibit 5-8 was used.
Construction Management	8%			$54,851	Percentage from Exhibit 5-8 was used.
			TOTAL	$863,899	
		TOTAL FUTURE CAPITAL COST		**$864,000**	Total future capital cost is rounded to the nearest $1,000.

INJECTION PERIODIC COSTS: (Assumed to be Incurred During Year 0 through 4)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Injection Event - Line 1	1	EA	$3,285,633	$3,285,633	Average cost of the three injection alternatives
EB Injection			$3,996,608		
ISCO Injection			$2,350,122		
ISCR Injection			$3,510,168		
			SUBTOTAL	$3,285,633	
Contingency (Scope and Bid)	20%			$657,127	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$3,942,760	
Project Management	5%			$197,138	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$591,414	Middle value of the recommended range was used.
			TOTAL	$4,731,312	
		TOTAL INJECTION COST		**$4,731,000**	Total periodic injection cost is rounded to the nearest $1,000.

TABLE CS G4

ALTERNATIVE G4
IN SITU TREATMENT (MID) AND GROUNDWATER TREATMENT AND DISCHARGE (LEADING EDGE)

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative G4 combines Alternative G2 with in situ treatment through groundwater amendments in the core of the contaminant plume. Operation of the treatment system would prevent further migration of contaminated groundwater and restore the aquifer to levels at or below the PCLs for the site. In situ treatment would further reduce concentrations, reducing the time table for aquifer restoration and operation of the treatment system

QUARTERLY MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 1)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
EB Groundwater Sampling Event	1	EA	$88,724	$88,724	
VOC-Only Groundwater Sampling Event	3	EA	$43,720	$131,160	
Groundwater Monitoring Event Report Preparation	4	EA	$29,788	$119,152	
			SUBTOTAL	$339,036	
Contingency (Scope and Bid)	20%			$67,807	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$406,843	
Project Management	8%			$32,547	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$61,026	Middle value of the recommended range was used.
			TOTAL	$500,416	
		TOTAL QUARTERLY MONITORING COST		**$500,000**	Total quarterly monitoring cost is rounded to the nearest $1,000.

SEMIANNUAL MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 2 through 5)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
EB Groundwater Sampling Event	1	EA	$88,724	$88,724	
VOC-Only Groundwater Sampling Event	1	EA	$43,720	$43,720	
Groundwater Monitoring Event Report Preparation	2	EA	$29,788	$59,576	
			SUBTOTAL	$192,020	
Contingency (Scope and Bid)	20%			$38,404	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$230,424	
Project Management	8%			$18,434	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$34,564	Middle value of the recommended range was used.
			TOTAL	$283,422	
		TOTAL SEMIANNUAL MONITORING COST		**$283,000**	Total semiannual monitoring cost is rounded to the nearest $1,000.

ANNUAL MONITORING ANNUAL COSTS: (Assumed to be Incurred During Year 6 through 75)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
EB Groundwater Sampling Event	1	EA	$88,724	$88,724	
Groundwater Monitoring Event Report Preparation	1	EA	$29,788	$29,788	
			SUBTOTAL	$118,512	
Contingency (Scope and Bid)	20%			$23,702	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$142,214	
Project Management	8%			$11,377	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$21,332	Middle value of the recommended range was used.
			TOTAL	$174,923	
		TOTAL ANNUAL MONITORING COST		**$175,000**	Total annual monitoring cost is rounded to the nearest $1,000.

TABLE CS G4

ALTERNATIVE G4
IN SITU TREATMENT (MID) AND GROUNDWATER TREATMENT AND DISCHARGE (LEADING EDGE)

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative G4 combines Alternative G2 with in situ treatment through groundwater amendments in the core of the contaminant plume. Operation of the treatment system would prevent further migration of contaminated groundwater and restore the aquifer to levels at or below the PCLs for the site. In situ treatment would further reduce concentrations, reducing the time table for aquifer restoration and operation of the treatment system

ANNUAL GET O&M ANNUAL COSTS: (Assumed to be Incurred During Year 1 through 75)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
O&M of GET Treatment System	1	EA	$110,833	$110,833	
			SUBTOTAL	$110,833	
Contingency (Scope and Bid)	20%			$22,167	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$133,000	
Project Management	8%			$10,640	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$19,950	Middle value of the recommended range was used.
			TOTAL	$163,590	
		TOTAL ANNUAL O&M COST		**$164,000**	Total annual O&M cost is rounded to the nearest $1,000.

ANNUAL INSTITUTIONAL CONTROL ANNUAL COSTS: (Assumed to be Incurred During Year 1 through 75)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring and Enforcement of Institutional Controls	1	EA	$12,552	$12,552	
			SUBTOTAL	$12,552	
Contingency (Scope and Bid)	20%			$2,510	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$15,062	
Project Management	10%			$1,506	Percentage from Exhibit 5-8 was used.
Technical Support	15%			$2,259	Middle value of the recommended range was used.
			TOTAL	$18,827	
		TOTAL ANNUAL O&M COST		**$19,000**	Total annual O&M cost is rounded to the nearest $1,000.

WELL MAINTENANCE PERIODIC COSTS: (Every 10 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Monitoring Well Maintenance	1	EA	$55,496	$55,496	
Recovery Well Maintenance	1	EA	$17,005	$17,005	
Re-Injection Well Maintenance	1	EA	$12,637	$12,637	
			SUBTOTAL	$85,138	
Contingency (Scope and Bid)	20%			$17,028	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$102,166	
Project Management	10%			$10,217	The high end of the recommended range was used.
Technical Support	15%			$15,325	Middle value of the recommended range was used.
			TOTAL	$127,708	
		TOTAL WELL MAINTENANCE PERIODIC COST		**$128,000**	Periodic cost is rounded to the nearest $1,000.

TABLE CS G4

ALTERNATIVE G4
IN SITU TREATMENT (MID) AND GROUNDWATER TREATMENT AND DISCHARGE (LEADING EDGE)

COST ESTIMATE SUMMARY

Site: Garvey Elevator Site
Operable Unit: OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012
Date: May 2012

Description: Alternative G4 combines Alternative G2 with in situ treatment through groundwater amendments in the core of the contaminant plume. Operation of the treatment system would prevent further migration of contaminated groundwater and restore the aquifer to levels at or below the PCLs for the site. In situ treatment would further reduce concentrations, reducing the time table for aquifer restoration and operation of the treatment system

EQUIPMENT REPLACEMENT PERIODIC COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Equipment Replacement Allowance	1	EA	$75,000	$75,000	
			SUBTOTAL	$75,000	
Contingency (Scope and Bid)	20%			$15,000	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$90,000	
Project Management	10%			$9,000	The high end of the recommended range was used.
Technical Support	15%			$13,500	Middle value of the recommended range was used.
			TOTAL	$112,500	
			TOTAL WELL MAINTENANCE PERIODIC COST	**$113,000**	Periodic cost is rounded to the nearest $1,000.

FIVE-YEAR SITE REVIEW PERIODIC COSTS: (Every 5 years)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Five-Year Site Review	1	EA	$46,722	$46,722	
			SUBTOTAL	$46,722	
Contingency (Scope and Bid)	20%			$9,344	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	$56,066	
Project Management	10%			$5,607	The high end of the recommended range was used.
			TOTAL	$61,673	
			TOTAL FIVE-YEAR SITE REVIEW PERIODIC COST	**$62,000**	Periodic cost is rounded to the nearest $1,000.

Notes:
Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000. Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

Abbreviations:

EA	Each
LF	Linear feet
LS	Lump sum
QTY	Quantity

TABLE PV-G4

ALTERNATIVE G4

IN SITU TREATMENT (MID) AND GROUNDWATER TREATMENT AND DISCHARGE (LEADING EDGE)

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS						
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Injection Costs	Well Maintenance	Equipment Replacement Costs	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
0	$6,661,000	$0	$0	$4,731,000	$0	$0	$0	$11,392,000	1.0000	$11,392,000
1	$0	$183,000	$500,000	$4,731,000	$0	$0	$0	$5,414,000	0.9524	$5,156,294
2	$0	$183,000	$283,000	$4,731,000	$0	$0	$0	$5,197,000	0.9070	$4,713,679
3	$0	$183,000	$283,000	$4,731,000	$0	$0	$0	$5,197,000	0.8638	$4,489,169
4	$0	$183,000	$283,000	$4,731,000	$0	$0	$0	$5,197,000	0.8227	$4,275,572
5	$0	$183,000	$283,000	$0	$0	$113,000	$62,000	$641,000	0.7835	$502,224
6	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.7462	$267,140
7	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.7107	$254,431
8	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.6768	$242,294
9	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.6446	$230,767
10	$0	$183,000	$175,000	$0	$128,000	$113,000	$62,000	$661,000	0.6139	$405,788
11	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.5847	$209,323
12	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.5568	$199,334
13	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.5303	$189,847
14	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.5051	$180,826
15	$0	$183,000	$175,000	$0	$0	$113,000	$62,000	$533,000	0.4810	$256,373
16	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.4581	$164,000
17	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.4363	$156,195
18	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.4155	$148,749
19	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.3957	$141,661
20	$0	$183,000	$175,000	$0	$128,000	$113,000	$62,000	$661,000	0.3769	$249,131
21	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.3589	$128,486
22	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.3418	$122,364
23	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.3256	$116,565
24	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.3101	$111,016
25	$0	$183,000	$175,000	$0	$0	$113,000	$62,000	$533,000	0.2953	$157,395
26	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.2812	$100,670
27	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.2678	$95,872
28	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.2551	$91,326
29	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.2429	$86,958

TABLE PV-G4

ALTERNATIVE G4

IN SITU TREATMENT (MID) AND GROUNDWATER TREATMENT AND DISCHARGE (LEADING EDGE)

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS						
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Injection Costs	Well Maintenance	Equipment Replacement Costs	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
30	$0	$183,000	$175,000	$0	$128,000	$113,000	$62,000	$661,000	0.2314	$152,955
31	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.2204	$78,903
32	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.2099	$75,144
33	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.1999	$71,564
34	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.1904	$68,163
35	$0	$183,000	$175,000	$0	$0	$113,000	$62,000	$533,000	0.1813	$96,633
36	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.1727	$61,827
37	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.1644	$58,855
38	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.1566	$56,063
39	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.1491	$53,378
40	$0	$183,000	$175,000	$0	$128,000	$113,000	$62,000	$661,000	0.1420	$93,862
41	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.1353	$48,437
42	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.1288	$46,110
43	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.1227	$43,927
44	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.1169	$41,850
45	$0	$183,000	$175,000	$0	$0	$113,000	$62,000	$533,000	0.1113	$59,323
46	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.1060	$37,948
47	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.1009	$36,122
48	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0961	$34,404
49	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0916	$32,793
50	$0	$183,000	$175,000	$0	$128,000	$113,000	$62,000	$661,000	0.0872	$57,639
51	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0831	$29,750
52	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0791	$28,318
53	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0753	$26,957
54	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0717	$25,669
55	$0	$183,000	$175,000	$0	$0	$113,000	$62,000	$533,000	0.0683	$36,404
56	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0651	$23,306
57	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0620	$22,196
58	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0590	$21,122
59	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0562	$20,120

TABLE PV-G4

ALTERNATIVE G4

IN SITU TREATMENT (MID) AND GROUNDWATER TREATMENT AND DISCHARGE (LEADING EDGE)

PRESENT VALUE ANALYSIS

Site: Garvey Elevator Site
Operable Unit: OU1
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate: 5.00%

		ANNUAL COSTS		PERIODIC COSTS						
Year[1]	Capital Costs[2]	O&M Costs	Monitoring Costs	Injection Costs	Well Maintenance	Equipment Replacement Costs	Five-year Review Costs	Total Annual Expenditure[3]	Discount Factor	Present Value[4,5]
60	$0	$183,000	$175,000	$0	$128,000	$113,000	$62,000	$661,000	0.0535	$35,364
61	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0510	$18,258
62	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0486	$17,399
63	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0462	$16,540
64	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0440	$15,752
65	$0	$183,000	$175,000	$0	$0	$113,000	$62,000	$533,000	0.0419	$22,333
66	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0399	$14,284
67	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0380	$13,604
68	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0362	$12,960
69	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0345	$12,351
70	$0	$183,000	$175,000	$0	$128,000	$113,000	$62,000	$661,000	0.0329	$21,747
71	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0313	$11,205
72	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0298	$10,668
73	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0284	$10,167
74	$0	$183,000	$175,000	$0	$0	$0	$0	$358,000	0.0270	$9,666
75	$864,000	$183,000	$175,000	$0	$0	$0	$62,000	$1,284,000	0.0258	$33,127
TOTALS:	**$7,525,000**	**$13,725,000**	**$13,882,000**	**$23,655,000**	**$896,000**	**$1,582,000**	**$930,000**	**$62,195,000**		$36,650,616
TOTAL PRESENT VALUE OF ALTERNATIVE G4										**$36,651,000**

Notes:

1 - Duration is estimated for present value analysis. Estimated remedial timeframes are discussed within the FS report.

2 - Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-G4.

3 - Total annual expenditure is the total cost per year with no discounting.

4 - Present value is the total cost per year including a discount factor for that year. See Table PV-ADRFT for details.

5 - Total present value is rounded to the nearest $1,000. Depreciation is excluded from the present value cost.

6 - Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for FS evaluation purposes.

TABLE PV-ADRFT

ANNUAL DISCOUNT RATE FACTORS TABLE

Site: Garvey Elevator Site
Unit: OU1 and OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Discount Rate (Percent): 5.00%

Year	Discount Factor[1,2]	Year	Discount Factor[1,2]	Year	Discount Factor[1,2]
0	1.0000	34	0.1904	68	0.0362
1	0.9524	35	0.1813	69	0.0345
2	0.9070	36	0.1727	70	0.0329
3	0.8638	37	0.1644	71	0.0313
4	0.8227	38	0.1566	72	0.0298
5	0.7835	39	0.1491	73	0.0284
6	0.7462	40	0.1420	74	0.0270
7	0.7107	41	0.1353	75	0.0258
8	0.6768	42	0.1288	76	0.0245
9	0.6446	43	0.1227	77	0.0234
10	0.6139	44	0.1169	78	0.0222
11	0.5847	45	0.1113	79	0.0212
12	0.5568	46	0.1060	80	0.0202
13	0.5303	47	0.1009	81	0.0192
14	0.5051	48	0.0961	82	0.0183
15	0.4810	49	0.0916	83	0.0174
16	0.4581	50	0.0872	84	0.0166
17	0.4363	51	0.0831	85	0.0158
18	0.4155	52	0.0791	86	0.0151
19	0.3957	53	0.0753	87	0.0143
20	0.3769	54	0.0717	88	0.0137
21	0.3589	55	0.0683	89	0.0130
22	0.3418	56	0.0651	90	0.0124
23	0.3256	57	0.0620	91	0.0118
24	0.3101	58	0.0590	92	0.0112
25	0.2953	59	0.0562	93	0.0107
26	0.2812	60	0.0535	94	0.0102
27	0.2678	61	0.0510	95	0.0097
28	0.2551	62	0.0486	96	0.0092
29	0.2429	63	0.0462	97	0.0088
30	0.2314	64	0.0440	98	0.0084
31	0.2204	65	0.0419	99	0.0080
32	0.2099	66	0.0399	100	0.0076
33	0.1999	67	0.0380		

Notes:

1 - Annual discount factors were calculated using the formulas and guidance presented in Section 4.0 of *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* , EPA 2000.
2 - The net present value will not be calculated with the real discount rate as recommended by EPA's A Guide to Developing and Documenting Cost Estimates during the Feasibility Study; rather a nominal discount (interest) rate of 5 percent (Treasury interest rates) was used in the determination of net present value.

TABLE PV-OMB

OMB NOMINAL TREASURY INTEREST RATES

Site: Garvey Elevator Site
Operable Unit: OU1 and OU2
Location: Hastings, Nebraska
Phase: Feasibility Study
Base Year: 2012

Year	3-Year	5-Year	7-Year	10-Year	20-Year	30-Year
1992	6.1%	6.5%	6.7%	7.0%	N/A	7.1%
1993	5.6%	6.0%	6.3%	6.7%	N/A	6.8%
1994	5.0%	5.3%	5.5%	5.7%	N/A	5.8%
1995	7.3%	7.6%	7.7%	7.9%	N/A	8.1%
1996	5.4%	5.5%	5.5%	5.6%	N/A	5.7%
1997	5.8%	5.9%	6.0%	6.1%	N/A	6.3%
1998	5.6%	5.7%	5.8%	5.9%	N/A	6.1%
1999	4.7%	4.8%	4.9%	4.9%	N/A	5.0%
2000	5.9%	6.0%	6.0%	6.1%	N/A	6.3%
2001	5.4%	5.4%	5.4%	5.4%	N/A	5.3%
2002	4.1%	4.5%	4.8%	5.1%	N/A	5.8%
2003	3.1%	3.6%	3.9%	4.2%	N/A	5.1%
2004	3.0%	3.7%	4.2%	4.6%	5.4%	5.5%
2005	3.7%	4.1%	4.4%	4.6%	5.2%	5.2%
2006	4.7%	4.8%	4.9%	5.0%	5.3%	5.2%
2007	4.9%	4.9%	4.9%	5.0%	5.1%	5.1%
2008	4.1%	4.3%	4.4%	4.6%	4.9%	4.9%
2009	2.7%	3.3%	3.7%	4.2%	4.7%	4.5%
2010	2.3%	3.1%	3.5%	3.9%	4.4%	4.5%
2011	1.4%	1.9%	2.4%	3.0%	3.9%	4.2%
2012	1.6%	2.1%	2.5%	2.8%	3.5%	3.8%
20-year Ave.	5.00%	5.00%	5.00%	7.50%	5.00%	7.50%
10-year Ave.	3.25%	3.75%	4.00%	4.25%	4.75%	**5.00%**

Notes:

- Nominal Treasury interest rates were taken from the annual budget assumptions for the first year of the budget forecast
- Averages rounded to nearest quarter of a percent

N/A - No data is available prior to 2004 for the 20-year interest rate.

US EPA ARCHIVE DOCUMENT

Detailed Cost Breakout

US EPA ARCHIVE DOCUMENT

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Standard Report Selections

Title Page

Garvey Elevator Site

Hastings, NE

Estimated by	CDM
Designed by	CDM Federal Programs Corporation (CDM Smith)
Prepared by	Justin Nielsen
Preparation Date	5/18/2012
Effective Date of Pricing	5/18/2012
Estimated Construction Time	Days

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Contract Cost Summary Report 1
Contaminated Soil 1
Common Components for Contaminated Soil 1
Institutional Controls 1
Five-Year Review 1
Site Visit 1
Annual Monitoring 1
Sampling Event 1
Report Preparation 2
OU1 Soil (Source Area) 2
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Description	Contractor	Quantity	UOM	ProjectCost
Contract Cost Summary Report				**41,712,288**
Contaminated Soil		**1.00**	**EA**	**903,259**
Common Components for Contaminated Soil		**1.00**	**LS**	**94,344**
Institutional Controls	**AE Contractor L**	**1.00**	**LS**	**30,400**
Reproduction Costs for Institutional Controls (Note: Per Estimator)	AE Contractor ME	1.00	LS	325
Paralegal (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Paralegal: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	60.00	HR	4,722
Environmental Lawyer (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Lawyer: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6 [redacted]	AE Contractor L	120.00	HR	19,544
Clerks, Typists, Bookkeepers & Receptionist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]%)	AE Contractor L	40.00	HR	1,794
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6.5%)	AE Contractor L	40.00	HR	4,014
Five-Year Review	**AE Contractor L**	**1.00**	**EA**	**46,722**
Reproduction Costs for Five-Year Site Review Reports (Note: Per Estimator)	AE Contractor ME	1.00	LS	696
Drafter CAD (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Draftsman: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	40.00	HR	2,433
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	40.00	HR	4,014
Clerks, Typists, Bookkeepers & Receptionist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	40.00	HR	1,794
Quality Control Engineer (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Quality Control Engineer: [redacted] Assumed Benefits: 15.2% Assumed Bonus: [redacted]	AE Contractor L	24.00	HR	2,739
Environmental Scientist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Environmental Scientist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	160.00	HR	18,772
Environmental Engineer (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Environmental Engineer: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	120.00	HR	12,697
Site Visit	**AE Contractor L**	**1.00**	**LS**	**3,577**
Weekly Pickup Truck Rental (Note: Weekly Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	1.00	WK	537
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	3.00	DAY	501
Environmental Engineer (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Environmental Engineer: [redacted] Assumed Benefits: 15.2% Assumed Bonus: [redacted]	AE Contractor L	24.00	HR	2,539
Annual Monitoring	**AE Contractor ME**	**1.00**	**EA**	**17,223**
Sampling Event	**AE Contractor ME**	**1.00**	**EA**	**8,697**
VOC Vapor Analysis (Summa Canister)	AE Contractor ME	15.00	EA	3,777

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Vendor Quote: TestAmerica GSA, 2012)				
Overnight Sample Shipment	AE Contractor ME	3.00	EA	390
General Operator/Tech	AE Contractor ME	60.00	HR	2,710
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Project Manager	AE Contractor ME	6.00	HR	455
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted]				
Per Diem	AE Contractor ME	6.00	DAY	1,001
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	3.00	DAY	322
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	3.00	DAY	42
(Note: Per Estimator)				
Report Preparation	**AE Contractor ME**	**1.00**	**EA**	**8,526**
Reproduction Costs for Groundwater Sampling Event Reports	AE Contractor ME	1.00	LS	696
(Note: Per Estimator)				
Drafter CAD	AE Contractor L	20.00	HR	1,216
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Draftsman: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Project Manager	AE Contractor L	4.00	HR	401
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted]1 Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Clerks, Typists, Bookkeepers & Receptionist	AE Contractor L	5.00	HR	224
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: 6[redacted]				
Geologist	AE Contractor L	60.00	HR	5,988
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed [redacted]				
OU1 Soil (Source Area)		**1.00**	**LS**	**808,915**
Excavation, Treatment, and Disposal of Soil Contamination		**1.00**	**EA**	**223,135**
Mobilization and Demobilization	**Earthwork Subcontractor**	**1.00**	**EA**	**5,428**
Tractor w/Low Bed Trailer (Heavy Equipment)	Earthwork Subcontractor	4.00	EA	3,698
Tractor w/ Flatbed Trailer (Large Equipment)	Earthwork Subcontractor	2.00	EA	1,729
Earthwork		**1.00**	**LS**	**42,856**
Excavation of Contaminated Soil	**Earthwork Subcontractor**	**297.00**	**BCY**	**5,884**
Sheet piling, wood, solid sheeting, 50 S.F./hour in & 150 S.F./hour out, 10' deep excavation, drive, extract and salvage, includes wales, braces and spacers	Earthwork Subcontractor	400.00	SF	2,218
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	Earthwork Subcontractor	297.00	BCY	2,522
Spray washing, decontaminate heavy equipment, decontaminate heavy equipment	Earthwork Subcontractor	6.00	EA	1,143
(Note: Crew Output - MII English Cost Book 2010; Source - HTW; Source Tag - 019413103112.)				
Treatment of Contaminated Soils	**Earthwork Subcontractor**	**357.00**	**LCY**	**25,566**
Berm Construction	**Earthwork Subcontractor**	**1.00**	**LS**	**418**
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	Earthwork Subcontractor	29.90	BCY	254
Hauling between Borrow Area and Treatment Area	Earthwork Subcontractor	35.90	LCY	99
(Note: Crew Output - CostWorks 2011; Source Tag - 312323201016)				
Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with sheepsfoot roller	Earthwork Subcontractor	26.90	ECY	65
Liner and Gravel Placement	**Earthwork Subcontractor**	**1.00**	**LS**	**5,180**
Polymeric liner and cover system, polyvinyl chloride (PVC), 40 mil	Earthwork Subcontractor	4,406.00	SF	3,600

Description	Contractor	Quantity	UOM	ProjectCost
Borrow, material only, bank run gravel	Earthwork Subcontractor	81.60	TON	1,580
(Note: Material cost from RS Means CostWorks 2011 item 312323155050.)				
Piping and Equipment	**General Contractor**	**1.00**	**LS**	**12,165**
Air sparging, blowers, 170 SCFM, 10.3 HP, 10 psi	General Contractor	1.00	EA	6,293
Slotted PVC, 2" diameter	General Contractor	129.00	LF	918
Pipe, plastic, PVC, 2" diameter, schedule 80, excludes couplings and hangers	General Contractor	536.00	LF	2,598
Tee, plastic, PVC, socket joint, 2", schedule 80	General Contractor	1.00	EA	50
Elbow, 90 Deg., plastic, PVC, socket joint, 2", schedule 80	General Contractor	2.00	EA	38
Valves, plastic, PVC, ball, single union, socket or threaded, 2"	General Contractor	1.00	EA	103
Pressure Gauge	General Contractor	1.00	EA	165
(Note: Vendor Quote: Indelco Plastics, 2010)				
Electrical and instrumentation and controls allowance		1.00	LS	2,000
(Note: Per estimator.)				
Placement of Contaminated Soil	**Earthwork Subcontractor**	**1.00**	**LS**	**1,700**
Hauling between Excavation Area and Borrow Area	Earthwork Subcontractor	357.00	LCY	980
Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with sheepsfoot roller	Earthwork Subcontractor	297.00	ECY	720
Deconstruction of Berm	**Earthwork Subcontractor**	**1.00**	**LS**	**254**
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	Earthwork Subcontractor	29.90	BCY	254
Treatment System O&M	**Earthwork Subcontractor**	**1.00**	**LS**	**3,326**
Electrical Consumption	Earthwork Subcontractor	15,100.00	KWH	1,646
(Note: Cost Source: U.S. Energy Information Administration)				
Weekly maintenance visit	Earthwork Subcontractor	8.00	EA	1,680
Loading of Treated Soils	**Earthwork Subcontractor**	**1.00**	**LS**	**2,522**
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	Earthwork Subcontractor	297.00	BCY	2,522
Disposal of Treated Soils at Borrow Area	**Earthwork Subcontractor**	**357.00**	**LCY**	**2,000**
Hauling of Treated Soils	**Earthwork Subcontractor**	**1.00**	**LS**	**980**
Hauling between Borrow Area and Treatment Area	Earthwork Subcontractor	357.00	LCY	980
(Note: Crew Output - CostWorks 2011; Source Tag - 312323201016)				
Hauling of Deconstructed Berm Soils	**Earthwork Subcontractor**	**1.00**	**LS**	**82**
Hauling between Borrow Area and Treatment Area	Earthwork Subcontractor	30.00	LCY	82
(Note: Crew Output - CostWorks 2011; Source Tag - 312323201016)				
Spreading and Compaction of Backfill	**Earthwork Subcontractor**	**1.00**	**LS**	**846**
Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with sheepsfoot roller	Earthwork Subcontractor	349.00	ECY	846
Seeding of Borrow Area	**Earthwork Subcontractor**	**1.00**	**LS**	**92**
Seeding athletic fields, seeding bluegrass, common with mulch and fertilizer, 4 lb. per M.S.F., hydro or air seeding	Earthwork Subcontractor	1.40	MSF	92
Restoration of Excavated Area	**Earthwork Subcontractor**	**400.00**	**SF**	**5,557**
Excavation of Borrow Material	**Earthwork Subcontractor**	**1.00**	**LS**	**2,488**
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	Earthwork Subcontractor	293.00	BCY	2,488
Hauling of Borrow Material	**Earthwork Subcontractor**	**1.00**	**LS**	**966**
Hauling between Excavation Area and Borrow Area	Earthwork Subcontractor	352.00	LCY	966
(Note: Crew Output - CostWorks 2011; Source Tag - 312323201016)				
Spreading and Compaction of Backfill	**Earthwork Subcontractor**	**1.00**	**LS**	**2,103**
Compaction of backfilled material in excavation	Earthwork Subcontractor	317.00	ECY	1,390
Borrow, common earth, 1 C.Y. bucket, loading and/or spreading, shovel	Earthwork Subcontractor	293.00	BCY	596
Borrow, material only, bank run gravel	Earthwork Subcontractor	6.00	TON	116

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Material cost from RS Means CostWorks 2011 item 312323155050.)				
Confirmation Sampling	**AE Contractor ME**	**1.00**	**LS**	**3,849**
VOCs Soil Analysis	AE Contractor ME	21.00	EA	2,331
(Note: Price Quote: Test America, GSA 6/2011)				
Miscellaneous Sampling Equipment	AE Contractor ME	1.00	LS	278
(Note: Previous Work. Includes paper towels, tape, gloves, ice, and ziplock bags.)				
Environmental Engineer	AE Contractor L	9.00	HR	952
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Environmental Engineer: [redacted] Assumed Benefits: 1[redacted]% Assumed Bonus: [redacted]				
Per Diem	AE Contractor ME	1.00	DAY	167
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	1.00	DAY	107
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	1.00	DAY	14
(Note: Per Estimator)				
Miscellaneous Requirements for Sampling	**AE Contractor ME**	**1.00**	**LS**	**53,300**
Contractor Quality Assurance Plan	AE Contractor ME	1.00	LS	19,500
(Note: Per Estimator)				
Sampling and Analysis Plan	AE Contractor ME	1.00	LS	26,000
(Note: Per Estimator)				
Site Safety and Health Plan	AE Contractor ME	1.00	LS	7,800
(Note: Per Estimator)				
Well Abandonment - Soil Vapor Extraction Wells	**General Contractor**	**11.00**	**EA**	**31,410**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**26,365**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 4" Well	Drilling Subcontractor	730.00	VLF	17,539
Portland cement grout	Drilling Subcontractor	64.00	CF	556
(Note: Cost Source: HTW)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**5,045**
Daily Pickup Truck Rental	AE Contractor ME	4.00	DAY	430
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	4.00	DAY	56
(Note: Per Estimator)				
Per Diem	AE Contractor ME	4.00	DAY	668
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	39.00	HR	3,892
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Decommissioning Treatment System	**General Contractor**	**1.00**	**LS**	**50,000**
Decommisioning Treatment Systems		1.00	LS	50,000
(Note: Per Estimator)				
Treatment System O&M	**General Contractor**	**1.00**	**EA**	**40,141**
Electrical Consumption	General Contractor	287,600.00	KWH	28,045
(Note: Cost Source: U.S. Energy Information Administration)				

Description	Contractor	Quantity	UOM	ProjectCost
Weekly maintenance visit	General Contractor	52.00	EA	9,767
Blower Maintenance	General Contractor	1.00	EA	555
(Note: Cost Source: Echos 33410201)				
Pump Maintenance	General Contractor	1.00	EA	555
(Note: Cost Source: Echos 33410101)				
Miscellaneous repairs allowance	General Contractor	1.00	EA	1,220
(Note: Per estimator.)				
Expand SVE System		**1.00**	**EA**	**265,742**
Mobilization and Demobilization	**Earthwork Subcontractor**	**1.00**	**EA**	**5,428**
Tractor w/Low Bed Trailer (Heavy Equipment)	Earthwork Subcontractor	4.00	EA	3,698
Tractor w/ Flatbed Trailer (Large Equipment)	Earthwork Subcontractor	2.00	EA	1,729
Miscellaneous Requirements for Sampling	**AE Contractor ME**	**1.00**	**LS**	**53,300**
Contractor Quality Assurance Plan	AE Contractor ME	1.00	LS	19,500
(Note: Per Estimator)				
Sampling and Analysis Plan	AE Contractor ME	1.00	LS	26,000
(Note: Per Estimator)				
Site Safety and Health Plan	AE Contractor ME	1.00	LS	7,800
(Note: Per Estimator)				
Soil Vapor Extraction Well Installation	**General Contractor**	**2.00**	**EA**	**34,241**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**32,466**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Monitoring well construction, drilling, hollow stem auger, normal soil, 4" or less casing/screen, 6-5/8" ID x 11" OD auger	Drilling Subcontractor	160.00	LF	6,828
Well screen assembly, slotted PVC, 4" diameter	Drilling Subcontractor	80.00	LF	859
(Note: Cost Source: Means CostWorks 2011)				
Casing, PVC, flush threaded, standard length 10', 4" diameter, schedule 40	Drilling Subcontractor	80.00	LF	1,538
Gravel packing and annular sealant, No. 2 morie silica sand, contaminant free	Drilling Subcontractor	5.00	TON	4,935
Gravel packing and annular sealant, bentonite grout, 3.04 lb./gal. , 50 lb. yields 2.2 C.F.	Drilling Subcontractor	44.00	CF	5,687
Monitoring well fittings, solid plugs, flush threaded, PVC, 4"	Drilling Subcontractor	2.00	EA	105
Manhole frame and cover, aluminum, heavy duty, 24" x 24"	Drilling Subcontractor	2.00	EA	3,759
(Note: Cost Source: HNC - 334913104648)				
55-gallon Open Head Steel Drum	Drilling Subcontractor	2.00	EA	484
(Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**1,774**
Daily Pickup Truck Rental	AE Contractor ME	2.00	DAY	215
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	2.00	DAY	28
(Note: Per Estimator)				
Per Diem	AE Contractor ME	2.00	DAY	334
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	12.00	HR	1,198
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Pipe Installation	**General Contractor**	**310.00**	**FT**	**4,732**
Excavating, trench backfill, 1 C.Y. bucket, minimal haul, front end loader, wheel mounted, excludes dewatering	General Contractor	56.00	LCY	78

Description	Contractor	Quantity	UOM	ProjectCost
Borrow, material only, bank run gravel	General Contractor	92.00	TON	1,594
(Note: Material cost from RS Means CostWorks 2011 item 312323155050.)				
Fill, gravel fill, compacted	General Contractor	620.00	SF	569
Utility Line Signs, Markers, and Flags, underground tape, detectable, reinforced, aluminum foil core, 6", excludes excavation and backfill	General Contractor	4.00	CLF	42
Pipe, plastic, PVC, 2" diameter, schedule 80, excludes couplings and hangers	General Contractor	325.00	LF	1,575
Elbow, 90 Deg., plastic, PVC, socket joint, 2", schedule 80	General Contractor	4.00	EA	76
Valves, plastic, PVC, ball, single union, socket or threaded, 2"	General Contractor	3.00	EA	308
Backfill, sandy clay or loam, 3/4 C.Y. bucket, hydraulic backhoe	General Contractor	51.00	ECY	387
Hauling between Excavation Area and Onsite Disposal Area	General Contractor	42.00	LCY	103
(Note: Crew Output - CostWorks 2011; Source Tag - 312323201016)				
Well Abandonment - Soil Vapor Extraction Wells	**General Contractor**	**13.00**	**EA**	**36,463**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**30,331**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 4" Well	Drilling Subcontractor	890.00	VLF	21,383
Portland cement grout	Drilling Subcontractor	78.00	CF	677
(Note: Cost Source: HTW)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**6,132**
Daily Pickup Truck Rental	AE Contractor ME	5.00	DAY	537
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	5.00	DAY	70
(Note: Per Estimator)				
Per Diem	AE Contractor ME	5.00	DAY	835
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	47.00	HR	4,691
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Decommissioning Treatment System	**General Contractor**	**1.00**	**LS**	**50,000**
Decommisioning Treatment Systems		1.00	LS	50,000
(Note: Per Estimator)				
Well Maintenance - Soil Vapor Extraction Wells	**General Contractor**	**1.00**	**EA**	**41,438**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**37,978**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Monitoring well maintenance	Drilling Subcontractor	26.00	HR	6,247
Manhole frame and cover, aluminum, heavy duty, 24" x 24"	Drilling Subcontractor	13.00	EA	24,434
(Note: Cost Source: HNC - 334913104648)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**3,460**
Daily Pickup Truck Rental	AE Contractor ME	3.00	DAY	322
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	3.00	DAY	42
(Note: Per Estimator)				
Per Diem	AE Contractor ME	3.00	DAY	501
(Note: Standard Rate Per Diem - GSA, 2012)				

Description	Contractor	Quantity	UOM	ProjectCost
Geologist	AE Contractor L	26.00	HR	2,595
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: 1[redacted] Assumed Bonus: [redacted])				
Treatment System O&M	**General Contractor**	**1.00**	**EA**	**40,141**
Electrical Consumption	General Contractor	287,600.00	KWH	28,045
(Note: Cost Source: U.S. Energy Information Administration)				
Weekly maintenance visit	General Contractor	52.00	EA	9,767
Blower Maintenance	General Contractor	1.00	EA	555
(Note: Cost Source: Echos 33410201)				
Pump Maintenance	General Contractor	1.00	EA	555
(Note: Cost Source: Echos 33410101)				
Miscellaneous repairs allowance	General Contractor	1.00	EA	1,220
(Note: Per estimator.)				
Expand SVE System and Excavation, Treatment, and Disposal of Soil Contamination		**1.00**	**EA**	**320,038**
Mobilization and Demobilization	**Earthwork Subcontractor**	**1.00**	**EA**	**5,428**
Tractor w/Low Bed Trailer (Heavy Equipment)	Earthwork Subcontractor	4.00	EA	3,698
Tractor w/ Flatbed Trailer (Large Equipment)	Earthwork Subcontractor	2.00	EA	1,729
Earthwork		**1.00**	**LS**	**43,296**
Excavation of Contaminated Soil	**Earthwork Subcontractor**	**297.00**	**BCY**	**5,884**
Sheet piling, wood, solid sheeting, 50 S.F./hour in & 150 S.F./hour out, 10' deep excavation, drive, extract and salvage, includes wales, braces and spacers	Earthwork Subcontractor	400.00	SF	2,218
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	Earthwork Subcontractor	297.00	BCY	2,522
Spray washing, decontaminate heavy equipment, decontaminate heavy equipment	Earthwork Subcontractor	6.00	EA	1,143
(Note: Crew Output - MII English Cost Book 2010; Source - HTW; Source Tag - 019413103112.)				
Treatment of Contaminated Soils	**Earthwork Subcontractor**	**357.00**	**LCY**	**26,006**
Berm Construction	**Earthwork Subcontractor**	**1.00**	**LS**	**418**
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	Earthwork Subcontractor	29.90	BCY	254
Hauling between Borrow Area and Treatment Area	Earthwork Subcontractor	35.90	LCY	99
(Note: Crew Output - CostWorks 2011; Source Tag - 312323201016)				
Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with sheepsfoot roller	Earthwork Subcontractor	26.90	ECY	65
Liner and Gravel Placement	**Earthwork Subcontractor**	**1.00**	**LS**	**5,180**
Polymeric liner and cover system, polyvinyl chloride (PVC), 40 mil	Earthwork Subcontractor	4,406.00	SF	3,600
Borrow, material only, bank run gravel	Earthwork Subcontractor	81.60	TON	1,580
(Note: Material cost from RS Means CostWorks 2011 item 312323155050.)				
Piping and Equipment	**General Contractor**	**1.00**	**LS**	**12,605**
Air sparging, blowers, 170 SCFM, 10.3 HP, 10 psi	General Contractor	1.00	EA	6,293
Slotted PVC, 2" diameter	General Contractor	129.00	LF	918
Pipe, plastic, PVC, 2" diameter, schedule 80, excludes couplings and hangers	General Contractor	536.00	LF	2,598
Tee, plastic, PVC, socket joint, 2", schedule 80	General Contractor	1.00	EA	50
Elbow, 90 Deg., plastic, PVC, socket joint, 2", schedule 80	General Contractor	2.00	EA	38
Valves, plastic, PVC, ball, single union, socket or threaded, 2"	General Contractor	1.00	EA	103
Pressure Gauge	General Contractor	1.00	EA	165
(Note: Vendor Quote: Indelco Plastics, 2010)				
Electrical and instrumentation and controls allowance	General Contractor	1.00	LS	2,440
(Note: Per estimator.)				
Placement of Contaminated Soil	**Earthwork Subcontractor**	**1.00**	**LS**	**1,700**

Description	Contractor	Quantity	UOM	ProjectCost
Hauling between Excavation Area and Borrow Area	Earthwork Subcontractor	357.00	LCY	980
Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with sheepsfoot roller	Earthwork Subcontractor	297.00	ECY	720
Deconstruction of Berm	**Earthwork Subcontractor**	**1.00**	**LS**	**254**
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	Earthwork Subcontractor	29.90	BCY	254
Treatment System O&M	**Earthwork Subcontractor**	**1.00**	**LS**	**3,326**
Electrical Consumption	Earthwork Subcontractor	15,100.00	KWH	1,646
(Note: Cost Source: U.S. Energy Information Administration)				
Weekly maintenance visit	Earthwork Subcontractor	8.00	EA	1,680
Loading of Treated Soils	**Earthwork Subcontractor**	**1.00**	**LS**	**2,522**
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	Earthwork Subcontractor	297.00	BCY	2,522
Disposal of Treated Soils at Borrow Area	**Earthwork Subcontractor**	**357.00**	**LCY**	**2,000**
Hauling of Treated Soils	**Earthwork Subcontractor**	**1.00**	**LS**	**980**
Hauling between Borrow Area and Treatment Area	Earthwork Subcontractor	357.00	LCY	980
(Note: Crew Output - CostWorks 2011; Source Tag - 312323201016)				
Hauling of Deconstructed Berm Soils	**Earthwork Subcontractor**	**1.00**	**LS**	**82**
Hauling between Borrow Area and Treatment Area	Earthwork Subcontractor	30.00	LCY	82
(Note: Crew Output - CostWorks 2011; Source Tag - 312323201016)				
Spreading and Compaction of Backfill	**Earthwork Subcontractor**	**1.00**	**LS**	**846**
Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with sheepsfoot roller	Earthwork Subcontractor	349.00	ECY	846
Seeding of Borrow Area	**Earthwork Subcontractor**	**1.00**	**LS**	**92**
Seeding athletic fields, seeding bluegrass, common with mulch and fertilizer, 4 lb. per M.S.F., hydro or air seeding	Earthwork Subcontractor	1.40	MSF	92
Restoration of Excavated Area	**Earthwork Subcontractor**	**400.00**	**SF**	**5,557**
Excavation of Borrow Material	**Earthwork Subcontractor**	**1.00**	**LS**	**2,488**
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	Earthwork Subcontractor	293.00	BCY	2,488
Hauling of Borrow Material	**Earthwork Subcontractor**	**1.00**	**LS**	**966**
Hauling between Excavation Area and Borrow Area	Earthwork Subcontractor	352.00	LCY	966
(Note: Crew Output - CostWorks 2011; Source Tag - 312323201016)				
Spreading and Compaction of Backfill	**Earthwork Subcontractor**	**1.00**	**LS**	**2,103**
Compaction of backfilled material in excavation	Earthwork Subcontractor	317.00	ECY	1,390
Borrow, common earth, 1 C.Y. bucket, loading and/or spreading, shovel	Earthwork Subcontractor	293.00	BCY	596
Borrow, material only, bank run gravel	Earthwork Subcontractor	6.00	TON	116
(Note: Material cost from RS Means CostWorks 2011 item 312323155050.)				
Confirmation Sampling	**AE Contractor ME**	**1.00**	**LS**	**3,849**
VOCs Soil Analysis	AE Contractor ME	21.00	EA	2,331
(Note: Price Quote: Test America, GSA 6/2011)				
Miscellaneous Sampling Equipment	AE Contractor ME	1.00	LS	278
(Note: Previous Work. Includes paper towels, tape, gloves, ice, and ziplock bags.)				
Environmental Engineer	AE Contractor L	9.00	HR	952
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Environmental Engineer: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Per Diem	AE Contractor ME	1.00	DAY	167
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	1.00	DAY	107
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	1.00	DAY	14

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Per Estimator)				
Miscellaneous Requirements for Sampling	**AE Contractor ME**	**1.00**	**LS**	**53,300**
Contractor Quality Assurance Plan	AE Contractor ME	1.00	LS	19,500
(Note: Per Estimator)				
Sampling and Analysis Plan	AE Contractor ME	1.00	LS	26,000
(Note: Per Estimator)				
Site Safety and Health Plan	AE Contractor ME	1.00	LS	7,800
(Note: Per Estimator)				
Well Abandonment - Soil Vapor Extraction Wells	**General Contractor**	**11.00**	**EA**	**36,463**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**30,331**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 4" Well	Drilling Subcontractor	890.00	VLF	21,383
Portland cement grout	Drilling Subcontractor	78.00	CF	677
(Note: Cost Source: HTW)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**6,132**
Daily Pickup Truck Rental	AE Contractor ME	5.00	DAY	537
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	5.00	DAY	70
(Note: Per Estimator)				
Per Diem	AE Contractor ME	5.00	DAY	835
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	47.00	HR	4,691
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: 1 [redacted] Assumed Bonus: [redacted]				
Decommissioning Treatment System	**General Contractor**	**1.00**	**LS**	**61,000**
Decommisioning Treatment Systems	General Contractor	1.00	LS	61,000
(Note: Per Estimator)				
Treatment System O&M	**General Contractor**	**1.00**	**EA**	**40,141**
Electrical Consumption	General Contractor	287,600.00	KWH	28,045
(Note: Cost Source: U.S. Energy Information Administration)				
Weekly maintenance visit	General Contractor	52.00	EA	9,767
Blower Maintenance	General Contractor	1.00	EA	555
(Note: Cost Source: Echos 33410201)				
Pump Maintenance	General Contractor	1.00	EA	555
(Note: Cost Source: Echos 33410101)				
Miscellaneous repairs allowance	General Contractor	1.00	EA	1,220
(Note: Per estimator.)				
Soil Vapor Extraction Well Installation	**General Contractor**	**2.00**	**EA**	**34,241**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**32,466**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Monitoring well construction, drilling, hollow stem auger, normal soil, 4" or less casing/screen, 6-5/8" ID x 11" OD auger	Drilling Subcontractor	160.00	LF	6,828

Description	Contractor	Quantity	UOM	ProjectCost
Well screen assembly, slotted PVC, 4" diameter	Drilling Subcontractor	80.00	LF	859
(Note: Cost Source: Means CostWorks 2011)				
Casing, PVC, flush threaded, standard length 10', 4" diameter, schedule 40	Drilling Subcontractor	80.00	LF	1,538
Gravel packing and annular sealant, No. 2 morie silica sand, contaminant free	Drilling Subcontractor	5.00	TON	4,935
Gravel packing and annular sealant, bentonite grout, 3.04 lb./gal. , 50 lb. yields 2.2 C.F.	Drilling Subcontractor	44.00	CF	5,687
Monitoring well fittings, solid plugs, flush threaded, PVC, 4"	Drilling Subcontractor	2.00	EA	105
Manhole frame and cover, aluminum, heavy duty, 24" x 24"	Drilling Subcontractor	2.00	EA	3,759
(Note: Cost Source: HNC - 334913104648)				
55-gallon Open Head Steel Drum	Drilling Subcontractor	2.00	EA	484
(Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**1,774**
Daily Pickup Truck Rental	AE Contractor ME	2.00	DAY	215
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	2.00	DAY	28
(Note: Per Estimator)				
Per Diem	AE Contractor ME	2.00	DAY	334
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	12.00	HR	1,198
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Pipe Installation	**General Contractor**	**310.00**	**FT**	**4,732**
Excavating, trench backfill, 1 C.Y. bucket, minimal haul, front end loader, wheel mounted, excludes dewatering	General Contractor	56.00	LCY	78
Borrow, material only, bank run gravel	General Contractor	92.00	TON	1,594
(Note: Material cost from RS Means CostWorks 2011 item 312323155050.)				
Fill, gravel fill, compacted	General Contractor	620.00	SF	569
Utility Line Signs, Markers, and Flags, underground tape, detectable, reinforced, aluminum foil core, 6", excludes excavation and backfill	General Contractor	4.00	CLF	42
Pipe, plastic, PVC, 2" diameter, schedule 80, excludes couplings and hangers	General Contractor	325.00	LF	1,575
Elbow, 90 Deg., plastic, PVC, socket joint, 2", schedule 80	General Contractor	4.00	EA	76
Valves, plastic, PVC, ball, single union, socket or threaded, 2"	General Contractor	3.00	EA	308
Backfill, sandy clay or loam, 3/4 C.Y. bucket, hydraulic backhoe	General Contractor	51.00	ECY	387
Hauling between Excavation Area and Onsite Disposal Area	General Contractor	42.00	LCY	103
(Note: Crew Output - CostWorks 2011; Source Tag - 312323201016)				
Well Maintenance - Soil Vapor Extraction Wells	**General Contractor**	**1.00**	**EA**	**41,438**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**37,978**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Monitoring well maintenance	Drilling Subcontractor	26.00	HR	6,247
Manhole frame and cover, aluminum, heavy duty, 24" x 24"	Drilling Subcontractor	13.00	EA	24,434
(Note: Cost Source: HNC - 334913104648)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**3,460**
Daily Pickup Truck Rental	AE Contractor ME	3.00	DAY	322
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	3.00	DAY	42
(Note: Per Estimator)				
Per Diem	AE Contractor ME	3.00	DAY	501
(Note: Standard Rate Per Diem - GSA, 2012)				

Description	Contractor	Quantity	UOM	ProjectCost
Geologist	AE Contractor L	26.00	HR	2,595
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Contaminated Groundwater		**1.00**	**EA**	**40,809,029**
Common Components for Contaminated Groundwater		**1.00**	**EA**	**142,973**
Institutional Controls	**AE Contractor L**	**1.00**	**LS**	**30,400**
Reproduction Costs for Institutional Controls	AE Contractor ME	1.00	LS	325
(Note: Per Estimator)				
Paralegal	AE Contractor L	60.00	HR	4,722
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Paralegal: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Environmental Lawyer	AE Contractor L	120.00	HR	19,544
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Lawyer: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Clerks, Typists, Bookkeepers & Receptionist	AE Contractor L	40.00	HR	1,794
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Project Manager	AE Contractor L	40.00	HR	4,014
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Miscellaneous Requirements for Sampling	**AE Contractor ME**	**1.00**	**LS**	**53,300**
Contractor Quality Assurance Plan	AE Contractor ME	1.00	LS	19,500
(Note: Per Estimator)				
Sampling and Analysis Plan	AE Contractor ME	1.00	LS	26,000
(Note: Per Estimator)				
Site Safety and Health Plan	AE Contractor ME	1.00	LS	7,800
(Note: Per Estimator)				
Five-Year Review	**AE Contractor L**	**1.00**	**EA**	**46,722**
Reproduction Costs for Five-Year Site Review Reports	AE Contractor ME	1.00	LS	696
(Note: Per Estimator)				
Drafter CAD	AE Contractor L	40.00	HR	2,433
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Draftsman: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Project Manager	AE Contractor L	40.00	HR	4,014
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: 1[redacted] Assumed Bonus: [redacted]				
Clerks, Typists, Bookkeepers & Receptionist	AE Contractor L	40.00	HR	1,794
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: $[redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted])				
Quality Control Engineer	AE Contractor L	24.00	HR	2,739
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Quality Control Engineer: [redacted] Assumed Benefits: 15.2% Assumed Bonus: 6[redacted]				
Environmental Scientist	AE Contractor L	160.00	HR	18,772
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Environmental Scientist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Environmental Engineer	AE Contractor L	120.00	HR	12,697
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Environmental Engineer: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Site Visit	**AE Contractor L**	**1.00**	**EA**	**3,577**
Weekly Pickup Truck Rental	AE Contractor ME	1.00	WK	537
(Note: Weekly Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Per Diem	AE Contractor ME	3.00	DAY	501

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Standard Rate Per Diem - GSA, 2012)				
Environmental Engineer	AE Contractor L	24.00	HR	2,539
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Environmental Engineer: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6.5%)				
Monitoring and Institutional Controls	**AE Contractor L**	**1.00**	**EA**	**12,552**
Paralegal	AE Contractor L	20.00	HR	1,574
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Paralegal: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Environmental Lawyer	AE Contractor L	40.00	HR	6,515
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Lawyer: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Clerks, Typists, Bookkeepers & Receptionist	AE Contractor L	10.00	HR	449
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Project Manager	AE Contractor L	40.00	HR	4,014
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: 1[redacted] Assumed Bonus: [redacted]				
OU1 Groundwater (Source Area)	**General Contractor**	**1.00**	**EA**	**10,416,449**
No Action	**General Contractor**	**1.00**	**EA**	**323,063**
Well Abandonment - Monitoring Wells	**Drilling Subcontractor**	**47.00**	**EA**	**163,873**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**126,184**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 2" Well	Drilling Subcontractor	7,275.00	VLF	116,524
Portland cement grout	Drilling Subcontractor	160.00	CF	1,389
(Note: Cost Source: HTW)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**37,689**
Daily Pickup Truck Rental	AE Contractor ME	30.00	DAY	3,222
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	30.00	DAY	417
(Note: Per Estimator)				
Per Diem	AE Contractor ME	30.00	DAY	5,007
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	291.00	HR	29,043
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Decommissioning Treatment System		**1.00**	**LS**	**50,000**
Decommisioning Treatment Systems		1.00	LS	50,000
(Note: Per Estimator)				
Groundwater Monitoring Event	**AE Contractor L**	**1.00**	**EA**	**37,115**
Analysis	**AE Contractor ME**	**1.00**	**LS**	**6,494**
VOCs, EPA Method SW-846 8260	AE Contractor ME	55.00	EA	6,104
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Overnight Sample Shipment	AE Contractor ME	3.00	EA	390
Equipment	**AE Contractor ME**	**1.00**	**LS**	**12,962**
Water Quality Meter and Flow Through Cell	AE Contractor ME	3.00	WK	2,504
(Note: Weekly Rental. Vendor Quote: In-Situ, 4/27/2011)				

Description	Contractor	Quantity	UOM	ProjectCost
Photoionization Detector (PID) (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	835
Water Level Meter (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	250
Turbidimeter (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	334
Portable Bladder Pump (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	626
Replacement Poly Bladders (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	49.00	EA	545
Bladder Pump Controller (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	939
Compressed Nitrogen Gas Rental (Note: Per Estimator)	AE Contractor ME	3.00	WK	417
Combination Tubing for Bladder Pump (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	4,700.00	LF	3,923
Shipping Rental Equipment (Note: Previous Work)	AE Contractor ME	2.00	EA	696
55-gallon Open Head Steel Drum (Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)	AE Contractor ME	7.00	EA	1,616
Miscellaneous Sampling Equipment (Note: Per Estimator)	AE Contractor ME	1.00	LS	278
Crew	**AE Contractor L**	**1.00**	**LS**	**17,659**
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	12.00	DAY	1,289
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	12.00	DAY	167
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	24.00	DAY	4,006
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	4.00	HR	401
General Operator/Tech (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	190.00	HR	11,353
Procurement Specialist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	8.00	HR	443
Groundwater Monitoring Event Report Generation	**AE Contractor L**	**1.00**	**EA**	**25,005**
Reproduction Costs for Groundwater Sampling Event Reports (Note: Per Estimator)	AE Contractor ME	1.00	LS	696
Drafter CAD (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Draftsman: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	59.00	HR	3,588
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	8.00	HR	803
Quality Assurance Director (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Quality Assurance Director: [redacted] Assumed Benefits: [redacted] Assumed	AE Contractor L	4.00	HR	706

Description	Contractor	Quantity	UOM	ProjectCost
Bonus: [redacted]				
Clerks, Typists, Bookkeepers & Receptionist	AE Contractor L	10.00	HR	449
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted])				
Geologist	AE Contractor L	188.00	HR	18,763
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Monitoring Well Maintenance	**Drilling Subcontractor**	**1.00**	**EA**	**47,070**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**34,807**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Monitoring well maintenance	Drilling Subcontractor	94.00	EA	22,584
8" Vault	Drilling Subcontractor	47.00	EA	4,116
(Note: Cost Source: Previous Work)				
Locking J-Plug, 2" Well	Drilling Subcontractor	47.00	EA	809
(Note: Vendor Quote: Dean Bennett Supply, 4/27/2011)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**12,264**
Daily Pickup Truck Rental	AE Contractor ME	10.00	DAY	1,074
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	10.00	DAY	139
(Note: Per Estimator)				
Per Diem	AE Contractor ME	10.00	DAY	1,669
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	94.00	HR	9,382
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Maintain and Operate Existing GET System	**General Contractor**	**1.00**	**EA**	**478,085**
Well Abandonment - Monitoring Wells	**General Contractor**	**47.00**	**EA**	**163,873**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**126,184**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 2" Well	Drilling Subcontractor	7,275.00	VLF	116,524
Portland cement grout	Drilling Subcontractor	160.00	CF	1,389
(Note: Cost Source: HTW)				
Oversight	**AE Contractor ME**	**1.00**	**LS**	**37,689**
Daily Pickup Truck Rental	AE Contractor ME	30.00	DAY	3,222
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	30.00	DAY	417
(Note: Per Estimator)				
Per Diem	AE Contractor ME	30.00	DAY	5,007
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	291.00	HR	29,043
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Decommissioning Treatment System	**General Contractor**	**1.00**	**LS**	**50,000**
Decommisioning Treatment Systems		1.00	LS	50,000
(Note: Per Estimator)				

Description	Contractor	Quantity	UOM	ProjectCost
Groundwater Monitoring Event	**AE Contractor L**	**1.00**	**EA**	**37,115**
Analysis	**AE Contractor ME**	**1.00**	**LS**	**6,494**
VOCs, EPA Method SW-846 8260	AE Contractor ME	55.00	EA	6,104
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Overnight Sample Shipment	AE Contractor ME	3.00	EA	390
Equipment	**AE Contractor ME**	**1.00**	**LS**	**12,962**
Water Quality Meter and Flow Through Cell	AE Contractor ME	3.00	WK	2,504
(Note: Weekly Rental. Vendor Quote: In-Situ, 4/27/2011)				
Photoionization Detector (PID)	AE Contractor ME	3.00	WK	835
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Water Level Meter	AE Contractor ME	3.00	WK	250
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Turbidimeter	AE Contractor ME	3.00	WK	334
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Portable Bladder Pump	AE Contractor ME	3.00	WK	626
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Replacement Poly Bladders	AE Contractor ME	49.00	EA	545
(Note: Vendor Quote: Pine Env, 4/27/2011)				
Bladder Pump Controller	AE Contractor ME	3.00	WK	939
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Compressed Nitrogen Gas Rental	AE Contractor ME	3.00	WK	417
(Note: Per Estimator)				
Combination Tubing for Bladder Pump	AE Contractor ME	4,700.00	LF	3,923
(Note: Vendor Quote: Pine Env, 4/27/2011)				
Shipping Rental Equipment	AE Contractor ME	2.00	EA	696
(Note: Previous Work)				
55-gallon Open Head Steel Drum	AE Contractor ME	7.00	EA	1,616
(Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)				
Miscellaneous Sampling Equipment	AE Contractor ME	1.00	LS	278
(Note: Per Estimator)				
Crew	**AE Contractor L**	**1.00**	**LS**	**17,659**
Daily Pickup Truck Rental	AE Contractor ME	12.00	DAY	1,289
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	12.00	DAY	167
(Note: Per Estimator)				
Per Diem	AE Contractor ME	24.00	DAY	4,006
(Note: Standard Rate Per Diem - GSA, 2012)				
Project Manager	AE Contractor L	4.00	HR	401
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted]				
General Operator/Tech	AE Contractor L	190.00	HR	11,353
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Procurement Specialist	AE Contractor L	8.00	HR	443
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Groundwater Monitoring Event Report Generation	**AE Contractor L**	**1.00**	**EA**	**25,005**
Reproduction Costs for Groundwater Sampling Event Reports	AE Contractor ME	1.00	LS	696

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Per Estimator)				
Drafter CAD	AE Contractor L	59.00	HR	3,588
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Draftsman: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Project Manager	AE Contractor L	8.00	HR	803
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Quality Assurance Director	AE Contractor L	4.00	HR	706
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Quality Assurance Director: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Clerks, Typists, Bookkeepers & Receptionist	AE Contractor L	10.00	HR	449
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Geologist	AE Contractor L	188.00	HR	18,763
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Treatment System O&M	**General Contractor**	**1.00**	**EA**	**124,020**
Electrical Consumption	General Contractor	941,100.00	KWH	91,770
(Note: Cost Source: U.S. Energy Information Administration)				
Weekly maintenance visit	General Contractor	52.00	EA	9,767
Miscellaneous materials and consumables for operation and maintenance	General Contractor	1.00	LS	12,200
(Note: Per estimator)				
Packed column air stripper cleaning	General Contractor	4.00	EA	10,283
Monitoring Well Maintenance	**General Contractor**	**1.00**	**EA**	**47,070**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**34,807**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Monitoring well maintenance	Drilling Subcontractor	94.00	EA	22,584
8" Vault	Drilling Subcontractor	47.00	EA	4,116
(Note: Cost Source: Previous Work)				
Locking J-Plug, 2" Well	Drilling Subcontractor	47.00	EA	809
(Note: Vendor Quote: Dean Bennett Supply, 4/27/2011)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**12,264**
Daily Pickup Truck Rental	AE Contractor ME	10.00	DAY	1,074
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	10.00	DAY	139
(Note: Per Estimator)				
Per Diem	AE Contractor ME	10.00	DAY	1,669
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	94.00	HR	9,382
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Recovery Well Maintenance	**General Contractor**	**1.00**	**EA**	**20,014**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**15,668**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Extraction well maintenance	Drilling Subcontractor	32.00	HR	7,688
Miscellaneous materials for extraction well maintenance	Drilling Subcontractor	1.00	LS	682
(Note: Per estimator)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**4,347**

Description	Contractor	Quantity	UOM	ProjectCost
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	4.00	DAY	430
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	4.00	DAY	56
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	4.00	DAY	668
Geologist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	32.00	HR	3,194
Re-Injection Well Maintenance	**General Contractor**	**1.00**	**EA**	**10,988**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**9,901**
Mob/Demob of Drill Rig (Note: Previous Work)	Drilling Subcontractor	1.00	LS	7,297
Extraction well maintenance	Drilling Subcontractor	8.00	HR	1,922
Miscellaneous materials for extraction well maintenance (Note: Per estimator)	Drilling Subcontractor	1.00	LS	682
Oversight	**AE Contractor L**	**1.00**	**LS**	**1,087**
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	1.00	DAY	107
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	1.00	DAY	14
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	1.00	DAY	167
Geologist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	8.00	HR	798
In Situ Treatment via Groundwater Amendment	**General Contractor**	**1.00**	**EA**	**4,788,200**
Injection Equipment	**Injection Subcontractor**	**1.00**	**LS**	**23,851**
5,000 Gallon Storage Tank (Note: Vendor Quote: The Tank Depot, 2012)	Injection Subcontractor	1.00	EA	2,874
Trash Pump - 220 gpm (Note: Vendor Quote: Honda Power Equipment, 2012)	Injection Subcontractor	1.00	EA	751
Flat Bottom Tank Mixer (Note: Vendor Quote: Indelco Plastics, 2010)	Injection Subcontractor	1.00	EA	4,870
Pressure Gauge - Injection Point (Note: Vendor Quote: Indelco Plastics, 2012)	Injection Subcontractor	1.00	EA	185
Pressure Gauge - Water to Frac Tank (Note: Vendor Quote: Indelco Plastics, 2012)	Injection Subcontractor	1.00	EA	185
2" Steel Ball Valve (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	2.00	EA	485
2" Steel Pipe (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	20.00	LF	172
2" Steel Tee (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	4.00	EA	340
2" Steel Elbow, 90 Degree (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	2.00	EA	138
2" Female Camlock (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	5.00	EA	85

Description	Contractor	Quantity	UOM	ProjectCost
2" Male Camlock (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	5.00	EA	46
2" Hose (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	1,000.00	LF	12,989
Health and Safety Allowances (Note: Per estimator)	Injection Subcontractor	1.00	EA	730
Pilot Scale Groundwater Monitoring Event	**AE Contractor L**	**1.00**	**EA**	**59,171**
Analysis	**AE Contractor ME**	**1.00**	**LS**	**40,494**
VOCs, EPA Method SW-846 8260 (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	3,330
Metals, Dissolved, EPA Method 6010, Field Filtered (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	3,481
Nitrate/Nitrite (NO3/NO2) (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	757
Sulfate, EPA MCAWW, 300, Field Filtered (Note: Vendor Quote. Teklab (Previous Work), 2009)	AE Contractor ME	30.00	EA	835
Sulfide, SM 4500S2 E (Note: Vendor Quote. Teklab (Previous Work), 2009)	AE Contractor ME	30.00	EA	1,043
Total Iron (Fe) (Note: 25 Tests per kit. Vendor Quote: Hach, 4/27/2011)	AE Contractor ME	1.00	EA	36
Total Manganese (Mn) (Note: Vendor Quote. Teklab (Previous Work), 2009)	AE Contractor ME	30.00	EA	459
Chloride, EPA MCAWW, 300, Field Filtered (Note: Vendor Quote. Teklab (Previous Work), 2009)	AE Contractor ME	30.00	EA	835
Alkalinity, EPA MCAWW, 310.1, Field Filtered (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	606
Dissolved Total Organic Carbon (TOC) (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	1,362
Carbon Dioxide (CO2) (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	2,422
Volatile Fatty Acids (VFAs) (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	3,784
Methane/Ethane/Ethene (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	3,633
Microbiological DNA Analysis (Note: Previous Work)	AE Contractor ME	30.00	EA	15,148
Dissolved Oxygen, Colorimetic Test Kits, 0 to 1 ppm (Note: 30 Tests per kit. Vendor Quote: Cole Parmer, 4/27/2011)	AE Contractor ME	1.00	EA	75
Dissolved Oxygen, Colorimetic Test Kits, 1 to 12 ppm (Note: 30 Tests per kit. Vendor Quote: Cole Parmer, 4/27/2011)	AE Contractor ME	1.00	EA	78
Field Filter, 0.45 micron filter (Note: 25 Filters per pack. Vendor Quote: Hach, 4/27/2011)	AE Contractor ME	30.00	EA	1,051
Overnight Sample Shipment	AE Contractor ME	12.00	EA	1,560
Equipment	**AE Contractor ME**	**1.00**	**LS**	**8,221**
Water Quality Meter and Flow Through Cell (Note: Weekly Rental. Vendor Quote: In-Situ, 4/27/2011)	AE Contractor ME	2.00	WK	1,669

Description	Contractor	Quantity	UOM	ProjectCost
Photoionization Detector (PID) (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2.00	WK	556
Water Level Meter (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2.00	WK	167
Turbidimeter (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2.00	WK	223
Portable Bladder Pump (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2.00	WK	417
Replacement Poly Bladders (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	27.00	EA	300
Bladder Pump Controller (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2.00	WK	626
Compressed Nitrogen Gas Rental (Note: Per Estimator)	AE Contractor ME	2.00	WK	278
Combination Tubing for Bladder Pump (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2,500.00	LF	2,087
Shipping Rental Equipment (Note: Previous Work)	AE Contractor ME	2.00	EA	696
55-gallon Open Head Steel Drum (Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)	AE Contractor ME	4.00	EA	923
Miscellaneous Sampling Equipment (Note: Per Estimator)	AE Contractor ME	1.00	LS	278
Crew	**AE Contractor L**	**1.00**	**LS**	**10,456**
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	7.00	DAY	752
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	7.00	DAY	97
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	14.00	DAY	2,337
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	3.00	HR	301
General Operator/Tech (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	112.00	HR	6,692
[redacted] (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Assumed Benefits: [redacted]	[redacted]	[redacted]	[redacted]	277
Pilot Scale Groundwater Monitoring Event Report Generation	**AE Contractor L**	**1.00**	**EA**	**14,580**
Reproduction Costs for Groundwater Sampling Event Reports (Note: Per Estimator)	AE Contractor ME	1.00	LS	696
Drafter CAD (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Draftsman: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	32.00	HR	1,946
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	8.00	HR	803
Quality Assurance Director (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Quality Assurance Director: [redacted] Assumed Benefits: [redacted] Assumed Bonus:	AE Contractor L	4.00	HR	706

Description	Contractor	Quantity	UOM	ProjectCost
[redacted]				
Clerks, Typists, Bookkeepers & Receptionist	AE Contractor L	10.00	HR	449
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Geologist	AE Contractor L	100.00	HR	9,980
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Well Abandonment - Monitoring Wells	**General Contractor**	**47.00**	**EA**	**163,873**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**126,184**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 2" Well	Drilling Subcontractor	7,275.00	VLF	116,524
Portland cement grout	Drilling Subcontractor	160.00	CF	1,389
(Note: Cost Source: HTW)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**37,689**
Daily Pickup Truck Rental	AE Contractor ME	30.00	DAY	3,222
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	30.00	DAY	417
(Note: Per Estimator)				
Per Diem	AE Contractor ME	30.00	DAY	5,007
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	291.00	HR	29,043
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Benefits: [redacted] Assumed Bonus: [redacted]				
Well Abandonment - Injection Wells	**General Contractor**	**18.00**	**EA**	**67,437**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**53,488**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 2" Well	Drilling Subcontractor	2,790.00	VLF	44,687
Portland cement grout	Drilling Subcontractor	61.00	CF	530
(Note: Cost Source: HTW)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**13,949**
Daily Pickup Truck Rental	AE Contractor ME	11.00	DAY	1,181
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	11.00	DAY	153
(Note: Per Estimator)				
Per Diem	AE Contractor ME	11.00	DAY	1,836
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	108.00	HR	10,779
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] 7 Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Decommissioning Treatment System		**1.00**	**LS**	**50,000**
Decommisioning Treatment Systems		1.00	LS	50,000
(Note: Per Estimator)				
EAB Groundwater Monitoring Event	**AE Contractor L**	**1.00**	**EA**	**74,651**

Description	Contractor	Quantity	UOM	ProjectCost
Analysis	**AE Contractor ME**	**1.00**	**LS**	**44,030**
VOCs, EPA Method SW-846 8260	AE Contractor ME	55.00	EA	6,104
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Metals, Dissolved, EPA Method 6010, Field Filtered	AE Contractor ME	55.00	EA	6,382
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Nitrate/Nitrite (NO3/NO2)	AE Contractor ME	55.00	EA	1,388
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Sulfate, EPA MCAWW, 300, Field Filtered	AE Contractor ME	55.00	EA	1,530
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Sulfide, SM 4500S2 E	AE Contractor ME	55.00	EA	1,913
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Total Iron (Fe)	AE Contractor ME	2.00	EA	73
(Note: 25 Tests per kit. Vendor Quote: Hach, 4/27/2011)				
Total Manganese (Mn)	AE Contractor ME	55.00	EA	842
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Chloride, EPA MCAWW, 300, Field Filtered	AE Contractor ME	55.00	EA	1,530
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Alkalinity, EPA MCAWW, 310.1, Field Filtered	AE Contractor ME	55.00	EA	1,110
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Dissolved Total Organic Carbon (TOC)	AE Contractor ME	55.00	EA	2,497
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Carbon Dioxide (CO2)	AE Contractor ME	55.00	EA	4,440
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Volatile Fatty Acids (VFAs)	AE Contractor ME	55.00	EA	6,937
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Methane/Ethane/Ethene	AE Contractor ME	55.00	EA	6,660
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Dissolved Oxygen, Colorimetic Test Kits, 0 to 1 ppm	AE Contractor ME	2.00	EA	151
(Note: 30 Tests per kit. Vendor Quote: Cole Parmer, 4/27/2011)				
Dissolved Oxygen, Colorimetic Test Kits, 1 to 12 ppm	AE Contractor ME	2.00	EA	157
(Note: 30 Tests per kit. Vendor Quote: Cole Parmer, 4/27/2011)				
Field Filter, 0.45 micron filter	AE Contractor ME	55.00	EA	1,927
(Note: 25 Filters per pack. Vendor Quote: Hach, 4/27/2011)				
Overnight Sample Shipment	AE Contractor ME	3.00	EA	390
Equipment	**AE Contractor ME**	**1.00**	**LS**	**12,962**
Water Quality Meter and Flow Through Cell	AE Contractor ME	3.00	WK	2,504
(Note: Weekly Rental. Vendor Quote: In-Situ, 4/27/2011)				
Photoionization Detector (PID)	AE Contractor ME	3.00	WK	835
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Water Level Meter	AE Contractor ME	3.00	WK	250
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Turbidimeter	AE Contractor ME	3.00	WK	334
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Portable Bladder Pump	AE Contractor ME	3.00	WK	626
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Replacement Poly Bladders	AE Contractor ME	49.00	EA	545

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Vendor Quote: Pine Env, 4/27/2011)				
Bladder Pump Controller	AE Contractor ME	3.00	WK	939
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Compressed Nitrogen Gas Rental	AE Contractor ME	3.00	WK	417
(Note: Per Estimator)				
Combination Tubing for Bladder Pump	AE Contractor ME	4,700.00	LF	3,923
(Note: Vendor Quote: Pine Env, 4/27/2011)				
Shipping Rental Equipment	AE Contractor ME	2.00	EA	696
(Note: Previous Work)				
55-gallon Open Head Steel Drum	AE Contractor ME	7.00	EA	1,616
(Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)				
Miscellaneous Sampling Equipment	AE Contractor ME	1.00	LS	278
(Note: Per Estimator)				
	AE Contractor L	**1.00**	**LS**	**17,659**
Crew				
Daily Pickup Truck Rental	AE Contractor ME	12.00	DAY	1,289
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	12.00	DAY	167
(Note: Per Estimator)				
Per Diem	AE Contractor ME	24.00	DAY	4,006
(Note: Standard Rate Per Diem - GSA, 2012)				
Project Manager	AE Contractor L	4.00	HR	401
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
General Operator/Tech	AE Contractor L	190.00	HR	11,353
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Procurement Specialist	AE Contractor L	8.00	HR	443
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
VOC-Only Groundwater Monitoring Event	**AE Contractor L**	**1.00**	**EA**	**37,115**
Analysis	**AE Contractor ME**	**1.00**	**LS**	**6,494**
VOCs, EPA Method SW-846 8260	AE Contractor ME	55.00	EA	6,104
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Overnight Sample Shipment	AE Contractor ME	3.00	EA	390
	AE Contractor ME	**1.00**	**EA**	**12,962**
Equipment				
Water Quality Meter and Flow Through Cell	AE Contractor ME	3.00	WK	2,504
(Note: Weekly Rental. Vendor Quote: In-Situ, 4/27/2011)				
Photoionization Detector (PID)	AE Contractor ME	3.00	WK	835
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Water Level Meter	AE Contractor ME	3.00	WK	250
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Turbidimeter	AE Contractor ME	3.00	WK	334
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Portable Bladder Pump	AE Contractor ME	3.00	WK	626
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Replacement Poly Bladders	AE Contractor ME	49.00	EA	545
(Note: Vendor Quote: Pine Env, 4/27/2011)				
Bladder Pump Controller	AE Contractor ME	3.00	WK	939

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Compressed Nitrogen Gas Rental	AE Contractor ME	3.00	WK	417
(Note: Per Estimator)				
Combination Tubing for Bladder Pump	AE Contractor ME	4,700.00	LF	3,923
(Note: Vendor Quote: Pine Env, 4/27/2011)				
Shipping Rental Equipment	AE Contractor ME	2.00	EA	696
(Note: Previous Work)				
55-gallon Open Head Steel Drum	AE Contractor ME	7.00	EA	1,616
(Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)				
Miscellaneous Sampling Equipment	AE Contractor ME	1.00	LS	278
(Note: Per Estimator)				
Crew	**AE Contractor L**	**1.00**	**EA**	**17,659**
Daily Pickup Truck Rental	AE Contractor ME	12.00	DAY	1,289
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	12.00	DAY	167
(Note: Per Estimator)				
Per Diem	AE Contractor ME	24.00	DAY	4,006
(Note: Standard Rate Per Diem - GSA, 2012)				
Project Manager	AE Contractor L	4.00	HR	401
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: 6.5%)				
General Operator/Tech	AE Contractor L	190.00	HR	11,353
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted]4 Assumed Benefits: [redacted] Assumed Bonus: 6[redacted]				
Procurement Specialist	AE Contractor L	8.00	HR	443
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Benefits: [redacted] Assumed Bonus: [redacted]				
Groundwater Monitoring Event Report Generation	**AE Contractor L**	**1.00**	**EA**	**25,005**
Reproduction Costs for Groundwater Sampling Event Reports	AE Contractor ME	1.00	LS	696
(Note: Per Estimator)				
Drafter CAD	AE Contractor L	59.00	HR	3,588
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Draftsman: [redacted] Benefits: [redacted] Assumed Bonus: 6[redacted]				
Project Manager	AE Contractor L	8.00	HR	803
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6[redacted]				
Quality Assurance Director	AE Contractor L	4.00	HR	706
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Quality Assurance Director: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Clerks, Typists, Bookkeepers & Receptionist	AE Contractor L	10.00	HR	449
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted])				
Geologist	AE Contractor L	188.00	HR	18,763
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Monitoring Well Maintenance	**General Contractor**	**1.00**	**EA**	**47,070**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**34,807**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Monitoring well maintenance	Drilling Subcontractor	94.00	EA	22,584
8" Vault	Drilling Subcontractor	47.00	EA	4,116

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Cost Source: Previous Work)				
Locking J-Plug, 2" Well	Drilling Subcontractor	47.00	EA	809
(Note: Vendor Quote: Dean Bennett Supply, 4/27/2011)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**12,264**
Daily Pickup Truck Rental	AE Contractor ME	10.00	DAY	1,074
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	10.00	DAY	139
(Note: Per Estimator)				
Per Diem	AE Contractor ME	10.00	DAY	1,669
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	94.00	HR	9,382
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Benefits: [redacted] Bonus: [redacted]				
Pilot Scale Injection	**General Contractor**	**1.00**	**LS**	**246,458**
EAB Injection - Pilot	**General Contractor**	**1.00**	**EA**	**125,941**
EAB Injection	**General Contractor**	**1.00**	**EA**	**69,236**
Injection	**Injection Subcontractor**	**1.00**	**EA**	**63,689**
Mobilization/Demobilization of DPT Rig & Crew	Injection Subcontractor	1.00	LS	2,043
(Note: Previous Work, 2010)				
DPT Crew & Rig - Daily Rate	Injection Subcontractor	4.00	DAY	10,508
(Note: Previous Work, 2010)				
Decontamination Pad	Injection Subcontractor	1.00	LS	292
(Note: Previous Work, 2010)				
Borehole Abandonment, per Borehole	Injection Subcontractor	15.00	EA	2,189
(Note: Previous Work, 2010)				
IDW Handling	Injection Subcontractor	15.00	EA	2,189
(Note: Previous Work, 2010)				
Process Water Suplied by Water Line	Injection Subcontractor	28.00	KGA	139
EOS (Emulsified Oil Substrate)	Injection Subcontractor	1,997.00	GAL	43,136
(Note: Vendor Quote: EOS Remediation, 2009)				
EOS (Emulsified Oil Substrate) - Shipping	Injection Subcontractor	1,997.00	GAL	1,282
(Note: Vendor Quote: EOS Remediation, 2009)				
Per Diem	Injection Subcontractor	8.00	DAY	1,401
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	4.00	DAY	451
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	4.00	DAY	58
(Note: Per Estimator)				
Oversight	**AE Contractor L**	**1.00**	**EA**	**5,546**
Project Manager	AE Contractor L	4.00	HR	401
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Geologist	AE Contractor L	40.00	HR	3,992
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed [redacted]				
Per Diem	AE Contractor ME	4.00	DAY	668
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	4.00	DAY	430

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	4.00	DAY	56
(Note: Per Estimator)				
Bioaugmentation Injection	**General Contractor**	**1.00**	**LS**	**56,705**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**53,932**
Per Diem	Injection Subcontractor	4.00	DAY	700
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	2.00	DAY	225
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	2.00	DAY	29
(Note: Per Estimator)				
Bioaugmentation	Injection Subcontractor	350.00	LIT	51,082
(Note: Vendor Quote: EOS Remediation, 2009)				
General Operator/Tech	Injection Subcontractor	40.00	HR	1,895
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: 1[redacted] Assumed Bonus: [redacted]				
Oversight	**AE Contractor L**	**1.00**	**LS**	**2,773**
Project Manager	AE Contractor L	2.00	HR	201
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] 1 Assumed Benefits: 1[redacted] Assumed Bonus: [redacted])				
Geologist	AE Contractor L	20.00	HR	1,996
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: 1[redacted]% Assumed Bonus: [redacted]				
Per Diem	AE Contractor ME	2.00	DAY	334
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	2.00	DAY	215
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	2.00	DAY	28
(Note: Per Estimator)				
ISCO Injection - Pilot	**General Contractor**	**1.00**	**EA**	**50,738**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**45,192**
Mobilization/Demobilization of DPT Rig & Crew	Injection Subcontractor	1.00	LS	2,043
(Note: Previous Work, 2010)				
DPT Crew & Rig - Daily Rate	Injection Subcontractor	4.00	DAY	10,508
(Note: Previous Work, 2010)				
Decontamination Pad	Injection Subcontractor	1.00	LS	292
(Note: Previous Work, 2010)				
Borehole Abandonment, per Borehole	Injection Subcontractor	15.00	EA	2,189
(Note: Previous Work, 2010)				
IDW Handling	Injection Subcontractor	15.00	EA	2,189
(Note: Previous Work, 2010)				
Process Water Suplied by Water Line	Injection Subcontractor	30.00	KGA	149
Persulfate (Chemical Oxidant)	Injection Subcontractor	10,018.00	LB	22,078
(Note: Vendor Quote: ChemRem, 5/13/2011)				
NaOH (Chemical Oxidant Activator)	Injection Subcontractor	6,734.00	LB	3,833
(Note: Vendor Quote: ChemRem, 5/13/2011)				
Per Diem	Injection Subcontractor	8.00	DAY	1,401
(Note: Standard Rate Per Diem - GSA, 2012)				

Description	Contractor	Quantity	UOM	ProjectCost
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	Injection Subcontractor	4.00	DAY	451
Fuel for Rental Truck (Note: Per Estimator)	Injection Subcontractor	4.00	DAY	58
Oversight	**AE Contractor L**	**1.00**	**LS**	**5,546**
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	4.00	HR	401
Geologist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	40.00	HR	3,992
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	4.00	DAY	668
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	4.00	DAY	430
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	4.00	DAY	56
ISCR Injection - Pilot	**General Contractor**	**1.00**	**EA**	**69,778**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**58,685**
Mobilization/Demobilization of DPT Rig & Crew (Note: Previous Work, 2010)	Injection Subcontractor	1.00	LS	2,043
DPT Crew & Rig - Daily Rate (Note: Previous Work, 2010)	Injection Subcontractor	4.00	DAY	10,508
Decontamination Pad (Note: Previous Work, 2010)	Injection Subcontractor	1.00	LS	292
Borehole Abandonment, per Borehole (Note: Previous Work, 2010)	Injection Subcontractor	15.00	EA	2,189
IDW Handling (Note: Previous Work, 2010)	Injection Subcontractor	15.00	EA	2,189
Process Water Suplied by Water Line	Injection Subcontractor	30.00	KGA	149
EHC (Chemical Reductant) (Note: Cost Source: Adventus Group, 4/29/2011 Unit Price for EHC for quantities up to 20,000 lbs.)	Injection Subcontractor	10,018.00	LB	36,553
EHC (Chemical Reductant) - Shipping (Note: Cost Source: Adventus Group, 4/29/2011)	Injection Subcontractor	10,018.00	LB	2,851
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	Injection Subcontractor	8.00	DAY	1,401
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	Injection Subcontractor	4.00	DAY	451
Fuel for Rental Truck (Note: Per Estimator)	Injection Subcontractor	4.00	DAY	58
Oversight	**AE Contractor L**	**1.00**	**LS**	**11,093**
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	8.00	HR	803
Geologist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	80.00	HR	7,984
Per Diem	AE Contractor ME	8.00	DAY	1,335

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	8.00	DAY	859
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	8.00	DAY	111
(Note: Per Estimator)				
Injection - Area 1	**General Contractor**	**1.00**	**EA**	**3,978,990**
EAB Injection - Area 1	**General Contractor**	**1.00**	**EA**	**1,540,051**
EAB Injection	**General Contractor**	**1.00**	**EA**	**1,483,345**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**1,365,484**
Mobilization/Demobilization of DPT Rig & Crew	Injection Subcontractor	1.00	LS	2,043
(Note: Previous Work, 2010)				
DPT Crew & Rig - Daily Rate	Injection Subcontractor	85.00	DAY	223,300
(Note: Previous Work, 2010)				
Decontamination Pad	Injection Subcontractor	1.00	LS	292
(Note: Previous Work, 2010)				
Borehole Abandonment, per Borehole	Injection Subcontractor	337.00	EA	49,184
(Note: Previous Work, 2010)				
IDW Handling	Injection Subcontractor	337.00	EA	49,184
(Note: Previous Work, 2010)				
Process Water Suplied by Water Line	Injection Subcontractor	626.00	KGA	3,115
EOS (Emulsified Oil Substrate)	Injection Subcontractor	44,859.00	GAL	968,968
(Note: Vendor Quote: EOS Remediation, 2009)				
EOS (Emulsified Oil Substrate) - Shipping	Injection Subcontractor	44,859.00	GAL	28,807
(Note: Vendor Quote: EOS Remediation, 2009)				
Per Diem	Injection Subcontractor	170.00	DAY	29,771
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	85.00	DAY	9,577
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	85.00	DAY	1,241
(Note: Per Estimator)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**117,861**
Project Manager	AE Contractor L	85.00	HR	8,530
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Geologist	AE Contractor L	850.00	HR	84,834
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Per Diem	AE Contractor ME	85.00	DAY	14,187
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	85.00	DAY	9,128
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	85.00	DAY	1,182
(Note: Per Estimator)				
Bioaugmentation Injection	**General Contractor**	**1.00**	**LS**	**56,705**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**53,932**
Per Diem	Injection Subcontractor	4.00	DAY	700
(Note: Standard Rate Per Diem - GSA, 2012)				

Description	Contractor	Quantity	UOM	ProjectCost
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	Injection Subcontractor	2.00	DAY	225
Fuel for Rental Truck (Note: Per Estimator)	Injection Subcontractor	2.00	DAY	29
Bioaugmentation (Note: Vendor Quote: EOS Remediation, 2009)	Injection Subcontractor	350.00	LIT	51,082
General Operator/Tech (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	Injection Subcontractor	40.00	HR	1,895
Oversight	**AE Contractor L**	**1.00**	**LS**	**2,773**
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	2.00	DAY	334
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	2.00	DAY	215
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	2.00	DAY	28
Geologist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted])	AE Contractor L	20.00	HR	1,996
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: 1[redacted] Assumed Bonus: [redacted])	AE Contractor L	2.00	HR	201
ISCO Injection - Area 1	**General Contractor**	**1.00**	**EA**	**1,067,905**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**950,044**
Mobilization/Demobilization of DPT Rig & Crew (Note: Previous Work, 2010)	Injection Subcontractor	1.00	LS	2,043
DPT Crew & Rig - Daily Rate (Note: Previous Work, 2010)	Injection Subcontractor	85.00	DAY	223,300
Decontamination Pad (Note: Previous Work, 2010)	Injection Subcontractor	1.00	LS	292
Borehole Abandonment, per Borehole (Note: Previous Work, 2010)	Injection Subcontractor	337.00	EA	49,184
IDW Handling (Note: Previous Work, 2010)	Injection Subcontractor	337.00	EA	49,184
Process Water Suplied by Water Line	Injection Subcontractor	671.00	KGA	3,339
Persulfate (Chemical Oxidant) (Note: Vendor Quote: ChemRem, 5/13/2011)	Injection Subcontractor	225,063.00	LB	495,997
NaOH (Chemical Oxidant Activator) (Note: Vendor Quote: ChemRem, 5/13/2011)	Injection Subcontractor	151,290.00	LB	86,114
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	Injection Subcontractor	170.00	DAY	29,771
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	Injection Subcontractor	85.00	DAY	9,577
Fuel for Rental Truck (Note: Per Estimator)	Injection Subcontractor	85.00	DAY	1,241
Oversight	**AE Contractor L**	**1.00**	**LS**	**117,861**
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed	AE Contractor L	85.00	HR	8,530

Description	Contractor	Quantity	UOM	ProjectCost
Bonus: [redacted])				
Geologist	AE Contractor L	850.00	HR	84,834
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: 1[redacted] Assumed Bonus: 6[redacted])				
Per Diem	AE Contractor ME	85.00	DAY	14,187
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	85.00	DAY	9,128
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	85.00	DAY	1,182
(Note: Per Estimator)				
ISCR Injection - Area 1	**General Contractor**	**1.00**	**EA**	**1,371,034**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**1,253,173**
Mobilization/Demobilization of DPT Rig & Crew	Injection Subcontractor	1.00	LS	2,043
(Note: Previous Work, 2010)				
DPT Crew & Rig - Daily Rate	Injection Subcontractor	85.00	DAY	223,300
(Note: Previous Work, 2010)				
Decontamination Pad	Injection Subcontractor	1.00	LS	292
(Note: Previous Work, 2010)				
Borehole Abandonment, per Borehole	Injection Subcontractor	337.00	EA	49,184
(Note: Previous Work, 2010)				
IDW Handling	Injection Subcontractor	337.00	EA	49,184
(Note: Previous Work, 2010)				
Process Water Suplied by Water Line	Injection Subcontractor	671.00	KGA	3,339
EHC (Chemical Reductant)	Injection Subcontractor	225,063.00	LB	821,187
(Note: Cost Source: Adventus Group, 4/29/2011 Unit Price for EHC for quantities up to 20,000 lbs.)				
EHC (Chemical Reductant) - Shipping	Injection Subcontractor	225,063.00	LB	64,053
(Note: Cost Source: Adventus Group, 4/29/2011)				
Per Diem	Injection Subcontractor	170.00	DAY	29,771
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	85.00	DAY	9,577
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	85.00	DAY	1,241
(Note: Per Estimator)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**117,861**
Project Manager	AE Contractor L	85.00	HR	8,530
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted]1 Assumed Benefits:[redacted] Bonus: [redacted])				
Geologist	AE Contractor L	850.00	HR	84,834
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6[redacted]				
Per Diem	AE Contractor ME	85.00	DAY	14,187
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	85.00	DAY	9,128
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	85.00	DAY	1,182
(Note: Per Estimator)				
Maintain and Operate Existing GET System and In Situ Treatment via Groundwater Amendment	**General Contractor**	**1.00**	**EA**	**4,827,101**
Injection Equipment	**Injection Subcontractor**	**1.00**	**LS**	**23,851**

Description	Contractor	Quantity	UOM	ProjectCost
5,000 Gallon Storage Tank (Note: Vendor Quote: The Tank Depot, 2012)	Injection Subcontractor	1.00	EA	2,874
Trash Pump - 220 gpm (Note: Vendor Quote: Honda Power Equipment, 2012)	Injection Subcontractor	1.00	EA	751
Flat Bottom Tank Mixer (Note: Vendor Quote: Indelco Plastics, 2010)	Injection Subcontractor	1.00	EA	4,870
Pressure Gauge - Injection Point (Note: Vendor Quote: Indelco Plastics, 2012)	Injection Subcontractor	1.00	EA	185
Pressure Gauge - Water to Frac Tank (Note: Vendor Quote: Indelco Plastics, 2012)	Injection Subcontractor	1.00	EA	185
2" Steel Ball Valve (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	2.00	EA	485
2" Steel Pipe (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	20.00	LF	172
2" Steel Tee (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	4.00	EA	340
2" Steel Elbow, 90 Degree (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	2.00	EA	138
2" Female Camlock (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	5.00	EA	85
2" Male Camlock (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	5.00	EA	46
2" Hose (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	1,000.00	LF	12,989
Health and Safety Allowances (Note: Per estimator)	Injection Subcontractor	1.00	EA	730
Pilot Scale Groundwater Monitoring Event	**AE Contractor L**	**1.00**	**EA**	**60,200**
Analysis	**AE Contractor ME**	**1.00**	**LS**	**40,494**
VOCs, EPA Method SW-846 8260 (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	3,330
Metals, Dissolved, EPA Method 6010, Field Filtered (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	3,481
Nitrate/Nitrite (NO3/NO2) (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	757
Sulfate, EPA MCAWW, 300, Field Filtered (Note: Vendor Quote. Teklab (Previous Work), 2009)	AE Contractor ME	30.00	EA	835
Sulfide, SM 4500S2 E (Note: Vendor Quote. Teklab (Previous Work), 2009)	AE Contractor ME	30.00	EA	1,043
Total Iron (Fe) (Note: 25 Tests per kit. Vendor Quote: Hach, 4/27/2011)	AE Contractor ME	1.00	EA	36
Total Manganese (Mn) (Note: Vendor Quote. Teklab (Previous Work), 2009)	AE Contractor ME	30.00	EA	459
Chloride, EPA MCAWW, 300, Field Filtered (Note: Vendor Quote. Teklab (Previous Work), 2009)	AE Contractor ME	30.00	EA	835
Alkalinity, EPA MCAWW, 310.1, Field Filtered (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	606

Description	Contractor	Quantity	UOM	ProjectCost
Dissolved Total Organic Carbon (TOC) (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	1,362
Carbon Dioxide (CO2) (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	2,422
Volatile Fatty Acids (VFAs) (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	3,784
Methane/Ethane/Ethene (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	30.00	EA	3,633
Microbiological DNA Analysis (Note: Previous Work)	AE Contractor ME	30.00	EA	15,148
Dissolved Oxygen, Colorimetic Test Kits, 0 to 1 ppm (Note: 30 Tests per kit. Vendor Quote: Cole Parmer, 4/27/2011)	AE Contractor ME	1.00	EA	75
Dissolved Oxygen, Colorimetic Test Kits, 1 to 12 ppm (Note: 30 Tests per kit. Vendor Quote: Cole Parmer, 4/27/2011)	AE Contractor ME	1.00	EA	78
Field Filter, 0.45 micron filter (Note: 25 Filters per pack. Vendor Quote: Hach, 4/27/2011)	AE Contractor ME	30.00	EA	1,051
Overnight Sample Shipment	AE Contractor ME	12.00	EA	1,560
Equipment	**AE Contractor ME**	**1.00**	**LS**	**8,221**
Water Quality Meter and Flow Through Cell (Note: Weekly Rental. Vendor Quote: In-Situ, 4/27/2011)	AE Contractor ME	2.00	WK	1,669
Photoionization Detector (PID) (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2.00	WK	556
Water Level Meter (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2.00	WK	167
Turbidimeter (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2.00	WK	223
Portable Bladder Pump (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2.00	WK	417
Replacement Poly Bladders (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	27.00	EA	300
Bladder Pump Controller (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2.00	WK	626
Compressed Nitrogen Gas Rental (Note: Per Estimator)	AE Contractor ME	2.00	WK	278
Combination Tubing for Bladder Pump (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2,500.00	LF	2,087
Shipping Rental Equipment (Note: Previous Work)	AE Contractor ME	2.00	EA	696
55-gallon Open Head Steel Drum (Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)	AE Contractor ME	4.00	EA	923
Miscellaneous Sampling Equipment (Note: Per Estimator)	AE Contractor ME	1.00	LS	278
Crew	**AE Contractor L**	**1.00**	**LS**	**11,485**
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor L	7.00	DAY	995
Fuel for Rental Truck	AE Contractor L	7.00	DAY	129

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Per Estimator)				
Per Diem	AE Contractor L	14.00	DAY	3,092
(Note: Standard Rate Per Diem - GSA, 2012)				
Project Manager	AE Contractor L	3.00	HR	301
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted]				
General Operator/Tech	AE Contractor L	112.00	HR	6,692
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6[redacted])				
Procurement Specialist	AE Contractor L	5.00	HR	277
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Benefits: [redacted] Assumed Bonus: [redacted]				
Pilot Scale Groundwater Monitoring Event Report Generation	**AE Contractor L**	**1.00**	**EA**	**14,805**
Reproduction Costs for Groundwater Sampling Event Reports	AE Contractor L	1.00	LS	920
(Note: Per Estimator)				
Drafter CAD	AE Contractor L	32.00	HR	1,946
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Draftsman: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Project Manager	AE Contractor L	8.00	HR	803
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted]1 Assumed Benefits: [redacted] Assumed Bonus: 6[redacted]				
Quality Assurance Director	AE Contractor L	4.00	HR	706
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Quality Assurance Director: [redacted] Assumed Benefits: 1[redacted] Assumed Bonus: [redacted]				
Clerks, Typists, Bookkeepers & Receptionist	AE Contractor L	10.00	HR	449
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted]6 Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Geologist	AE Contractor L	100.00	HR	9,980
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Well Abandonment - Monitoring Wells	**General Contractor**	**47.00**	**EA**	**166,666**
	Drilling Subcontractor	**1.00**	**LS**	**126,184**
Driller				
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 2" Well	Drilling Subcontractor	7,275.00	VLF	116,524
Portland cement grout	Drilling Subcontractor	160.00	CF	1,389
(Note: Cost Source: HTW)				
	AE Contractor L	**1.00**	**LS**	**40,482**
Oversight				
Daily Pickup Truck Rental	AE Contractor L	30.00	DAY	4,262
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor L	30.00	DAY	552
(Note: Per Estimator)				
Per Diem	AE Contractor L	30.00	DAY	6,625
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	291.00	HR	29,043
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Decommissioning Treatment System	**General Contractor**	**1.00**	**LS**	**61,000**
Decommisioning Treatment Systems	General Contractor	1.00	LS	61,000
(Note: Per Estimator)				

Description	Contractor	Quantity	UOM	ProjectCost
EAB Groundwater Monitoring Event	**AE Contractor L**	**1.00**	**EA**	**76,415**
Analysis	**AE Contractor ME**	**1.00**	**LS**	**44,030**
VOCs, EPA Method SW-846 8260	AE Contractor ME	55.00	EA	6,104
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Metals, Dissolved, EPA Method 6010, Field Filtered	AE Contractor ME	55.00	EA	6,382
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Nitrate/Nitrite (NO3/NO2)	AE Contractor ME	55.00	EA	1,388
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Sulfate, EPA MCAWW, 300, Field Filtered	AE Contractor ME	55.00	EA	1,530
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Sulfide, SM 4500S2 E	AE Contractor ME	55.00	EA	1,913
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Total Iron (Fe)	AE Contractor ME	2.00	EA	73
(Note: 25 Tests per kit. Vendor Quote: Hach, 4/27/2011)				
Total Manganese (Mn)	AE Contractor ME	55.00	EA	842
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Chloride, EPA MCAWW, 300, Field Filtered	AE Contractor ME	55.00	EA	1,530
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Alkalinity, EPA MCAWW, 310.1, Field Filtered	AE Contractor ME	55.00	EA	1,110
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Dissolved Total Organic Carbon (TOC)	AE Contractor ME	55.00	EA	2,497
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Carbon Dioxide (CO2)	AE Contractor ME	55.00	EA	4,440
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Volatile Fatty Acids (VFAs)	AE Contractor ME	55.00	EA	6,937
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Methane/Ethane/Ethene	AE Contractor ME	55.00	EA	6,660
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Dissolved Oxygen, Colorimetic Test Kits, 0 to 1 ppm	AE Contractor ME	2.00	EA	151
(Note: 30 Tests per kit. Vendor Quote: Cole Parmer, 4/27/2011)				
Dissolved Oxygen, Colorimetic Test Kits, 1 to 12 ppm	AE Contractor ME	2.00	EA	157
(Note: 30 Tests per kit. Vendor Quote: Cole Parmer, 4/27/2011)				
Field Filter, 0.45 micron filter	AE Contractor ME	55.00	EA	1,927
(Note: 25 Filters per pack. Vendor Quote: Hach, 4/27/2011)				
Overnight Sample Shipment	AE Contractor ME	3.00	EA	390
Equipment	**AE Contractor ME**	**1.00**	**LS**	**12,962**
Water Quality Meter and Flow Through Cell	AE Contractor ME	3.00	WK	2,504
(Note: Weekly Rental. Vendor Quote: In-Situ, 4/27/2011)				
Photoionization Detector (PID)	AE Contractor ME	3.00	WK	835
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Water Level Meter	AE Contractor ME	3.00	WK	250
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Turbidimeter	AE Contractor ME	3.00	WK	334
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Portable Bladder Pump	AE Contractor ME	3.00	WK	626
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				

Description	Contractor	Quantity	UOM	ProjectCost
Replacement Poly Bladders (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	49.00	EA	545
Bladder Pump Controller (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	939
Compressed Nitrogen Gas Rental (Note: Per Estimator)	AE Contractor ME	3.00	WK	417
Combination Tubing for Bladder Pump (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	4,700.00	LF	3,923
Shipping Rental Equipment (Note: Previous Work)	AE Contractor ME	2.00	EA	696
55-gallon Open Head Steel Drum (Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)	AE Contractor ME	7.00	EA	1,616
Miscellaneous Sampling Equipment (Note: Per Estimator)	AE Contractor ME	1.00	LS	278
	AE Contractor L	**1.00**	**LS**	**19,423**
Crew				
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor L	12.00	DAY	1,705
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor L	12.00	DAY	221
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor L	24.00	DAY	5,300
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	4.00	HR	401
General Operator/Tech (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] 4 Assumed Benefits: 1[redacted] Assumed Bonus: [redacted])	AE Contractor L	190.00	HR	11,353
Procurement Specialist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted]%)	AE Contractor L	8.00	HR	443
VOC-Only Groundwater Monitoring Event	**AE Contractor L**	**1.00**	**EA**	**38,880**
Analysis	**AE Contractor ME**	**1.00**	**LS**	**6,494**
VOCs, EPA Method SW-846 8260 (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	55.00	EA	6,104
Overnight Sample Shipment	AE Contractor ME	3.00	EA	390
	AE Contractor ME	**1.00**	**EA**	**12,962**
Equipment				
Water Quality Meter and Flow Through Cell (Note: Weekly Rental. Vendor Quote: In-Situ, 4/27/2011)	AE Contractor ME	3.00	WK	2,504
Photoionization Detector (PID) (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	835
Water Level Meter (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	250
Turbidimeter (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	334
Portable Bladder Pump (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	626
Replacement Poly Bladders (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	49.00	EA	545

Description	Contractor	Quantity	UOM	ProjectCost
Bladder Pump Controller (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	939
Compressed Nitrogen Gas Rental (Note: Per Estimator)	AE Contractor ME	3.00	WK	417
Combination Tubing for Bladder Pump (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	4,700.00	LF	3,923
Shipping Rental Equipment (Note: Previous Work)	AE Contractor ME	2.00	EA	696
55-gallon Open Head Steel Drum (Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)	AE Contractor ME	7.00	EA	1,616
Miscellaneous Sampling Equipment (Note: Per Estimator)	AE Contractor ME	1.00	LS	278
Crew	**AE Contractor L**	**1.00**	**EA**	**19,423**
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor L	12.00	DAY	1,705
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor L	12.00	DAY	221
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor L	24.00	DAY	5,300
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted]1 Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	4.00	HR	401
General Operator/Tech (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	190.00	HR	11,353
Procurement Specialist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	8.00	HR	443
Groundwater Monitoring Event Report Generation	**AE Contractor L**	**1.00**	**EA**	**25,230**
Reproduction Costs for Groundwater Sampling Event Reports (Note: Per Estimator)	AE Contractor L	1.00	LS	920
Drafter CAD (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Draftsman: [redacted] Assumed Benefits: 1[redacted]% Assumed Bonus: [redacted])	AE Contractor L	59.00	HR	3,588
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	8.00	HR	803
Assurance Director (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Quality Assurance Director: [redacted]4 Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	4.00	HR	706
Clerks, Typists, Bookkeepers & Receptionist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	10.00	HR	449
Geologist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted]7 Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	188.00	HR	18,763
Monitoring Well Maintenance	**General Contractor**	**1.00**	**EA**	**48,001**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**34,807**
Mob/Demob of Drill Rig (Note: Previous Work)	Drilling Subcontractor	1.00	LS	7,297
Monitoring well maintenance	Drilling Subcontractor	94.00	EA	22,584

Description	Contractor	Quantity	UOM	ProjectCost
8" Vault	Drilling Subcontractor	47.00	EA	4,116
(Note: Cost Source: Previous Work)				
Locking J-Plug, 2" Well	Drilling Subcontractor	47.00	EA	809
(Note: Vendor Quote: Dean Bennett Supply, 4/27/2011)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**13,195**
Daily Pickup Truck Rental	AE Contractor L	10.00	DAY	1,421
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor L	10.00	DAY	184
(Note: Per Estimator)				
Per Diem	AE Contractor L	10.00	DAY	2,208
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	94.00	HR	9,382
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6[redacted]				
Treatment System O&M	**General Contractor**	**1.00**	**EA**	**92,153**
Electrical Consumption	General Contractor	614,300.00	KWH	59,902
(Note: Cost Source: U.S. Energy Information Administration)				
Weekly maintenance visit	General Contractor	52.00	EA	9,767
Miscellaneous materials and consumables for operation and maintenance	General Contractor	1.00	LS	12,200
(Note: Per estimator)				
Packed column air stripper cleaning	General Contractor	4.00	EA	10,283
Pilot Scale Injection	**General Contractor**	**1.00**	**LS**	**240,911**
EAB Injection - Pilot	**General Contractor**	**1.00**	**EA**	**125,941**
EAB Injection	**General Contractor**	**1.00**	**EA**	**69,236**
Injection	**Injection Subcontractor**	**1.00**	**EA**	**63,689**
Mobilization/Demobilization of DPT Rig & Crew	Injection Subcontractor	1.00	LS	2,043
(Note: Previous Work, 2010)				
DPT Crew & Rig - Daily Rate	Injection Subcontractor	4.00	DAY	10,508
(Note: Previous Work, 2010)				
Decontamination Pad	Injection Subcontractor	1.00	LS	292
(Note: Previous Work, 2010)				
Borehole Abandonment, per Borehole	Injection Subcontractor	15.00	EA	2,189
(Note: Previous Work, 2010)				
IDW Handling	Injection Subcontractor	15.00	EA	2,189
(Note: Previous Work, 2010)				
Process Water Suplied by Water Line	Injection Subcontractor	28.00	KGA	139
EOS (Emulsified Oil Substrate)	Injection Subcontractor	1,997.00	GAL	43,136
(Note: Vendor Quote: EOS Remediation, 2009)				
EOS (Emulsified Oil Substrate) - Shipping	Injection Subcontractor	1,997.00	GAL	1,282
(Note: Vendor Quote: EOS Remediation, 2009)				
Per Diem	Injection Subcontractor	8.00	DAY	1,401
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	4.00	DAY	451
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	4.00	DAY	58
(Note: Per Estimator)				
Oversight	**AE Contractor L**	**1.00**	**EA**	**5,546**

Description	Contractor	Quantity	UOM	ProjectCost
Project Manager	AE Contractor L	4.00	HR	401
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted])				
Geologist	AE Contractor L	40.00	HR	3,992
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Per Diem	AE Contractor ME	4.00	DAY	668
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	4.00	DAY	430
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	4.00	DAY	56
(Note: Per Estimator)				
Bioaugmentation Injection	**General Contractor**	**1.00**	**LS**	**56,705**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**53,932**
Per Diem	Injection Subcontractor	4.00	DAY	700
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	2.00	DAY	225
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	2.00	DAY	29
(Note: Per Estimator)				
Bioaugmentation	Injection Subcontractor	350.00	LIT	51,082
(Note: Vendor Quote: EOS Remediation, 2009)				
General Operator/Tech	Injection Subcontractor	40.00	HR	1,895
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6[redacted]				
Oversight	**AE Contractor L**	**1.00**	**LS**	**2,773**
Project Manager	AE Contractor L	2.00	HR	201
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: 1[redacted] Assumed Bonus: [redacted]				
Geologist	AE Contractor L	20.00	HR	1,996
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted])				
Per Diem	AE Contractor ME	2.00	DAY	334
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	2.00	DAY	215
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	2.00	DAY	28
(Note: Per Estimator)				
ISCO Injection - Pilot	**General Contractor**	**1.00**	**EA**	**50,738**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**45,192**
Mobilization/Demobilization of DPT Rig & Crew	Injection Subcontractor	1.00	LS	2,043
(Note: Previous Work, 2010)				
DPT Crew & Rig - Daily Rate	Injection Subcontractor	4.00	DAY	10,508
(Note: Previous Work, 2010)				
Decontamination Pad	Injection Subcontractor	1.00	LS	292
(Note: Previous Work, 2010)				
Borehole Abandonment, per Borehole	Injection Subcontractor	15.00	EA	2,189
(Note: Previous Work, 2010)				
IDW Handling	Injection Subcontractor	15.00	EA	2,189

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Previous Work, 2010)				
Process Water Suplied by Water Line	Injection Subcontractor	30.00	KGA	149
Persulfate (Chemical Oxidant)	Injection Subcontractor	10,018.00	LB	22,078
(Note: Vendor Quote: ChemRem, 5/13/2011)				
NaOH (Chemical Oxidant Activator)	Injection Subcontractor	6,734.00	LB	3,833
(Note: Vendor Quote: ChemRem, 5/13/2011)				
Per Diem	Injection Subcontractor	8.00	DAY	1,401
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	4.00	DAY	451
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	4.00	DAY	58
(Note: Per Estimator)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**5,546**
Project Manager	AE Contractor L	4.00	HR	401
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed [redacted] Assumed Bonus: [redacted]				
Geologist	AE Contractor L	40.00	HR	3,992
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] % Assumed Bonus: [redacted]				
Per Diem	AE Contractor ME	4.00	DAY	668
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	4.00	DAY	430
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	4.00	DAY	56
(Note: Per Estimator)				
ISCR Injection - Pilot	**General Contractor**	**1.00**	**EA**	**64,231**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**58,685**
Mobilization/Demobilization of DPT Rig & Crew	Injection Subcontractor	1.00	LS	2,043
(Note: Previous Work, 2010)				
DPT Crew & Rig - Daily Rate	Injection Subcontractor	4.00	DAY	10,508
(Note: Previous Work, 2010)				
Decontamination Pad	Injection Subcontractor	1.00	LS	292
(Note: Previous Work, 2010)				
Borehole Abandonment, per Borehole	Injection Subcontractor	15.00	EA	2,189
(Note: Previous Work, 2010)				
IDW Handling	Injection Subcontractor	15.00	EA	2,189
(Note: Previous Work, 2010)				
Process Water Suplied by Water Line	Injection Subcontractor	30.00	KGA	149
EHC (Chemical Reductant)	Injection Subcontractor	10,018.00	LB	36,553
(Note: Cost Source: Adventus Group, 4/29/2011 Unit Price for EHC for quantities up to 20,000 lbs.)				
EHC (Chemical Reductant) - Shipping	Injection Subcontractor	10,018.00	LB	2,851
(Note: Cost Source: Adventus Group, 4/29/2011)				
Per Diem	Injection Subcontractor	8.00	DAY	1,401
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	4.00	DAY	451
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	4.00	DAY	58

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Per Estimator)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**5,546**
Project Manager	AE Contractor L	4.00	HR	401
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Geologist	AE Contractor L	40.00	HR	3,992
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Per Diem	AE Contractor ME	4.00	DAY	668
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	4.00	DAY	430
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	4.00	DAY	56
(Note: Per Estimator)				
Injection - Area 1	**General Contractor**	**1.00**	**EA**	**3,978,990**
EAB Injection - Area 1	**General Contractor**	**1.00**	**EA**	**1,540,051**
EAB Injection	**General Contractor**	**1.00**	**EA**	**1,483,345**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**1,365,484**
Mobilization/Demobilization of DPT Rig & Crew	Injection Subcontractor	1.00	LS	2,043
(Note: Previous Work, 2010)				
DPT Crew & Rig - Daily Rate	Injection Subcontractor	85.00	DAY	223,300
(Note: Previous Work, 2010)				
Decontamination Pad	Injection Subcontractor	1.00	LS	292
(Note: Previous Work, 2010)				
Borehole Abandonment, per Borehole	Injection Subcontractor	337.00	EA	49,184
(Note: Previous Work, 2010)				
IDW Handling	Injection Subcontractor	337.00	EA	49,184
(Note: Previous Work, 2010)				
Process Water Suplied by Water Line	Injection Subcontractor	626.00	KGA	3,115
EOS (Emulsified Oil Substrate)	Injection Subcontractor	44,859.00	GAL	968,968
(Note: Vendor Quote: EOS Remediation, 2009)				
EOS (Emulsified Oil Substrate) - Shipping	Injection Subcontractor	44,859.00	GAL	28,807
(Note: Vendor Quote: EOS Remediation, 2009)				
Per Diem	Injection Subcontractor	170.00	DAY	29,771
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	85.00	DAY	9,577
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	85.00	DAY	1,241
(Note: Per Estimator)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**117,861**
Project Manager	AE Contractor L	85.00	HR	8,530
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: 1[redacted] Assumed Bonus: [redacted])				
Geologist	AE Contractor L	850.00	HR	84,834
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Per Diem	AE Contractor ME	85.00	DAY	14,187
(Note: Standard Rate Per Diem - GSA, 2012)				

Description	Contractor	Quantity	UOM	ProjectCost
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	85.00	DAY	9,128
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	85.00	DAY	1,182
Bioaugmentation Injection	**General Contractor**	**1.00**	**LS**	**56,705**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**53,932**
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	Injection Subcontractor	4.00	DAY	700
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	Injection Subcontractor	2.00	DAY	225
Fuel for Rental Truck (Note: Per Estimator)	Injection Subcontractor	2.00	DAY	29
Bioaugmentation (Note: Vendor Quote: EOS Remediation, 2009)	Injection Subcontractor	350.00	LIT	51,082
General Operator/Tech (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	Injection Subcontractor	40.00	HR	1,895
Oversight	**AE Contractor L**	**1.00**	**LS**	**2,773**
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	2.00	DAY	334
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	2.00	DAY	215
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	2.00	DAY	28
Geologist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	20.00	HR	1,996
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	2.00	HR	201
ISCO Injection - Area 1	**General Contractor**	**1.00**	**EA**	**1,067,905**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**950,044**
Mobilization/Demobilization of DPT Rig & Crew (Note: Previous Work, 2010)	Injection Subcontractor	1.00	LS	2,043
DPT Crew & Rig - Daily Rate (Note: Previous Work, 2010)	Injection Subcontractor	85.00	DAY	223,300
Decontamination Pad (Note: Previous Work, 2010)	Injection Subcontractor	1.00	LS	292
Borehole Abandonment, per Borehole (Note: Previous Work, 2010)	Injection Subcontractor	337.00	EA	49,184
IDW Handling (Note: Previous Work, 2010)	Injection Subcontractor	337.00	EA	49,184
Process Water Suplied by Water Line	Injection Subcontractor	671.00	KGA	3,339
Persulfate (Chemical Oxidant) (Note: Vendor Quote: ChemRem, 5/13/2011)	Injection Subcontractor	225,063.00	LB	495,997
NaOH (Chemical Oxidant Activator) (Note: Vendor Quote: ChemRem, 5/13/2011)	Injection Subcontractor	151,290.00	LB	86,114
Per Diem	Injection Subcontractor	170.00	DAY	29,771

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	85.00	DAY	9,577
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	85.00	DAY	1,241
(Note: Per Estimator)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**117,861**
Project Manager	AE Contractor L	85.00	HR	8,530
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Benefits: [redacted]% Assumed Bonus: [redacted])				
Geologist	AE Contractor L	8[redacted]	HR	84,834
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: 1[redacted]% Assumed Bonus: [redacted]%)				
Per Diem	AE Contractor ME	85.00	DAY	14,187
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	85.00	DAY	9,128
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	85.00	DAY	1,182
(Note: Per Estimator)				
ISCR Injection - Area 1	**General Contractor**	**1.00**	**EA**	**1,371,034**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**1,253,173**
Mobilization/Demobilization of DPT Rig & Crew	Injection Subcontractor	1.00	LS	2,043
(Note: Previous Work, 2010)				
DPT Crew & Rig - Daily Rate	Injection Subcontractor	85.00	DAY	223,300
(Note: Previous Work, 2010)				
Decontamination Pad	Injection Subcontractor	1.00	LS	292
(Note: Previous Work, 2010)				
Borehole Abandonment, per Borehole	Injection Subcontractor	337.00	EA	49,184
(Note: Previous Work, 2010)				
IDW Handling	Injection Subcontractor	337.00	EA	49,184
(Note: Previous Work, 2010)				
Process Water Suplied by Water Line	Injection Subcontractor	671.00	KGA	3,339
EHC (Chemical Reductant)	Injection Subcontractor	225,063.00	LB	821,187
(Note: Cost Source: Adventus Group, 4/29/2011 Unit Price for EHC for quantities up to 20,000 lbs.)				
EHC (Chemical Reductant) - Shipping	Injection Subcontractor	225,063.00	LB	64,053
(Note: Cost Source: Adventus Group, 4/29/2011)				
Per Diem	Injection Subcontractor	170.00	DAY	29,771
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	85.00	DAY	9,577
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	85.00	DAY	1,241
(Note: Per Estimator)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**117,861**
Project Manager	AE Contractor L	85.00	HR	8,530
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Geologist	AE Contractor L	850.00	HR	84,834
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted]7 Assumed Benefits: 1[redacted] Assumed Bonus: 6[redacted])				

Description	Contractor	Quantity	UOM	ProjectCost
Per Diem	AE Contractor ME	85.00	DAY	14,187
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	85.00	DAY	9,128
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	85.00	DAY	1,182
(Note: Per Estimator)				
OU2 Groundwater (Sitewide)	**General Contractor**	**1.00**	**EA**	**30,249,606**
No Action	**General Contractor**	**1.00**	**EA**	**177,951**
Monitoring Well Abandonment	**Drilling Subcontractor**	**27.00**	**EA**	**108,621**
Driller	**Drilling Subcontractor**	**1.00**	**EA**	**84,981**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 2" Well	Drilling Subcontractor	4,550.00	VLF	72,877
Cement-grout mixture	Drilling Subcontractor	101.00	CF	3,833
(Note: Based on RS Means CostWorks 2011 Number 31 43 1313 0200.)				
Oversight	**AE Contractor L**	**1.00**	**EA**	**23,640**
Daily Pickup Truck Rental	AE Contractor ME	19.00	DAY	2,040
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	19.00	DAY	264
(Note: Per Estimator)				
Per Diem	AE Contractor ME	19.00	DAY	3,171
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	182.00	HR	18,164
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Bonus: [redacted])				
Groundwater Monitoring Event	**AE Contractor L**	**1.00**	**EA**	**23,610**
Analysis	**AE Contractor ME**	**1.00**	**EA**	**3,812**
VOCs, EPA Method SW-846 8260	AE Contractor ME	32.00	EA	3,552
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Overnight Sample Shipment	AE Contractor ME	2.00	EA	260
Equipment	**AE Contractor ME**	**1.00**	**EA**	**8,410**
Water Quality Meter and Flow Through Cell	AE Contractor ME	2.00	WK	1,669
(Note: Weekly Rental. Vendor Quote: In-Situ, 4/27/2011)				
Photoionization Detector (PID)	AE Contractor ME	2.00	WK	556
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Water Level Meter	AE Contractor ME	2.00	WK	167
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Turbidimeter	AE Contractor ME	2.00	WK	223
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Portable Bladder Pump	AE Contractor ME	2.00	WK	417
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Replacement Poly Bladders	AE Contractor ME	29.00	EA	323
(Note: Vendor Quote: Pine Env, 4/27/2011)				
Bladder Pump Controller	AE Contractor ME	2.00	WK	626
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				

Description	Contractor	Quantity	UOM	ProjectCost
Compressed Nitrogen Gas Rental (Note: Per Estimator)	AE Contractor ME	2.00	WK	278
Combination Tubing for Bladder Pump (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2,700.00	LF	2,253
Shipping Rental Equipment (Note: Previous Work)	AE Contractor ME	2.00	EA	696
55-gallon Open Head Steel Drum (Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)	AE Contractor ME	4.00	EA	923
Miscellaneous Sampling Equipment (Note: Per Estimator)	AE Contractor ME	1.00	LS	278
Crew	**AE Contractor L**	**1.00**	**EA**	**11,389**
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	8.00	DAY	859
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	8.00	DAY	111
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	16.00	DAY	2,671
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project [redacted] Assumed Benefits: 1[redacted]% Assumed Bonus: [redacted]	AE Contractor L	3.00	HR	301
General Operator/Tech (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed [redacted] Assumed [redacted]	AE Contractor L	120.00	HR	7,170
Procurement Specialist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Benefits: 1[redacted] Assumed Bonus: [redacted])	AE Contractor L	5.00	HR	277
Groundwater Monitoring Event Report Generation	**AE Contractor L**	**1.00**	**EA**	**15,500**
Reproduction Costs for Groundwater Sampling Event Reports (Note: Per Estimator)	AE Contractor ME	1.00	LS	696
Drafter CAD (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Draftsman: $[redacted] Assumed Benefits: [redacted]% Assumed Bonus: 6[redacted]	AE Contractor L	34.00	HR	2,068
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	8.00	HR	803
Quality Assurance Director (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Quality Assurance Director: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	4.00	HR	706
Clerks, Typists, Bookkeepers & Receptionist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	10.00	HR	449
Geologist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	108.00	HR	10,779
Monitoring Well Maintenance	**Drilling Subcontractor**	**1.00**	**EA**	**30,219**
Driller	**Drilling Subcontractor**	**1.00**	**EA**	**23,101**
Mob/Demob of Drill Rig (Note: Previous Work)	Drilling Subcontractor	1.00	LS	7,297
Monitoring well maintenance	Drilling Subcontractor	54.00	EA	12,974
8" Vault (Note: Cost Source: Previous Work)	Drilling Subcontractor	27.00	EA	2,364

Description	Contractor	Quantity	UOM	ProjectCost
Locking J-Plug, 2" Well (Note: Vendor Quote: Dean Bennett Supply, 4/27/2011)	Drilling Subcontractor	27.00	EA	465
Oversight	**AE Contractor L**	**1.00**	**EA**	**7,119**
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	6.00	DAY	644
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	6.00	DAY	83
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	6.00	DAY	1,001
Geologist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	54.00	HR	5,389
Groundwater Recovery, Treatment, and Discharge (leading edge of plume)	**General Contractor**	**1.00**	**EA**	**3,450,945**
Monitoring Well Installation	**General Contractor**	**30.00**	**EA**	**329,045**
Driller	**Drilling Subcontractor**	**40.00**	**EA**	**264,732**
Mob/Demob of Drill Rig (Note: Previous Work)	Drilling Subcontractor	1.00	LS	7,297
Decontamination Pad Construction/Removal (Note: Previous Work)	Drilling Subcontractor	1.00	LS	973
Drilling, hollow stem auger, normal soil, 2" or less casing/screen, 4-1/4" ID x 8" OD auger (Note: Cost Source: HTW)	Drilling Subcontractor	4,750.00	LF	165,874
Well screen assembly, slotted PVC, 2" diameter (Note: Cost Source: Means CostWorks 2011)	Drilling Subcontractor	300.00	LF	2,455
Gravel Pack, 2" Well (Note: Cost Source: Echos 2005, 33 23 1401)	Drilling Subcontractor	300.00	LF	6,252
Casing, PVC, flush threaded, standard length 10', 2" diameter, schedule 80 (Note: Cost Source: HTW)	Drilling Subcontractor	4,450.00	LF	22,537
Pressure Transducer (Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)	Drilling Subcontractor	30.00	EA	31,963
Pressure Transducer Cable (Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)	Drilling Subcontractor	4,450.00	LF	15,263
Bentonite Seal (Note: Gravel packing and annular sealant, bentonite tablets, 10.80 lb./gallon, 1/4". Cost Source: Means CostWorks 2011 - 023223136123)	Drilling Subcontractor	6.00	CF	363
Portland cement grout (Note: Cost Source: HTW)	Drilling Subcontractor	289.00	CF	2,510
Locking J-Plug, 2" Well (Note: Vendor Quote: Dean Bennett Supply, 4/27/2011)	Drilling Subcontractor	30.00	EA	517
8" Vault (Note: Cost Source: Previous Work)	Drilling Subcontractor	30.00	EA	2,627
Hauling to Landfill (Note: Assume 2 hours for loading/transporting/dumping of well cuttings at landfill.)	Drilling Subcontractor	1.00	EA	231
Drill Cuttings Disposal (Note: Vendor Quote: City of Hastings, Special Waste Classification - Solid Waste Disposal)	Drilling Subcontractor	29.00	TON	3,682
Roll Off Rental (Note: Previous Work)	Drilling Subcontractor	50.00	DAY	2,189
Oversight	**AE Contractor L**	**40.00**	**EA**	**64,312**
Well Development	AE Contractor L	120.00	HR	11,977

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Assume 4 hrs/well)				
Geologist	AE Contractor L	380.00	HR	37,926
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Per Diem	AE Contractor ME	50.00	DAY	8,345
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	50.00	DAY	5,369
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	50.00	DAY	696
(Note: Per Estimator)				
Recovery Well Installation	**General Contractor**	**6.00**	**EA**	**641,543**
	Drilling Subcontractor	**1.00**	**EA**	**612,946**
Driller				
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Drilling, hollow stem auger, normal soil, 6" or less casing/screen, 8-1/4" ID x 13-3/4" OD auger	Drilling Subcontractor	1,155.00	LF	63,355
Stainless steel well screen, flush threaded, 5' sections, 6" diameter, no. 304 stainless steel	Drilling Subcontractor	120.00	LF	30,805
Well casing, stainless steel, flush threaded, 10' sections, 6" diameter, 304 stainless steel	Drilling Subcontractor	1,035.00	LF	430,999
Gravel packing and annular sealant, No. 2 morie silica sand, contaminant free	Drilling Subcontractor	18.00	TON	17,767
Bentonite Seal	Drilling Subcontractor	12.00	CF	725
(Note: Gravel packing and annular sealant, bentonite tablets, 10.80 lb./gallon, 1/4". Cost Source: Means CostWorks 2011 - 023223136123)				
Portland cement grout	Drilling Subcontractor	597.00	CF	5,184
(Note: Cost Source: HTW)				
Hauling to Landfill	Drilling Subcontractor	3.00	EA	693
(Note: Assume 2 hours for loading/transporting/dumping of well cuttings at landfill.)				
Drill Cuttings Disposal	Drilling Subcontractor	80.40	TON	10,209
(Note: Vendor Quote: City of Hastings, Special Waste Classification - Solid Waste Disposal)				
Roll Off Rental	Drilling Subcontractor	22.00	DAY	963
(Note: Previous Work)				
Pressure Transducer Cable	Drilling Subcontractor	1,215.00	LF	4,167
(Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)				
Pressure Transducer	Drilling Subcontractor	6.00	EA	6,393
(Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)				
Submersible pump, 56 - 95 gpm, 101'< Head <=220', 5 hp, 4" discharge, w/ controls	Drilling Subcontractor	3.00	EA	11,247
Submersible pump, 201 - 410 gpm, 176'< Head <=225', 25 hp, 6" discharge, w/ controls	Drilling Subcontractor	3.00	EA	22,166
	AE Contractor L	**1.00**	**EA**	**28,597**
Oversight				
Well Development	AE Contractor L	48.00	HR	4,791
(Note: Assume 4 hrs/well)				
Geologist	AE Contractor L	175.00	HR	17,466
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted])				
Per Diem	AE Contractor ME	22.00	DAY	3,672
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	22.00	DAY	2,362
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	22.00	DAY	306
(Note: Per Estimator)				

Description	Contractor	Quantity	UOM	ProjectCost
Re-Injection Well Installation	**General Contractor**	**3.00**	**EA**	**335,548**
Driller	**Drilling Subcontractor**	**1.00**	**EA**	**319,714**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Drilling, hollow stem auger, normal soil, 6" or less casing/screen, 8-1/4" ID x 13-3/4" OD auger	Drilling Subcontractor	630.00	LF	34,557
Stainless steel well screen, flush threaded, 5' sections, 6" diameter, no. 304 stainless steel	Drilling Subcontractor	60.00	LF	15,403
Well casing, stainless steel, flush threaded, 10' sections, 6" diameter, 304 stainless steel	Drilling Subcontractor	570.00	LF	237,362
Gravel packing and annular sealant, No. 2 morie silica sand, contaminant free	Drilling Subcontractor	9.00	TON	8,884
Bentonite Seal	Drilling Subcontractor	6.00	CF	363
(Note: Gravel packing and annular sealant, bentonite tablets, 10.80 lb./gallon, 1/4". Cost Source: Means CostWorks 2011 - 023223136123)				
Portland cement grout	Drilling Subcontractor	330.00	CF	2,866
(Note: Cost Source: HTW)				
Hauling to Landfill	Drilling Subcontractor	2.00	EA	462
(Note: Assume 2 hours for loading/transporting/dumping of well cuttings at landfill.)				
Drill Cuttings Disposal	Drilling Subcontractor	43.80	TON	5,561
(Note: Vendor Quote: City of Hastings, Special Waste Classification - Solid Waste Disposal)				
Roll Off Rental	Drilling Subcontractor	12.00	DAY	525
(Note: Previous Work)				
Pressure Transducer Cable	Drilling Subcontractor	660.00	LF	2,264
(Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)				
Pressure Transducer	Drilling Subcontractor	3.00	EA	3,196
(Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)				
Oversight	**AE Contractor L**	**1.00**	**EA**	**15,834**
Well Development	AE Contractor L	24.00	HR	2,395
(Note: Assume 4 hrs/well)				
Geologist	AE Contractor L	100.00	HR	9,980
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Per Diem	AE Contractor ME	12.00	DAY	2,003
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	12.00	DAY	1,289
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	12.00	DAY	167
(Note: Per Estimator)				
Well Vault	**General Contractor**	**9.00**	**EA**	**440,466**
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	General Contractor	27.00	BCY	205
Borrow, material only, bank run gravel	General Contractor	27.00	TON	468
(Note: Material cost from RS Means CostWorks 2011 item 312323155050.)				
Fill, gravel fill, compacted	General Contractor	144.00	SF	132
Utility structures, utility vaults precast concrete, meter pit, 6' x 6', 6' deep, excludes excavation and backfill	General Contractor	9.00	EA	31,625
Doors, specialty, access, floor, industrial, steel, 300 psf L.L., double leaf, 5' x 5', 645 lb	General Contractor	9.00	OPN	29,535
Pipe, plastic, PVC, 6" diameter, schedule 80, excludes couplings and hangers	General Contractor	90.00	LF	1,990
Elbow, 90 Deg., plastic, PVC, socket joint, 6", schedule 80	General Contractor	36.00	EA	5,103
Tee, plastic, PVC, socket joint, 6", schedule 80	General Contractor	9.00	EA	2,104
Flange, plastic, PVC, socket joint, 150 lb., 6", schedule 80, excludes gasket and bolt set	General Contractor	72.00	EA	7,363

Description	Contractor	Quantity	UOM	ProjectCost
Valves, cast iron, lined, corrosion resistant, high purity, check lift, horizontal, PPL or SL lined, flanged, 125 lb., 6"	General Contractor	9.00	EA	39,912
Valves, ductile iron, lined, corrosion resistant, high purity, butterfly, wafer type for flanged installation, 150 lb., 6"	General Contractor	18.00	EA	60,656
Magnetic flow meter, 6"	General Contractor	9.00	EA	38,477
(Note: Material cost based on vendor quote for 3" mag meter from Endress+Hauser, September 2011. Material cost apportioned for a 6" mag meter.)				
Bolt and flange pack	General Contractor	45.00	EA	993
(Note: Vendor quote, Star Pipe Products, March 2011)				
Electric heating, heat trace system, 400 degree, 115 V, 5 watts per L.F.	General Contractor	90.00	LF	1,116
Insulation, pipe, fiberglass with 0.010" thick, for aluminum jacket, 2-1/2" wall, 4" iron pipe size	General Contractor	90.00	LF	1,188
(Note: Material cost from Means CostWorks 2011 number 22071 910 7578 and 22071 910 7811.)				
Electrical drop and materials	General Contractor	9.00	LS	219,600
(Note: Per estimator)				
Pipe Installation	**General Contractor**	**13,480.00**	**LF**	**828,916**
Disposal of Excess Soils	**General Contractor**	**1.00**	**EA**	**327,109**
Hauling to Landfill Facility	General Contractor	4,784.00	LCY	16,317
(Note: Crew Productivity: RSM - 312323201069. 30 Miles to Butler County Landfill in David City, NE)				
Special Waste Disposal Costs at Landfill Facility	General Contractor	7,176.00	TON	310,793
(Note: Butler County Landfill, September 2011. Cost includes $1 per ton environmental fee.)				
Trench Excavation	**General Contractor**	**1.00**	**EA**	**60,542**
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	General Contractor	7,971.00	BCY	60,542
Backfill of Trench	**General Contractor**	**1.00**	**EA**	**225,825**
Borrow, material only, bank run gravel	General Contractor	6,821.00	TON	118,158
(Note: Material cost from RS Means CostWorks 2011 item 312323155050.)				
Excavating, trench backfill, 1 C.Y. bucket, minimal haul, front end loader, wheel mounted, excludes dewatering	General Contractor	9,566.00	LCY	13,373
Fill, gravel fill, compacted	General Contractor	53,920.00	SF	49,506
Topsoil placement and grading, loam or topsoil screened, 6" deep, furnish and place, truck dumped	General Contractor	5,992.00	SY	41,632
Seeding athletic fields, seeding bluegrass, common with mulch and fertilizer, 4 lb. per M.S.F., hydro or air seeding	General Contractor	5,992.00	SY	3,157
Piping Placement	**General Contractor**	**1.00**	**EA**	**174,348**
Piping	**General Contractor**	**1.00**	**EA**	**146,053**
Pipe, plastic, high density polyethylene (HDPE), single wall, straight, welded, based on 40' length, 8" diam., DR 11, add 1 weld per joint, excludes hangers, trenching, backfill, hoisting or digging equipment.	General Contractor	13,480.00	LF	146,053
Joints	**General Contractor**	**1.00**	**EA**	**1,715**
Tee, plastic, high density polyethylene (HDPE), single wall, welded, 8" diam., DR 11, add 1 weld per joint, excludes hangers, trenching, backfill, hoisting or digging equipment.	General Contractor	10.00	EA	1,488
Elbow, 90 Deg., plastic, high density polyethylene (HDPE), single wall, welded, 8" diam., DR 11, add 1 weld per joint, excludes hangers, trenching, backfill, hoisting or digging equipment.	General Contractor	2.00	EA	227
Welding	**General Contractor**	**1.00**	**EA**	**7,048**
Welding, plastic, high density polyethylene (HDPE), single wall, labor per joint, cost based on the thickest wall for each diameter, 8" pipe size, weld, excludes welding machine	General Contractor	340.00	EA	5,281
Welding, plastic, high density polyethylene (HDPE), dual wall, machine, rental per day based on diam. capacity, 6" thru 8" diameter	General Contractor	7.00	DAY	1,768
Detectable Tape and Pipe Testing	**General Contractor**	**1.00**	**EA**	**19,531**
Utility Line Signs, Markers, and Flags, underground tape, detectable, reinforced, aluminum foil core, 6", excludes excavation and backfill	General Contractor	135.00	CLF	1,413
Pipe testing, nondestructive hydraulic pressure test, isolate, 1 hour hold, 6" to 10" pipe, 1000 - 2000 L.F.	General Contractor	7.00	EA	18,118
Concrete Demolition	**General Contractor**	**1.00**	**EA**	**431**
Concrete sawing, concrete slabs, mesh reinforcing, up to 3" deep	General Contractor	68.00	LF	102

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Cost Source: RSM - 038113500400)				
Demolish, remove pavement & curb, remove bituminous pavement, 4" to 6" thick, excludes hauling and disposal fees	General Contractor	14.00	SY	56
Hauling to Landfill Facility	General Contractor	4.00	LCY	14
(Note: Crew Productivity: RSM - 312323201032. 2 Miles to City of Hastings Landfill in Hastings, NE)				
Special Waste Disposal Costs at Landfill Facility	General Contractor	6.00	TON	260
(Note: City of Hastings Landfill, September 2011.)				
Concrete Paving	**General Contractor**	**1.00**	**EA**	**404**
Concrete paving surface treatment, 4500 psi, fixed form, unreinforced, 12' pass, 6" thick, includes joints, finishing, and curing	General Contractor	14.00	SY	404
Electrical	**General Contractor**	**1.00**	**EA**	**2,621**
Electrical Underground Ducts and Manholes, hand holes, precast concrete, with concrete cover, 2' x 2' x 3' deep, excludes excavation, backfill and cast in place concrete	General Contractor	2.00	EA	1,642
Electrical lines for extraction well piping	General Contractor	250.00	LF	979
(Note: Per estimator)				
Pipe Jacking under Railroad Tracks	**General Contractor**	**1.00**	**EA**	**37,635**
Horizontal boring, railroad work, 24" diameter, includes casing only	General Contractor	110.00	LF	37,323
Borrow, material only, bank run gravel	General Contractor	18.00	TON	312
(Note: Material cost from RS Means CostWorks 2011 item 312323155050.)				
Treatment System Building	**General Contractor**	**1.00**	**EA**	**98,469**
Pre-Eng Steel Bldg, clear span rigid frame, 30 psf roof and 20 psf wind load, 20' W x 14' eave H, incl. 26 ga. colored ribbed roofing & siding, excl. footings, slab, anchor bolts	General Contractor	600.00	SF	11,571
Structural concrete, in place, continuous strip footing (3000 psi), 24" wide x 12" deep, unreinforced, includes forms, reinforcing steel, concrete, placing and finishing	General Contractor	8.00	CY	1,436
Base course drainage layers, aggregate base course for concrete slabs and capillary water barrier, 1" minus graded gravel, 6" compacted thickness	General Contractor	15.00	CY	2,520
Structural concrete, placing, slab on grade, direct chute, up to 6" thick, includes strike off & consolidation, excludes material	General Contractor	12.00	CY	106
C.I.P. concrete forms, slab on grade, metal, radius, 10' long, 6" high, 100 uses, includes stakes, erecting, bracing, stripping and cleaning	General Contractor	100.00	LF	267
C.I.P. concrete forms, slab on grade, depressed, edge, wood, to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	General Contractor	100.00	LF	278
Reinforcing Steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	General Contractor	1.80	TON	2,272
Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	General Contractor	12.00	CY	1,613
Wall Insulation, Rigid, fiberglass, foil faced, 2" thick, R8.7, 3#/CF	General Contractor	1,400.00	SF	3,389
Electric heating, unit heater, heavy duty, single phase, 208-240-277 volt, 15 kW, includes fan & mounting bracket	General Contractor	1.00	EA	1,816
Electrical allowance	General Contractor	1.00	LS	36,600
(Note: Per estimator. Includes electrical hookup, interior electrical, and lights.)				
Misc. appurtenances allowance	General Contractor	1.00	LS	36,600
(Note: Per estimator. Includes entry door, overhead doors, etc.)				
Treatment System	**General Contractor**	**1.00**	**EA**	**135,871**
Tray air stripper assembly, 6 tray 10-1000 GPM.		1.00	LS	95,554
(Note: Vendor quote from QED Environmental, July 2011. EZ-Tray series 96 unit has a flow rate of 10-1000 GPM, 304 stainless steel trays and shell with integral sump, tray levels, see-through front hatch, polypropylene de-mister, liquid level sight gauge, sump pressure gauge, blower, controls, and installation.)				
Electrical work	General Contractor	1.00	LS	6,100
(Note: Allowance per estimator)				
Instrumentation and controls	General Contractor	1.00	LS	18,300
(Note: Allowance per estimator.)				

Description	Contractor	Quantity	UOM	ProjectCost
Magnetic flow meter, 4"	General Contractor	1.00	EA	4,275
(Note: Material cost based on vendor quote for 3" mag meter from Endress+Hauser, September 2011. Material cost apportioned for a 4" mag meter.)				
Pipe, plastic, PVC, 4" diameter, schedule 80, excludes couplings and hangers	General Contractor	50.00	LF	516
Elbow, 90 Deg., plastic, PVC, socket joint, 4", schedule 80	General Contractor	6.00	EA	347
Flange, plastic, PVC, socket joint, 150 lb., 4", schedule 80, excludes gasket and bolt set	General Contractor	10.00	EA	647
Valves, cast iron, lined, corrosion resistant, high purity, check lift, horizontal, PPL or SL lined, flanged, 125 lb., 4"	General Contractor	2.00	EA	5,224
Valves, ductile iron, lined, corrosion resistant, high purity, butterfly, wafer type for flanged installation, 150 lb., 4"	General Contractor	2.00	EA	4,753
Bolt and flange pack, 4"	General Contractor	7.00	EA	154
(Note: Vendor quote, Star Pipe Products, March 2011)				
Treatment System Startup Testing	**General Contractor**	**1.00**	**EA**	**13,947**
Electrical Consumption	General Contractor	336.00	KWH	33
(Note: Cost Source: U.S. Energy Information Administration)				
Treatment System Startup Testing	General Contractor	80.00	HR	13,914
Well Abandonment - Monitoring Wells	**General Contractor**	**57.00**	**EA**	**207,088**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**159,009**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 2" Well	Drilling Subcontractor	9,300.00	VLF	148,958
Portland cement grout	Drilling Subcontractor	205.00	CF	1,780
(Note: Cost Source: HTW)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**48,079**
Daily Pickup Truck Rental	AE Contractor ME	38.00	DAY	4,081
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	38.00	DAY	529
(Note: Per Estimator)				
Per Diem	AE Contractor ME	38.00	DAY	6,342
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	372.00	HR	37,127
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Well Abandonment - Recovery Wells	**General Contractor**	**6.00**	**EA**	**53,532**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**41,956**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 6" Well	Drilling Subcontractor	1,155.00	VLF	31,714
Portland cement grout	Drilling Subcontractor	227.00	CF	1,971
(Note: Cost Source: HTW)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**11,576**
Daily Pickup Truck Rental	AE Contractor ME	9.00	DAY	966
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	9.00	DAY	125
(Note: Per Estimator)				
Per Diem	AE Contractor ME	9.00	DAY	1,502

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	90.00	HR	8,982
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Well Abandonment - Re-Injection Wells	**General Contractor**	**3.00**	**EA**	**32,578**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**26,646**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 6" Well	Drilling Subcontractor	630.00	VLF	17,298
Portland cement grout	Drilling Subcontractor	124.00	CF	1,077
(Note: Cost Source: HTW)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**5,932**
Daily Pickup Truck Rental	AE Contractor ME	5.00	DAY	537
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	5.00	DAY	70
(Note: Per Estimator)				
Per Diem	AE Contractor ME	5.00	DAY	835
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	45.00	HR	4,491
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for [redacted] Benefits: [redacted] Assumed Bonus: [redacted]				
Decommissioning Treatment System	**General Contractor**	**1.00**	**LS**	**50,000**
Decommisioning Treatment Systems		1.00	LS	50,000
(Note: Per Estimator)				
Groundwater Monitoring Event	**AE Contractor L**	**1.00**	**EA**	**43,720**
Analysis	**AE Contractor ME**	**1.00**	**LS**	**7,845**
VOCs, EPA Method SW-846 8260	AE Contractor ME	66.00	EA	7,325
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Overnight Sample Shipment	AE Contractor ME	4.00	EA	520
Equipment	**AE Contractor ME**	**1.00**	**EA**	**14,370**
Water Quality Meter and Flow Through Cell	AE Contractor ME	3.00	WK	2,504
(Note: Weekly Rental. Vendor Quote: In-Situ, 4/27/2011)				
Photoionization Detector (PID)	AE Contractor ME	3.00	WK	835
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Water Level Meter	AE Contractor ME	3.00	WK	250
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Turbidimeter	AE Contractor ME	3.00	WK	334
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Portable Bladder Pump	AE Contractor ME	3.00	WK	626
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Replacement Poly Bladders	AE Contractor ME	59.00	EA	657
(Note: Vendor Quote: Pine Env, 4/27/2011)				
Bladder Pump Controller	AE Contractor ME	3.00	WK	939
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Compressed Nitrogen Gas Rental	AE Contractor ME	3.00	WK	417
(Note: Per Estimator)				

Description	Contractor	Quantity	UOM	ProjectCost
Combination Tubing for Bladder Pump (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	5,700.00	LF	4,757
Shipping Rental Equipment (Note: Previous Work)	AE Contractor ME	2.00	EA	696
55-gallon Open Head Steel Drum (Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)	AE Contractor ME	9.00	EA	2,078
Miscellaneous Sampling Equipment (Note: Per Estimator)	AE Contractor ME	1.00	LS	278
Crew	**AE Contractor L**	**1.00**	**EA**	**21,505**
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	15.00	DAY	1,611
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	15.00	DAY	209
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	30.00	DAY	5,007
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: 1[redacted] Assumed Bonus:[redacted]	AE Contractor L	5.00	HR	502
General Operator/Tech (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical:[redacted] Benefits: 1[redacted] Assumed Bonus: 6[redacted])	AE Contractor L	228.00	HR	13,624
Procurement Specialist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk:[redacted] Assumed Benefits: 1[redacted] Assumed Bonus: 6.[redacted]	AE Contractor L	10.00	HR	553
Groundwater Monitoring Event Report Generation	**AE Contractor L**	**1.00**	**EA**	**29,788**
Reproduction Costs for Groundwater Sampling Event Reports (Note: Per Estimator)	AE Contractor ME	1.00	LS	696
Drafter CAD (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Draftsman: [redacted] Assumed Benefits: 1[redacted] Assumed Bonus: 6[redacted]	AE Contractor L	72.00	HR	4,379
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	8.00	HR	803
Quality Assurance Director (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Quality Assurance Director: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6[redacted]	AE Contractor L	4.00	HR	706
Clerks, Typists, Bookkeepers & Receptionist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative [redacted]6 Assumed Benefits:[redacted] Assumed Bonus:[redacted]	AE Contractor L	10.00	HR	449
Geologist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	228.00	HR	22,755
Treatment System O&M	**General Contractor**	**1.00**	**EA**	**110,833**
Electrical Consumption (Note: Cost Source: U.S. Energy Information Administration)	General Contractor	858,600.00	KWH	83,725
Weekly maintenance visit	General Contractor	52.00	EA	9,767
Miscellaneous materials and consumables for operation and maintenance (Note: Per estimator)	General Contractor	1.00	LS	12,200
Tray air stripper cleaning	General Contractor	4.00	EA	5,142
Monitoring Well Maintenance	**General Contractor**	**1.00**	**EA**	**55,496**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**40,660**

Description	Contractor	Quantity	UOM	ProjectCost
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Monitoring well maintenance	Drilling Subcontractor	114.00	EA	27,389
8" Vault	Drilling Subcontractor	57.00	EA	4,991
(Note: Cost Source: Previous Work)				
Locking J-Plug, 2" Well	Drilling Subcontractor	57.00	EA	982
(Note: Vendor Quote: Dean Bennett Supply, 4/27/2011)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**14,836**
Daily Pickup Truck Rental	AE Contractor ME	12.00	DAY	1,289
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	12.00	DAY	167
(Note: Per Estimator)				
Per Diem	AE Contractor ME	12.00	DAY	2,003
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	114.00	HR	11,378
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6[redacted]				
Recovery Well Maintenance	**General Contractor**	**1.00**	**EA**	**17,005**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**13,746**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Extraction well maintenance	Drilling Subcontractor	24.00	HR	5,766
Miscellaneous materials for extraction well maintenance	Drilling Subcontractor	1.00	LS	682
(Note: Per estimator)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**3,260**
Daily Pickup Truck Rental	AE Contractor ME	3.00	DAY	322
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	3.00	DAY	42
(Note: Per Estimator)				
Per Diem	AE Contractor ME	3.00	DAY	501
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	24.00	HR	2,395
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for [redacted] Benefits: [redacted] Assumed Bonus: [redacted]				
Re-Injection Well Maintenance	**General Contractor**	**1.00**	**EA**	**12,637**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**10,862**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Extraction well maintenance	Drilling Subcontractor	12.00	HR	2,883
Miscellaneous materials for extraction well maintenance	Drilling Subcontractor	1.00	LS	682
(Note: Per estimator)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**1,774**
Daily Pickup Truck Rental	AE Contractor ME	2.00	DAY	215
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	2.00	DAY	28
(Note: Per Estimator)				
Per Diem	AE Contractor ME	2.00	DAY	334
(Note: Standard Rate Per Diem - GSA, 2012)				

Description	Contractor	Quantity	UOM	ProjectCost
Geologist	AE Contractor L	12.00	HR	1,198
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted]7 Assumed Benefits: 1[redacted] Assumed Bonus: [redacted])				
Land Acquisition/Easement Requirements	**General Contractor**	**1.00**	**EA**	**14,464**
Environmental Lawyer	AE Contractor L	40.00	HR	6,515
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Lawyer: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Paralegal	General Contractor	80.00	HR	4,466
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Paralegal: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6[redacted])				
Clerks, Typists, Bookkeepers & Receptionist	General Contractor	20.00	HR	636
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Project Manager	General Contractor	40.00	HR	2,847
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: $[redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Groundwater Recovery, Treatment, and Discharge (mid-plume and leading edge of plume)	**General Contractor**	**1.00**	**EA**	**5,253,915**
Monitoring Well Installation	**General Contractor**	**30.00**	**EA**	**329,045**
Driller	**Drilling Subcontractor**	**40.00**	**EA**	**264,732**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Drilling, hollow stem auger, normal soil, 2" or less casing/screen, 4-1/4" ID x 8" OD auger	Drilling Subcontractor	4,750.00	LF	165,874
(Note: Cost Source: HTW)				
Well screen assembly, slotted PVC, 2" diameter	Drilling Subcontractor	300.00	LF	2,455
(Note: Cost Source: Means CostWorks 2011)				
Gravel Pack, 2" Well	Drilling Subcontractor	300.00	LF	6,252
(Note: Cost Source: Echos 2005, 33 23 1401)				
Casing, PVC, flush threaded, standard length 10', 2" diameter, schedule 80	Drilling Subcontractor	4,450.00	LF	22,537
(Note: Cost Source: HTW)				
Pressure Transducer	Drilling Subcontractor	30.00	EA	31,963
(Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)				
Pressure Transducer Cable	Drilling Subcontractor	4,450.00	LF	15,263
(Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)				
Bentonite Seal	Drilling Subcontractor	6.00	CF	363
(Note: Gravel packing and annular sealant, bentonite tablets, 10.80 lb./gallon, 1/4". Cost Source: Means CostWorks 2011 - 023223136123)				
Portland cement grout	Drilling Subcontractor	289.00	CF	2,510
(Note: Cost Source: HTW)				
Locking J-Plug, 2" Well	Drilling Subcontractor	30.00	EA	517
(Note: Vendor Quote: Dean Bennett Supply, 4/27/2011)				
8" Vault	Drilling Subcontractor	30.00	EA	2,627
(Note: Cost Source: Previous Work)				
Hauling to Landfill	Drilling Subcontractor	1.00	EA	231
(Note: Assume 2 hours for loading/transporting/dumping of well cuttings at landfill.)				
Drill Cuttings Disposal	Drilling Subcontractor	29.00	TON	3,682
(Note: Vendor Quote: City of Hastings, Special Waste Classification - Solid Waste Disposal)				
Roll Off Rental	Drilling Subcontractor	50.00	DAY	2,189
(Note: Previous Work)				
Oversight	**AE Contractor L**	**40.00**	**EA**	**64,312**

Description	Contractor	Quantity	UOM	ProjectCost
Well Development	AE Contractor L	120.00	HR	11,977
(Note: Assume 4 hrs/well)				
Geologist	AE Contractor L	380.00	HR	37,926
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: 1[redacted]% Assumed Bonus: [redacted]%)				
Per Diem	AE Contractor ME	50.00	DAY	8,345
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	50.00	DAY	5,369
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	50.00	DAY	696
(Note: Per Estimator)				
Recovery Well Installation	**General Contractor**	**12.00**	**EA**	**1,273,253**
	Drilling Subcontractor	**1.00**	**EA**	**1,217,346**
Driller				
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Drilling, hollow stem auger, normal soil, 6" or less casing/screen, 8-1/4" ID x 13-3/4" OD auger	Drilling Subcontractor	2,310.00	LF	126,710
Stainless steel well screen, flush threaded, 5' sections, 6" diameter, no. 304 stainless steel	Drilling Subcontractor	240.00	LF	61,610
Well casing, stainless steel, flush threaded, 10' sections, 6" diameter, 304 stainless steel	Drilling Subcontractor	2,070.00	LF	861,998
Gravel packing and annular sealant, No. 2 morie silica sand, contaminant free	Drilling Subcontractor	36.00	TON	35,535
Bentonite Seal	Drilling Subcontractor	24.00	CF	1,450
(Note: Gravel packing and annular sealant, bentonite tablets, 10.80 lb./gallon, 1/4". Cost Source: Means CostWorks 2011 - 023223136123)				
Portland cement grout	Drilling Subcontractor	1,194.00	CF	10,369
(Note: Cost Source: HTW)				
Hauling to Landfill	Drilling Subcontractor	5.00	EA	1,156
(Note: Assume 2 hours for loading/transporting/dumping of well cuttings at landfill.)				
Drill Cuttings Disposal	Drilling Subcontractor	160.80	TON	20,418
(Note: Vendor Quote: City of Hastings, Special Waste Classification - Solid Waste Disposal)				
Roll Off Rental	Drilling Subcontractor	43.00	DAY	1,883
(Note: Previous Work)				
Pressure Transducer Cable	Drilling Subcontractor	2,430.00	LF	8,334
(Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)				
Pressure Transducer	Drilling Subcontractor	12.00	EA	12,785
(Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)				
Submersible pump, 56 - 95 gpm, 101'< Head <=220', 5 hp, 4" discharge, w/ controls	Drilling Subcontractor	6.00	EA	22,495
Submersible pump, 201 - 410 gpm, 176'< Head <=225', 25 hp, 6" discharge, w/ controls	Drilling Subcontractor	6.00	EA	44,332
	AE Contractor L	**1.00**	**EA**	**55,907**
Oversight				
Well Development	AE Contractor L	96.00	HR	9,581
(Note: Assume 4 hrs/well)				
Geologist	AE Contractor L	340.00	HR	33,933
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6[redacted]				
Per Diem	AE Contractor ME	43.00	DAY	7,177
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	43.00	DAY	4,618
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	43.00	DAY	598

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Per Estimator)				
Re-Injection Well Installation	**General Contractor**	**6.00**	**EA**	**608,129**
Driller	**Drilling Subcontractor**	**1.00**	**EA**	**579,532**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Drilling, hollow stem auger, normal soil, 6" or less casing/screen, 8-1/4" ID x 13-3/4" OD auger	Drilling Subcontractor	1,155.00	LF	63,355
Stainless steel well screen, flush threaded, 5' sections, 6" diameter, no. 304 stainless steel	Drilling Subcontractor	120.00	LF	30,805
Well casing, stainless steel, flush threaded, 10' sections, 6" diameter, 304 stainless steel	Drilling Subcontractor	1,035.00	LF	430,999
Gravel packing and annular sealant, No. 2 morie silica sand, contaminant free	Drilling Subcontractor	18.00	TON	17,767
Bentonite Seal	Drilling Subcontractor	12.00	CF	725
(Note: Gravel packing and annular sealant, bentonite tablets, 10.80 lb./gallon, 1/4". Cost Source: Means CostWorks 2011 - 023223136123)				
Portland cement grout	Drilling Subcontractor	597.00	CF	5,184
(Note: Cost Source: HTW)				
Hauling to Landfill	Drilling Subcontractor	3.00	EA	693
(Note: Assume 2 hours for loading/transporting/dumping of well cuttings at landfill.)				
Drill Cuttings Disposal	Drilling Subcontractor	80.40	TON	10,209
(Note: Vendor Quote: City of Hastings, Special Waste Classification - Solid Waste Disposal)				
Roll Off Rental	Drilling Subcontractor	22.00	DAY	963
(Note: Previous Work)				
Pressure Transducer Cable	Drilling Subcontractor	1,215.00	LF	4,167
(Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)				
Pressure Transducer	Drilling Subcontractor	6.00	EA	6,393
(Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)				
Oversight	**AE Contractor L**	**1.00**	**EA**	**28,597**
Well Development	AE Contractor L	48.00	HR	4,791
(Note: Assume 4 hrs/well)				
Geologist	AE Contractor L	175.00	HR	17,466
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: 1[redacted] Assumed Bonus:[redacted]				
Per Diem	AE Contractor ME	22.00	DAY	3,672
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	22.00	DAY	2,362
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	22.00	DAY	306
(Note: Per Estimator)				
Well Vault	**General Contractor**	**18.00**	**EA**	**880,931**
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	General Contractor	54.00	BCY	410
Borrow, material only, bank run gravel	General Contractor	54.00	TON	935
(Note: Material cost from RS Means CostWorks 2011 item 312323155050.)				
Fill, gravel fill, compacted	General Contractor	288.00	SF	264
Utility structures, utility vaults precast concrete, meter pit, 6' x 6', 6' deep, excludes excavation and backfill	General Contractor	18.00	EA	63,249
Doors, specialty, access, floor, industrial, steel, 300 psf L.L., double leaf, 5' x 5', 645 lb	General Contractor	18.00	OPN	59,071
Pipe, plastic, PVC, 6" diameter, schedule 80, excludes couplings and hangers	General Contractor	180.00	LF	3,979
Elbow, 90 Deg., plastic, PVC, socket joint, 6", schedule 80	General Contractor	72.00	EA	10,207
Tee, plastic, PVC, socket joint, 6", schedule 80	General Contractor	18.00	EA	4,207

Description	Contractor	Quantity	UOM	ProjectCost
Flange, plastic, PVC, socket joint, 150 lb., 6", schedule 80, excludes gasket and bolt set	General Contractor	144.00	EA	14,725
Valves, cast iron, lined, corrosion resistant, high purity, check lift, horizontal, PPL or SL lined, flanged, 125 lb., 6"	General Contractor	18.00	EA	79,823
Valves, ductile iron, lined, corrosion resistant, high purity, butterfly, wafer type for flanged installation, 150 lb., 6"	General Contractor	36.00	EA	121,312
Magnetic flow meter, 6"	General Contractor	18.00	EA	76,953
(Note: Material cost based on vendor quote for 3" mag meter from Endress+Hauser, September 2011. Material cost apportioned for a 6" mag meter.)				
Bolt and flange pack	General Contractor	90.00	EA	1,986
(Note: Vendor quote, Star Pipe Products, March 2011)				
Electric heating, heat trace system, 400 degree, 115 V, 5 watts per L.F.	General Contractor	180.00	LF	2,232
Insulation, pipe, fiberglass with 0.010" thick, for aluminum jacket, 2-1/2" wall, 4" iron pipe size	General Contractor	180.00	LF	2,376
(Note: Material cost from Means CostWorks 2011 number 22071 910 7578 and 22071 910 7811.)				
Electrical drop and materials	General Contractor	18.00	LS	439,200
(Note: Per estimator)				
Pipe Installation	**General Contractor**	**18,250.00**	**LF**	**1,047,130**
Disposal of Excess Soils	**General Contractor**	**1.00**	**EA**	**443,027**
Hauling to Landfill Facility	General Contractor	6,479.00	LCY	22,098
(Note: Crew Productivity: RSM - 312323201069. 30 Miles to Butler County Landfill in David City, NE)				
Special Waste Disposal Costs at Landfill Facility	General Contractor	9,719.00	TON	420,930
(Note: Butler County Landfill, September 2011. Cost includes $1 per ton environmental fee.)				
Trench Excavation	**General Contractor**	**1.00**	**EA**	**82,143**
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	General Contractor	10,815.00	BCY	82,143
Backfill of Trench	**General Contractor**	**1.00**	**EA**	**292,183**
Borrow, material only, bank run gravel	General Contractor	8,973.00	TON	155,436
(Note: Material cost from RS Means CostWorks 2011 item 312323155050.)				
Excavating, trench backfill, 1 C.Y. bucket, minimal haul, front end loader, wheel mounted, excludes dewatering	General Contractor	6,501.00	LCY	9,088
Fill, gravel fill, compacted	General Contractor	73,000.00	SF	67,024
Topsoil placement and grading, loam or topsoil screened, 6" deep, furnish and place, truck dumped	General Contractor	8,112.00	SY	56,361
Seeding athletic fields, seeding bluegrass, common with mulch and fertilizer, 4 lb. per M.S.F., hydro or air seeding	General Contractor	8,112.00	SY	4,274
Piping Placement	**General Contractor**	**1.00**	**EA**	**188,031**
Piping	**General Contractor**	**1.00**	**EA**	**142,941**
Pipe, plastic, high density polyethylene (HDPE), single wall, straight, welded, based on 40' length, 10" diam., DR 26, add 1 weld per joint, excludes hangers, trenching, backfill, hoisting or digging equipment.	General Contractor	18,250.00	LF	142,941
Joints	**General Contractor**	**1.00**	**EA**	**4,843**
Tee, plastic, high density polyethylene (HDPE), single wall, welded, 10" diam., DR 11, add 1 weld per joint, excludes hangers, trenching, backfill, hoisting or digging equipment.	General Contractor	9.00	EA	3,995
Elbow, 90 Deg., plastic, high density polyethylene (HDPE), single wall, welded, 10" diam., DR 11, add 1 weld per joint, excludes hangers, trenching, backfill, hoisting or digging equipment.	General Contractor	2.00	EA	849
Welding	**General Contractor**	**1.00**	**EA**	**12,448**
Welding, plastic, high density polyethylene (HDPE), single wall, labor per joint, cost based on the thickest wall for each diameter, 10" pipe size, weld, excludes welding machine	General Contractor	465.00	EA	8,666
Welding, plastic, high density polyethylene (HDPE), dual wall, machine, rental per day based on diam. capacity, 10" thru 12" diameter	General Contractor	10.00	DAY	3,782
Detectable Tape and Pipe Testing	**General Contractor**	**1.00**	**EA**	**27,798**
Utility Line Signs, Markers, and Flags, underground tape, detectable, reinforced, aluminum foil core, 6", excludes excavation and backfill	General Contractor	183.00	CLF	1,915
Pipe testing, nondestructive hydraulic pressure test, isolate, 1 hour hold, 6" to 10" pipe, 1000 - 2000 L.F.	General Contractor	10.00	EA	25,883
Concrete Demolition	**General Contractor**	**1.00**	**EA**	**710**

Description	Contractor	Quantity	UOM	ProjectCost
Concrete sawing, concrete slabs, mesh reinforcing, up to 3" deep	General Contractor	128.00	LF	191
(Note: Cost Source: RSM - 038113500400)				
Demolish, remove pavement & curb, remove bituminous pavement, 4" to 6" thick, excludes hauling and disposal fees	General Contractor	27.00	SY	108
Hauling to Landfill Facility	General Contractor	6.00	LCY	20
(Note: Crew Productivity: RSM - 312323201032. 2 Miles to City of Hastings Landfill in Hastings, NE)				
Special Waste Disposal Costs at Landfill Facility	General Contractor	9.00	TON	390
(Note: City of Hastings Landfill, September 2011.)				
Concrete Paving	**General Contractor**	**1.00**	**EA**	**780**
Concrete paving surface treatment, 4500 psi, fixed form, unreinforced, 12' pass, 6" thick, includes joints, finishing, and curing	General Contractor	27.00	SY	780
Electrical	**General Contractor**	**1.00**	**EA**	**2,621**
Electrical Underground Ducts and Manholes, hand holes, precast concrete, with concrete cover, 2' x 2' x 3' deep, excludes excavation, backfill and cast in place concrete	General Contractor	2.00	EA	1,642
Electrical lines for extraction well piping	General Contractor	250.00	LF	979
(Note: Per estimator)				
Pipe Jacking under Railroad Tracks	**General Contractor**	**1.00**	**EA**	**37,635**
Horizontal boring, railroad work, 24" diameter, includes casing only	General Contractor	110.00	LF	37,323
Borrow, material only, bank run gravel	General Contractor	18.00	TON	312
(Note: Material cost from RS Means CostWorks 2011 item 312323155050.)				
Treatment System Building	**General Contractor**	**1.00**	**EA**	**98,469**
Pre-Eng Steel Bldg, clear span rigid frame, 30 psf roof and 20 psf wind load, 20' W x 14' eave H, incl. 26 ga. colored ribbed roofing & siding, excl. footings, slab, anchor bolts	General Contractor	600.00	SF	11,571
Structural concrete, in place, continuous strip footing (3000 psi), 24" wide x 12" deep, unreinforced, includes forms, reinforcing steel, concrete, placing and finishing	General Contractor	8.00	CY	1,436
Base course drainage layers, aggregate base course for concrete slabs and capillary water barrier, 1" minus graded gravel, 6" compacted thickness	General Contractor	15.00	CY	2,520
Structural concrete, placing, slab on grade, direct chute, up to 6" thick, includes strike off & consolidation, excludes material	General Contractor	12.00	CY	106
C.I.P. concrete forms, slab on grade, metal, radius, 10' long, 6" high, 100 uses, includes stakes, erecting, bracing, stripping and cleaning	General Contractor	100.00	LF	267
C.I.P. concrete forms, slab on grade, depressed, edge, wood, to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	General Contractor	100.00	LF	278
Reinforcing Steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	General Contractor	1.80	TON	2,272
Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	General Contractor	12.00	CY	1,613
Wall Insulation, Rigid, fiberglass, foil faced, 2" thick, R8.7, 3#/CF	General Contractor	1,400.00	SF	3,389
Electric heating, unit heater, heavy duty, single phase, 208-240-277 volt, 15 kW, includes fan & mounting bracket	General Contractor	1.00	EA	1,816
Electrical allowance	General Contractor	1.00	LS	36,600
(Note: Per estimator. Includes electrical hookup, interior electrical, and lights.)				
Misc. appurtenances allowance	General Contractor	1.00	LS	36,600
(Note: Per estimator. Includes entry door, overhead doors, etc.)				
Treatment System	**General Contractor**	**1.00**	**EA**	**231,425**
Tray air stripper assembly, 6 tray 10-1000 GPM.		2.00	LS	191,108
(Note: Vendor quote from QED Environmental, July 2011. EZ-Tray series 96 unit has a flow rate of 10-1000 GPM, 304 stainless steel trays and shell with integral sump, tray levels, see-through front hatch, polypropylene de-mister, liquid level sight gauge, sump pressure gauge, blower, controls, and installation.)				
Electrical work	General Contractor	1.00	LS	6,100
(Note: Allowance per estimator)				
Instrumentation and controls	General Contractor	1.00	LS	18,300

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Allowance per estimator.)				
Magnetic flow meter, 4"	General Contractor	1.00	EA	4,275
(Note: Material cost based on vendor quote for 3" mag meter from Endress+Hauser, September 2011. Material cost apportioned for a 4" mag meter.)				
Pipe, plastic, PVC, 4" diameter, schedule 80, excludes couplings and hangers	General Contractor	50.00	LF	516
Elbow, 90 Deg., plastic, PVC, socket joint, 4", schedule 80	General Contractor	6.00	EA	347
Flange, plastic, PVC, socket joint, 150 lb., 4", schedule 80, excludes gasket and bolt set	General Contractor	10.00	EA	647
Valves, cast iron, lined, corrosion resistant, high purity, check lift, horizontal, PPL or SL lined, flanged, 125 lb., 4"	General Contractor	2.00	EA	5,224
Valves, ductile iron, lined, corrosion resistant, high purity, butterfly, wafer type for flanged installation, 150 lb., 4"	General Contractor	2.00	EA	4,753
Bolt and flange pack, 4"	General Contractor	7.00	EA	154
(Note: Vendor quote, Star Pipe Products, March 2011)				
Treatment System Startup Testing	**General Contractor**	**1.00**	**EA**	**13,947**
Electrical Consumption	General Contractor	336.00	KWH	33
(Note: Cost Source: U.S. Energy Information Administration)				
Treatment System Startup Testing	General Contractor	80.00	HR	13,914
Well Abandonment - Monitoring Wells	**General Contractor**	**57.00**	**EA**	**207,088**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**159,009**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 2" Well	Drilling Subcontractor	9,300.00	VLF	148,958
Portland cement grout	Drilling Subcontractor	205.00	CF	1,780
(Note: Cost Source: HTW)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**48,079**
Daily Pickup Truck Rental	AE Contractor ME	38.00	DAY	4,081
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	38.00	DAY	529
(Note: Per Estimator)				
Per Diem	AE Contractor ME	38.00	DAY	6,342
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	372.00	HR	37,127
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Well Abandonment - Recovery Wells	**General Contractor**	**12.00**	**EA**	**98,793**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**75,641**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 6" Well	Drilling Subcontractor	2,310.00	VLF	63,427
Portland cement grout	Drilling Subcontractor	454.00	CF	3,942
(Note: Cost Source: HTW)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**23,152**
Daily Pickup Truck Rental	AE Contractor ME	18.00	DAY	1,933
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	18.00	DAY	250
(Note: Per Estimator)				

Description	Contractor	Quantity	UOM	ProjectCost
Per Diem	AE Contractor ME	18.00	DAY	3,004
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	180.00	HR	17,965
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted]7 Assumed Benefits: 1[redacted] Assumed Bonus: [redacted])				
Well Abandonment - Re-Injection Wells	**General Contractor**	**6.00**	**EA**	**56,597**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**45,021**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 6" Well	Drilling Subcontractor	1,260.00	VLF	34,597
Portland cement grout	Drilling Subcontractor	248.00	CF	2,154
(Note: Cost Source: HTW)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**11,576**
Daily Pickup Truck Rental	AE Contractor ME	9.00	DAY	966
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	9.00	DAY	125
(Note: Per Estimator)				
Per Diem	AE Contractor ME	9.00	DAY	1,502
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	90.00	HR	8,982
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: 6[redacted])				
Decommissioning Treatment System	**General Contractor**	**1.00**	**LS**	**50,000**
Decommisioning Treatment Systems		1.00	LS	50,000
(Note: Per Estimator)				
Groundwater Monitoring Event	**AE Contractor L**	**1.00**	**EA**	**43,720**
Analysis	**AE Contractor ME**	**1.00**	**LS**	**7,845**
VOCs, EPA Method SW-846 8260	AE Contractor ME	66.00	EA	7,325
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Overnight Sample Shipment	AE Contractor ME	4.00	EA	520
Equipment	**AE Contractor ME**	**1.00**	**EA**	**14,370**
Water Quality Meter and Flow Through Cell	AE Contractor ME	3.00	WK	2,504
(Note: Weekly Rental. Vendor Quote: In-Situ, 4/27/2011)				
Photoionization Detector (PID)	AE Contractor ME	3.00	WK	835
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Water Level Meter	AE Contractor ME	3.00	WK	250
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Turbidimeter	AE Contractor ME	3.00	WK	334
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Portable Bladder Pump	AE Contractor ME	3.00	WK	626
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Replacement Poly Bladders	AE Contractor ME	59.00	EA	657
(Note: Vendor Quote: Pine Env, 4/27/2011)				
Bladder Pump Controller	AE Contractor ME	3.00	WK	939
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				
Compressed Nitrogen Gas Rental	AE Contractor ME	3.00	WK	417

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Per Estimator)				
Combination Tubing for Bladder Pump	AE Contractor ME	5,700.00	LF	4,757
(Note: Vendor Quote: Pine Env, 4/27/2011)				
Shipping Rental Equipment	AE Contractor ME	2.00	EA	696
(Note: Previous Work)				
55-gallon Open Head Steel Drum	AE Contractor ME	9.00	EA	2,078
(Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)				
Miscellaneous Sampling Equipment	AE Contractor ME	1.00	LS	278
(Note: Per Estimator)				
Crew	**AE Contractor L**	**1.00**	**EA**	**21,505**
Daily Pickup Truck Rental	AE Contractor ME	15.00	DAY	1,611
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	15.00	DAY	209
(Note: Per Estimator)				
Per Diem	AE Contractor ME	30.00	DAY	5,007
(Note: Standard Rate Per Diem - GSA, 2012)				
Project Manager	AE Contractor L	5.00	HR	502
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted]				
General Operator/Tech	AE Contractor L	228.00	HR	13,624
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Benefits: [redacted]% Assumed Bonus: [redacted]				
Procurement Specialist	AE Contractor L	10.00	HR	553
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: $[redacted]3 Assumed Benefits: [redacted]% Assumed Bonus: [redacted])				
Groundwater Monitoring Event Report Generation	**AE Contractor L**	**1.00**	**EA**	**29,788**
Reproduction Costs for Groundwater Sampling Event Reports	AE Contractor ME	1.00	LS	696
(Note: Per Estimator)				
Drafter CAD	AE Contractor L	72.00	HR	4,379
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Draftsman: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted])				
Project Manager	AE Contractor L	8.00	HR	803
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: $77,121 Assumed Benefits: [redacted]% Assumed Bonus: [redacted]				
Quality Assurance Director	AE Contractor L	4.00	HR	706
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Quality Assurance Director: [redacted]4 Assumed Benefits: [redacted]% Assumed Bonus: [redacted]				
Clerks, Typists, Bookkeepers & Receptionist	AE Contractor L	10.00	HR	449
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: $[redacted] Assumed Bonus: [redacted]				
Geologist	AE Contractor L	228.00	HR	22,755
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted]7 Assumed Benefits: 15[redacted] Assumed Bonus: 6[redacted]				
Treatment System O&M	**General Contractor**	**1.00**	**EA**	**172,891**
Electrical Consumption	General Contractor	1,495,000.00	KWH	145,783
(Note: Cost Source: U.S. Energy Information Administration)				
Weekly maintenance visit	General Contractor	52.00	EA	9,767
Miscellaneous materials and consumables for operation and maintenance	General Contractor	1.00	LS	12,200
(Note: Per estimator)				
Tray air stripper cleaning	General Contractor	4.00	EA	5,142
Monitoring Well Maintenance	**General Contractor**	**1.00**	**EA**	**55,496**

Description	Contractor	Quantity	UOM	ProjectCost
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**40,660**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Monitoring well maintenance	Drilling Subcontractor	114.00	EA	27,389
8" Vault	Drilling Subcontractor	57.00	EA	4,991
(Note: Cost Source: Previous Work)				
Locking J-Plug, 2" Well	Drilling Subcontractor	57.00	EA	982
(Note: Vendor Quote: Dean Bennett Supply, 4/27/2011)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**14,836**
Daily Pickup Truck Rental	AE Contractor ME	12.00	DAY	1,289
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	12.00	DAY	167
(Note: Per Estimator)				
Per Diem	AE Contractor ME	12.00	DAY	2,003
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	114.00	HR	11,378
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6[redacted])				
Recovery Well Maintenance	**General Contractor**	**1.00**	**EA**	**25,743**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**19,512**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Extraction well maintenance	Drilling Subcontractor	48.00	HR	11,532
Miscellaneous materials for extraction well maintenance	Drilling Subcontractor	1.00	LS	682
(Note: Per estimator)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**6,232**
Daily Pickup Truck Rental	AE Contractor ME	5.00	DAY	537
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	5.00	DAY	70
(Note: Per Estimator)				
Per Diem	AE Contractor ME	5.00	DAY	835
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	48.00	HR	4,791
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6[redacted])				
Re-Injection Well Maintenance	**General Contractor**	**1.00**	**EA**	**17,005**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**13,746**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Extraction well maintenance	Drilling Subcontractor	24.00	HR	5,766
Miscellaneous materials for extraction well maintenance	Drilling Subcontractor	1.00	LS	682
(Note: Per estimator)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**3,260**
Daily Pickup Truck Rental	AE Contractor ME	3.00	DAY	322
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	3.00	DAY	42
(Note: Per Estimator)				
Per Diem	AE Contractor ME	3.00	DAY	501

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	24.00	HR	2,395
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Land Acquisition/Easement Requirements	**General Contractor**	**1.00**	**EA**	**14,464**
Environmental Lawyer	AE Contractor L	40.00	HR	6,515
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Lawyer: [redacted] Assumed Benefits: 1[redacted] Assumed Bonus: [redacted])				
Paralegal	General Contractor	80.00	HR	4,466
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Paralegal: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6.[redacted]				
Clerks, Typists, Bookkeepers & Receptionist	General Contractor	20.00	HR	636
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] 6 Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Project Manager	General Contractor	40.00	HR	2,847
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] 1 Assumed Benefits: [redacted] Assumed Bonus: 6[redacted]				
In Situ Treatment (at core of plume) and Groundwater Recovery, Treatment, and Discharge (leading edge of plume)	**General Contractor**	**1.00**	**EA**	**21,366,795**
Monitoring Well Installation	**General Contractor**	**30.00**	**EA**	**329,045**
Driller	**Drilling Subcontractor**	**40.00**	**EA**	**264,732**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Drilling, hollow stem auger, normal soil, 2" or less casing/screen, 4-1/4" ID x 8" OD auger	Drilling Subcontractor	4,750.00	LF	165,874
(Note: Cost Source: HTW)				
Well screen assembly, slotted PVC, 2" diameter	Drilling Subcontractor	300.00	LF	2,455
(Note: Cost Source: Means CostWorks 2011)				
Gravel Pack, 2" Well	Drilling Subcontractor	300.00	LF	6,252
(Note: Cost Source: Echos 2005, 33 23 1401)				
Casing, PVC, flush threaded, standard length 10', 2" diameter, schedule 80	Drilling Subcontractor	4,450.00	LF	22,537
(Note: Cost Source: HTW)				
Pressure Transducer	Drilling Subcontractor	30.00	EA	31,963
(Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)				
Pressure Transducer Cable	Drilling Subcontractor	4,450.00	LF	15,263
(Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)				
Bentonite Seal	Drilling Subcontractor	6.00	CF	363
(Note: Gravel packing and annular sealant, bentonite tablets, 10.80 lb./gallon, 1/4". Cost Source: Means CostWorks 2011 - 023223136123)				
Portland cement grout	Drilling Subcontractor	289.00	CF	2,510
(Note: Cost Source: HTW)				
Locking J-Plug, 2" Well	Drilling Subcontractor	30.00	EA	517
(Note: Vendor Quote: Dean Bennett Supply, 4/27/2011)				
8" Vault	Drilling Subcontractor	30.00	EA	2,627
(Note: Cost Source: Previous Work)				
Hauling to Landfill	Drilling Subcontractor	1.00	EA	231
(Note: Assume 2 hours for loading/transporting/dumping of well cuttings at landfill.)				
Drill Cuttings Disposal	Drilling Subcontractor	29.00	TON	3,682
(Note: Vendor Quote: City of Hastings, Special Waste Classification - Solid Waste Disposal)				
Roll Off Rental	Drilling Subcontractor	50.00	DAY	2,189

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Previous Work)				
Oversight	**AE Contractor L**	**40.00**	**EA**	**64,312**
Well Development	AE Contractor L	120.00	HR	11,977
(Note: Assume 4 hrs/well)				
Geologist	AE Contractor L	380.00	HR	37,926
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Benefits: [redacted] Assumed Bonus: [redacted]				
Per Diem	AE Contractor ME	50.00	DAY	8,345
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	50.00	DAY	5,369
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	50.00	DAY	696
(Note: Per Estimator)				
Injection Well Installation	**General Contractor**	**78.00**	**EA**	**883,846**
Driller	**Drilling Subcontractor**	**40.00**	**EA**	**843,485**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Drilling, hollow stem auger, normal soil, 2" or less casing/screen, 4-1/4" ID x 8" OD auger	Drilling Subcontractor	16,770.00	LF	585,622
(Note: Cost Source: HTW)				
Well screen assembly, slotted PVC, 2" diameter	Drilling Subcontractor	5,460.00	LF	44,681
(Note: Cost Source: Means CostWorks 2011)				
Gravel Pack, 2" Well	Drilling Subcontractor	5,460.00	LF	113,794
(Note: Cost Source: Echos 2005, 33 23 1401)				
Casing, PVC, flush threaded, standard length 10', 2" diameter, schedule 80	Drilling Subcontractor	11,310.00	LF	57,278
(Note: Cost Source: HTW)				
Portland cement grout	Drilling Subcontractor	780.00	CF	6,773
(Note: Cost Source: HTW)				
Locking J-Plug, 2" Well	Drilling Subcontractor	78.00	EA	1,343
(Note: Vendor Quote: Dean Bennett Supply, 4/27/2011)				
8" Vault	Drilling Subcontractor	78.00	EA	6,830
(Note: Cost Source: Previous Work)				
55-gallon Open Head Steel Drum	Drilling Subcontractor	78.00	EA	18,892
(Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)				
Oversight	**AE Contractor L**	**40.00**	**EA**	**40,361**
Daily Pickup Truck Rental	AE Contractor ME	32.00	DAY	3,436
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	32.00	DAY	445
(Note: Per Estimator)				
Per Diem	AE Contractor ME	32.00	DAY	5,341
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	312.00	HR	31,139
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Recovery Well Installation	**General Contractor**	**6.00**	**EA**	**641,543**
Driller	**Drilling Subcontractor**	**1.00**	**EA**	**612,946**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Drilling, hollow stem auger, normal soil, 6" or less casing/screen, 8-1/4" ID x 13-3/4" OD auger	Drilling Subcontractor	1,155.00	LF	63,355
Stainless steel well screen, flush threaded, 5' sections, 6" diameter, no. 304 stainless steel	Drilling Subcontractor	120.00	LF	30,805
Well casing, stainless steel, flush threaded, 10' sections, 6" diameter, 304 stainless steel	Drilling Subcontractor	1,035.00	LF	430,999
Gravel packing and annular sealant, No. 2 morie silica sand, contaminant free	Drilling Subcontractor	18.00	TON	17,767
Bentonite Seal	Drilling Subcontractor	12.00	CF	725
(Note: Gravel packing and annular sealant, bentonite tablets, 10.80 lb./gallon, 1/4". Cost Source: Means CostWorks 2011 - 023223136123)				
Portland cement grout	Drilling Subcontractor	597.00	CF	5,184
(Note: Cost Source: HTW)				
Hauling to Landfill	Drilling Subcontractor	3.00	EA	693
(Note: Assume 2 hours for loading/transporting/dumping of well cuttings at landfill.)				
Drill Cuttings Disposal	Drilling Subcontractor	80.40	TON	10,209
(Note: Vendor Quote: City of Hastings, Special Waste Classification - Solid Waste Disposal)				
Roll Off Rental	Drilling Subcontractor	22.00	DAY	963
(Note: Previous Work)				
Pressure Transducer Cable	Drilling Subcontractor	1,215.00	LF	4,167
(Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)				
Pressure Transducer	Drilling Subcontractor	6.00	EA	6,393
(Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)				
Submersible pump, 56 - 95 gpm, 101'< Head <=220', 5 hp, 4" discharge, w/ controls	Drilling Subcontractor	3.00	EA	11,247
Submersible pump, 201 - 410 gpm, 176'< Head <=225', 25 hp, 6" discharge, w/ controls	Drilling Subcontractor	3.00	EA	22,166
Oversight	**AE Contractor L**	**1.00**	**EA**	**28,597**
Well Development	AE Contractor L	48.00	HR	4,791
(Note: Assume 4 hrs/well)				
Geologist	AE Contractor L	175.00	HR	17,466
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Per Diem	AE Contractor ME	22.00	DAY	3,672
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	22.00	DAY	2,362
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	22.00	DAY	306
(Note: Per Estimator)				
Re-Injection Well Installation	**General Contractor**	**2.00**	**EA**	**335,548**
	Drilling Subcontractor	**1.00**	**EA**	**319,714**
Driller				
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Drilling, hollow stem auger, normal soil, 6" or less casing/screen, 8-1/4" ID x 13-3/4" OD auger	Drilling Subcontractor	630.00	LF	34,557
Stainless steel well screen, flush threaded, 5' sections, 6" diameter, no. 304 stainless steel	Drilling Subcontractor	60.00	LF	15,403
Well casing, stainless steel, flush threaded, 10' sections, 6" diameter, 304 stainless steel	Drilling Subcontractor	570.00	LF	237,362
Gravel packing and annular sealant, No. 2 morie silica sand, contaminant free	Drilling Subcontractor	9.00	TON	8,884
Bentonite Seal	Drilling Subcontractor	6.00	CF	363
(Note: Gravel packing and annular sealant, bentonite tablets, 10.80 lb./gallon, 1/4". Cost Source: Means CostWorks 2011 - 023223136123)				

Description	Contractor	Quantity	UOM	ProjectCost
Portland cement grout (Note: Cost Source: HTW)	Drilling Subcontractor	330.00	CF	2,866
Hauling to Landfill (Note: Assume 2 hours for loading/transporting/dumping of well cuttings at landfill.)	Drilling Subcontractor	2.00	EA	462
Drill Cuttings Disposal (Note: Vendor Quote: City of Hastings, Special Waste Classification - Solid Waste Disposal)	Drilling Subcontractor	43.80	TON	5,561
Roll Off Rental (Note: Previous Work)	Drilling Subcontractor	12.00	DAY	525
Pressure Transducer Cable (Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)	Drilling Subcontractor	660.00	LF	2,264
Pressure Transducer (Note: Instrumentation Northwest Model PS-9800. Vendor Quote, 9/15/2011)	Drilling Subcontractor	3.00	EA	3,196
Oversight	**AE Contractor L**	**1.00**	**EA**	**15,834**
Well Development (Note: Assume 4 hrs/well)	AE Contractor L	24.00	HR	2,395
Geologist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: 1[redacted] Assumed Bonus: [redacted]	AE Contractor L	100.00	HR	9,980
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	12.00	DAY	2,003
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	12.00	DAY	1,289
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	12.00	DAY	167
Injection Equipment	**Injection Subcontractor**	**1.00**	**LS**	**23,851**
5,000 Gallon Storage Tank (Note: Vendor Quote: The Tank Depot, 2012)	Injection Subcontractor	1.00	EA	2,874
Trash Pump - 220 gpm (Note: Vendor Quote: Honda Power Equipment, 2012)	Injection Subcontractor	1.00	EA	751
Flat Bottom Tank Mixer (Note: Vendor Quote: Indelco Plastics, 2012)	Injection Subcontractor	1.00	EA	4,870
Pressure Gauge - Injection Point (Note: Vendor Quote: Indelco Plastics, 2012)	Injection Subcontractor	1.00	EA	185
Pressure Gauge - Water to Frac Tank (Note: Vendor Quote: Indelco Plastics, 2012)	Injection Subcontractor	1.00	EA	185
2" Steel Ball Valve (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	2.00	EA	485
2" Steel Pipe (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	20.00	LF	172
2" Steel Tee (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	4.00	EA	340
2" Steel Elbow, 90 Degree (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	2.00	EA	138
2" Female Camlock (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	5.00	EA	85
2" Male Camlock (Note: Vendor Quote: Ace Hose & Rubber, 2012)	Injection Subcontractor	5.00	EA	46

Description	Contractor	Quantity	UOM	ProjectCost
2" Hose	Injection Subcontractor	1,000.00	LF	12,989
(Note: Vendor Quote: Ace Hose & Rubber, 2012)				
Health and Safety Allowances	Injection Subcontractor	1.00	EA	730
(Note: Per estimator)				
Pilot Scale Groundwater Monitoring Event	**AE Contractor L**	**1.00**	**EA**	**57,871**
Analysis	**AE Contractor ME**	**1.00**	**LS**	**39,194**
VOCs, EPA Method SW-846 8260	AE Contractor ME	30.00	EA	3,330
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Metals, Dissolved, EPA Method 6010, Field Filtered	AE Contractor ME	30.00	EA	3,481
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Nitrate/Nitrite (NO3/NO2)	AE Contractor ME	30.00	EA	757
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Sulfate, EPA MCAWW, 300, Field Filtered	AE Contractor ME	30.00	EA	835
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Sulfide, SM 4500S2 E	AE Contractor ME	30.00	EA	1,043
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Total Iron (Fe)	AE Contractor ME	1.00	EA	36
(Note: 25 Tests per kit. Vendor Quote: Hach, 4/27/2011)				
Total Manganese (Mn)	AE Contractor ME	30.00	EA	459
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Chloride, EPA MCAWW, 300, Field Filtered	AE Contractor ME	30.00	EA	835
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Alkalinity, EPA MCAWW, 310.1, Field Filtered	AE Contractor ME	30.00	EA	606
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Dissolved Total Organic Carbon (TOC)	AE Contractor ME	30.00	EA	1,362
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Carbon Dioxide (CO2)	AE Contractor ME	30.00	EA	2,422
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Volatile Fatty Acids (VFAs)	AE Contractor ME	30.00	EA	3,784
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Methane/Ethane/Ethene	AE Contractor ME	30.00	EA	3,633
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Microbiological DNA Analysis	AE Contractor ME	30.00	EA	15,148
(Note: Previous Work)				
Dissolved Oxygen, Colorimetic Test Kits, 0 to 1 ppm	AE Contractor ME	1.00	EA	75
(Note: 30 Tests per kit. Vendor Quote: Cole Parmer, 4/27/2011)				
Dissolved Oxygen, Colorimetic Test Kits, 1 to 12 ppm	AE Contractor ME	1.00	EA	78
(Note: 30 Tests per kit. Vendor Quote: Cole Parmer, 4/27/2011)				
Field Filter, 0.45 micron filter	AE Contractor ME	30.00	EA	1,051
(Note: 25 Filters per pack. Vendor Quote: Hach, 4/27/2011)				
Overnight Sample Shipment	AE Contractor ME	2.00	EA	260
	AE Contractor ME	**1.00**	**LS**	**8,221**
Equipment				
Water Quality Meter and Flow Through Cell	AE Contractor ME	2.00	WK	1,669
(Note: Weekly Rental. Vendor Quote: In-Situ, 4/27/2011)				
Photoionization Detector (PID)	AE Contractor ME	2.00	WK	556
(Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)				

Description	Contractor	Quantity	UOM	ProjectCost
Water Level Meter (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2.00	WK	167
Turbidimeter (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2.00	WK	223
Portable Bladder Pump (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2.00	WK	417
Replacement Poly Bladders (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	27.00	EA	300
Bladder Pump Controller (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2.00	WK	626
Compressed Nitrogen Gas Rental (Note: Per Estimator)	AE Contractor ME	2.00	WK	278
Combination Tubing for Bladder Pump (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	2,500.00	LF	2,087
Shipping Rental Equipment (Note: Previous Work)	AE Contractor ME	2.00	EA	696
55-gallon Open Head Steel Drum (Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)	AE Contractor ME	4.00	EA	923
Miscellaneous Sampling Equipment (Note: Per Estimator)	AE Contractor ME	1.00	LS	278
Crew	**AE Contractor L**	**1.00**	**LS**	**10,456**
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	7.00	DAY	752
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	7.00	DAY	97
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	14.00	DAY	2,337
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: 1[redacted]% Assumed Bonus[redacted]	AE Contractor L	3.00	HR	301
General Operator/Tech (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted]4 Assumed Benefits: 1[redacted]% Assumed Bonus: 6[redacted])	AE Contractor L	112.00	HR	6,692
Procurement Specialist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: $[redacted] Assumed Benefits:[redacted]% Assumed Bonus:[redacted]	AE Contractor L	5.00	HR	277
Pilot Scale Groundwater Monitoring Event Report Generation	**AE Contractor L**	**1.00**	**EA**	**14,580**
Reproduction Costs for Groundwater Sampling Event Reports (Note: Per Estimator)	AE Contractor ME	1.00	LS	696
Drafter CAD (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Draftsman:[redacted] Assumed Benefits: [redacted] Assumed Bonus: 6[redacted])	AE Contractor L	32.00	HR	1,946
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: $77,121 Assumed Benefits: 15.2% Assumed Bonus: [redacted]	AE Contractor L	8.00	HR	803
Quality Assurance Director (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Quality Assurance Director: [redacted]34 Assumed [redacted] Assumed Bonus: [redacted]	AE Contractor L	4.00	HR	706
Clerks, Typists, Bookkeepers & Receptionist	AE Contractor L	10.00	HR	449

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Geologist	AE Contractor L	100.00	HR	9,980
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Well Vault	**General Contractor**	**8.00**	**EA**	**440,466**
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	General Contractor	27.00	BCY	205
Borrow, material only, bank run gravel	General Contractor	27.00	TON	468
(Note: Material cost from RS Means CostWorks 2011 item 312323155050.)				
Fill, gravel fill, compacted	General Contractor	144.00	SF	132
Utility structures, utility vaults precast concrete, meter pit, 6' x 6', 6' deep, excludes excavation and backfill	General Contractor	9.00	EA	31,625
Doors, specialty, access, floor, industrial, steel, 300 psf L.L., double leaf, 5' x 5', 645 lb	General Contractor	9.00	OPN	29,535
Pipe, plastic, PVC, 6" diameter, schedule 80, excludes couplings and hangers	General Contractor	90.00	LF	1,990
Elbow, 90 Deg., plastic, PVC, socket joint, 6", schedule 80	General Contractor	36.00	EA	5,103
Tee, plastic, PVC, socket joint, 6", schedule 80	General Contractor	9.00	EA	2,104
Flange, plastic, PVC, socket joint, 150 lb., 6", schedule 80, excludes gasket and bolt set	General Contractor	72.00	EA	7,363
Valves, cast iron, lined, corrosion resistant, high purity, check lift, horizontal, PPL or SL lined, flanged, 125 lb., 6"	General Contractor	9.00	EA	39,912
Valves, ductile iron, lined, corrosion resistant, high purity, butterfly, wafer type for flanged installation, 150 lb., 6"	General Contractor	18.00	EA	60,656
Magnetic flow meter, 6"	General Contractor	9.00	EA	38,477
(Note: Material cost based on vendor quote for 3" mag meter from Endress+Hauser, September 2011. Material cost apportioned for a 6" mag meter.)				
Bolt and flange pack	General Contractor	45.00	EA	993
(Note: Vendor quote, Star Pipe Products, March 2011)				
Electric heating, heat trace system, 400 degree, 115 V, 5 watts per L.F.	General Contractor	90.00	LF	1,116
Insulation, pipe, fiberglass with 0.010" thick, for aluminum jacket, 2-1/2" wall, 4" iron pipe size	General Contractor	90.00	LF	1,188
(Note: Material cost from Means CostWorks 2011 number 22071 910 7578 and 22071 910 7811.)				
Electrical drop and materials	General Contractor	9.00	LS	219,600
(Note: Per estimator)				
Pipe Installation	**General Contractor**	**13,480.00**	**LF**	**828,916**
Disposal of Excess Soils	**General Contractor**	**1.00**	**EA**	**327,109**
Hauling to Landfill Facility	General Contractor	4,784.00	LCY	16,317
(Note: Crew Productivity: RSM - 312323201069. 30 Miles to Butler County Landfill in David City, NE)				
Special Waste Disposal Costs at Landfill Facility	General Contractor	7,176.00	TON	310,793
(Note: Butler County Landfill, September 2011. Cost includes $1 per ton environmental fee.)				
Trench Excavation	**General Contractor**	**1.00**	**EA**	**60,542**
Excavation, bank measure, sandy clay or loam, 3/4 C.Y. bucket, machine excavation, hydraulic backhoe	General Contractor	7,971.00	BCY	60,542
Backfill of Trench	**General Contractor**	**1.00**	**EA**	**225,825**
Borrow, material only, bank run gravel	General Contractor	6,821.00	TON	118,158
(Note: Material cost from RS Means CostWorks 2011 item 312323155050.)				
Excavating, trench backfill, 1 C.Y. bucket, minimal haul, front end loader, wheel mounted, excludes dewatering	General Contractor	9,566.00	LCY	13,373
Fill, gravel fill, compacted	General Contractor	53,920.00	SF	49,506
Topsoil placement and grading, loam or topsoil screened, 6" deep, furnish and place, truck dumped	General Contractor	5,992.00	SY	41,632
Seeding athletic fields, seeding bluegrass, common with mulch and fertilizer, 4 lb. per M.S.F., hydro or air seeding	General Contractor	5,992.00	SY	3,157
Piping Placement	**General Contractor**	**1.00**	**EA**	**174,348**
Piping	**General Contractor**	**1.00**	**EA**	**146,053**
Pipe, plastic, high density polyethylene (HDPE), single wall, straight, welded, based on 40' length, 8" diam., DR 11, add 1 weld per joint, excludes hangers, trenching, backfill, hoisting or digging equipment.	General Contractor	13,480.00	LF	146,053
Joints	**General Contractor**	**1.00**	**EA**	**1,715**
Tee, plastic, high density polyethylene (HDPE), single wall, welded, 8" diam., DR 11, add 1 weld per joint, excludes hangers,	General Contractor	10.00	EA	1,488

Description	Contractor	Quantity	UOM	ProjectCost
trenching, backfill, hoisting or digging equipment.				
Elbow, 90 Deg., plastic, high density polyethylene (HDPE), single wall, welded, 8" diam., DR 11, add 1 weld per joint, excludes hangers, trenching, backfill, hoisting or digging equipment.	General Contractor	2.00	EA	227
Welding	**General Contractor**	**1.00**	**EA**	**7,048**
Welding, plastic, high density polyethylene (HDPE), single wall, labor per joint, cost based on the thickest wall for each diameter, 8" pipe size, weld, excludes welding machine	General Contractor	340.00	EA	5,281
Welding, plastic, high density polyethylene (HDPE), dual wall, machine, rental per day based on diam. capacity, 6" thru 8" diameter	General Contractor	7.00	DAY	1,768
Detectable Tape and Pipe Testing	**General Contractor**	**1.00**	**EA**	**19,531**
Utility Line Signs, Markers, and Flags, underground tape, detectable, reinforced, aluminum foil core, 6", excludes excavation and backfill	General Contractor	135.00	CLF	1,413
Pipe testing, nondestructive hydraulic pressure test, isolate, 1 hour hold, 6" to 10" pipe, 1000 - 2000 L.F.	General Contractor	7.00	EA	18,118
Concrete Demolition	**General Contractor**	**1.00**	**EA**	**431**
Concrete sawing, concrete slabs, mesh reinforcing, up to 3" deep (Note: Cost Source: RSM - 038113500400)	General Contractor	68.00	LF	102
Demolish, remove pavement & curb, remove bituminous pavement, 4" to 6" thick, excludes hauling and disposal fees	General Contractor	14.00	SY	56
Hauling to Landfill Facility (Note: Crew Productivity: RSM - 312323201032. 2 Miles to City of Hastings Landfill in Hastings, NE)	General Contractor	4.00	LCY	14
Special Waste Disposal Costs at Landfill Facility (Note: City of Hastings Landfill, September 2011.)	General Contractor	6.00	TON	260
Concrete Paving	**General Contractor**	**1.00**	**EA**	**404**
Concrete paving surface treatment, 4500 psi, fixed form, unreinforced, 12' pass, 6" thick, includes joints, finishing, and curing	General Contractor	14.00	SY	404
Electrical	**General Contractor**	**1.00**	**EA**	**2,621**
Electrical Underground Ducts and Manholes, hand holes, precast concrete, with concrete cover, 2' x 2' x 3' deep, excludes excavation, backfill and cast in place concrete	General Contractor	2.00	EA	1,642
Electrical lines for extraction well piping (Note: Per estimator)	General Contractor	250.00	LF	979
Pipe Jacking under Railroad Tracks	**General Contractor**	**1.00**	**EA**	**37,635**
Horizontal boring, railroad work, 24" diameter, includes casing only	General Contractor	110.00	LF	37,323
Borrow, material only, bank run gravel (Note: Material cost from RS Means CostWorks 2011 item 312323155050.)	General Contractor	18.00	TON	312
Treatment System Building	**General Contractor**	**1.00**	**EA**	**98,469**
Pre-Eng Steel Bldg, clear span rigid frame, 30 psf roof and 20 psf wind load, 20' W x 14' eave H, incl. 26 ga. colored ribbed roofing & siding, excl. footings, slab, anchor bolts	General Contractor	600.00	SF	11,571
Structural concrete, in place, continuous strip footing (3000 psi), 24" wide x 12" deep, unreinforced, includes forms, reinforcing steel, concrete, placing and finishing	General Contractor	8.00	CY	1,436
Base course drainage layers, aggregate base course for concrete slabs and capillary water barrier, 1" minus graded gravel, 6" compacted thickness	General Contractor	15.00	CY	2,520
Structural concrete, placing, slab on grade, direct chute, up to 6" thick, includes strike off & consolidation, excludes material	General Contractor	12.00	CY	106
C.I.P. concrete forms, slab on grade, metal, radius, 10' long, 6" high, 100 uses, includes stakes, erecting, bracing, stripping and cleaning	General Contractor	100.00	LF	267
C.I.P. concrete forms, slab on grade, depressed, edge, wood, to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	General Contractor	100.00	LF	278
Reinforcing Steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	General Contractor	1.80	TON	2,272
Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	General Contractor	12.00	CY	1,613

Description	Contractor	Quantity	UOM	ProjectCost
Wall Insulation, Rigid, fiberglass, foil faced, 2" thick, R8.7, 3#/CF	General Contractor	1,400.00	SF	3,389
Electric heating, unit heater, heavy duty, single phase, 208-240-277 volt, 15 kW, includes fan & mounting bracket	General Contractor	1.00	EA	1,816
Electrical allowance	General Contractor	1.00	LS	36,600
(Note: Per estimator. Includes electrical hookup, interior electrical, and lights.)				
Misc. appurtenances allowance	General Contractor	1.00	LS	36,600
(Note: Per estimator. Includes entry door, overhead doors, etc.)				
Treatment System	**General Contractor**	**1.00**	**EA**	**156,893**
Tray air stripper assembly, 6 tray 10-1000 GPM.	General Contractor	1.00	LS	116,576
(Note: Vendor quote from QED Environmental, July 2011. EZ-Tray series 96 unit has a flow rate of 10-1000 GPM, 304 stainless steel trays and shell with integral sump, tray levels, see-through front hatch, polypropylene de-mister, liquid level sight gauge, sump pressure gauge, blower, controls, and installation. Cost is based on 800 gpm flow rate apportioned for 300 gpm.)				
Electrical work	General Contractor	1.00	LS	6,100
(Note: Allowance per estimator)				
Instrumentation and controls	General Contractor	1.00	LS	18,300
(Note: Allowance per estimator.)				
Magnetic flow meter, 4"	General Contractor	1.00	EA	4,275
(Note: Material cost based on vendor quote for 3" mag meter from Endress+Hauser, September 2011. Material cost apportioned for a 4" mag meter.)				
Pipe, plastic, PVC, 4" diameter, schedule 80, excludes couplings and hangers	General Contractor	50.00	LF	516
Elbow, 90 Deg., plastic, PVC, socket joint, 4", schedule 80	General Contractor	6.00	EA	347
Flange, plastic, PVC, socket joint, 150 lb., 4", schedule 80, excludes gasket and bolt set	General Contractor	10.00	EA	647
Valves, cast iron, lined, corrosion resistant, high purity, check lift, horizontal, PPL or SL lined, flanged, 125 lb., 4"	General Contractor	2.00	EA	5,224
Valves, ductile iron, lined, corrosion resistant, high purity, butterfly, wafer type for flanged installation, 150 lb., 4"	General Contractor	2.00	EA	4,753
Bolt and flange pack, 4"	General Contractor	7.00	EA	154
(Note: Vendor quote, Star Pipe Products, March 2011)				
Treatment System Startup Testing	**General Contractor**	**1.00**	**EA**	**13,947**
Electrical Consumption	General Contractor	336.00	KWH	33
(Note: Cost Source: U.S. Energy Information Administration)				
Treatment System Startup Testing	General Contractor	80.00	HR	13,914
Well Abandonment - Monitoring Wells	**General Contractor**	**57.00**	**EA**	**207,088**
	Drilling Subcontractor	**1.00**	**LS**	**159,009**
Driller				
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 2" Well	Drilling Subcontractor	9,300.00	VLF	148,958
Portland cement grout	Drilling Subcontractor	205.00	CF	1,780
(Note: Cost Source: HTW)				
	AE Contractor L	**1.00**	**LS**	**48,079**
Oversight				
Daily Pickup Truck Rental	AE Contractor ME	38.00	DAY	4,081
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	38.00	DAY	529
(Note: Per Estimator)				
Per Diem	AE Contractor ME	38.00	DAY	6,342
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	372.00	HR	37,127
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Well Abandonment - Injection Wells	**General Contractor**	**78.00**	**EA**	**228,164**

Description	Contractor	Quantity	UOM	ProjectCost
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**197,893**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 2" Well	Drilling Subcontractor	11,700.00	VLF	187,399
Portland cement grout	Drilling Subcontractor	256.00	CF	2,223
(Note: Cost Source: HTW)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**30,271**
Daily Pickup Truck Rental	AE Contractor ME	24.00	DAY	2,577
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	24.00	DAY	334
(Note: Per Estimator)				
Per Diem	AE Contractor ME	24.00	DAY	4,006
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	234.00	HR	23,354
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted])				
Well Abandonment - Recovery Wells	**General Contractor**	**6.00**	**EA**	**53,532**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**41,956**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 6" Well	Drilling Subcontractor	1,155.00	VLF	31,714
Portland cement grout	Drilling Subcontractor	227.00	CF	1,971
(Note: Cost Source: HTW)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**11,576**
Daily Pickup Truck Rental	AE Contractor ME	9.00	DAY	966
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	9.00	DAY	125
(Note: Per Estimator)				
Per Diem	AE Contractor ME	9.00	DAY	1,502
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	90.00	HR	8,982
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Well Abandonment - Re-Injection Wells	**General Contractor**	**2.00**	**EA**	**32,578**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**26,646**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Decontamination Pad Construction/Removal	Drilling Subcontractor	1.00	LS	973
(Note: Previous Work)				
Well Abandonment, 6" Well	Drilling Subcontractor	630.00	VLF	17,298
Portland cement grout	Drilling Subcontractor	124.00	CF	1,077
(Note: Cost Source: HTW)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**5,932**
Daily Pickup Truck Rental	AE Contractor ME	5.00	DAY	537

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	5.00	DAY	70
(Note: Per Estimator)				
Per Diem	AE Contractor ME	5.00	DAY	835
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	45.00	HR	4,491
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] 7 Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Decommissioning Treatment System	**General Contractor**	**1.00**	**LS**	**50,000**
Decommisioning Treatment Systems		1.00	LS	50,000
(Note: Per Estimator)				
EAB Groundwater Monitoring Event	**AE Contractor L**	**1.00**	**EA**	**88,724**
Analysis	**AE Contractor ME**	**1.00**	**LS**	**52,848**
VOCs, EPA Method SW-846 8260	AE Contractor ME	66.00	EA	7,325
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Metals, Dissolved, EPA Method 6010, Field Filtered	AE Contractor ME	66.00	EA	7,658
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Nitrate/Nitrite (NO3/NO2)	AE Contractor ME	66.00	EA	1,665
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Sulfate, EPA MCAWW, 300, Field Filtered	AE Contractor ME	66.00	EA	1,836
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Sulfide, SM 4500S2 E	AE Contractor ME	66.00	EA	2,295
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Total Iron (Fe)	AE Contractor ME	3.00	EA	109
(Note: 25 Tests per kit. Vendor Quote: Hach, 4/27/2011)				
Total Manganese (Mn)	AE Contractor ME	66.00	EA	1,010
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Chloride, EPA MCAWW, 300, Field Filtered	AE Contractor ME	66.00	EA	1,836
(Note: Vendor Quote. Teklab (Previous Work), 2009)				
Alkalinity, EPA MCAWW, 310.1, Field Filtered	AE Contractor ME	66.00	EA	1,332
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Dissolved Total Organic Carbon (TOC)	AE Contractor ME	66.00	EA	2,997
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Carbon Dioxide (CO2)	AE Contractor ME	66.00	EA	5,328
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Volatile Fatty Acids (VFAs)	AE Contractor ME	66.00	EA	8,325
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Methane/Ethane/Ethene	AE Contractor ME	66.00	EA	7,992
(Note: Vendor Quote: TestAmerica GSA, 4/27/2011)				
Dissolved Oxygen, Colorimetic Test Kits, 0 to 1 ppm	AE Contractor ME	2.00	EA	151
(Note: 30 Tests per kit. Vendor Quote: Cole Parmer, 4/27/2011)				
Dissolved Oxygen, Colorimetic Test Kits, 1 to 12 ppm	AE Contractor ME	2.00	EA	157
(Note: 30 Tests per kit. Vendor Quote: Cole Parmer, 4/27/2011)				
Field Filter, 0.45 micron filter	AE Contractor ME	66.00	EA	2,313
(Note: 25 Filters per pack. Vendor Quote: Hach, 4/27/2011)				
Overnight Sample Shipment	AE Contractor ME	4.00	EA	520
Equipment	**AE Contractor ME**	**1.00**	**EA**	**14,370**

Description	Contractor	Quantity	UOM	ProjectCost
Water Quality Meter and Flow Through Cell (Note: Weekly Rental. Vendor Quote: In-Situ, 4/27/2011)	AE Contractor ME	3.00	WK	2,504
Photoionization Detector (PID) (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	835
Water Level Meter (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	250
Turbidimeter (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	334
Portable Bladder Pump (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	626
Replacement Poly Bladders (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	59.00	EA	657
Bladder Pump Controller (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	939
Compressed Nitrogen Gas Rental (Note: Per Estimator)	AE Contractor ME	3.00	WK	417
Combination Tubing for Bladder Pump (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	5,700.00	LF	4,757
Shipping Rental Equipment (Note: Previous Work)	AE Contractor ME	2.00	EA	696
55-gallon Open Head Steel Drum (Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)	AE Contractor ME	9.00	EA	2,078
Miscellaneous Sampling Equipment (Note: Per Estimator)	AE Contractor ME	1.00	LS	278
Crew	**AE Contractor L**	**1.00**	**EA**	**21,505**
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	15.00	DAY	1,611
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	15.00	DAY	209
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	30.00	DAY	5,007
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	5.00	HR	502
General Operator/Tech (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: [redacted] % Assumed Bonus: [redacted]	AE Contractor L	228.00	HR	13,624
Procurement Specialist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	10.00	HR	553
VOC-Only Groundwater Monitoring Event	**AE Contractor L**	**1.00**	**EA**	**43,720**
Analysis	**AE Contractor ME**	**1.00**	**LS**	**7,845**
VOCs, EPA Method SW-846 8260 (Note: Vendor Quote: TestAmerica GSA, 4/27/2011)	AE Contractor ME	66.00	EA	7,325
Overnight Sample Shipment	AE Contractor ME	4.00	EA	520
Equipment	**AE Contractor ME**	**1.00**	**EA**	**14,370**
Water Quality Meter and Flow Through Cell (Note: Weekly Rental. Vendor Quote: In-Situ, 4/27/2011)	AE Contractor ME	3.00	WK	2,504

Description	Contractor	Quantity	UOM	ProjectCost
Photoionization Detector (PID) (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	835
Water Level Meter (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	250
Turbidimeter (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	334
Portable Bladder Pump (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	626
Replacement Poly Bladders (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	59.00	EA	657
Bladder Pump Controller (Note: Weekly Rental. Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	3.00	WK	939
Compressed Nitrogen Gas Rental (Note: Per Estimator)	AE Contractor ME	3.00	WK	417
Combination Tubing for Bladder Pump (Note: Vendor Quote: Pine Env, 4/27/2011)	AE Contractor ME	5,700.00	LF	4,757
Shipping Rental Equipment (Note: Previous Work)	AE Contractor ME	2.00	EA	696
55-gallon Open Head Steel Drum (Note: Vendor Quote: Global Industrial, 4/27/2011. Includes shipping.)	AE Contractor ME	9.00	EA	2,078
Miscellaneous Sampling Equipment (Note: Per Estimator)	AE Contractor ME	1.00	LS	278
Crew	**AE Contractor L**	**1.00**	**EA**	**21,505**
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	15.00	DAY	1,611
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	15.00	DAY	209
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	30.00	DAY	5,007
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted]	AE Contractor L	5.00	HR	502
General Operator/Tech (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	228.00	HR	13,624
Procurement Specialist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Assumed Benefits: 1[redacted]% Assumed Bonus: 6[redacted])	AE Contractor L	10.00	HR	553
Groundwater Monitoring Event Report Generation	**AE Contractor L**	**1.00**	**EA**	**29,788**
Reproduction Costs for Groundwater Sampling Event Reports (Note: Per Estimator)	AE Contractor ME	1.00	LS	696
Drafter CAD (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Draftsman: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted])	AE Contractor L	72.00	HR	4,379
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	8.00	HR	803
Quality Assurance Director (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Quality Assurance Director: [redacted] Assumed Benefits: [redacted] Assumed Bonus:	AE Contractor L	4.00	HR	706

Description	Contractor	Quantity	UOM	ProjectCost
[redacted])				
Clerks, Typists, Bookkeepers & Receptionist	AE Contractor L	10.00	HR	449
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted]6 Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Geologist	AE Contractor L	228.00	HR	22,755
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Bonus: [redacted]				
Treatment System O&M	**General Contractor**	**1.00**	**EA**	**110,833**
Electrical Consumption	General Contractor	858,600.00	KWH	83,725
(Note: Cost Source: U.S. Energy Information Administration)				
Weekly maintenance visit	General Contractor	52.00	EA	9,767
Miscellaneous materials and consumables for operation and maintenance	General Contractor	1.00	LS	12,200
(Note: Per estimator)				
Tray air stripper cleaning	General Contractor	4.00	EA	5,142
Monitoring Well Maintenance	**General Contractor**	**1.00**	**EA**	**55,496**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**40,660**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Monitoring well maintenance	Drilling Subcontractor	114.00	EA	27,389
8" Vault	Drilling Subcontractor	57.00	EA	4,991
(Note: Cost Source: Previous Work)				
Locking J-Plug, 2" Well	Drilling Subcontractor	57.00	EA	982
(Note: Vendor Quote: Dean Bennett Supply, 4/27/2011)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**14,836**
Daily Pickup Truck Rental	AE Contractor ME	12.00	DAY	1,289
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	12.00	DAY	167
(Note: Per Estimator)				
Per Diem	AE Contractor ME	12.00	DAY	2,003
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	114.00	HR	11,378
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed [redacted]				
Recovery Well Maintenance	**General Contractor**	**1.00**	**EA**	**17,005**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**13,746**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Extraction well maintenance	Drilling Subcontractor	24.00	HR	5,766
Miscellaneous materials for extraction well maintenance	Drilling Subcontractor	1.00	LS	682
(Note: Per estimator)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**3,260**
Daily Pickup Truck Rental	AE Contractor ME	3.00	DAY	322
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	3.00	DAY	42
(Note: Per Estimator)				
Per Diem	AE Contractor ME	3.00	DAY	501
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	24.00	HR	2,395
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted]				

Description	Contractor	Quantity	UOM	ProjectCost
Re-Injection Well Maintenance	**General Contractor**	**1.00**	**EA**	**12,637**
Driller	**Drilling Subcontractor**	**1.00**	**LS**	**10,862**
Mob/Demob of Drill Rig	Drilling Subcontractor	1.00	LS	7,297
(Note: Previous Work)				
Extraction well maintenance	Drilling Subcontractor	12.00	HR	2,883
Miscellaneous materials for extraction well maintenance	Drilling Subcontractor	1.00	LS	682
(Note: Per estimator)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**1,774**
Daily Pickup Truck Rental	AE Contractor ME	2.00	DAY	215
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	2.00	DAY	28
(Note: Per Estimator)				
Per Diem	AE Contractor ME	2.00	DAY	334
(Note: Standard Rate Per Diem - GSA, 2012)				
Geologist	AE Contractor L	12.00	HR	1,198
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6[redacted]				
Land Acquisition/Easement Requirements	**General Contractor**	**1.00**	**EA**	**14,464**
Environmental Lawyer	AE Contractor L	40.00	HR	6,515
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Lawyer: [redacted]7 Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Paralegal	General Contractor	80.00	HR	4,466
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Paralegal: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]%)				
Clerks, Typists, Bookkeepers & Receptionist	General Contractor	20.00	HR	636
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Administrative Clerk: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Project Manager	General Contractor	40.00	HR	2,847
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: $[redacted]1 Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Pilot Scale Injection	**General Contractor**	**1.00**	**LS**	**6,740,896**
EAB Injection - Pilot	**General Contractor**	**1.00**	**EA**	**2,775,528**
EAB Injection	**General Contractor**	**1.00**	**EA**	**2,662,318**
Injection	**Injection Subcontractor**	**1.00**	**EA**	**2,620,720**
Per Diem	Injection Subcontractor	60.00	DAY	10,507
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	30.00	DAY	3,380
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	30.00	DAY	438
(Note: Per Estimator)				
Process Water Suplied by Water Line	Injection Subcontractor	1,612.00	KGA	8,023
EOS (Emulsified Oil Substrate) - Shipping	Injection Subcontractor	115,542.00	GAL	74,198
(Note: Vendor Quote: EOS Remediation, 2009)				
EOS (Emulsified Oil Substrate)	Injection Subcontractor	115,542.00	GAL	2,495,742
(Note: Vendor Quote: EOS Remediation, 2009)				
General Operator/Tech	Injection Subcontractor	600.00	HR	28,432
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: $48,244 Assumed Benefits: 15.2% Assumed Bonus: 6.5%)				
Oversight	**AE Contractor L**	**1.00**	**EA**	**41,598**
Per Diem	AE Contractor ME	30.00	DAY	5,007
(Note: Standard Rate Per Diem - GSA, 2012)				

Description	Contractor	Quantity	UOM	ProjectCost
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	30.00	DAY	3,222
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	30.00	DAY	417
Geologist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted]17 Assumed Benefits: [redacted] Assumed Bonus: [redacted])	AE Contractor L	300.00	HR	29,941
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted]1 Assumed Benefits: 1[redacted]% Assumed Bonus: 6.5%)	AE Contractor L	30.00	HR	3,011
Bioaugmentation Injection	**General Contractor**	**1.00**	**LS**	**113,210**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**107,865**
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	Injection Subcontractor	8.00	DAY	1,401
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	Injection Subcontractor	4.00	DAY	451
Fuel for Rental Truck (Note: Per Estimator)	Injection Subcontractor	4.00	DAY	58
Bioaugmentation (Note: Vendor Quote: EOS Remediation, 2009)	Injection Subcontractor	700.00	LIT	102,164
General Operator/Tech (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])	Injection Subcontractor	80.00	HR	3,791
Oversight	**AE Contractor L**	**1.00**	**LS**	**5,346**
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	AE Contractor ME	4.00	DAY	668
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	AE Contractor ME	4.00	DAY	430
Fuel for Rental Truck (Note: Per Estimator)	AE Contractor ME	4.00	DAY	56
Geologist (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: 6[redacted]	AE Contractor L	40.00	HR	3,992
Project Manager (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]	AE Contractor L	2.00	HR	201
ISCO Injection - Pilot	**General Contractor**	**1.00**	**EA**	**1,592,299**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**1,550,701**
Per Diem (Note: Standard Rate Per Diem - GSA, 2012)	Injection Subcontractor	60.00	DAY	10,507
Daily Pickup Truck Rental (Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)	Injection Subcontractor	30.00	DAY	3,380
Fuel for Rental Truck (Note: Per Estimator)	Injection Subcontractor	30.00	DAY	438
Process Water Suplied by Water Line	Injection Subcontractor	1,728.00	KGA	8,600
General Operator/Tech (Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted]4 Assumed [redacted] Assumed Bonus: [redacted])	Injection Subcontractor	600.00	HR	28,432
Persulfate (Chemical Oxidant) (Note: Vendor Quote: ChemRem, 5/13/2011)	Injection Subcontractor	579,695.00	LB	1,277,540

Description	Contractor	Quantity	UOM	ProjectCost
NaOH (Chemical Oxidant Activator)	Injection Subcontractor	389,678.00	LB	221,804
(Note: Vendor Quote: ChemRem, 5/13/2011)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**41,598**
Per Diem	AE Contractor ME	30.00	DAY	5,007
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	30.00	DAY	3,222
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	30.00	DAY	417
(Note: Per Estimator)				
Geologist	AE Contractor L	300.00	HR	29,941
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted]				
Project Manager	AE Contractor L	30.00	HR	3,011
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: $[redacted] Benefits: [redacted]% Assumed Bonus: [redacted]				
ISCR Injection - Pilot	**General Contractor**	**1.00**	**EA**	**2,373,069**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**2,331,470**
Per Diem	Injection Subcontractor	60.00	DAY	10,507
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	30.00	DAY	3,380
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	30.00	DAY	438
(Note: Per Estimator)				
Process Water Suplied by Water Line	Injection Subcontractor	1,728.00	KGA	8,600
General Operator/Tech	Injection Subcontractor	600.00	HR	28,432
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: $[redacted] Benefits: [redacted] Assumed Bonus: [redacted]				
EHC (Chemical Reductant)	Injection Subcontractor	579,695.00	LB	2,115,133
(Note: Cost Source: Adventus Group, 4/29/2011 Unit Price for EHC for quantities up to 20,000 lbs.)				
EHC (Chemical Reductant) - Shipping	Injection Subcontractor	579,695.00	LB	164,980
(Note: Cost Source: Adventus Group, 4/29/2011)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**41,598**
Per Diem	AE Contractor ME	30.00	DAY	5,007
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	30.00	DAY	3,222
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	30.00	DAY	417
(Note: Per Estimator)				
Geologist	AE Contractor L	300.00	HR	29,941
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: 1[redacted] Assumed Bonus: [redacted]				
Project Manager	AE Contractor L	30.00	HR	3,011
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: 6[redacted]				
Injection (Line 1)	**General Contractor**	**1.00**	**LS**	**9,856,897**
EAB Injection (Line 1)	**General Contractor**	**1.00**	**EA**	**3,996,608**
EAB Injection	**General Contractor**	**1.00**	**EA**	**3,939,902**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**3,885,825**
Per Diem	Injection Subcontractor	78.00	DAY	13,660

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	39.00	DAY	4,394
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	39.00	DAY	569
(Note: Per Estimator)				
Process Water Suplied by Water Line	Injection Subcontractor	2,395.00	KGA	11,920
EOS (Emulsified Oil Substrate) - Shipping	Injection Subcontractor	171,668.00	GAL	110,240
(Note: Vendor Quote: EOS Remediation, 2009)				
EOS (Emulsified Oil Substrate)	Injection Subcontractor	171,668.00	GAL	3,708,081
(Note: Vendor Quote: EOS Remediation, 2009)				
General Operator/Tech	Injection Subcontractor	780.00	HR	36,961
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Oversight	**AE Contractor L**	**1.00**	**LS**	**54,078**
Per Diem	AE Contractor ME	39.00	DAY	6,509
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	39.00	DAY	4,188
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	39.00	DAY	542
(Note: Per Estimator)				
Geologist	AE Contractor L	390.00	HR	38,924
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Project Manager	AE Contractor L	39.00	HR	3,914
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] Assumed Benefits: [redacted]% Assumed Bonus: [redacted])				
Bioaugmentation Injection	**General Contractor**	**1.00**	**LS**	**56,705**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**53,932**
Per Diem	Injection Subcontractor	4.00	DAY	700
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	2.00	DAY	225
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	2.00	DAY	29
(Note: Per Estimator)				
Bioaugmentation	Injection Subcontractor	350.00	LIT	51,082
(Note: Vendor Quote: EOS Remediation, 2009)				
General Operator/Tech	Injection Subcontractor	40.00	HR	1,895
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Bonus: [redacted])				
Oversight	**AE Contractor L**	**1.00**	**LS**	**2,773**
Per Diem	AE Contractor ME	2.00	DAY	334
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	2.00	DAY	215
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	2.00	DAY	28
(Note: Per Estimator)				
Geologist	AE Contractor L	20.00	HR	1,996
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] Assumed Bonus: [redacted])				
Project Manager	AE Contractor L	2.00	HR	201

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: $77,121 Assumed Benefits: 15.2% Assumed Bonus: 6.5%)				
ISCO Injection (Line 1)	**General Contractor**	**1.00**	**EA**	**2,350,122**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**2,296,044**
Per Diem	Injection Subcontractor	78.00	DAY	13,660
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	39.00	DAY	4,394
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	39.00	DAY	569
(Note: Per Estimator)				
Process Water Suplied by Water Line	Injection Subcontractor	2,567.00	KGA	12,776
General Operator/Tech	Injection Subcontractor	780.00	HR	36,961
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: [redacted] Assumed [redacted]				
Persulfate (Chemical Oxidant)	Injection Subcontractor	861,295.00	LB	1,898,135
(Note: Vendor Quote: ChemRem, 5/13/2011)				
NaOH (Chemical Oxidant Activator)	Injection Subcontractor	578,973.00	LB	329,550
(Note: Vendor Quote: ChemRem, 5/13/2011)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**54,078**
Per Diem	AE Contractor ME	39.00	DAY	6,509
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	39.00	DAY	4,188
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	39.00	DAY	542
(Note: Per Estimator)				
Geologist	AE Contractor L	390.00	HR	38,924
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] Assumed Benefits: [redacted] % Assumed Bonus: 6[redacted]				
Project Manager	AE Contractor L	39.00	HR	3,914
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: $77,121 Assumed Benefits: 15.2% Assumed Bonus: 6.5%)				
ISCR Injection (Line 1)	**General Contractor**	**1.00**	**EA**	**3,510,168**
Injection	**Injection Subcontractor**	**1.00**	**LS**	**3,456,090**
Per Diem	Injection Subcontractor	78.00	DAY	13,660
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	Injection Subcontractor	39.00	DAY	4,394
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	Injection Subcontractor	39.00	DAY	569
(Note: Per Estimator)				
Process Water Suplied by Water Line	Injection Subcontractor	2,567.00	KGA	12,776
General Operator/Tech	Injection Subcontractor	780.00	HR	36,961
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Operator Chemical: [redacted] Assumed Benefits: [redacted] % Assumed Bonus: 6[redacted]				
EHC (Chemical Reductant)	Injection Subcontractor	861,295.00	LB	3,142,607
(Note: Cost Source: Adventus Group, 4/29/2011 Unit Price for EHC for quantities up to 20,000 lbs.)				
EHC (Chemical Reductant) - Shipping	Injection Subcontractor	861,295.00	LB	245,123
(Note: Cost Source: Adventus Group, 4/29/2011)				
Oversight	**AE Contractor L**	**1.00**	**LS**	**54,078**
Per Diem	AE Contractor ME	39.00	DAY	6,509

Description	Contractor	Quantity	UOM	ProjectCost
(Note: Standard Rate Per Diem - GSA, 2012)				
Daily Pickup Truck Rental	AE Contractor ME	39.00	DAY	4,188
(Note: Daily Rental Rate. Vendor Quote: Enterprise, 4/27/2011)				
Fuel for Rental Truck	AE Contractor ME	39.00	DAY	542
(Note: Per Estimator)				
Geologist	AE Contractor L	390.00	HR	38,924
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Geologist: [redacted] 7 Assumed Benefits: [redacted] % Assumed [redacted]				
Project Manager	AE Contractor L	39.00	HR	3,914
(Note: Source: http://www.SalaryExpert.com/ Rates are based on the Omaha, NE area Median Percentile Base Salary for Engineering Project Manager: [redacted] 121 Assumed Benefits: [redacted] Assumed Bonus: [redacted])				

US EPA ARCHIVE DOCUMENT

Calculations

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CALCULATION WORKSHEET INDEX - ALTERNATIVE S2

Wrksht No.	Description
C-01	Calculations for determination of quantities for abandonment of soil vapor extraction wells
C-02	Calculations for determination of quantities for excavation of contaminated soil
C-03	Calculations for determination of quantities for restoration of excavated area
C-04	Calculations for determination of quantities for hauling treated soils to borrow area for disposal and re-seeding of the area
C-05	Calculations for determination of quantities for ex-situ soil vapor extraction treatment of contaminated soils

CDM

PROJECT:	Garvey Elevator Site	COMPUTED BY :	JN	CHECKED BY:	MS
JOB NO.:	51029-68208	DATE :	12/27/2011	DATE CHECKED:	12/30/2011
CLIENT:	USEPA Region 7			WRKSHT NO. :	C-01

Description: Quantities for abandonment of soil vapor extraction wells. Assumes all soil vapor extraction wells will be abandoned when site is closed.

Assumed Material Properties

Soil Expansion Factor:	**1.2**	*Conversion from BCY to LCY*
Soil Compaction Factor:	**1.1**	*Conversion from BCY to ECY*
Soil Compaction Factor:	**0.9**	*Conversion from LCY to ECY*

BCY - bank cubic yard - in place volume prior to excavation
LCY - loose cubic yards - volume after excavation
ECY - embankment cubic yards (aka compacted cubic yards) - volume after compaction

Concrete Expansion Factor:	1.30	*Conversion from BCY to LCY*
Density of base course gravel, TN/LCY:	1.50	
Density of concrete, TN/LCY:	1.89	
Density of soil, TN/LCY:	1.50	

Well Abandonment

Shallow SVE Well Quantities, per well		**Deep SVE Well Quantities, per well**	
Number of SVE Wells:	8	Number of SVE Wells:	3
Well diameter, IN:	4	Well diameter, IN:	4
SVE Well Depth, VLF:	50	SVE Well Depth, VLF:	110
Estimated time to abandon well, HR:	3	Estimated time to abandon well, HR:	5
Estimated length of work day, HR:	10	Estimated length of work day, HR:	10

Total

Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	730
Cement-grout, CF:	64
Geologist, HR:	39
Per Diem, DY:	4
Pickup Truck Rental, DY:	4
Fuel for Rental Truck, DY:	4

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for excavation of contaminated soil.

Excavation Support		
Width of Excavation, FT:	40	
Length of Excavation, FT:	10	
Perimeter length where excavation support is needed, LF	**100**	
Excavation - 0 to 20 feet bgs		
Estimated area for excavation, SF:	**400**	
Top of interval, FT BGS:	0	
Bottom of interval, FT BGS:	20	
Estimated depth of excavation, FT:	**20**	
Volume of excavation - non-hazardous, CF:	8000	
Totals		
Total excavation, CF:	8000	
Total excavation, BCY:	297	*Rounded up to nearest whole number*
Total excavation, LCY:	357	*Rounded up to nearest whole number*
Total excavation, ECY:	322	
Total excavation, TON:	481	*Assumes 1.62 tons per BCY*

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for restoration of excavated area. Assumes general backfill for excavated areas comes from on-site borrow area and surface is finished with gravel only.

Restoration of Excavated Area		
Gravel thickness, IN:	**3**	
Gravel area, SF:	400	
Gravel area, SY:	45	*Rounded up to nearest whole number*
Quantities for Backfill of Excavations		
Total backfill, CF:	8000	
Gravel, CF:	100	
Backfill needed, CF:	7900	
Backfill needed, BCY:	293	*Rounded up to nearest whole number*
Backfill needed, LCY:	352	*Rounded up to nearest whole number*
Backfill needed, ECY:	317	*Rounded up to nearest whole number*
Excavation of Borrow Material, BCY:	293	*Assumes backfill comes from onsite borrow area*
Surface Area of Borrow Excavation, FT:	1317	*Assumes 6 ft depth of excavation at borrow area*
Gravel, CF:	100	
Gravel, BCY:	4	*Rounded up to nearest whole number*
Gravel, LCY:	5	*Rounded up to nearest whole number*
Gravel, ECY:	4	*Rounded up to nearest whole number*
Gravel, TON:	6	*Assumes 1.5 tons per CY*

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for hauling treated soils to borrow area for disposal and re-seeding of the area.

Disposal of Treated Soils at Borrow Area

Hauling of Soils to Borrow Area

Hauling of Treated Soils, LCY:	357
Hauling of Berm Soils, LCY:	30
Total Soil for Disposal at Borrow Area, LCY:	387

Compaction and Spreading of Soils

Spreading and Compaction of Soils at Disposal Area, LCY:	387
Spreading and Compaction of Soils at Disposal Area, ECY:	349

Restoration of Disposal Site

Surface Area of Disposal Area, SF:	1317
Surface Area of Disposal Area, MSF:	1.4
Seeding of Disposal Area, MSF:	1.4

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Description: Calculations for determination of quantities for ex-situ soil vapor extraction treatment of contaminated soils. Ex-situ treatment will be conducted on on-site prior to disposal of treated soils at the borrow area.

Ex-Situ Soil Vapor Extraction System		
Excavated Volume for Treatment, LCY:	357	
Excavated Volume for Treatment, BCY:	297	
Dimensions of Ex-Situ Treatment Cell		
Height of Soil Pile, FT:	8	*Per Engineer*
Side Slope of Soil Pile:	1.5	*Per Engineer*
Angle of Repose, ^{o}:	34	*Calculated from assumed side slopes*
Length-to-Width Ratio of Soil Pile Base:	2	
Gravel Layer beneath Soil Pile, IN:	6	
Base Area, SF:	**2070**	*Calculated*
Soil Pile Width, FT:	**32.2**	*Calculated*
Width of Treatment Bed, FT:	52.2	*Assumes 10 ft clearance between soil pile and berm*
Soil Pile Length, FT:	**64.4**	*Calculated*
Length of Treatment Bed, FT:	84.4	*Assumes 10 ft clearance between soil pile and berm*
Perimeter of Treatment Bed, FT:	**193.2**	
Treatment Bed Area, SF:	**4406**	
Height of Berm, FT:	1.5	
Top Width of Berm, FT:	1	
Bottom Width of Berm, FT:	4	
Cross Sectional Area of Berm, SF:	3.75	
Quantities for Ex-Situ Treatment Cell		
Volume of Soil for Berm Construction, ECY:	**26.9**	
Volume of Soil for Berm Construction, LCY:	**29.9**	
Volume of Soil for Berm Construction, BCY:	**25.0**	
40 mil PVC Liner, SF:	4406	
Gravel beneath Soil Pile, CY:	**81.6**	
Gravel beneath Soil Pile, TON:	**122.4**	*Assumes 1.5 tons per CY*
Slotted PVC Pipe, FT:	**129**	
PVC Pipe, FT:	**536**	*Assumes cell is 500 ft from existing treatment system*
90^{o} Elbow, EA:	2	
Tee, EA:	1	
Pressure Gauge, EA:	1	
Ball Valve, EA:	1	
Blower, EA:	1	
Skid Pilot Treatment System, EA:	1	
Confirmation Samples		
Excavation Volume, LCY:	357	
Duplicate frequency, 1 per:	**10**	
MS/MSD frequency, 1 per:	**20**	
Number of Soil Samples for Characterization, EA:	**18**	*Assumed 1 sample per 20 CY treated soil*
Estimated number of confirmation samples, EA:	18	
Number of duplicates, EA:	2	
Number of MS/MSD, EA:	1	
Total number of confirmation samples, EA:	**21**	

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Description: Calculations for determination of quantities for ex-situ soil vapor extraction treatment of contaminated soils. Ex-situ treatment will be conducted on on-site prior to disposal of treated soils at the borrow area.

Environmental Engineer, HR:	9	*Assumes 30 minutes per soil sample*
Per Diem, DY:	1	
Pickup Truck Rental, DY:	1	
Fuel for Rental Truck, DY:	1	
Electrical Consumption by Current Treatment System		
Energy equivalent, HP-HR to kW-HR:	0.746	
Assumed pump efficiency, %:	50%	
Number of hours per year, HR:	8760	*Assumes 24/7 operation for 2 months*
HP of SVE System 1 blower, HP:	5	
HP of SVE System 2 blower, HP:	15	
SVE blowers, HP-HR:	**175,200**	
Equivalent electrical consumption, kW-HR:	**261,400**	*Assumes motor efficiency, rounded up to nearest hundred*
Assumed equivalent HP for remaining treatment system, HP:	2	
Remaining system, HP-HR:	**17,520**	
Equivalent electrical consumption, kW-HR:	**26,200**	*Assumes motor efficiency, rounded up to nearest hundred*
Estimated total electrical consumption, KW-HR:	**287,600**	
Electrical Consumption by Temporary Ex Situ Treatment System		
Energy equivalent, HP-HR to kW-HR:	0.746	
Assumed pump efficiency, %:	50%	
Assumed months of operation, MO:	2	
Number of hours per year, HR:	1440	*Assumes 24/7 operation for 2 months*
HP of temporary system blower, HP:	5	
Temporary blower, HP-HR:	**7,200**	
Equivalent electrical consumption, kW-HR:	**10,800**	*Assumes motor efficiency, rounded up to nearest hundred*
Assumed equivalent HP for remaining treatment system, HP:	2	
Remaining system, HP-HR:	**2,880**	
Equivalent electrical consumption, kW-HR:	**4,300**	*Assumes motor efficiency, rounded up to nearest hundred*
Estimated total electrical consumption, KW-HR:	**15,100**	
Treatment System Operation and Maintenance		
Number of site visits, EA:	52	
Number of hours per visit, HR:	5	*Includes travel to and from site.*
Total number of hours, HR:	260	

US EPA ARCHIVE DOCUMENT

CALCULATION WORKSHEET INDEX - ALTERNATIVE S3

Wrksht No.	Description
C-01	Calculations for determination of quantities for abandonment of soil vapor extraction wells
C-02	Calculations for determination of quantities for installation of soil vapor extraction wells
C-03	Calculations for determination of quantities for equipment for trenching for SVE piping
C-04	Calculations for determination of quantities for O&M of soil vapor extraction treatment system

CDM

PROJECT:	Garvey Elevator Site	COMPUTED BY :	JN	CHECKED BY:	MS
JOB NO.:	51029-68208	DATE :	12/27/2011	DATE CHECKED:	12/30/2011
CLIENT:	USEPA Region 7			WRKSHT NO. :	C-01

Description: Quantities for abandonment of soil vapor extraction wells. Assumes all air sparging and soil vapor extraction wells will be abandoned when site is closed.

Assumed Material Properties

Soil Expansion Factor:	**1.2**	*Conversion from BCY to LCY*
Soil Compaction Factor:	**1.1**	*Conversion from BCY to ECY*
Soil Compaction Factor:	**0.9**	*Conversion from LCY to ECY*

BCY - bank cubic yard - in place volume prior to excavation
LCY - loose cubic yards - volume after excavation
ECY - embankment cubic yards (aka compacted cubic yards) - volume after compaction

Concrete Expansion Factor:	1.30	*Conversion from BCY to LCY*
Density of base course gravel, TN/LCY:	1.50	
Density of concrete, TN/LCY:	1.89	
Density of soil, TN/LCY:	1.50	

Well Abandonment

Shallow SVE Well Quantities, per well		**Deep SVE Well Quantities, per well**	
Number of SVE Wells:	9	Number of SVE Wells:	4
Well diameter, IN:	4	Well diameter, IN:	4
SVE Well Depth, VLF:	50	SVE Well Depth, VLF:	110
Estimated time to abandon well, HR:	3	Estimated time to abandon well, HR:	5
Estimated length of work day, HR:	10	Estimated length of work day, HR:	10

Total

Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	890
Cement-grout, CF:	78
Geologist, HR:	47
Per Diem, DY:	5
Pickup Truck Rental, DY:	5
Fuel for Rental Truck, DY:	5

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Description: Quantities for installation of soil vapor extraction wells.

Soil Vapor Extraction Well Quantities Per Well

Shallow SVE Well Quantities, per well		Deep SVE Well Quantities, per well	
Well casing inner diameter, IN:	4	Well casing inner diameter, IN:	4
Well casing outer diameter, IN:	4.5	Well casing outer diameter, IN:	4.5
Hollow Stem Drilling drilling, IN:	11	Hollow Stem Drilling drilling, IN:	11
Hollow Stem Drilling, LF:	50	Hollow Stem Drilling, LF:	110
Well Screen, LF:	30	Well Screen, LF:	50
Sand Pack, LF:	30	Sand Pack, LF:	50
Sand, CF:	17	Sand, CF:	28
Sand, CY:	1	Sand, CY:	2
Sand, TON:	1.5	Sand, TON:	3
Casing, LF:	20	Casing, LF:	60
Well Grout, CF:	11	Well Grout, CF:	33
Well Plug, EA:	1	Well Plug, EA:	1
12" Vault, EA:	1	12" Vault, EA:	1
55-gallon drum, EA:	0.5	55-gallon drum, EA:	1
Geologist per well, HR:	4	Geologist per well, HR:	8
Pickup Truck Rental, DY:	0.4	Pickup Truck Rental, DY:	0.8
Fuel for Rental Truck, DY:	0.4	Fuel for Rental Truck, DY:	0.8

Total Soil Vapor Extraction Well Installation Quantities

Shallow SVE Wells Installed:	1
Deep SVE Wells Installed:	1
Hollow Stem Drilling, LF:	160
Well Screen, LF:	80
PVC Casing, LF:	80
Sand pack, TON:	5
Annular seal, CF:	44
Well Plug, EA:	2
12" Vault, EA:	2
55-gallon drum, EA:	2
Geologist, HR:	12
Pickup Truck Rental, DY:	2
Fuel for Rental Truck, DY:	2

Well Maintenance -Soil Vapor Extraction Wells

Number of wells requiring maintenance, EA:	13
Estimated time to complete well head repairs per well, HR	2
Estimated time to develop well, HR:	0
Total time per well, HR:	2
Total time for all wells, HR:	26
Estimated length of work day, HR:	10
12" Vault, EA:	13
Geologist, HR:	26
Pickup Truck Rental, DY:	3
Fuel for Rental Truck, DY:	3

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Description: Quantities for equipment for trenching for SVE piping.

Piping Installation

Number of soil vapor extraction wells, EA:	2	
Trench width, FT:	2	*Lines placed in a common trench.*
Trench depth, FT:	2	
Trenching in Unpaved Area, LF:	310	
Total length of pipe to install, LF:	310	
Unpaved area disturbed, SF:	620	
Excavation, BCF:	1240	
Excavation, BCY:	46	*Rounded up to nearest whole number*
Excavation, LCY:	56	*Rounded up to nearest whole number*
Excavation, ECY:	51	*Rounded up to nearest whole number*
O.D. of 2" Pipe, IN:	2.375	
O.D. of 2" Pipe, CF:	10	
Depth of Aggregate under pipe, IN:	3	
Depth of Aggregate over pipe, IN:	3	
Depth of Aggregate (including pipe), FT:	1.0	
Volume of Aggregate Required, BCF:	610	
Volume of Aggregate Required, BCY:	23	
Volume of Aggregate Required, LCY:	46	*Rounded up to nearest whole number*
Volume of Aggregate Required, ECY:	12	*Rounded up to nearest whole number*
Volume of Aggregate Required, TON:	69	*Assumes 1.5 tons per CY*
Volume of Aggregate Required, SF:	620	
Volume of Backfill, BCF:	310	
Volume of Backfill, BCY:	12	
Volume of Backfill, LCY:	15	*Rounded up to nearest whole number*
Volume of Backfill, ECY:	14	*Rounded up to nearest whole number*
Detectable Tape, LF:	310	
Detectable Tape, CLF:	4	*Rounded up to nearest whole number*
2" Piping (outside building), LF:	310	
2" Piping (inside building), LF:	15	
Total 2" Piping, LF:	325	
Number of 2" Elbow, 90 Deg., EA:	4	
Number of 2" ball valves, EA:	3	
Gravel cover thickness, IN:	**6**	
Gravel cover, CF:	310	
Gravel cover, BCY:	12	*Rounded up to nearest whole number*
Gravel cover, LCY:	15	*Rounded up to nearest whole number*
Gravel cover, ECY:	14	*Rounded up to nearest whole number*
Gravel cover, TON:	23	*Assumes 1.5 tons per CY*
Volume of Soil for Disposal, CF:	930	
Volume of Soil for Disposal, BCY:	35	*Rounded up to nearest whole number*
Volume of Soil for Disposal, LCY:	42	*Rounded up to nearest whole number*
Volume of Soil for Disposal, TON:	63	*Assumes 1.5 tons per CY*

US EPA ARCHIVE DOCUMENT

Description: Quantities for O&M of soil vapor extraction treatment system.

Electrical Consumption by Treatment System

Energy equivalent, HP-HR to kW-HR:	0.746	
Assumed pump efficiency, %:	50%	
Number of hours per year, HR:	8760	*Assumes 24/7 operation*
HP of SVE System 1 blower, HP:	5	
HP of SVE System 2 blower, HP:	15	
Air stripper blower, HP-HR:	**175,200**	
Equivalent electrical consumption, kW-HR:	**261,400**	*Assumes motor efficiency, rounded up to nearest hundred*
Assumed equivalent HP for remaining treatment system, HP:	2	
Remaining system, HP-HR:	**17,520**	
Equivalent electrical consumption, kW-HR:	**26,200**	*Assumes motor efficiency, rounded up to nearest hundred*
Estimated total electrical consumption, KW-HR:	**287,600**	

Treatment System Operation and Maintenance

Number of site visits per year, EA:	52	
Number of hours per visit, HR:	5	*Includes travel to and from site.*
Total number of hours, HR:	260	

US EPA ARCHIVE DOCUMENT

CALCULATION WORKSHEET INDEX - ALTERNATIVE S2

Wrksht No.	Description
C-01	Calculations for determination of quantities for abandonment of soil vapor extraction wells
C-02	Calculations for determination of quantities for excavation of contaminated soil
C-03	Calculations for determination of quantities for restoration of excavated area
C-04	Calculations for determination of quantities for hauling treated soils to borrow area for disposal and re-seeding of the area
C-05	Calculations for determination of quantities for ex-situ soil vapor extraction treatment of contaminated soils
C-06	Calculations for determination of quantities for installation of soil vapor extraction wells
C-07	Calculations for determination of quantities for equipment for trenching for SVE piping
C-08	Calculations for determination of quantities for O&M of soil vapor extraction treatment system

CDM

PROJECT:	Garvey Elevator Site	COMPUTED BY :	JN	CHECKED BY:	AH
JOB NO.:	51029-68208	DATE :	5/14/2012	DATE CHECKED:	5/15/2012
CLIENT:	USEPA Region 7			WRKSHT NO. :	C-01

Description: Quantities for abandonment of soil vapor extraction wells. Assumes all soil vapor extraction wells will be abandoned when site is closed.

Assumed Material Properties

Soil Expansion Factor:	**1.2**	*Conversion from BCY to LCY*
Soil Compaction Factor:	**1.1**	*Conversion from BCY to ECY*
Soil Compaction Factor:	**0.9**	*Conversion from LCY to ECY*

BCY - bank cubic yard - in place volume prior to excavation
LCY - loose cubic yards - volume after excavation
ECY - embankment cubic yards (aka compacted cubic yards) - volume after compaction

Concrete Expansion Factor:	1.30	*Conversion from BCY to LCY*
Density of base course gravel, TN/LCY:	1.50	
Density of concrete, TN/LCY:	1.89	
Density of soil, TN/LCY:	1.50	

Well Abandonment

Shallow SVE Well Quantities, per well		**Deep SVE Well Quantities, per well**	
Number of SVE Wells:	9	Number of SVE Wells:	4
Well diameter, IN:	4	Well diameter, IN:	4
SVE Well Depth, VLF:	50	SVE Well Depth, VLF:	110
Estimated time to abandon well, HR:	3	Estimated time to abandon well, HR:	5
Estimated length of work day, HR:	10	Estimated length of work day, HR:	10

Total

Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	890
Cement-grout, CF:	78
Geologist, HR:	47
Per Diem, DY:	5
Pickup Truck Rental, DY:	5
Fuel for Rental Truck, DY:	5

US EPA ARCHIVE DOCUMENT

CDM

PROJECT:	Garvey Elevator Site	COMPUTED BY :	JN	CHECKED BY:	AH
JOB NO.:	51029-68208	DATE :	5/14/2012	DATE CHECKED:	5/15/2012
CLIENT:	USEPA Region 7			WRKSHT NO. :	C-02

Description: Calculations for determination of quantities for excavation of contaminated soil.

Excavation Support		
Width of Excavation, FT:	40	
Length of Excavation, FT:	10	
Perimeter length where excavation support is needed, LF	**100**	
Excavation - 0 to 20 feet bgs		
Estimated area for excavation, SF:	**400**	
Top of interval, FT BGS:	0	
Bottom of interval, FT BGS:	20	
Estimated depth of excavation, FT:	**20**	
Volume of excavation - non-hazardous, CF:	8000	
Totals		
Total excavation, CF:	8000	
Total excavation, BCY:	297	*Rounded up to nearest whole number*
Total excavation, LCY:	357	*Rounded up to nearest whole number*
Total excavation, ECY:	322	
Total excavation, TON:	481	*Assumes 1.62 tons per BCY*

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for restoration of excavated area. Assumes general backfill for excavated areas comes from on-site borrow area and surface is finished with gravel only.

Restoration of Excavated Area		
Gravel thickness, IN:	**3**	
Gravel area, SF:	400	
Gravel area, SY:	45	*Rounded up to nearest whole number*
Quantities for Backfill of Excavations		
Total backfill, CF:	8000	
Gravel, CF:	100	
Backfill needed, CF:	7900	
Backfill needed, BCY:	293	*Rounded up to nearest whole number*
Backfill needed, LCY:	352	*Rounded up to nearest whole number*
Backfill needed, ECY:	317	*Rounded up to nearest whole number*
Excavation of Borrow Material, BCY:	293	*Assumes backfill comes from onsite borrow area*
Surface Area of Borrow Excavation, FT:	1317	*Assumes 6 ft depth of excavation at borrow area*
Gravel, CF:	100	
Gravel, BCY:	4	*Rounded up to nearest whole number*
Gravel, LCY:	5	*Rounded up to nearest whole number*
Gravel, ECY:	4	*Rounded up to nearest whole number*
Gravel, TON:	6	*Assumes 1.5 tons per CY*

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for hauling treated soils to borrow area for disposal and re-seeding of the area.

Disposal of Treated Soils at Borrow Area

Hauling of Soils to Borrow Area

Hauling of Treated Soils, LCY:	357
Hauling of Berm Soils, LCY:	30
Total Soil for Disposal at Borrow Area, LCY:	387

Compaction and Spreading of Soils

Spreading and Compaction of Soils at Disposal Area, LCY:	387
Spreading and Compaction of Soils at Disposal Area, ECY:	349

Restoration of Disposal Site

Surface Area of Disposal Area, SF:	1317
Surface Area of Disposal Area, MSF:	1.4
Seeding of Disposal Area, MSF:	1.4

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for ex-situ soil vapor extraction treatment of contaminated soils. Ex-situ treatment will be conducted on on-site prior to disposal of treated soils at the borrow area.

Ex-Situ Soil Vapor Extraction System		
Excavated Volume for Treatment, LCY:	357	
Excavated Volume for Treatment, BCY:	297	
Dimensions of Ex-Situ Treatment Cell		
Height of Soil Pile, FT:	8	*Per Engineer*
Side Slope of Soil Pile:	1.5	*Per Engineer*
Angle of Repose, ^{o}:	34	*Calculated from assumed side slopes*
Length-to-Width Ratio of Soil Pile Base:	2	
Gravel Layer beneath Soil Pile, IN:	6	
Base Area, SF:	**2070**	*Calculated*
Soil Pile Width, FT:	**32.2**	*Calculated*
Width of Treatment Bed, FT:	52.2	*Assumes 10 ft clearance between soil pile and berm*
Soil Pile Length, FT:	**64.4**	*Calculated*
Length of Treatment Bed, FT:	84.4	*Assumes 10 ft clearance between soil pile and berm*
Perimeter of Treatment Bed, FT:	**193.2**	
Treatment Bed Area, SF:	**4406**	
Height of Berm, FT:	1.5	
Top Width of Berm, FT:	1	
Bottom Width of Berm, FT:	4	
Cross Sectional Area of Berm, SF:	3.75	
Quantities for Ex-Situ Treatment Cell		
Volume of Soil for Berm Construction, ECY:	**26.9**	
Volume of Soil for Berm Construction, LCY:	**29.9**	
Volume of Soil for Berm Construction, BCY:	**25.0**	
40 mil PVC Liner, SF:	4406	
Gravel beneath Soil Pile, CY:	**81.6**	
Gravel beneath Soil Pile, TON:	**122.4**	*Assumes 1.5 tons per CY*
Slotted PVC Pipe, FT:	**129**	
PVC Pipe, FT:	**536**	*Assumes cell is 500 ft from existing treatment system*
90^{o} Elbow, EA:	2	
Tee, EA:	1	
Pressure Gauge, EA:	1	
Ball Valve, EA:	1	
Blower, EA:	1	
Skid Pilot Treatment System, EA:	1	
Confirmation Samples		
Excavation Volume, LCY:	357	
Duplicate frequency, 1 per:	**10**	
MS/MSD frequency, 1 per:	**20**	
Number of Soil Samples for Characterization, EA:	**18**	*Assumed 1 sample per 20 CY treated soil*
Estimated number of confirmation samples, EA:	18	
Number of duplicates, EA:	2	
Number of MS/MSD, EA:	1	
Total number of confirmation samples, EA:	**21**	

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for ex-situ soil vapor extraction treatment of contaminated soils. Ex-situ treatment will be conducted on on-site prior to disposal of treated soils at the borrow area.

Environmental Engineer, HR:	9	*Assumes 30 minutes per soil sample*
Per Diem, DY:	1	
Pickup Truck Rental, DY:	1	
Fuel for Rental Truck, DY:	1	
Electrical Consumption by Current Treatment System		
Energy equivalent, HP-HR to kW-HR:	0.746	
Assumed pump efficiency, %:	50%	
Number of hours per year, HR:	8760	*Assumes 24/7 operation for 2 months*
HP of SVE System 1 blower, HP:	5	
HP of SVE System 2 blower, HP:	15	
SVE blowers, HP-HR:	**175,200**	
Equivalent electrical consumption, kW-HR:	**261,400**	*Assumes motor efficiency, rounded up to nearest hundred*
Assumed equivalent HP for remaining treatment system, HP:	2	
Remaining system, HP-HR:	**17,520**	
Equivalent electrical consumption, kW-HR:	**26,200**	*Assumes motor efficiency, rounded up to nearest hundred*
Estimated total electrical consumption, KW-HR:	**287,600**	
Electrical Consumption by Temporary Ex Situ Treatment System		
Energy equivalent, HP-HR to kW-HR:	0.746	
Assumed pump efficiency, %:	50%	
Assumed months of operation, MO:	2	
Number of hours per year, HR:	1440	*Assumes 24/7 operation for 2 months*
HP of temporary system blower, HP:	5	
Temporary blower, HP-HR:	**7,200**	
Equivalent electrical consumption, kW-HR:	**10,800**	*Assumes motor efficiency, rounded up to nearest hundred*
Assumed equivalent HP for remaining treatment system, HP:	2	
Remaining system, HP-HR:	**2,880**	
Equivalent electrical consumption, kW-HR:	**4,300**	*Assumes motor efficiency, rounded up to nearest hundred*
Estimated total electrical consumption, KW-HR:	**15,100**	
Treatment System Operation and Maintenance		
Number of site visits, EA:	52	
Number of hours per visit, HR:	5	*Includes travel to and from site.*
Total number of hours, HR:	260	

US EPA ARCHIVE DOCUMENT

Description: Quantities for installation of soil vapor extraction wells.

Soil Vapor Extraction Well Quantities Per Well

Shallow SVE Well Quantities, per well		Deep SVE Well Quantities, per well	
Well casing inner diameter, IN:	4	Well casing inner diameter, IN:	4
Well casing outer diameter, IN:	4.5	Well casing outer diameter, IN:	4.5
Hollow Stem Drilling drilling, IN:	11	Hollow Stem Drilling drilling, IN:	11
Hollow Stem Drilling, LF:	50	Hollow Stem Drilling, LF:	110
Well Screen, LF:	30	Well Screen, LF:	50
Sand Pack, LF:	30	Sand Pack, LF:	50
Sand, CF:	17	Sand, CF:	28
Sand, CY:	1	Sand, CY:	2
Sand, TON:	1.5	Sand, TON:	3
Casing, LF:	20	Casing, LF:	60
Well Grout, CF:	11	Well Grout, CF:	33
Well Plug, EA:	1	Well Plug, EA:	1
12" Vault, EA:	1	12" Vault, EA:	1
55-gallon drum, EA:	0.5	55-gallon drum, EA:	1
Geologist per well, HR:	4	Geologist per well, HR:	8
Pickup Truck Rental, DY:	0.4	Pickup Truck Rental, DY:	0.8
Fuel for Rental Truck, DY:	0.4	Fuel for Rental Truck, DY:	0.8

Total Soil Vapor Extraction Well Installation Quantities

Shallow SVE Wells Installed:	1
Deep SVE Wells Installed:	1
Hollow Stem Drilling, LF:	160
Well Screen, LF:	80
PVC Casing, LF:	80
Sand pack, TON:	5
Annular seal, CF:	44
Well Plug, EA:	2
12" Vault, EA:	2
55-gallon drum, EA:	2
Geologist, HR:	12
Pickup Truck Rental, DY:	2
Fuel for Rental Truck, DY:	2

Well Maintenance -Soil Vapor Extraction Wells

Number of wells requiring maintenance, EA:	13
Estimated time to complete well head repairs per well, HR	2
Estimated time to develop well, HR:	0
Total time per well, HR:	2
Total time for all wells, HR:	26
Estimated length of work day, HR:	10
12" Vault, EA:	13
Geologist, HR:	26
Pickup Truck Rental, DY:	3
Fuel for Rental Truck, DY:	3

US EPA ARCHIVE DOCUMENT

Description: Quantities for equipment for trenching for SVE piping.

Piping Installation

Number of soil vapor extraction wells, EA:	2	
Trench width, FT:	2	*Lines placed in a common trench.*
Trench depth, FT:	2	
Trenching in Unpaved Area, LF:	310	
Total length of pipe to install, LF:	310	
Unpaved area disturbed, SF:	620	
Excavation, BCF:	1240	
Excavation, BCY:	46	*Rounded up to nearest whole number*
Excavation, LCY:	56	*Rounded up to nearest whole number*
Excavation, ECY:	51	*Rounded up to nearest whole number*
O.D. of 2" Pipe, IN:	2.375	
O.D. of 2" Pipe, CF:	10	
Depth of Aggregate under pipe, IN:	3	
Depth of Aggregate over pipe, IN:	3	
Depth of Aggregate (including pipe), FT:	1.0	
Volume of Aggregate Required, BCF:	610	
Volume of Aggregate Required, BCY:	23	
Volume of Aggregate Required, LCY:	46	*Rounded up to nearest whole number*
Volume of Aggregate Required, ECY:	12	*Rounded up to nearest whole number*
Volume of Aggregate Required, TON:	69	*Assumes 1.5 tons per CY*
Volume of Aggregate Required, SF:	620	
Volume of Backfill, BCF:	310	
Volume of Backfill, BCY:	12	
Volume of Backfill, LCY:	15	*Rounded up to nearest whole number*
Volume of Backfill, ECY:	14	*Rounded up to nearest whole number*
Detectable Tape, LF:	310	
Detectable Tape, CLF:	4	*Rounded up to nearest whole number*
2" Piping (outside building), LF:	310	
2" Piping (inside building), LF:	15	
Total 2" Piping, LF:	325	
Number of 2" Elbow, 90 Deg., EA:	4	
Number of 2" ball valves, EA:	3	
Gravel cover thickness, IN:	**6**	
Gravel cover, CF:	310	
Gravel cover, BCY:	12	*Rounded up to nearest whole number*
Gravel cover, LCY:	15	*Rounded up to nearest whole number*
Gravel cover, ECY:	14	*Rounded up to nearest whole number*
Gravel cover, TON:	23	*Assumes 1.5 tons per CY*
Volume of Soil for Disposal, CF:	930	
Volume of Soil for Disposal, BCY:	35	*Rounded up to nearest whole number*
Volume of Soil for Disposal, LCY:	42	*Rounded up to nearest whole number*
Volume of Soil for Disposal, TON:	57	*Assumes 1.62 tons per BCY*

US EPA ARCHIVE DOCUMENT

Description: Quantities for O&M of soil vapor extraction treatment system.

Electrical Consumption by Treatment System

Energy equivalent, HP-HR to kW-HR:	0.746	
Assumed pump efficiency, %:	50%	
Number of hours per year, HR:	8760	*Assumes 24/7 operation*
HP of SVE System 1 blower, HP:	5	
HP of SVE System 2 blower, HP:	15	
Air stripper blower, HP-HR:	**175,200**	
Equivalent electrical consumption, kW-HR:	**261,400**	*Assumes motor efficiency, rounded up to nearest hundred*
Assumed equivalent HP for remaining treatment system, HP:	2	
Remaining system, HP-HR:	**17,520**	
Equivalent electrical consumption, kW-HR:	**26,200**	*Assumes motor efficiency, rounded up to nearest hundred*
Estimated total electrical consumption, KW-HR:	**287,600**	

Treatment System Operation and Maintenance

Number of site visits per year, EA:	52	
Number of hours per visit, HR:	5	*Includes travel to and from site.*
Total number of hours, HR:	260	

US EPA ARCHIVE DOCUMENT

CALCULATION WORKSHEET INDEX - ALTERNATIVE SG1

Wrksht No.	Description
C-01	Calculations for determination of quantities for preparing groundwater monitoring reports
C-02	Calculations for determination of quantities for groundwater monitoring per sampling event
C-03	Calculations for determination of quantities for maintenance of monitoring wells
C-04	Calculations for determination of quantities for abandonment of monitoring wells

Description: Calculations for determination of quantities for preparing groundwater monitoring reports.

Groundwater Monitoring Report Generation

Assumed CAD hours per well, HR:	1.25	
Assumed Geologist hours per well, HR:	4	*Includes data review and tabulation, report, figures, etc.*
Number of wells:	47	
Project Manager, HR:	8	
CAD Drafter, HR:	59	
Geologist, HR:	188	
Quality Assurance Director, HR:	4	
Clerks, Typist, Bookkeeper & Receptionist, HR:	10	
Reproduction, LS:	1	

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for groundwater monitoring per sampling event.

Groundwater Monitoring		
No. of monitoring wells to be sampled for general analysis	**47**	
Analytical Requirements for General Analysis		
Samples, EA:	55	*Includes QC samples*
Sampling Equipment		
Water Quality Meter and Flow Through Cell, WK:	3	*Rounded up to nearest week*
Photoionization Detector (PID), WK:	3	*Rounded up to nearest week*
Water Level Meter, WK:	3	*Rounded up to nearest week*
Turbidimeter, WK:	3	*Rounded up to nearest week*
Portable Bladder Pump, WK:	3	*Rounded up to nearest week*
Replacement Poly Bladders, EA:	49	*Assumes 2 extra bladders*
Bladder Pump Controller, WK:	3	*Rounded up to nearest week*
Compressed Nitrogen Gas Rental, WK:	3	*Rounded up to nearest week*
Combination Tubing, LF:	4,700	*Assume 100 feet per well. Rounded up to nearest 100*
Shipping Rental Equipment, EA:	**2**	
55-gallon Open Head Steel Drum, EA:	**7**	*Assume 500 mL per minute for 60 minutes per well*
Miscellaneous Sampling Equipment, LS:	**1**	
Labor Requirements for General Analysis		
Assumed length of time per day, HR:	**8**	
Time assumed to sample a well, HR:	**1**	*Includes setup, purging, and sample collection*
Number of sampling team members:	**2**	
Prepartory time, HR:	**8**	
Time to collect water level measurements, HR:	12	*Assume 15 minutes per well. Rounded up to nearest hour*
Time to sample all wells for general analysis, HR:	47	*Rounded up to nearest hour*
Prepartory time, HR:	8	
Time to collect water level measurements, HR:	12	*Assume 15 minutes per well. Rounded up to nearest hour*
Time to sample all wells for general analysis, HR:	47	*Rounded up to nearest hour*
Time for decon, HR:	16	*Assume 20 minutes per well. Rounded up to nearest hour*
Time for sample management, HR:	12	*Assume 15 minutes per well. Rounded up to nearest hour*
Total, HR:	**95**	*Rounded up to nearest 10 hours*
Time to sample all wells for general analysis, DY:	**12**	*Rounded up to nearest day*
Project Manager, HR:	4	*5 minutes per sample, rounded up to nearest hour*
General Operator/Technician, HR:	190	*Two member team*
Contracting/Procurement Specialist, HR:	8	*10 minutes per sample, rounded up to nearest hour*
Pickup Truck Rental, DY:	12	
Fuel for Pickup Truck, DY:	12	
Per diem, DY:	24	

US EPA ARCHIVE DOCUMENT

Description: Quantities for maintenance of monitoring wells.

Monitoring Well Maintenance	
Number of wells requiring maintenance, EA:	47
Estimated time to complete well head repairs per well, HR	1
Estimated time to develop well, HR:	1
Total time per well, HR:	2
Total time for all wells, HR:	94
Estimated length of work day, HR:	10
Locking J-Plug, EA:	47
8" Vault, EA:	47
Geologist, HR:	94
Pickup Truck Rental, DY:	10
Fuel for Rental Truck, DY:	10
Per diem, DY:	10

US EPA ARCHIVE DOCUMENT

CDM

PROJECT:	Garvey Elevator Site	COMPUTED BY :	JN	CHECKED BY:	MS
JOB NO.:	51029-68208	DATE :	12/27/2011	DATE CHECKED:	12/30/2011
CLIENT:	USEPA Region 7			WRKSHT NO. :	C-04

Description: Quantities for abandonment of monitoring wells. Assumes all monitoring wells will be abandoned when site is closed.

Well Abandonment

Number of Shallow Monitoring Wells:	23	Number of Deep Monitoring Wells:	16
Well diameter, IN:	2	Well diameter, IN:	2
Shallow Monitoring Well Depth, VLF:	125	Shallow Monitoring Well Depth, VLF:	200
Estimated time to abandon shallow well, HR:	5	Estimated time to abandon shallow well, HR:	8
Number of Middle Monitoring Wells:	8		
Well diameter, IN:	2		
Middle Monitoring Well Depth, VLF:	150		
Estimated time to abandon middle well, HR:	6		
Estimated length of work day, HR:	10		

Shallow Well Quantities		Middle Well Quantities		Deep Well Quantities	
Geologist, HR:	115	Geologist, HR:	48	Geologist, HR:	128
Geologist, DY:	12	Geologist, DY:	5	Geologist, DY:	13
Abandonment, VLF:	2,875	Abandonment, VLF:	1,200	Abandonment, VLF:	3,200
Cement-grout, CF:	63	Cement-grout, CF:	27	Cement-grout, CF:	70

Total

Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	7,275
Cement-grout, CF:	160
Geologist, HR:	291
Pickup Truck Rental, DY:	30
Fuel for Rental Truck, DY:	30
Per diem, DY:	30

US EPA ARCHIVE DOCUMENT

CALCULATION WORKSHEET INDEX - ALTERNATIVE SG2

Wrksht No.	Description
C-01	Calculations for determination of quantities for preparing groundwater monitoring reports
C-02	Calculations for determination of quantities for groundwater monitoring per sampling event
C-03	Calculations for determination of quantities for abandonment of monitoring wells
C-04	Calculations for determination of quantities for maintenance of monitoring wells
C-05	Quantities for O&M of groundwater extraction treatment systems

Description: Calculations for determination of quantities for preparing groundwater monitoring reports.

Monitoring Report Generation

Assumed CAD hours per well, HR:	1.25	
Assumed Geologist hours per well, HR:	4	*Includes data review and tabulation, report, figures, etc.*
Number of wells:	47	
Project Manager, HR:	8	
CAD Drafter, HR:	59	
Geologist, HR:	188	
Quality Assurance Director, HR:	4	
Clerks, Typist, Bookkeeper & Receptionist, HR:	10	
Reproduction, LS:	1	

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for monitoring per sampling event.

Groundwater Monitoring		
No. of monitoring wells to be sampled for general analysis	**47**	
Analytical Requirements		
Samples, including VOCs, EA:	55	*Includes QC samples*
Sampling Equipment		
Water Quality Meter and Flow Through Cell, WK:	3	*Rounded up to nearest week*
Photoionization Detector (PID), WK:	3	*Rounded up to nearest week*
Water Level Meter, WK:	3	*Rounded up to nearest week*
Turbidimeter, WK:	3	*Rounded up to nearest week*
Portable Bladder Pump, WK:	3	*Rounded up to nearest week*
Replacement Poly Bladders, EA:	49	*Assumes 2 extra bladders*
Bladder Pump Controller, WK:	3	*Rounded up to nearest week*
Compressed Nitrogen Gas Rental, WK:	3	*Rounded up to nearest week*
Combination Tubing, LF:	4,700	*Assume 100 feet per well. Rounded up to nearest 100.*
Shipping Rental Equipment, EA:	**2**	
55-gallon Open Head Steel Drum, EA:	**7**	*Assume 500 mL per minute for 60 minutes per well*
Miscellaneous Sampling Equipment, LS:	**1**	
Labor Requirements		
Assumed length of time per day, HR:	**8**	
Time assumed to sample a well, HR:	**1**	*Includes setup, purging, and sample collection*
Number of sampling team members:	**2**	
Prepartory time, HR:	8	
Time to collect water level measurements, HR:	12	*Assume 15 minutes per well. Rounded up to nearest hour*
Time to sample all wells for general analysis, HR:	47	*Rounded up to nearest hour*
Time for decon, HR:	16	*Assume 20 minutes per well. Rounded up to nearest hour*
Time for sample management, HR:	12	*Assume 15 minutes per well. Rounded up to nearest hour*
Total, HR:	**95**	
Time to sample all wells for general analysis, DY:	**12**	*Rounded up to nearest day*
Project Manager, HR:	4	*5 minutes per sample, rounded up to nearest hour*
General Operator/Technician, HR:	190	*Two member team*
Contracting/Procurement Specialist, HR:	8	*10 minutes per sample, rounded up to nearest hour*
Pickup Truck Rental, DY:	12	*Rounded up to nearest week*
Fuel for Pickup Truck, DY:	12	

US EPA ARCHIVE DOCUMENT

Description: Quantities for abandonment of monitoring wells. Assumes all monitoring wells will be abandoned when site is closed.

Well Abandonment

Number of Shallow Monitoring Wells:	23	Number of Deep Monitoring Wells:	16
Well diameter, IN:	2	Well diameter, IN:	2
Shallow Monitoring Well Depth, VLF:	125	Deep Monitoring Well Depth, VLF:	200
Estimated time to abandon shallow well, HR:	5	Estimated time to abandon deep well, HR:	8
Number of Middle Monitoring Wells:	8		
Well diameter, IN:	2		
Middle Monitoring Well Depth, VLF:	150		
Estimated time to abandon middle well, HR:	6		
Estimated length of work day, HR:	10		

Shallow Well Quantities		Middle Well Quantities		Deep Well Quantities	
Geologist, HR:	115	Geologist, HR:	48	Geologist, HR:	128
Geologist, DY:	12	Geologist, DY:	5	Geologist, DY:	13
Abandonment, VLF:	2,875	Abandonment, VLF:	1,200	Abandonment, VLF:	3,200
Cement-grout, CF:	63	Cement-grout, CF:	27	Cement-grout, CF:	70

Total

Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	7,275
Cement-grout, CF:	160
Geologist, HR:	291
Pickup Truck Rental, DY:	30
Fuel for Rental Truck, DY:	30
Per diem, DY:	30

US EPA ARCHIVE DOCUMENT

Description: Quantities for maintenance of monitoring wells. Assumes all monitoring wells will require replacement of vault and development.

Monitoring Well Maintenance

Number of wells requiring maintenance, EA:	47
Estimated time to complete well head repairs per well, HR	1
Estimated time to develop well, HR:	1
Total time per well, HR:	2
Total time for all wells, HR:	94
Estimated length of work day, HR:	10
Locking J-Plug, EA:	47
8" Vault, EA:	47
Geologist, HR:	94
Pickup Truck Rental, DY:	10
Fuel for Rental Truck, DY:	10

US EPA ARCHIVE DOCUMENT

Description: Quantities for O&M of groundwater extraction treatment system.

Electrical Consumption by Treatment System

Energy equivalent, HP-HR to kW-HR:	0.746	
Assumed pump efficiency, %:	50%	
Number of hours per year, HR:	8,760	*Assumes 24/7 operation*
Number of shallow submersible pumps, EA:	5	
HP for shallow submersible pumps, HP:	5	
Shallow submersible pumps, HP-HR:	219,000	
Equivalent electrical consumption, kW-HR:	326,800	*Assumes motor efficiency, rounded up to nearest hundred*
Number of medial submersible pumps, EA:	3	
HP for medial submersible pumps, HP:	10	
Medial submersible pumps, HP-HR:	262,800	
Equivalent electrical consumption, kW-HR:	392,100	*Assumes motor efficiency, rounded up to nearest hundred*
Assumed equivalent HP for remaining treatment system, HP:	17	
Remaining system, HP-HR:	148,920	
Equivalent electrical consumption, kW-HR:	222,200	*Assumes motor efficiency, rounded up to nearest hundred*
Estimated total electrical consumption, KW-HR:	**941,100**	

Treatment System Operation and Maintenance

Number of site visits per year, EA:	52	
Number of hours per visit, HR:	5	*Includes travel to and from site.*
Total number of hours, HR:	260	

US EPA ARCHIVE DOCUMENT

CALCULATION WORKSHEET INDEX - ALTERNATIVE SG3

Wrksht No.	Description
C-01	Calculations for determination of quantities for preparing groundwater monitoring reports
C-02	Calculations for determination of quantities for groundwater monitoring per sampling event
C-03	Calculations for determination of quantities for abandonment of monitoring and injection wells
C-04	Calculations for determination of quantities for maintenance of monitoring wells
C-05	Quantities for equipment for injection
C-06	Calculations for determination of quantities for pilot-test monitoring event
C-07	Quantities for EOS injection at Pilot Test
C-08	Calculations for determination of quantities for bioaugmentation
C-09	Quantities for EOS injection at Area 1

Description: Calculations for determination of quantities for preparing groundwater monitoring reports.

Monitoring Report Generation

Assumed CAD hours per well, HR:	1.25	
Assumed Geologist hours per well, HR:	4	*Includes data review and tabulation, report, figures, etc.*
Number of wells:	47	
Project Manager, HR:	8	
CAD Drafter, HR:	59	
Geologist, HR:	188	
Quality Assurance Director, HR:	4	
Clerks, Typist, Bookkeeper & Receptionist, HR:	10	
Reproduction, LS:	1	

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for monitoring per sampling event.

Groundwater Monitoring		
No. of monitoring wells to be sampled for general analysis	**47**	
Analytical Requirements		
Samples, including VOCs, EA:	55	*Includes QC samples*
Metals, Dissolved, EPA Method 6010, Field Filtered, EA:	55	
Nitrate/Nitrite (NO3/NO2), EA:	55	
Sulfate, EPA MCAWW, 300, Field Filtered, EA:	55	
Sulfide, SM 4500S2 E, EA:	55	
Total Iron (Fe), EA:	2	*25 per kit, rounded up to nearest kit*
Total Manganese (Mn), EA:	55	
Chloride, EPA MCAWW, 300, Field Filtered, EA:	55	
Alkalinity, EPA MCAWW, 310.1, Field Filtered, EA:	55	
Dissolved Total Organic Carbon (TOC), EA:	55	
Carbon Dioxide (CO2), EA:	55	
Volatile Fatty Acids (VFAs), EA:	55	
Methane/Ethane/Ethene, EA:	55	
Dissolved Oxygen, Colormetic Test Kits, 0 to 1 ppm, EA:	2	*30 per kit, rounded up to nearest kit*
Dissolved Oxygen, Colormetic Test Kits, 1 to 12 ppm, EA:	2	*30 per kit, rounded up to nearest kit*
Field Filter, 0.45 micron filter, EA:	55	
Sampling Equipment		
Water Quality Meter and Flow Through Cell, WK:	3	*Rounded up to nearest week*
Photoionization Detector (PID), WK:	3	*Rounded up to nearest week*
Water Level Meter, WK:	3	*Rounded up to nearest week*
Turbidimeter, WK:	3	*Rounded up to nearest week*
Portable Bladder Pump, WK:	3	*Rounded up to nearest week*
Replacement Poly Bladders, EA:	49	*Assumes 2 extra bladders*
Bladder Pump Controller, WK:	3	*Rounded up to nearest week*
Compressed Nitrogen Gas Rental, WK:	3	*Rounded up to nearest week*
Combination Tubing, LF:	4,700	*Assume 100 feet per well. Rounded up to nearest 100.*
Shipping Rental Equipment, EA:	**2**	
55-gallon Open Head Steel Drum, EA:	**7**	*Assume 500 mL per minute for 60 minutes per well*
Miscellaneous Sampling Equipment, LS:	**1**	
Labor Requirements		
Assumed length of time per day, HR:	**8**	
Time assumed to sample a well, HR:	**1**	*Includes setup, purging, and sample collection*
Number of sampling team members:	**2**	
Prepartory time, HR:	8	
Time to collect water level measurements, HR:	12	*Assume 15 minutes per well. Rounded up to nearest hour*
Time to sample all wells for general analysis, HR:	47	*Rounded up to nearest hour*
Time for decon, HR:	16	*Assume 20 minutes per well. Rounded up to nearest hour*
Time for sample management, HR:	12	*Assume 15 minutes per well. Rounded up to nearest hour*
Total, HR:	**95**	
Time to sample all wells for general analysis, DY:	**12**	*Rounded up to nearest day*
Project Manager, HR:	4	*5 minutes per sample, rounded up to nearest hour*
General Operator/Technician, HR:	190	*Two member team*
Contracting/Procurement Specialist, HR:	8	*10 minutes per sample, rounded up to nearest hour*
Pickup Truck Rental, DY:	12	*Rounded up to nearest week*
Fuel for Pickup Truck, DY:	12	

US EPA ARCHIVE DOCUMENT

Description: Quantities for abandonment of monitoring and injection wells. Assumes all monitoring and injection wells will be abandoned when site is closed.

Well Abandonment

Number of Shallow Monitoring Wells:	23	Number of Deep Monitoring Wells:	16
Well diameter, IN:	2	Well diameter, IN:	2
Shallow Monitoring Well Depth, VLF:	125	Deep Monitoring Well Depth, VLF:	200
Estimated time to abandon shallow well, HR:	5	Estimated time to abandon deep well, HR:	8
Number of Middle Monitoring Wells:	8		
Well diameter, IN:	2		
Middle Monitoring Well Depth, VLF:	150		
Estimated time to abandon middle well, HR:	6		
Estimated length of work day, HR:	10		

Shallow Well Quantities		Middle Well Quantities		Deep Well Quantities	
Geologist, HR:	115	Geologist, HR:	48	Geologist, HR:	128
Geologist, DY:	12	Geologist, DY:	5	Geologist, DY:	13
Abandonment, VLF:	2,875	Abandonment, VLF:	1,200	Abandonment, VLF:	3,200
Cement-grout, CF:	63	Cement-grout, CF:	27	Cement-grout, CF:	70

Total Monitoring Well Quantities	
Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	7,275
Cement-grout, CF:	160
Geologist, HR:	291
Pickup Truck Rental, DY:	30
Fuel for Rental Truck, DY:	30
Per diem, DY:	30

US EPA ARCHIVE DOCUMENT

Description: Quantities for maintenance of monitoring wells. Assumes all monitoring wells will require replacement of vault and development.

Monitoring Well Maintenance

Number of wells requiring maintenance, EA:	47
Estimated time to complete well head repairs per well, HR	1
Estimated time to develop well, HR:	1
Total time per well, HR:	2
Total time for all wells, HR:	94
Estimated length of work day, HR:	10
Locking J-Plug, EA:	47
8" Vault, EA:	47
Geologist, HR:	94
Pickup Truck Rental, DY:	10
Fuel for Rental Truck, DY:	10

US EPA ARCHIVE DOCUMENT

Description: Quantities for equipment for injection.

Injection Equipment	
Plastic Tank - 5,000 gallon, EA:	2
Mechanical Mixer, EA:	2
Transfer Pump, EA:	2
Pressure Gauge - Injection Point, EA:	1
Pressure Gauge - Water to Frac Tank, EA:	1
2" Ball Valve, EA:	2
2" Steel Piping, LF:	20
2" Tee, EA:	4
2" Elbow, EA:	2
2" Female Camlock, EA:	5
2" Male Camlock, EA:	5
Hose, LF:	1,000
Health and Safety Allowance, EA:	1

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for monitoring per sampling event.

Pilot Test Monitoring Event		
No. of monitoring wells to be sampled for MNA analysis:	**25**	
Analytical Requirements		
VOCs, EPA Method SW-846 8260, EA:	30	*Includes QC samples*
Metals, Dissolved, EPA Method 6010, Field Filtered, EA:	30	
Nitrate/Nitrite (NO3/NO2), EA:	30	
Sulfate, EPA MCAWW, 300, Field Filtered, EA:	30	
Sulfide, SM 4500S2 E, EA:	30	
Total Iron (Fe), EA:	1	*25 per kit, rounded up to nearest kit*
Total Manganese (Mn), EA:	30	
Chloride, EPA MCAWW, 300, Field Filtered, EA:	30	
Alkalinity, EPA MCAWW, 310.1, Field Filtered, EA:	30	
Dissolved Total Organic Carbon (TOC), EA:	30	
Carbon Dioxide (CO2), EA:	30	
Volatile Fatty Acids (VFAs), EA:	30	
Methane/Ethane/Ethene, EA:	30	
Microbiological DNA Analysis, EA:	30	
Dissolved Oxygen, Colormetic Test Kits, 0 to 1 ppm, EA:	1	*30 per kit, rounded up to nearest kit*
Dissolved Oxygen, Colormetic Test Kits, 1 to 12 ppm, EA:	1	*30 per kit, rounded up to nearest kit*
Field Filter, 0.45 micron filter, EA:	30	
Sampling Equipment		
Water Quality Meter and Flow Through Cell, WK:	2	*Rounded up to nearest week*
Photoionization Detector (PID), WK:	2	*Rounded up to nearest week*
Water Level Meter, WK:	2	*Rounded up to nearest week*
Turbidimeter, WK:	2	*Rounded up to nearest week*
Portable Bladder Pump, WK:	2	*Rounded up to nearest week*
Replacement Poly Bladders, EA:	27	*Assumes 2 extra bladders*
Bladder Pump Controller, WK:	2	*Rounded up to nearest week*
Compressed Nitrogen Gas Rental, WK:	2	*Rounded up to nearest week*
Combination Tubing, LF:	2,500	*Assume 100 feet per well. Rounded up to nearest 100*
Shipping Rental Equipment, EA:	**2**	
55-gallon Open Head Steel Drum, EA:	**4**	*Assume 500 mL per minute for 60 minutes per well*
Miscellaneous Sampling Equipment, LS:	**1**	
Labor Requirements		
Assumed length of time per day, HR:	**8**	
Time assumed to sample a well, HR:	**1**	*Includes setup, purging, and sample collection*
Number of sampling team members:	**2**	
Prepartory time, HR:	8	
Time to collect water level measurements, HR:	7	*Assume 15 minutes per well. Rounded up to nearest hour*
Time to sample all wells for general analysis, HR:	25	*Rounded up to nearest hour*
Time for decon, HR:	9	*Assume 20 minutes per well. Rounded up to nearest hour*
Time for sample management, HR:	7	*Assume 15 minutes per well. Rounded up to nearest hour*
Total, HR:	**56**	
Time to sample all wells for general analysis, DY:	**7**	*Rounded up to nearest day*
Project Manager, HR:	3	*5 minutes per sample, rounded up to nearest hour*
General Operator/Technician, HR:	112	*Two member team*
Contracting/Procurement Specialist, HR:	5	*10 minutes per sample, rounded up to nearest hour*
Pickup Truck Rental, DY:	7	
Fuel for Pickup Truck, DY:	7	

US EPA ARCHIVE DOCUMENT

Description: Determine an estimated mass and volume of EOS for injection into the contaminated portion of the groundwater plume. Calculation is per injection round. Highlighted cells are user input fields.

Calculation for EOS - Pilot Test

Assumptions

Estimated top of groundwater table, ft bgs:	120	
Estimated bottom of treatment of area, ft bgs:	135	
Saturated thickness, ft:	15	
Injection point spacing, ft:	15	
Assumed ROI, ft:	7.5	
Number of Injection Points:	15	
Effective porosity (normal):	0.32	*Average of sample results*
Effective porosity (injection):	0.10	

Determination of EOS Parameters Based on Volume of Ideal Cylinder

Assumed ROI, ft:	7.5	
Saturated thickness, ft:	15	
Ideal volume of per injection, ft^3:	266	*ROI squared x π x sat thick x effective porosity*
Volume of solution per injection point, gal:	1,990	
Concentration of EOS Solution Desired, %:	4	
Standard Concentration of EOS 598 Solution, %:	59.8	
Dilution Factor:	15	
Volume of EOS 598 per injection point, gal:	133	

Determination of Preferred EOS Parameters

Volume of EOS 598 per injection point, gal:	133	
Volume of solution per injection point, gal:	1,990	
Volume of EOS 598 per injection event for area, gal:	1,997	
Volume of water per injection event for area, kgal:	28	
Volume of solution per injection event for area, gal:	29,850	
Estimated number of points per day, EA:	4	
Number of hours per work day, HR:	10	
Number of injection days, DY:	4	
DPT Crew & Rig, DY:	4	
DPT Crew Per Diem, DY:	8	*Two Member team*
Truck Rental, DY:	4	
Fuel for Pickup Truck, DY:	4	
Estimated project management time per hour, HR/HR:	0.1	
Project Manager, HR:	4	
Geologist, HR:	40	
Per Diem, DY:	4	
Truck Rental, DY:	4	
Fuel for Pickup Truck, DY:	4	

US EPA ARCHIVE DOCUMENT

Description: Determine an estimated mass and volume of EOS for injection into the contaminated portion of the groundwater plume. Calculation is per injection round. Highlighted cells are user input fields.

Determination of Alternative Injection Materials

ISCO Quantities		
Concentration of Persulfate Solution Desired*, %:	4	
Pounds Persulfate per gallon (calculated), lbs/gal:	0.3356	
Volume of solution per injection point, gal:	1,990	
Mass of Persulfate per injection point, lbs:	668	*Assume 4 moles of NaOH per 1 mole of persulfate*
Mass of NaOH Activator Solution per injection point, lbs:	449	*Activator solution is 25% NaOH*
Volume of solution per injection event for area, gal:	29,850	
Volume of solution per injection event for area, kgal:	30	
Mass of Persulfate per event, lbs:	10,018	
Mass of NaOH per event, lbs:	6,734	
ISCR Quantities		
Concentration of Reductant Solution Desired*, %:	4	
Pounds Reductant per gallon (calculated), lbs/gal:	0.3356	
Volume of solution per injection point, gal:	1,990	
Mass of Reductant per injection point, lbs:	668	
Volume of solution per injection event for area, gal:	29,850	
Volume of solution per injection event for area, kgal:	30	
Mass of Reductant per event, lbs:	10,018	

US EPA ARCHIVE DOCUMENT

Description: Quantities for bioaugmentation.

Bioaugmentation		
Number of biobarrier wells for bioaugmentation, EA:	10	*Assume 10 injection points at source area*
Liters of bioaugmentation solution per well, L:	35	
Estimated number of wells per day, EA/DY:	5	
Estimated workday length, HR/DY:	10	
Estimated workweek length, DY/WK:	5	
Number of technicians per event, EA:	2	
Total bioaugmentation solution, L:	350	
Number of days for bioaugmentation, DY:	2	*Rounded up to the nearest whole number*
Project Manager, HR:	2	*Rounded up to the nearest whole number*
Operator/Tech, HR:	40	
Geologist, HR:	20	
Per Diem, DY:	6	
Pickup Truck Rental, DY:	4	
Fuel for Rental Truck, DY:	4	

US EPA ARCHIVE DOCUMENT

Description: Determine an estimated mass and volume of EOS for injection into the contaminated portion of the groundwater plume. Calculation is per injection round. Highlighted cells are user input fields.

Calculation for EOS - Area 1

Assumptions		
Area of treatment area, ft^2:	59400	
Estimated top of groundwater table, ft bgs:	120	
Estimated bottom of treatment of area, ft bgs:	135	
Saturated thickness, ft:	15	
Injection point spacing, ft:	15	
Assumed ROI, ft:	7.5	
Number of Injection Points:	337	
Effective porosity (normal):	0.32	*Average of sample results*
Effective porosity (injection):	0.10	
Determination of EOS Parameters Based on Volume of Ideal Cylinder		
Assumed ROI, ft:	7.5	
Saturated thickness, ft:	15	
Ideal volume per injection point, ft^3:	266	*ROI squared x π x sat thick x effective porosity*
Volume of solution per injection point, gal:	1,990	
Concentration of EOS Solution Desired, %:	4	
Standard Concentration of EOS 598 Solution, %:	59.8	
Dilution Factor:	15	
Volume of EOS 598 per injection point, gal:	133	
Determination of Preferred EOS Parameters		
Volume of EOS 598 per injection point, gal:	133	
Volume of solution per injection point, gal:	1,990	
Volume of EOS 598 per injection event for area, gal:	44,859	
Volume of water per injection event for area, kgal:	626	
Volume of solution per injection event for area, gal:	670,630	
Estimated number of points per day, EA:	4	
Number of hours per work day, HR:	10	
Number of injection days, DY:	85	
DPT Crew & Rig, DY:	85	
DPT Crew Per Diem, DY:	170	*Two Member team*
Truck Rental, DY:	85	
Fuel for Pickup Truck, DY:	85	
Estimated project management time per hour, HR/HR:	0.1	
Project Manager, HR:	85	
Geologist, HR:	850	
Per Diem, DY:	85	
Truck Rental, DY:	85	
Fuel for Pickup Truck, DY:	85	

US EPA ARCHIVE DOCUMENT

Description: Determine an estimated mass and volume of EOS for injection into the contaminated portion of the groundwater plume. Calculation is per injection round. Highlighted cells are user input fields.

Determination of Alternative Injection Materials

ISCO Quantities		
Concentration of Persulfate Solution Desired*, %:	4	
Pounds Persulfate per gallon (calculated), lbs/gal:	0.3356	
Volume of solution per injection point, gal:	1,990	
Mass of Persulfate per injection point, lbs:	668	*Assume 4 moles of NaOH per 1 mole of persulfate*
Mass of NaOH Activator Solution per injection point, lbs:	449	*Activator solution is 25% NaOH*
Volume of solution per injection event for area, gal:	670,630	
Volume of solution per injection event for area, kgal:	671	
Mass of Persulfate per event, lbs:	225,063	
Mass of NaOH per event, lbs:	151,290	
ISCR Quantities		
Concentration of Reductant Solution Desired*, %:	4	
Pounds Reductant per gallon (calculated), lbs/gal:	0.3356	
Volume of solution per injection point, gal:	1,990	
Mass of Reductant per injection point, lbs:	668	
Volume of solution per injection event for area, gal:	670,630	
Volume of solution per injection event for area, kgal:	671	
Mass of Reductant per event, lbs:	225,063	

US EPA ARCHIVE DOCUMENT

CALCULATION WORKSHEET INDEX - ALTERNATIVE SG3

Wrksht No.	Description
C-01	Calculations for determination of quantities for preparing groundwater monitoring reports
C-02	Calculations for determination of quantities for groundwater monitoring per sampling event
C-03	Calculations for determination of quantities for abandonment of monitoring and injection wells
C-04	Calculations for determination of quantities for maintenance of monitoring wells
C-05	Quantities for equipment for injection
C-06	Calculations for determination of quantities for pilot-test monitoring event
C-07	Quantities for EOS injection at Pilot Test
C-08	Calculations for determination of quantities for bioaugmentation
C-09	Quantities for EOS injection at Area 1
C-10	Quantities for O&M of groundwater extraction treatment systems

Description: Calculations for determination of quantities for preparing groundwater monitoring reports.

Monitoring Report Generation

Assumed CAD hours per well, HR:	1.25	
Assumed Geologist hours per well, HR:	4	*Includes data review and tabulation, report, figures, etc.*
Number of wells:	47	
Project Manager, HR:	8	
CAD Drafter, HR:	59	
Geologist, HR:	188	
Quality Assurance Director, HR:	4	
Clerks, Typist, Bookkeeper & Receptionist, HR:	10	
Reproduction, LS:	1	

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for monitoring per sampling event.

Groundwater Monitoring		
No. of monitoring wells to be sampled for general analysis	**47**	
Analytical Requirements		
Samples, including VOCs, EA:	55	*Includes QC samples*
Metals, Dissolved, EPA Method 6010, Field Filtered, EA:	55	
Nitrate/Nitrite (NO3/NO2), EA:	55	
Sulfate, EPA MCAWW, 300, Field Filtered, EA:	55	
Sulfide, SM 4500S2 E, EA:	55	
Total Iron (Fe), EA:	2	*25 per kit, rounded up to nearest kit*
Total Manganese (Mn), EA:	55	
Chloride, EPA MCAWW, 300, Field Filtered, EA:	55	
Alkalinity, EPA MCAWW, 310.1, Field Filtered, EA:	55	
Dissolved Total Organic Carbon (TOC), EA:	55	
Carbon Dioxide (CO2), EA:	55	
Volatile Fatty Acids (VFAs), EA:	55	
Methane/Ethane/Ethene, EA:	55	
Dissolved Oxygen, Colormetic Test Kits, 0 to 1 ppm, EA:	2	*30 per kit, rounded up to nearest kit*
Dissolved Oxygen, Colormetic Test Kits, 1 to 12 ppm, EA:	2	*30 per kit, rounded up to nearest kit*
Field Filter, 0.45 micron filter, EA:	55	
Sampling Equipment		
Water Quality Meter and Flow Through Cell, WK:	3	*Rounded up to nearest week*
Photoionization Detector (PID), WK:	3	*Rounded up to nearest week*
Water Level Meter, WK:	3	*Rounded up to nearest week*
Turbidimeter, WK:	3	*Rounded up to nearest week*
Portable Bladder Pump, WK:	3	*Rounded up to nearest week*
Replacement Poly Bladders, EA:	49	*Assumes 2 extra bladders*
Bladder Pump Controller, WK:	3	*Rounded up to nearest week*
Compressed Nitrogen Gas Rental, WK:	3	*Rounded up to nearest week*
Combination Tubing, LF:	4,700	*Assume 100 feet per well. Rounded up to nearest 100.*
Shipping Rental Equipment, EA:	**2**	
55-gallon Open Head Steel Drum, EA:	**7**	*Assume 500 mL per minute for 60 minutes per well*
Miscellaneous Sampling Equipment, LS:	**1**	
Labor Requirements		
Assumed length of time per day, HR:	**8**	
Time assumed to sample a well, HR:	**1**	*Includes setup, purging, and sample collection*
Number of sampling team members:	**2**	
Prepartory time, HR:	8	
Time to collect water level measurements, HR:	12	*Assume 15 minutes per well. Rounded up to nearest hour*
Time to sample all wells for general analysis, HR:	47	*Rounded up to nearest hour*
Time for decon, HR:	16	*Assume 20 minutes per well. Rounded up to nearest hour*
Time for sample management, HR:	12	*Assume 15 minutes per well. Rounded up to nearest hour*
Total, HR:	**95**	
Time to sample all wells for general analysis, DY:	**12**	*Rounded up to nearest day*
Project Manager, HR:	4	*5 minutes per sample, rounded up to nearest hour*
General Operator/Technician, HR:	190	*Two member team*
Contracting/Procurement Specialist, HR:	8	*10 minutes per sample, rounded up to nearest hour*
Pickup Truck Rental, DY:	12	*Rounded up to nearest week*
Fuel for Pickup Truck, DY:	12	

US EPA ARCHIVE DOCUMENT

Description: Quantities for abandonment of monitoring and injection wells. Assumes all monitoring and injection wells will be abandoned when site is closed.

Well Abandonment

Number of Shallow Monitoring Wells:	23	Number of Deep Monitoring Wells:	16
Well diameter, IN:	2	Well diameter, IN:	2
Shallow Monitoring Well Depth, VLF:	125	Deep Monitoring Well Depth, VLF:	200
Estimated time to abandon shallow well, HR:	5	Estimated time to abandon deep well, HR:	8
Number of Middle Monitoring Wells:	8		
Well diameter, IN:	2		
Middle Monitoring Well Depth, VLF:	150		
Estimated time to abandon middle well, HR:	6		
Estimated length of work day, HR:	10		

Shallow Well Quantities		Middle Well Quantities		Deep Well Quantities	
Geologist, HR:	115	Geologist, HR:	48	Geologist, HR:	128
Geologist, DY:	12	Geologist, DY:	5	Geologist, DY:	13
Abandonment, VLF:	2,875	Abandonment, VLF:	1,200	Abandonment, VLF:	3,200
Cement-grout, CF:	63	Cement-grout, CF:	27	Cement-grout, CF:	70

Total Monitoring Well Quantities

Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	7,275
Cement-grout, CF:	160
Geologist, HR:	291
Pickup Truck Rental, DY:	30
Fuel for Rental Truck, DY:	30
Per diem, DY:	30

US EPA ARCHIVE DOCUMENT

Description: Quantities for maintenance of monitoring wells. Assumes all monitoring wells will require replacement of vault and development.

Monitoring Well Maintenance

Number of wells requiring maintenance, EA:	47
Estimated time to complete well head repairs per well, HR	1
Estimated time to develop well, HR:	1
Total time per well, HR:	2
Total time for all wells, HR:	94
Estimated length of work day, HR:	10
Locking J-Plug, EA:	47
8" Vault, EA:	47
Geologist, HR:	94
Pickup Truck Rental, DY:	10
Fuel for Rental Truck, DY:	10

US EPA ARCHIVE DOCUMENT

Description: Quantities for equipment for injection.

Injection Equipment	
Plastic Tank - 5,000 gallon, EA:	2
Mechanical Mixer, EA:	2
Transfer Pump, EA:	2
Pressure Gauge - Injection Point, EA:	1
Pressure Gauge - Water to Frac Tank, EA:	1
2" Ball Valve, EA:	2
2" Steel Piping, LF:	20
2" Tee, EA:	4
2" Elbow, EA:	2
2" Female Camlock, EA:	5
2" Male Camlock, EA:	5
Hose, LF:	1,000
Health and Safety Allowance, EA:	1

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for monitoring per sampling event.

Pilot Test Monitoring Event		
No. of monitoring wells to be sampled for MNA analysis:	**25**	
Analytical Requirements		
VOCs, EPA Method SW-846 8260, EA:	30	*Includes QC samples*
Metals, Dissolved, EPA Method 6010, Field Filtered, EA:	30	
Nitrate/Nitrite (NO3/NO2), EA:	30	
Sulfate, EPA MCAWW, 300, Field Filtered, EA:	30	
Sulfide, SM 4500S2 E, EA:	30	
Total Iron (Fe), EA:	1	*25 per kit, rounded up to nearest kit*
Total Manganese (Mn), EA:	30	
Chloride, EPA MCAWW, 300, Field Filtered, EA:	30	
Alkalinity, EPA MCAWW, 310.1, Field Filtered, EA:	30	
Dissolved Total Organic Carbon (TOC), EA:	30	
Carbon Dioxide (CO2), EA:	30	
Volatile Fatty Acids (VFAs), EA:	30	
Methane/Ethane/Ethene, EA:	30	
Microbiological DNA Analysis, EA:	30	
Dissolved Oxygen, Colormetic Test Kits, 0 to 1 ppm, EA:	1	*30 per kit, rounded up to nearest kit*
Dissolved Oxygen, Colormetic Test Kits, 1 to 12 ppm, EA:	1	*30 per kit, rounded up to nearest kit*
Field Filter, 0.45 micron filter, EA:	30	
Sampling Equipment		
Water Quality Meter and Flow Through Cell, WK:	2	*Rounded up to nearest week*
Photoionization Detector (PID), WK:	2	*Rounded up to nearest week*
Water Level Meter, WK:	2	*Rounded up to nearest week*
Turbidimeter, WK:	2	*Rounded up to nearest week*
Portable Bladder Pump, WK:	2	*Rounded up to nearest week*
Replacement Poly Bladders, EA:	27	*Assumes 2 extra bladders*
Bladder Pump Controller, WK:	2	*Rounded up to nearest week*
Compressed Nitrogen Gas Rental, WK:	2	*Rounded up to nearest week*
Combination Tubing, LF:	2,500	*Assume 100 feet per well. Rounded up to nearest 100*
Shipping Rental Equipment, EA:	**2**	
55-gallon Open Head Steel Drum, EA:	**4**	*Assume 500 mL per minute for 60 minutes per well*
Miscellaneous Sampling Equipment, LS:	**1**	
Labor Requirements		
Assumed length of time per day, HR:	**8**	
Time assumed to sample a well, HR:	**1**	*Includes setup, purging, and sample collection*
Number of sampling team members:	**2**	
Prepartory time, HR:	8	
Time to collect water level measurements, HR:	7	*Assume 15 minutes per well. Rounded up to nearest hour*
Time to sample all wells for general analysis, HR:	25	*Rounded up to nearest hour*
Time for decon, HR:	9	*Assume 20 minutes per well. Rounded up to nearest hour*
Time for sample management, HR:	7	*Assume 15 minutes per well. Rounded up to nearest hour*
Total, HR:	**56**	
Time to sample all wells for general analysis, DY:	**7**	*Rounded up to nearest day*
Project Manager, HR:	3	*5 minutes per sample, rounded up to nearest hour*
General Operator/Technician, HR:	112	*Two member team*
Contracting/Procurement Specialist, HR:	5	*10 minutes per sample, rounded up to nearest hour*
Pickup Truck Rental, DY:	7	
Fuel for Pickup Truck, DY:	7	

US EPA ARCHIVE DOCUMENT

Description: Determine an estimated mass and volume of EOS for injection into the contaminated portion of the groundwater plume. Calculation is per injection round. Highlighted cells are user input fields.

Calculation for EOS - Pilot Test

Assumptions

Estimated top of groundwater table, ft bgs:	120	
Estimated bottom of treatment of area, ft bgs:	135	
Saturated thickness, ft:	15	
Injection point spacing, ft:	15	
Assumed ROI, ft:	7.5	
Number of Injection Points:	15	
Effective porosity (normal):	0.32	*Average of sample results*
Effective porosity (injection):	0.10	

Determination of EOS Parameters Based on Volume of Ideal Cylinder

Assumed ROI, ft:	7.5	
Saturated thickness, ft:	15	
Ideal volume of per injection, ft^3:	266	*ROI squared x π x sat thick x effective porosity*
Volume of solution per injection point, gal:	1,990	
Concentration of EOS Solution Desired, %:	4	
Standard Concentration of EOS 598 Solution, %:	59.8	
Dilution Factor:	15	
Volume of EOS 598 per injection point, gal:	133	

Determination of Preferred EOS Parameters

Volume of EOS 598 per injection point, gal:	133	
Volume of solution per injection point, gal:	1,990	
Volume of EOS 598 per injection event for area, gal:	1,997	
Volume of water per injection event for area, kgal:	28	
Volume of solution per injection event for area, gal:	29,850	
Estimated number of points per day, EA:	4	
Number of hours per work day, HR:	10	
Number of injection days, DY:	4	
DPT Crew & Rig, DY:	4	
DPT Crew Per Diem, DY:	8	*Two Member team*
Truck Rental, DY:	4	
Fuel for Pickup Truck, DY:	4	
Estimated project management time per hour, HR/HR:	0.1	
Project Manager, HR:	4	
Geologist, HR:	40	
Per Diem, DY:	4	
Truck Rental, DY:	4	
Fuel for Pickup Truck, DY:	4	

US EPA ARCHIVE DOCUMENT

Description: Determine an estimated mass and volume of EOS for injection into the contaminated portion of the groundwater plume. Calculation is per injection round. Highlighted cells are user input fields.

Determination of Alternative Injection Materials		
ISCO Quantities		
Concentration of Persulfate Solution Desired*, %:	4	
Pounds Persulfate per gallon (calculated), lbs/gal:	0.3356	
Volume of solution per injection point, gal:	1,990	
Mass of Persulfate per injection point, lbs:	668	*Assume 4 moles of NaOH per 1 mole of persulfate*
Mass of NaOH Activator Solution per injection point, lbs:	449	*Activator solution is 25% NaOH*
Volume of solution per injection event for area, gal:	29,850	
Volume of solution per injection event for area, kgal:	30	
Mass of Persulfate per event, lbs:	10,018	
Mass of NaOH per event, lbs:	6,734	
ISCR Quantities		
Concentration of Reductant Solution Desired*, %:	4	
Pounds Reductant per gallon (calculated), lbs/gal:	0.3356	
Volume of solution per injection point, gal:	1,990	
Mass of Reductant per injection point, lbs:	668	
Volume of solution per injection event for area, gal:	29,850	
Volume of solution per injection event for area, kgal:	30	
Mass of Reductant per event, lbs:	10,018	

US EPA ARCHIVE DOCUMENT

Description: Quantities for bioaugmentation.

Bioaugmentation		
Number of biobarrier wells for bioaugmentation, EA:	10	*Assume 10 injection points at source area*
Liters of bioaugmentation solution per well, L:	35	
Estimated number of wells per day, EA/DY:	5	
Estimated workday length, HR/DY:	10	
Estimated workweek length, DY/WK:	5	
Number of technicians per event, EA:	2	
Total bioaugmentation solution, L:	350	
Number of days for bioaugmentation, DY:	2	*Rounded up to the nearest whole number*
Project Manager, HR:	2	*Rounded up to the nearest whole number*
Operator/Tech, HR:	40	
Geologist, HR:	20	
Per Diem, DY:	6	
Pickup Truck Rental, DY:	4	
Fuel for Rental Truck, DY:	4	

US EPA ARCHIVE DOCUMENT

Description: Determine an estimated mass and volume of EOS for injection into the contaminated portion of the groundwater plume. Calculation is per injection round. Highlighted cells are user input fields.

Calculation for EOS - Area 1

Assumptions		
Area of treatment area, ft^2:	59400	
Estimated top of groundwater table, ft bgs:	120	
Estimated bottom of treatment of area, ft bgs:	135	
Saturated thickness, ft:	15	
Injection point spacing, ft:	15	
Assumed ROI, ft:	7.5	
Number of Injection Points:	337	
Effective porosity (normal):	0.32	*Average of sample results*
Effective porosity (injection):	0.10	
Determination of EOS Parameters Based on Volume of Ideal Cylinder		
Assumed ROI, ft:	7.5	
Saturated thickness, ft:	15	
Ideal volume per injection point, ft^3:	266	*ROI squared x π x sat thick x effective porosity*
Volume of solution per injection point, gal:	1,990	
Concentration of EOS Solution Desired, %:	4	
Standard Concentration of EOS 598 Solution, %:	59.8	
Dilution Factor:	15	
Volume of EOS 598 per injection point, gal:	133	
Determination of Preferred EOS Parameters		
Volume of EOS 598 per injection point, gal:	133	
Volume of solution per injection point, gal:	1,990	
Volume of EOS 598 per injection event for area, gal:	44,859	
Volume of water per injection event for area, kgal:	626	
Volume of solution per injection event for area, gal:	670,630	
Estimated number of points per day, EA:	4	
Number of hours per work day, HR:	10	
Number of injection days, DY:	85	
DPT Crew & Rig, DY:	85	
DPT Crew Per Diem, DY:	170	*Two Member team*
Truck Rental, DY:	85	
Fuel for Pickup Truck, DY:	85	
Estimated project management time per hour, HR/HR:	0.1	
Project Manager, HR:	85	
Geologist, HR:	850	
Per Diem, DY:	85	
Truck Rental, DY:	85	
Fuel for Pickup Truck, DY:	85	

US EPA ARCHIVE DOCUMENT

Description: Determine an estimated mass and volume of EOS for injection into the contaminated portion of the groundwater plume. Calculation is per injection round. Highlighted cells are user input fields.

Determination of Alternative Injection Materials		
ISCO Quantities		
Concentration of Persulfate Solution Desired*, %:	4	
Pounds Persulfate per gallon (calculated), lbs/gal:	0.3356	
Volume of solution per injection point, gal:	1,990	
Mass of Persulfate per injection point, lbs:	668	*Assume 4 moles of NaOH per 1 mole of persulfate*
Mass of NaOH Activator Solution per injection point, lbs:	449	*Activator solution is 25% NaOH*
Volume of solution per injection event for area, gal:	670,630	
Volume of solution per injection event for area, kgal:	671	
Mass of Persulfate per event, lbs:	225,063	
Mass of NaOH per event, lbs:	151,290	
ISCR Quantities		
Concentration of Reductant Solution Desired*, %:	4	
Pounds Reductant per gallon (calculated), lbs/gal:	0.3356	
Volume of solution per injection point, gal:	1,990	
Mass of Reductant per injection point, lbs:	668	
Volume of solution per injection event for area, gal:	670,630	
Volume of solution per injection event for area, kgal:	671	
Mass of Reductant per event, lbs:	225,063	

US EPA ARCHIVE DOCUMENT

Description: Quantities for O&M of groundwater extraction treatment system.

Electrical Consumption by Treatment System		
Energy equivalent, HP-HR to kW-HR:	0.746	
Assumed pump efficiency, %:	50%	
Number of hours per year, HR:	8,760	*Assumes 24/7 operation*
Number of shallow submersible pumps, EA:	4	
HP for shallow submersible pumps, HP:	5	
Shallow submersible pumps, HP-HR:	175,200	
Equivalent electrical consumption, kW-HR:	261,400	*Assumes motor efficiency, rounded up to nearest hundred*
Number of medial submersible pumps, EA:	1	
HP for medial submersible pumps, HP:	10	
Medial submersible pumps, HP-HR:	87,600	
Equivalent electrical consumption, kW-HR:	130,700	*Assumes motor efficiency, rounded up to nearest hundred*
Assumed equivalent HP for remaining treatment system, HP:	17	
Remaining system, HP-HR:	148,920	
Equivalent electrical consumption, kW-HR:	222,200	*Assumes motor efficiency, rounded up to nearest hundred*
Estimated total electrical consumption, KW-HR:	**614,300**	
Treatment System Operation and Maintenance		
Number of site visits per year, EA:	52	
Number of hours per visit, HR:	5	*Includes travel to and from site.*
Total number of hours, HR:	260	

US EPA ARCHIVE DOCUMENT

CALCULATION WORKSHEET INDEX - ALTERNATIVE G1

Wrksht No.	Description
C-01	Calculations for determination of quantities for preparing groundwater monitoring reports
C-02	Calculations for determination of quantities for groundwater monitoring per sampling event
C-03	Calculations for determination of quantities for maintenance of monitoring wells
C-04	Calculations for determination of quantities for abandonment of monitoring wells

Description: Calculations for determination of quantities for preparing groundwater monitoring reports.

Groundwater Monitoring Report Generation

Assumed CAD hours per well, HR:	1.25	
Assumed Geologist hours per well, HR:	4	*Includes data review and tabulation, report, figures, etc.*
Number of wells:	27	
Project Manager, HR:	8	
CAD Drafter, HR:	34	
Geologist, HR:	108	
Quality Assurance Director, HR:	4	
Clerks, Typist, Bookkeeper & Receptionist, HR:	10	
Reproduction, LS:	1	

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for groundwater monitoring per sampling event.

Groundwater Monitoring		
No. of monitoring wells to be sampled for general analysis	**27**	
Analytical Requirements for General Analysis		
Samples, EA:	32	*Includes QC samples*
Sampling Equipment		
Water Quality Meter and Flow Through Cell, WK:	2	*Rounded up to nearest week*
Photoionization Detector (PID), WK:	2	*Rounded up to nearest week*
Water Level Meter, WK:	2	*Rounded up to nearest week*
Turbidimeter, WK:	2	*Rounded up to nearest week*
Portable Bladder Pump, WK:	2	*Rounded up to nearest week*
Replacement Poly Bladders, EA:	29	*Assumes 2 extra bladders*
Bladder Pump Controller, WK:	2	*Rounded up to nearest week*
Compressed Nitrogen Gas Rental, WK:	2	*Rounded up to nearest week*
Combination Tubing, LF:	2,700	*Assume 100 feet per well. Rounded up to nearest 100*
Shipping Rental Equipment, EA:	**2**	
55-gallon Open Head Steel Drum, EA:	**4**	*Assume 500 mL per minute for 60 minutes per well*
Miscellaneous Sampling Equipment, LS:	**1**	
Labor Requirements for General Analysis		
Assumed length of time per day, HR:	**8**	
Time assumed to sample a well, HR:	**1**	*Includes setup, purging, and sample collection*
Number of sampling team members:	**2**	
Prepartory time, HR:	**8**	
Time to collect water level measurements, HR:	7	*Assume 15 minutes per well. Rounded up to nearest hour*
Time to sample all wells for general analysis, HR:	27	*Rounded up to nearest hour*
Time for decon, HR:	9	*Assume 20 minutes per well. Rounded up to nearest hour*
Time for sample management, HR:	7	*Assume 15 minutes per well. Rounded up to nearest hour*
Total, HR:	**60**	*Rounded up to nearest 10 hours*
Time to sample all wells for general analysis, DY:	**8**	*Rounded up to nearest day*
Project Manager, HR:	3	*5 minutes per sample, rounded up to nearest hour*
General Operator/Technician, HR:	120	*Two member team*
Contracting/Procurement Specialist, HR:	5	*10 minutes per sample, rounded up to nearest hour*
Pickup Truck Rental, DY:	8	
Fuel for Pickup Truck, DY:	8	
Per diem, DY:	16	

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Description: Quantities for maintenance of monitoring wells.

Monitoring Well Maintenance	
Number of wells requiring maintenance, EA:	27
Estimated time to complete well head repairs per well, HR	1
Estimated time to develop well, HR:	1
Total time per well, HR:	2
Total time for all wells, HR:	54
Estimated length of work day, HR:	10
Locking J-Plug, EA:	27
8" Vault, EA:	27
Geologist, HR:	54
Pickup Truck Rental, DY:	6
Fuel for Rental Truck, DY:	6
Per diem, DY:	6

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Description: Quantities for abandonment of monitoring wells. Assumes all monitoring wells will be abandoned when site is closed.

Well Abandonment

Number of Shallow Monitoring Wells:	8	Number of Deep Monitoring Wells:	14
Well diameter, IN:	2	Well diameter, IN:	2
Shallow Monitoring Well Depth, VLF:	125	Deep Monitoring Well Depth, VLF:	200
Estimated time to abandon shallow well, HR:	5	Estimated time to abandon deep well, HR:	8
Number of Middle Monitoring Wells:	5		
Well diameter, IN:	2		
Middle Monitoring Well Depth, VLF:	150		
Estimated time to abandon middle well, HR:	6		
Estimated length of work day, HR:	10		

Shallow Well Quantities		Middle Well Quantities		Deep Well Quantities	
Geologist, HR:	40	Geologist, HR:	30	Geologist, HR:	112
Geologist, DY:	4	Geologist, DY:	3	Geologist, DY:	12
Abandonment, VLF:	1,000	Abandonment, VLF:	750	Abandonment, VLF:	2,800
Cement-grout, CF:	22	Cement-grout, CF:	17	Cement-grout, CF:	62

Total

Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	4,550
Cement-grout, CF:	101
Geologist, HR:	182
Pickup Truck Rental, DY:	19
Fuel for Rental Truck, DY:	19
Per diem, DY:	19

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CALCULATION WORKSHEET INDEX - ALTERNATIVE G2

Wrksht No.	Description
C-01	Calculations for determination of quantities for preparing groundwater monitoring reports
C-02	Calculations for determination of quantities for groundwater monitoring per sampling event
C-03	Calculations for determination of quantities for abandonment of monitoring wells
C-04	Calculations for determination of quantities for maintenance of monitoring wells
C-05	Calculations for determination of quantities for installation of monitoring wells
C-06	Quantities for O&M of groundwater extraction treatment systems
C-07	Quantities for installation and abandonment of recovery wells
C-08	Quantities for equipment for trenching for GET piping and installation of recovery and re-injection well vaults
C-09	Quantities for construction of treatment system building
C-10	Quantities for installation and abandonment of re-injection wells

Description: Calculations for determination of quantities for preparing groundwater monitoring reports.

Monitoring Report Generation

Assumed CAD hours per well, HR:	1.25	
Assumed Geologist hours per well, HR:	4	*Includes data review and tabulation, report, figures, etc.*
Number of wells:	57	
Project Manager, HR:	8	
CAD Drafter, HR:	72	
Geologist, HR:	228	
Quality Assurance Director, HR:	4	
Clerks, Typist, Bookkeeper & Receptionist, HR:	10	
Reproduction, LS:	1	

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Description: Calculations for determination of quantities for monitoring per sampling event.

Groundwater Monitoring		
No. of monitoring wells to be sampled for general analysis	**57**	
Analytical Requirements		
Samples, including VOCs, EA:	66	*Includes QC samples*
Sampling Equipment		
Water Quality Meter and Flow Through Cell, WK:	3	*Rounded up to nearest week*
Photoionization Detector (PID), WK:	3	*Rounded up to nearest week*
Water Level Meter, WK:	3	*Rounded up to nearest week*
Turbidimeter, WK:	3	*Rounded up to nearest week*
Portable Bladder Pump, WK:	3	*Rounded up to nearest week*
Replacement Poly Bladders, EA:	59	*Assumes 2 extra bladders*
Bladder Pump Controller, WK:	3	*Rounded up to nearest week*
Compressed Nitrogen Gas Rental, WK:	3	*Rounded up to nearest week*
Combination Tubing, LF:	5,700	*Assume 100 feet per well. Rounded up to nearest 100*
Shipping Rental Equipment, EA:	**2**	
55-gallon Open Head Steel Drum, EA:	**9**	*Assume 500 mL per minute for 60 minutes per well*
Miscellaneous Sampling Equipment, LS:	**1**	
Labor Requirements		
Assumed length of time per day, HR:	**8**	
Time assumed to sample a well, HR:	**1**	*Includes setup, purging, and sample collection*
Number of sampling team members:	**2**	
Prepartory time, HR:	8	
Time to collect water level measurements, HR:	15	*Assume 15 minutes per well. Rounded up to nearest hour*
Time to sample all wells for general analysis, HR:	57	*Rounded up to nearest hour*
Time for decon, HR:	19	*Assume 20 minutes per well. Rounded up to nearest hour*
Time for sample management, HR:	15	*Assume 15 minutes per well. Rounded up to nearest hour*
Total, HR:	**114**	
Time to sample all wells for general analysis, DY:	**15**	*Rounded up to nearest day*
Project Manager, HR:	5	*5 minutes per sample, rounded up to nearest hour*
General Operator/Technician, HR:	228	*Two member team*
Contracting/Procurement Specialist, HR:	10	*10 minutes per sample, rounded up to nearest hour*
Pickup Truck Rental, DY:	15	*Rounded up to nearest week*
Fuel for Pickup Truck, DY:	15	

US EPA ARCHIVE DOCUMENT

Description: Quantities for abandonment of monitoring wells. Assumes all monitoring wells will be abandoned when site is closed.

Well Abandonment

Number of Shallow Monitoring Wells:	18	Number of Deep Monitoring Wells:	24
Well diameter, IN:	2	Well diameter, IN:	2
Shallow Monitoring Well Depth, VLF:	125	Deep Monitoring Well Depth, VLF:	200
Estimated time to abandon shallow well, HR:	5	Estimated time to abandon deep well, HR:	8
Number of Middle Monitoring Wells:	15		
Well diameter, IN:	2		
Middle Monitoring Well Depth, VLF:	150		
Estimated time to abandon middle well, HR:	6		
Estimated length of work day, HR:	10		

Shallow Well Quantities		Middle Well Quantities		Deep Well Quantities	
Geologist, HR:	90	Geologist, HR:	90	Geologist, HR:	192
Geologist, DY:	9	Geologist, DY:	9	Geologist, DY:	20
Abandonment, VLF:	2,250	Abandonment, VLF:	2,250	Abandonment, VLF:	4,800
Cement-grout, CF:	50	Cement-grout, CF:	50	Cement-grout, CF:	105

Total

Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	9,300
Cement-grout, CF:	205
Geologist, HR:	372
Pickup Truck Rental, DY:	38
Fuel for Rental Truck, DY:	38
Per diem, DY:	38

US EPA ARCHIVE DOCUMENT

Description: Quantities for maintenance of monitoring wells. Assumes all monitoring wells will require replacement of vault and development.

Monitoring Well Maintenance

Number of wells requiring maintenance, EA:	57
Estimated time to complete well head repairs per well, HR	1
Estimated time to develop well, HR:	1
Total time per well, HR:	2
Total time for all wells, HR:	114
Estimated length of work day, HR:	10
Locking J-Plug, EA:	57
8" Vault, EA:	57
Geologist, HR:	114
Pickup Truck Rental, DY:	12
Fuel for Rental Truck, DY:	12

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Description: Quantities for installation of monitoring wells.

Monitoring Well Installation

		Top	Bottom
Number of Shallow Monitoring Wells:	10		
Shallow Monitoring Well Depth, VLF:	125	Top	Bottom
Screened Interval, FT:	10	115	125
Estimated time to install shallow monitoring well, HR	10		
Estimated time to develop shallow monitoring well, HR	4		
Number of Middle Monitoring Wells:	10		
Middle Monitoring Well Depth, VLF:	150	Top	Bottom
Screened Interval, FT:	10	140	150
Estimated time to install middle monitoring well, HR	12		
Estimated time to develop middle monitoring well, HR	4		
Number of Deep Monitoring Wells:	10		
Deep Monitoring Well Depth, VLF:	200	Top	Bottom
Screened Interval, FT:	10	190	200
Estimated time to install deep monitoring well, HR	16		
Estimated time to develop deep monitoring well, HR	4		

Shallow Monitoring Well Quantities		Middle Monitoring Well Quantities	
Hollow Stem Drilling, LF:	1,250	Hollow Stem Drilling, LF:	1,500
Well Screen - PVC Slotted, LF:	100	Well Screen - PVC Slotted, LF:	100
Gravel Pack, LF:	100	Gravel Pack, LF:	100
Bentonite Seal, LF:	20	Bentonite Seal, LF:	20
Well Grout, LF:	1,130	Well Grout, LF:	1,380
PVC Casing, LF:	1,150	PVC Casing, LF:	1,400
Pressure Transducer, EA:	10	Pressure Transducer, EA:	10
Pressure Transducer, LF:	1,150	Pressure Transducer, LF:	1,400
Bentonite Seal, CF:	2	Bentonite Seal, CF:	2
Well Grout, CF:	74	Well Grout, CF:	91
Monitoring Well Plug, EA:	10	Monitoring Well Plug, EA:	10
8" Vault, EA:	10	8" Vault, EA:	10
Hauling Drill Cuttings to Landfill, LCY:	4.9	Hauling Drill Cuttings to Landfill, LCY:	5.9
Drill Cuttings Disposal, TON:	8	Drill Cuttings Disposal, TON:	9
Roll Off Rental for Drill Cuttings, DY:	14	Roll Off Rental for Drill Cuttings, DY:	16
Well Development, HR:	40	Well Development, HR:	40
Geologist, HR:	100	Geologist, HR:	120
Pickup Truck Rental, DY:	14	Pickup Truck Rental, DY:	16
Fuel for Rental Truck, DY:	14	Fuel for Rental Truck, DY:	16

Deep Monitoring Well Quantities

Hollow Stem Drilling, LF:	2,000
Well Screen - PVC Slotted, LF:	100
Gravel Pack, LF:	100
Bentonite Seal, LF:	20
Well Grout, LF:	1,880
PVC Casing, LF:	1,900
Pressure Transducer, EA:	10
Pressure Transducer, LF:	1,900
Bentonite Seal, CF:	2
Well Grout, CF:	124
Monitoring Well Plug, EA:	10
8" Vault, EA:	10
Hauling Drill Cuttings to Landfill, LCY:	7.8
Drill Cuttings Disposal, TON:	12
Roll Off Rental for Drill Cuttings, DY:	20
Well Development, HR:	40
Geologist, HR:	160
Pickup Truck Rental, DY:	20
Fuel for Rental Truck, DY:	20

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Description: Quantities for installation of monitoring wells.

Total		
Hollow Stem Drilling, LF:	4,750	
Well Screen - PVC Slotted, LF:	300	
Gravel Pack, LF:	300	
PVC Casing, LF:	4,450	
Pressure Transducer, EA:	30	
Pressure Transducer, LF:	4,450	
Bentonite Seal, CF:	6	
Well Grout, CF:	289	
Monitoring Well Plug, EA:	30	
8" Vault, EA:	30	
Hauling Drill Cuttings to Landfill, LCY:	18.6	
Transportation of Drill Cuttings to Landfill, EA:	1	*Assume roll off capacity of 25 yd*
Drill Cuttings Disposal, TON:	29	
Roll Off Rental for Drill Cuttings, DY:	50	
Well Development, HR:	120	
Geologist, HR:	380	
Pickup Truck Rental, DY:	50	
Fuel for Rental Truck, DY:	50	

US EPA ARCHIVE DOCUMENT

Description: Quantities for O&M of groundwater extraction treatment systems

Electrical Consumption by Treatment System		
Energy equivalent, HP-HR to kW-HR:	0.746	
Assumed pump efficiency, %:	50%	
Number of hours per year, HR:	8,760	*Assumes 24/7 operation*
Number of medial submersible pumps, EA:	3	
HP for medial submersible pumps, HP:	5	
Medial submersible pumps, HP-HR:	131,400	
Equivalent electrical consumption, kW-HR:	196,100	*Assumes motor efficiency, rounded up to nearest hundred*
Number of deep submersible pumps, EA:	3	
HP for deep submersible pumps, HP:	25	
Deep submersible pumps, HP-HR:	657,000	
Equivalent electrical consumption, kW-HR:	440,300	*Assumes motor efficiency, rounded up to nearest hundred*
Assumed equivalent HP for remaining treatment system, HP:	17	
Remaining system, HP-HR:	148,920	
Equivalent electrical consumption, kW-HR:	222,200	*Assumes motor efficiency, rounded up to nearest hundred*
Estimated total electrical consumption, KW-HR:	**858,600**	
Treatment System Operation and Maintenance		
Number of site visits per year, EA:	52	
Number of hours per visit, HR:	5	*Includes travel to and from site.*
Total number of hours, HR:	260	

US EPA ARCHIVE DOCUMENT

Description: Quantities for installation and abandonment of recovery wells.

Recovery Well Installation			
Number of Medial Recovery Wells:	3	Number of Deep Recovery Wells:	3
Recovery Well Depth, VLF:	175	Recovery Well Depth, VLF:	210
Estimated time to install well, HR:	25	Estimated time to install well, HR:	30
Estimated time to develop well, HR:	8	Estimated time to develop well, HR:	8
Pump Rate per Well, GPM:	75	Pump Rate per Well, GPM:	200
Total Flow Rate, GPM:	225	Total Flow Rate, GPM:	600
Recovery Well Quantities			
Well casing, OD:	6.75	Well casing, OD:	6.75
Borehole diameter, OD:	13.75	Borehole diameter, OD:	13.75
Drilling – 8-inch nominal borehole, VLF:	175	Drilling – 8-inch nominal borehole, VLF:	210
Stainless Steel Screen - 6", VLF:	20	Stainless Steel Screen - 6", VLF:	20
Filter Pack, 6" Screen, VLF:	22	Filter Pack, 6" Screen, VLF:	22
Steel Casing, VLF:	155	Steel Casing, VLF:	190
Bentonite Seal, VLF:	2	Bentonite Seal, VLF:	2
Well Grout, VLF:	151	Well Grout, VLF:	186
Filter Pack, CF:	12	Filter Pack, CF:	12
Filter Pack, BCY:	1	Filter Pack, BCY:	1
Filter Pack, LCY:	2	Filter Pack, LCY:	2
Filter Pack, TON:	3	Filter Pack, TON:	3
Bentonite Seal, CF:	2	Bentonite Seal, CF:	2
Well Grout, CF:	89	Well Grout, CF:	110
Hauling Drill Cuttings to Landfill, LCY:	8.1	Hauling Drill Cuttings to Landfill, LCY:	9.7
Drill Cuttings Disposal, TON:	12.2	Drill Cuttings Disposal, TON:	14.6
Roll Off Rental for Drill Cuttings, DY:	4	Roll Off Rental for Drill Cuttings, DY:	4
Well Development, HR:	8	Well Development, HR:	8
Geologist oversight, HR:	25	Geologist oversight, HR:	30
Geologist mob and demob, HR:	10	Geologist mob and demob, HR:	10
Geologist, HR:	35	Geologist, HR:	40
Pickup Truck Rental, DY:	4	Pickup Truck Rental, DY:	4
Fuel for Rental Truck, DY:	4	Fuel for Rental Truck, DY:	4

Total Recovery Well Quantities		
Drilling – 8-inch nominal borehole, VLF:	1155	
Stainless Steel Screen - 6", VLF:	120	
Steel Casing, VLF:	1035	
Filter Pack, TON:	18	*Assumes 1.5 tons per CY*
Bentonite Seal, CF:	12	
Well Grout, CF:	597	
Hauling Drill Cuttings to Landfill, LCY:	53.4	
Transportation of Drill Cuttings to Landfill, EA:	3	
Drill Cuttings Disposal, TON:	80.4	
Roll Off Rental for Drill Cuttings, DY:	22	
Pressure Transducer Cable, LF:	1215	
Pressure Transducer, EA:	6	
Medial Submersible Pump, EA:	3	*Assumes 5 hp pump*
Deep Submersible Pump, EA:	3	*Assumes 25 hp pump*
Well Development, HR:	48	
Geologist oversight, HR:	165	
Geologist mobilization and demobilization, HR	10	
Geologist, HR:	175	
Pickup Truck Rental, DY:	22	
Fuel for Rental Truck, DY:	22	

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Description: Quantities for installation and abandonment of recovery wells.

Well Abandonment

Number of Medial Recovery Wells:	3	Number of Deep Recovery Wells:	3
Well diameter, IN:	6	Well diameter, IN:	6
Recovery Well Depth, VLF:	175	Recovery Well Depth, VLF:	210
Estimated time to abandon Recovery well, HR:	15	Estimated time to abandon Recovery well, HR:	15
Estimated length of work day, HR:	10	Estimated length of work day, HR:	10

Total Recovery Well Abandonment Quantities

Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	1155
Cement-grout, CF:	227
Geologist, HR:	90
Pickup Truck Rental, DY:	9
Fuel for Rental Truck, DY:	9
Per diem, DY:	9

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Description: Quantities for equipment for trenching for GET piping and installation of recovery and re-injection well vaults Well vaults are assumed to be below grade vaults. All well vault pipe materials are assumed to be Schedule 80 PVC.

Assumed Material Properties		
Soil Expansion Factor:	**1.2**	*Conversion from BCY to LCY*
Soil Compaction Factor:	**1.1**	*Conversion from BCY to ECY*
Soil Compaction Factor:	**0.9**	*Conversion from LCY to ECY*
BCY - bank cubic yard - in place volume prior to excavation		
LCY - loose cubic yards - volume after excavation		
ECY - embankment cubic yards (aka compacted cubic yards) - volume after compaction		
Concrete Expansion Factor:	1.30	*Conversion from BCY to LCY*
Density of base course gravel, TN/LCY:	1.50	
Density of concrete, TN/LCY:	1.89	
Density of soil, TN/LCY:	1.50	
Recovery & Re-Injection Well Piping Installation		
Trench width, FT:	4	
Trench depth, FT:	5	
Trenching in Unpaved Area, LF:	13,450	*Assume 4 ft trench depth*
Trenching in Paved Area, LF:	30	
Total length of pipe to install, LF:	13,480	
Concrete sawing, LF:	68	
Excavation, BCF:	215,200	
Excavation, BCY:	7,971	*Rounded up to nearest whole number*
Excavation, LCY:	9,566	*Rounded up to nearest whole number*
Excavation, ECY:	7,247	*Rounded up to nearest whole number*
Excavation, TON:	14,349	*Rounded up to nearest whole number*
Minimum Pipe Diameter, IN:	**7**	*Rounded up to nearest whole number*
Pipe Diameter, IN:	**8**	
O.D. of Pipe, IN:	8.5	
Volume of Pipe Installed, CF:	5,301	
Depth of Aggregate under pipe, IN:	6	
Depth of Aggregate over pipe, IN:	6	
Depth of Aggregate (including pipe), FT:	2.0	
Volume of Aggregate Required, BCF:	102,299	
Volume of Aggregate Required, BCY:	3,789	
Volume of Aggregate Required, LCY:	4,547	*Rounded up to nearest whole number*
Volume of Aggregate Required, ECY:	3,445	*Rounded up to nearest whole number*
Volume of Aggregate Required, TON:	6,821	*Assumes 1.5 tons per CY*
Volume of Aggregate Required, SF:	53,920	
Volume of Backfill, BCF:	107,600	
Volume of Backfill, BCY:	3,986	
Volume of Backfill, LCY:	4,784	*Rounded up to nearest whole number*
Volume of Backfill, ECY:	3,624	*Rounded up to nearest whole number*
6" wide, 4-mil Detectable Tape, LF:	13,450	
6" wide, 4-mil Detectable Tape, CLF:	135	*Rounded up to nearest whole number*
Piping, LF:	13,450	
Tee, EA:	10	
Elbow, 90 Deg., EA:	2	
Joints Welded, EA:	340	*Assume 40 foot pipe sections*
Welding, DY:	7	*Assume 50 joints welded per day*
Parking and alley pavement thickness, IN:	**6**	
Topsoil thickness, IN:	**6**	

US EPA ARCHIVE DOCUMENT

Description: Quantities for equipment for trenching for GET piping and installation of recovery and re-injection well vaults Well vaults are assumed to be below grade vaults. All well vault pipe materials are assumed to be Schedule 80 PVC.

Topsoil, CF:	60	
Topsoil, BCY:	3	*Rounded up to nearest whole number*
Topsoil, LCY:	4	*Rounded up to nearest whole number*
Topsoil, ECY:	4	*Rounded up to nearest whole number*
Topsoil, TON:	6	*Assumes 1.5 tons per CY*
Seeding Disturbed Area, SY:	5,992	
Area of pavement disturbed, SF:	120	
Area of pavement disturbed, SY:	14	*Rounded up to nearest whole number*
Volume of pavement, CF:	60	
Volume of pavement, BCY:	3	*Rounded up to nearest whole number*
Volume of pavement, LCY:	4	*Rounded up to nearest whole number*
Volume of pavement, TON:	6	*Assumes 1.5 tons per CY*
Pipe Jacking under Railroad Tracks, LF:	110	
Horizontal Boring, LF:	110	
Boring Diameter, IN:	24	
O.D. of Pipe, IN:	8.5	
Volume of Aggregate, CF:	303	*Bedding between boring and piping*
Volume of Aggregate Required, BCY:	12	*Rounded up to nearest whole number*
Volume of Aggregate Required, LCY:	15	*Rounded up to nearest whole number*
Volume of Aggregate Required, TON:	18	*Assumes 1.5 tons per CY*
Volume of Soil for Disposal, CF:	107,600	
Volume of Soil for Disposal, BCY:	3,986	*Rounded up to nearest whole number*
Volume of Soil for Disposal, LCY:	4,784	*Rounded up to nearest whole number*
Volume of Soil for Disposal, TON:	7,176	*Assumes 1.5 tons per CY*
Well Vault		
Number of Well Vaults, EA:	9	
Depth of vault, FT:	4	
Width of vault, FT:	4	
Length of vault, FT:	4	
Excavation, CF:	64	
Excavation, BCY:	3	*Rounded up to nearest whole number*
Excavation, LCY:	4	*Rounded up to nearest whole number*
Depth of Bedding Material, FT:	1	
Total Volume of Bedding Material Required, CF:	16	
Total Volume of Bedding Material Required, BCY:	1	*Rounded up to nearest whole number*
Total Volume of Bedding Material Required, LCY:	2	*Rounded up to nearest whole number*
Total Volume of Bedding Material Required, ECY:	2	*Rounded up to nearest whole number*
Total Volume of Bedding Material Required, TON:	3	*Assumes 1.5 tons per CY*
Area of Compaction, SF:	16	
Well vault, 6'x6'x4', EA:	1	
Well vault door, EA:	1	
Number of Elbow, 90 Deg Required, EA:	4	
Number of Tees Required, EA:	1	
Length of PVC piping, LF:	10	
Number of flanged fittings, EA:	8	
Number of check valves, EA:	1	
Number of butterfly valves, EA:	2	
Bolt pack, EA:	5	
Flow meter, EA:	1	

US EPA ARCHIVE DOCUMENT

Description: Quantities for equipment for trenching for GET piping and installation of recovery and re-injection well vaults Well vaults are assumed to be below grade vaults. All well vault pipe materials are assumed to be Schedule 80 PVC.

Total Well Vault Quantities		
Excavation, BCY:	27	*Rounded up to nearest whole number*
Total Volume of Bedding Material Required, CF:	144	
Total Volume of Bedding Material Required, TON:	27	*Assumes 1.5 tons per CY*
Area of Compaction, SF:	144	
Well vault, 6'x6'x4', EA:	9	
Well vault door, EA:	9	
Number of Elbow, 90 Deg Required, EA:	36	
Number of Tees Required, EA:	9	
Length of PVC piping, LF:	90	
Number of flanged fittings, EA:	72	
Number of check valves, EA:	9	
Number of butterfly valves, EA:	18	
Bolt pack, EA:	45	
Flow meter, EA:	9	
Insulation and metal jacket		
Pipe ID, IN:	8.0	
Pipe OD, IN:	8.5	
Pipe Insulation Thickness, IN:	2.5	
Overall diameter, IN:	13.5	
Pipe OD, FT:	1.13	
Circumference, FT:	3.5	
Area per unit, SF/FT:	3.5	

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Description: Quantities for construction of treatment system building

Treatment System Building

Estimated width of building, FT:	20	
Estimated length of building, FT:	30	
Estimated building height, FT:	14	
Building, SF:	600	
Perimeter, LF:	100	
Footing width, IN:	24	
Footing depth, IN:	12	
Footing, CF:	200	
Footing, CY:	8	*Rounded up to nearest whole number*
Excavation width, IN:	36	
Excavation depth, IN:	12	
Exacavation, CF:	300	
Exacavation, BCY:	12	*Rounded up to nearest whole number*
Exacavation, LCY:	15	*Rounded up to nearest whole number*
Exacavation, ECY:	11	*Rounded up to nearest whole number*
Exacavation, TON:	23	*Assumes 1.5 tons per CY*
Base course, IN:	6	
Base course, CF:	300	
Base course, BCY:	12	*Rounded up to nearest whole number*
Base course, LCY:	15	*Rounded up to nearest whole number*
Base course, ECY:	11	*Rounded up to nearest whole number*
Base course, TON:	23	*Assumes 1.5 tons per CY*
Rebar spacing, IN OC:	6	
Number of bars width, EA:	38	
Width length, FT:	19	
Number of bars length, EA:	58	
Bar length along length, FT/EA:	29	
Total length, FT:	2,404	
64 rebar unit weight, LBS/FT:	**1.502**	
Reinforcing steel, LBS:	3,611	
Reinforcing steel, TON:	1.8	
Forms, LF:	100	
Concrete slab thickness, IN:	6	
Concrete, CF:	300	
Concrete, CY:	12	*Rounded up to nearest whole number*
Insulation, SF:	1,400	

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Description: Quantities for installation and abandonment of re-injection wells

Re-injection Well Installation		
Number of Re-injection Wells:	3	
Re-injection Well Depth, VLF:	210	
Estimated time to install re-injection well, HR:	30	
Estimated time to develop re-injection well, HR:	8	
Re-injection Well Quantities		
Well casing, OD:	6.75	
Borehole diameter, OD:	13.75	
Drilling – 8-inch nominal borehole, VLF:	210	
Stainless Steel Screen - 6", VLF:	20	
Filter Pack, 6" Screen, VLF:	22	*Assumes 2 feet more than screen*
Steel Casing, VLF:	190	
Bentonite Seal, VLF:	2	
Well Grout, VLF:	186	
Filter Pack, CF:	12	
Filter Pack, BCY:	1	*Rounded up to nearest whole number*
Filter Pack, LCY:	2	*Rounded up to nearest whole number*
Filter Pack, TON:	3	*Assumes 1.5 tons per CY*
Bentonite Seal, CF:	2	
Well Grout, CF:	110	
Hauling Drill Cuttings to Landfill, LCY:	9.7	
Drill Cuttings Disposal, TON:	14.6	
Roll Off Rental for Drill Cuttings, DY:	30	
Well Development, HR:	8	
Geologist oversight, HR:	30	
Geologist mobilization and demobilization, HR	10	
Geologist, HR:	40	
Pickup Truck Rental, DY:	3	
Fuel for Rental Truck, DY:	3	
Total Re-injection Well Quantities		
Drilling – 8-inch nominal borehole, VLF:	630	
Stainless Steel Screen - 6", VLF:	60	
Steel Casing, VLF:	570	
Filter Pack, TON:	9	*Assumes 1.5 tons per CY*
Bentonite Seal, CF:	6	
Well Grout, CF:	330	
Hauling Drill Cuttings to Landfill, LCY:	29.1	
Transportation of Drill Cuttings to Landfill, EA:	2	
Drill Cuttings Disposal, TON:	43.8	
Roll Off Rental for Drill Cuttings, DY:	12	
Pressure Transducer, LF:	660	
Pressure Transducer, EA:	3	
Well Development, HR:	24	
Geologist oversight, HR:	90	
Geologist mobilization and demobilization, HR	10	
Geologist, HR:	100	
Pickup Truck Rental, DY:	12	
Fuel for Rental Truck, DY:	12	
Well Abandonment		

US EPA ARCHIVE DOCUMENT

CDM

PROJECT:	Garvey Elevator Site	COMPUTED BY :	JN	CHECKED BY:	MS
JOB NO.:	51029-68208	DATE :	12/27/2011	DATE CHECKED:	12/30/2011
CLIENT:	USEPA Region 7			WRKSHT NO. :	C-10

Description: Quantities for installation and abandonment of re-injection wells

Number of Re-injection Wells:	3
Well diameter, IN:	6
Re-injection Well Depth, VLF:	210
Estimated time to abandon re-injection well, HR:	15
Estimated length of work day, HR:	10
Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	630
Cement-grout, CF:	124
Geologist, HR:	45
Pickup Truck Rental, DY:	5
Fuel for Rental Truck, DY:	5
Per diem, DY:	5

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CALCULATION WORKSHEET INDEX - ALTERNATIVE G3

Wrksht No.	Description
C-01	Calculations for determination of quantities for preparing groundwater monitoring reports
C-02	Calculations for determination of quantities for groundwater monitoring per sampling event
C-03	Calculations for determination of quantities for abandonment of monitoring wells
C-04	Calculations for determination of quantities for maintenance of monitoring wells
C-05	Calculations for determination of quantities for installation of monitoring wells
C-06	Quantities for O&M of groundwater extraction treatment systems
C-07	Quantities for installation and abandonment of recovery wells
C-08	Quantities for equipment for trenching for GET piping and installation of recovery and re-injection well vaults
C-09	Quantities for construction of treatment system building
C-10	Quantities for installation and abandonment of re-injection wells

Description: Calculations for determination of quantities for preparing groundwater monitoring reports.

Monitoring Report Generation

Assumed CAD hours per well, HR:	1.25	
Assumed Geologist hours per well, HR:	4	*Includes data review and tabulation, report, figures, etc.*
Number of wells:	57	
Project Manager, HR:	8	
CAD Drafter, HR:	72	
Geologist, HR:	228	
Quality Assurance Director, HR:	4	
Clerks, Typist, Bookkeeper & Receptionist, HR:	10	
Reproduction, LS:	1	

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Description: Calculations for determination of quantities for monitoring per sampling event.

Groundwater Monitoring		
No. of monitoring wells to be sampled for general analysis	**57**	
Analytical Requirements		
Samples, including VOCs, EA:	66	*Includes QC samples*
Sampling Equipment		
Water Quality Meter and Flow Through Cell, WK:	3	*Rounded up to nearest week*
Photoionization Detector (PID), WK:	3	*Rounded up to nearest week*
Water Level Meter, WK:	3	*Rounded up to nearest week*
Turbidimeter, WK:	3	*Rounded up to nearest week*
Portable Bladder Pump, WK:	3	*Rounded up to nearest week*
Replacement Poly Bladders, EA:	59	*Assumes 2 extra bladders*
Bladder Pump Controller, WK:	3	*Rounded up to nearest week*
Compressed Nitrogen Gas Rental, WK:	3	*Rounded up to nearest week*
Combination Tubing, LF:	5700	*Assume 100 feet per well. Rounded up to nearest 100*
Shipping Rental Equipment, EA:	**2**	
55-gallon Open Head Steel Drum, EA:	**9**	*Assume 500 mL per minute for 60 minutes per well*
Miscellaneous Sampling Equipment, LS:	**1**	
Labor Requirements		
Assumed length of time per day, HR:	**8**	
Time assumed to sample a well, HR:	**1**	*Includes setup, purging, and sample collection*
Number of sampling team members:	**2**	
Prepartory time, HR:	8	
Time to collect water level measurements, HR:	15	*Assume 15 minutes per well. Rounded up to nearest hour*
Time to sample all wells for general analysis, HR:	57	*Rounded up to nearest hour*
Time for decon, HR:	19	*Assume 20 minutes per well. Rounded up to nearest hour*
Time for sample management, HR:	15	*Assume 15 minutes per well. Rounded up to nearest hour*
Total, HR:	**114**	
Time to sample all wells for general analysis, DY:	**15**	*Rounded up to nearest day*
Project Manager, HR:	5	*5 minutes per sample, rounded up to nearest hour*
General Operator/Technician, HR:	228	*Two member team*
Contracting/Procurement Specialist, HR:	10	*10 minutes per sample, rounded up to nearest hour*
Pickup Truck Rental, DY:	15	*Rounded up to nearest week*
Fuel for Pickup Truck, DY:	15	

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Description: Quantities for abandonment of monitoring wells. Assumes all monitoring wells will be abandoned when site is closed.

Well Abandonment

Number of Shallow Monitoring Wells:	18	Number of Deep Monitoring Wells:	24
Well diameter, IN:	2	Well diameter, IN:	2
Shallow Monitoring Well Depth, VLF:	125	Deep Monitoring Well Depth, VLF:	200
Estimated time to abandon shallow well, HR:	5	Estimated time to abandon deep well, HR:	8
Number of Middle Monitoring Wells:	15		
Well diameter, IN:	2		
Middle Monitoring Well Depth, VLF:	150		
Estimated time to abandon middle well, HR:	6		
Estimated length of work day, HR:	10		

Shallow Well Quantities		Middle Well Quantities		Deep Well Quantities	
Geologist, HR:	90	Geologist, HR:	90	Geologist, HR:	192
Geologist, DY:	9	Geologist, DY:	9	Geologist, DY:	20
Abandonment, VLF:	2250	Abandonment, VLF:	2250	Abandonment, VLF:	4800
Cement-grout, CF:	50	Cement-grout, CF:	50	Cement-grout, CF:	105

Total

Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	9300
Cement-grout, CF:	205
Geologist, HR:	372
Pickup Truck Rental, DY:	38
Fuel for Rental Truck, DY:	38
Per diem, DY:	38

US EPA ARCHIVE DOCUMENT

Description: Quantities for maintenance of monitoring wells. Assumes all monitoring wells will require replacement of vault and development.

Monitoring Well Maintenance

Number of wells requiring maintenance, EA:	57
Estimated time to complete well head repairs per well, HR	1
Estimated time to develop well, HR:	1
Total time per well, HR:	2
Total time for all wells, HR:	114
Estimated length of work day, HR:	10
Locking J-Plug, EA:	57
8" Vault, EA:	57
Geologist, HR:	114
Pickup Truck Rental, DY:	12
Fuel for Rental Truck, DY:	12

US EPA ARCHIVE DOCUMENT

Description: Quantities for installation of monitoring wells.

Monitoring Well Installation

		Top	Bottom
Number of Shallow Monitoring Wells:	10		
Shallow Monitoring Well Depth, VLF:	125	Top	Bottom
Screened Interval, FT:	10	115	125
Estimated time to install shallow monitoring well, HR	10		
Estimated time to develop shallow monitoring well, HR	4		
Number of Middle Monitoring Wells:	10		
Middle Monitoring Well Depth, VLF:	150	Top	Bottom
Screened Interval, FT:	10	140	150
Estimated time to install middle monitoring well, HR	12		
Estimated time to develop middle monitoring well, HR	4		
Number of Deep Monitoring Wells:	10		
Deep Monitoring Well Depth, VLF:	200	Top	Bottom
Screened Interval, FT:	10	190	200
Estimated time to install deep monitoring well, HR	16		
Estimated time to develop deep monitoring well, HR	4		

Shallow Monitoring Well Quantities		Middle Monitoring Well Quantities	
Hollow Stem Drilling, LF:	1,250	Hollow Stem Drilling, LF:	1,500
Well Screen - PVC Slotted, LF:	100	Well Screen - PVC Slotted, LF:	100
Gravel Pack, LF:	100	Gravel Pack, LF:	100
Bentonite Seal, LF:	20	Bentonite Seal, LF:	20
Well Grout, LF:	1,130	Well Grout, LF:	1,380
PVC Casing, LF:	1,150	PVC Casing, LF:	1,400
Pressure Transducer, EA:	10	Pressure Transducer, EA:	10
Pressure Transducer, LF:	1,150	Pressure Transducer, LF:	1,400
Bentonite Seal, CF:	2	Bentonite Seal, CF:	2
Well Grout, CF:	74	Well Grout, CF:	91
Monitoring Well Plug, EA:	10	Monitoring Well Plug, EA:	10
8" Vault, EA:	10	8" Vault, EA:	10
Hauling Drill Cuttings to Landfill, LCY:	4.9	Hauling Drill Cuttings to Landfill, LCY:	5.9
Drill Cuttings Disposal, TON:	8	Drill Cuttings Disposal, TON:	9
Roll Off Rental for Drill Cuttings, DY:	14	Roll Off Rental for Drill Cuttings, DY:	16
Well Development, HR:	40	Well Development, HR:	40
Geologist, HR:	100	Geologist, HR:	120
Pickup Truck Rental, DY:	14	Pickup Truck Rental, DY:	16
Fuel for Rental Truck, DY:	14	Fuel for Rental Truck, DY:	16

Deep Monitoring Well Quantities

Hollow Stem Drilling, LF:	2,000
Well Screen - PVC Slotted, LF:	100
Gravel Pack, LF:	100
Bentonite Seal, LF:	20
Well Grout, LF:	1,880
PVC Casing, LF:	1,900
Pressure Transducer, EA:	10
Pressure Transducer, LF:	1,900
Bentonite Seal, CF:	2
Well Grout, CF:	124
Monitoring Well Plug, EA:	10
8" Vault, EA:	10
Hauling Drill Cuttings to Landfill, LCY:	7.8
Drill Cuttings Disposal, TON:	12
Roll Off Rental for Drill Cuttings, DY:	20
Well Development, HR:	40
Geologist, HR:	160
Pickup Truck Rental, DY:	20
Fuel for Rental Truck, DY:	20

US EPA ARCHIVE DOCUMENT

Description: Quantities for installation of monitoring wells.

Total		
Hollow Stem Drilling, LF:	4,750	
Well Screen - PVC Slotted, LF:	300	
Gravel Pack, LF:	300	
PVC Casing, LF:	4,450	
Pressure Transducer, EA:	30	
Pressure Transducer, LF:	4,450	
Bentonite Seal, CF:	6	
Well Grout, CF:	289	
Monitoring Well Plug, EA:	30	
8" Vault, EA:	30	
Hauling Drill Cuttings to Landfill, LCY:	18.6	
Transportation of Drill Cuttings to Landfill, EA:	1	*Assume roll off capacity of 25 yd*
Drill Cuttings Disposal, TON:	29	
Roll Off Rental for Drill Cuttings, DY:	50	
Well Development, HR:	120	
Geologist, HR:	380	
Pickup Truck Rental, DY:	50	
Fuel for Rental Truck, DY:	50	

US EPA ARCHIVE DOCUMENT

Description: Quantities for O&M of groundwater extraction treatment systems.

Electrical Consumption by Treatment System		
Energy equivalent, HP-HR to kW-HR:	0.746	
Assumed pump efficiency, %:	50%	
Number of hours per year, HR:	8,760	*Assumes 24/7 operation*
Number of medial submersible pumps, EA:	6	
HP for medial submersible pumps, HP:	5	
Medial submersible pumps, HP-HR:	262,800	
Equivalent electrical consumption, kW-HR:	392,100	*Assumes motor efficiency, rounded up to nearest hundred*
Number of deep submersible pumps, EA:	6	
HP for deep submersible pumps, HP:	25	
Deep submersible pumps, HP-HR:	1,314,000	
Equivalent electrical consumption, kW-HR:	880,700	*Assumes motor efficiency, rounded up to nearest hundred*
Assumed equivalent HP for remaining treatment system, HP:	17	
Remaining system, HP-HR:	148,920	
Equivalent electrical consumption, kW-HR:	222,200	*Assumes motor efficiency, rounded up to nearest hundred*
Estimated total electrical consumption, KW-HR:	**1,495,000**	
Treatment System Operation and Maintenance		
Number of site visits per year, EA:	52	
Number of hours per visit, HR:	5	*Includes travel to and from site.*
Total number of hours, HR:	260	

US EPA ARCHIVE DOCUMENT

Description: Quantities for installation and abandonment of Recovery wells.

Recovery Well Installation			
Number of Medial Recovery Wells:	6	Number of Deep Recovery Wells:	6
Recovery Well Depth, VLF:	175	Recovery Well Depth, VLF:	210
Estimated time to install well, HR:	25	Estimated time to install well, HR:	30
Estimated time to develop well, HR:	8	Estimated time to develop well, HR:	8
Pump Rate per Well, GPM:	75	Pump Rate per Well, GPM:	200
Total Flow Rate, GPM:	450	Total Flow Rate, GPM:	1200
Recovery Well Quantities			
Well casing, OD:	6.75	Well casing, OD:	6.75
Borehole diameter, OD:	13.75	Borehole diameter, OD:	13.75
Drilling – 8-inch nominal borehole, VLF:	175	Drilling – 8-inch nominal borehole, VLF:	210
Stainless Steel Screen - 6", VLF:	20	Stainless Steel Screen - 6", VLF:	20
Filter Pack, 6" Screen, VLF:	22	Filter Pack, 6" Screen, VLF:	22
Steel Casing, VLF:	155	Steel Casing, VLF:	190
Bentonite Seal, VLF:	2	Bentonite Seal, VLF:	2
Well Grout, VLF:	151	Well Grout, VLF:	186
Filter Pack, CF:	12	Filter Pack, CF:	12
Filter Pack, BCY:	1	Filter Pack, BCY:	1
Filter Pack, LCY:	2	Filter Pack, LCY:	2
Filter Pack, TON:	3	Filter Pack, TON:	3
Bentonite Seal, CF:	2	Bentonite Seal, CF:	2
Well Grout, CF:	89	Well Grout, CF:	110
Hauling Drill Cuttings to Landfill, LCY:	8.1	Hauling Drill Cuttings to Landfill, LCY:	9.7
Drill Cuttings Disposal, TON:	12.2	Drill Cuttings Disposal, TON:	14.6
Roll Off Rental for Drill Cuttings, DY:	4	Roll Off Rental for Drill Cuttings, DY:	4
Well Development, HR:	8	Well Development, HR:	8
Geologist oversight, HR:	25	Geologist oversight, HR:	30
Geologist mob and demob, HR:	10	Geologist mob and demob, HR:	10
Geologist, HR:	35	Geologist, HR:	40
Pickup Truck Rental, DY:	4	Pickup Truck Rental, DY:	4
Fuel for Rental Truck, DY:	4	Fuel for Rental Truck, DY:	4

Total Recovery Well Quantities		
Drilling – 8-inch nominal borehole, VLF:	2310	
Stainless Steel Screen - 6", VLF:	240	
Steel Casing, VLF:	2070	
Filter Pack, TON:	36	*Assumes 1.5 tons per CY*
Bentonite Seal, CF:	24	
Well Grout, CF:	1194	
Hauling Drill Cuttings to Landfill, LCY:	106.8	
Transportation of Drill Cuttings to Landfill, EA:	5	
Drill Cuttings Disposal, TON:	160.8	
Roll Off Rental for Drill Cuttings, DY:	43	
Pressure Transducer Cable, LF:	2430	
Pressure Transducer, EA:	12	
Medial Submersible Pump, EA:	6	*Assumes 5 hp pump*
Deep Submersible Pump, EA:	6	*Assumes 25 hp pump*
Well Development, HR:	96	
Geologist oversight, HR:	330	
Geologist mobilization and demobilization, HR	10	
Geologist, HR:	340	
Pickup Truck Rental, DY:	43	
Fuel for Rental Truck, DY:	43	

US EPA ARCHIVE DOCUMENT

Description: Quantities for installation and abandonment of Recovery wells.

Well Abandonment

Number of Medial Recovery Wells:	6	Number of Deep Recovery Wells:	6
Well diameter, IN:	6	Well diameter, IN:	6
Recovery Well Depth, VLF:	175	Recovery Well Depth, VLF:	210
Estimated time to abandon well, HR:	15	Estimated time to abandon well, HR:	15
Estimated length of work day, HR:	10	Estimated length of work day, HR:	10

Total Recovery Well Abandonment Quantities

Mob and Demob of DPT Rig, LS:	1
Well Abandonment, VLF:	2310
Cement-grout, CF:	454
Geologist, HR:	180
Pickup Truck Rental, DY:	18
Fuel for Rental Truck, DY:	18
Per diem, DY:	18

US EPA ARCHIVE DOCUMENT

Description: Quantities for equipment for trenching for GET piping and installation of recovery and re-injection well vaults Well vaults are assumed to be below grade vaults. All well vault pipe materials are assumed to be Schedule 80 PVC.

Assumed Material Properties		
Soil Expansion Factor:	**1.2**	*Conversion from BCY to LCY*
Soil Compaction Factor:	**1.1**	*Conversion from BCY to ECY*
Soil Compaction Factor:	**0.9**	*Conversion from LCY to ECY*
BCY - bank cubic yard - in place volume prior to excavation		
LCY - loose cubic yards - volume after excavation		
ECY - embankment cubic yards (aka compacted cubic yards) - volume after compaction		
Concrete Expansion Factor:	1.30	*Conversion from BCY to LCY*
Density of base course gravel, TN/LCY:	1.50	
Density of concrete, TN/LCY:	1.89	
Density of soil, TN/LCY:	1.50	
Recovery & Re-Injection Well Piping Installation		
Trench width, FT:	4	
Trench depth, FT:	5	
Trenching in Unpaved Area, LF:	18,190	*Assume 4 ft trench depth*
Trenching in Paved Area, LF:	60	
Total length of pipe to install, LF:	18,250	
Concrete sawing, LF:	128	
Excavation, BCF:	292,000	
Excavation, BCY:	10,815	*Rounded up to nearest whole number*
Excavation, LCY:	12,978	*Rounded up to nearest whole number*
Excavation, ECY:	9,832	*Rounded up to nearest whole number*
Excavation, TON:	19,467	*Rounded up to nearest whole number*
Minimum Pipe Diameter, IN:	**10**	*Rounded up to nearest whole number*
O.D. of Pipe, IN:	10.5	
Volume of Pipe Installed, CF:	10,939	
Depth of Aggregate under pipe, IN:	6	
Depth of Aggregate over pipe, IN:	6	
Depth of Aggregate (including pipe), FT:	2.0	
Volume of Aggregate Required, BCF:	134,581	
Volume of Aggregate Required, BCY:	4,985	
Volume of Aggregate Required, LCY:	5,982	*Rounded up to nearest whole number*
Volume of Aggregate Required, ECY:	4,532	*Rounded up to nearest whole number*
Volume of Aggregate Required, TON:	8,973	*Assumes 1.5 tons per CY*
Volume of Aggregate Required, SF:	73,000	
Volume of Backfill, BCF:	146,240	
Volume of Backfill, BCY:	5,417	
Volume of Backfill, LCY:	6,501	*Rounded up to nearest whole number*
Volume of Backfill, ECY:	4,925	*Rounded up to nearest whole number*
6" wide, 4-mil Detectable Tape, LF:	18,250	
6" wide, 4-mil Detectable Tape, CLF:	183	*Rounded up to nearest whole number*
Total Piping, LF:	18,250	
Tee, EA:	6	
Elbows, 90 Deg., EA:	2	
Joints Welded, EA:	465	*Assume 40 foot pipe sections*
Welding, DY:	10	*Assume 50 joints welded per day*
Parking and alley pavement thickness, IN:	**6**	
Topsoil thickness, IN:	**6**	
Topsoil, CF:	120	

US EPA ARCHIVE DOCUMENT

Description: Quantities for equipment for trenching for GET piping and installation of recovery and re-injection well vaults Well vaults are assumed to be below grade vaults. All well vault pipe materials are assumed to be Schedule 80 PVC.

Topsoil, BCY:	5	*Rounded up to nearest whole number*
Topsoil, LCY:	6	*Rounded up to nearest whole number*
Topsoil, ECY:	6	*Rounded up to nearest whole number*
Topsoil, TON:	9	*Assumes 1.5 tons per CY*
Seeding Disturbed Area, SY:	8,112	
Area of pavement disturbed, SF:	240	
Area of pavement disturbed, SY:	27	*Rounded up to nearest whole number*
Volume of pavement, CF:	120	
Volume of pavement, BCY:	5	*Rounded up to nearest whole number*
Volume of pavement, LCY:	6	*Rounded up to nearest whole number*
Volume of pavement, TON:	9	*Assumes 1.5 tons per CY*
Pipe Jacking under Railroad Tracks, LF:	110	
Horizontal Boring, LF:	110	
Boring Diameter, IN:	24	
O.D. of Pipe, IN:	10.5	
Volume of Aggregate, CF:	280	*Bedding between boring and piping*
Volume of Aggregate Required, BCY:	11	*Rounded up to nearest whole number*
Volume of Aggregate Required, LCY:	14	*Rounded up to nearest whole number*
Volume of Aggregate Required, TON:	17	*Assumes 1.5 tons per CY*
Volume of Soil for Disposal, CF:	145,760	
Volume of Soil for Disposal, BCY:	5,399	*Rounded up to nearest whole number*
Volume of Soil for Disposal, LCY:	6,479	*Rounded up to nearest whole number*
Volume of Soil for Disposal, TON:	9,719	*Assumes 1.5 tons per CY*
Well Vault		
Number of Well Vaults, EA:	18	
Depth of vault, FT:	4	
Width of vault, FT:	4	
Length of vault, FT:	4	
Excavation, CF:	64	
Excavation, BCY:	3	*Rounded up to nearest whole number*
Excavation, LCY:	4	*Rounded up to nearest whole number*
Depth of Bedding Material, FT:	1	
Total Volume of Bedding Material Required, CF:	16	
Total Volume of Bedding Material Required, BCY:	1	*Rounded up to nearest whole number*
Total Volume of Bedding Material Required, LCY:	2	*Rounded up to nearest whole number*
Total Volume of Bedding Material Required, ECY:	2	*Rounded up to nearest whole number*
Total Volume of Bedding Material Required, TON:	3	*Assumes 1.5 tons per CY*
Area of Compaction, SF:	16	
Well vault, 6'x6'x4', EA:	1	
Well vault door, EA:	1	
Number of Elbow, 90 Deg Required, EA:	4	
Number of Tees Required, EA:	1	
Length of PVC piping, LF:	10	
Number of flanged fittings, EA:	8	
Number of check valves, EA:	1	
Number of butterfly valves, EA:	2	
Bolt pack, EA:	5	
Flow meter, EA:	1	

US EPA ARCHIVE DOCUMENT

Description: Quantities for equipment for trenching for GET piping and installation of recovery and re-injection well vaults Well vaults are assumed to be below grade vaults. All well vault pipe materials are assumed to be Schedule 80 PVC.

Total Well Vault Quantities		
Excavation, BCY:	54	*Rounded up to nearest whole number*
Total Volume of Bedding Material Required, CF:	288	
Total Volume of Bedding Material Required, TON:	54	*Assumes 1.5 tons per CY*
Area of Compaction, SF:	288	
Well vault, 6'x6'x4', EA:	18	
Well vault door, EA:	18	
Total Well Vault Quantities (continued)		
Number of Elbow, 90 Deg Required, EA:	72	
Number of Tees Required, EA:	18	
Length of PVC piping, LF:	180	
Number of flanged fittings, EA:	144	
Number of check valves, EA:	18	
Number of butterfly valves, EA:	36	
Bolt pack, EA:	90	
Flow meter, EA:	18	
Insulation and metal jacket		
Pipe ID, IN:	10.0	
Pipe OD, IN:	10.5	
Pipe Insulation Thickness, IN:	2.5	
Overall diameter, IN:	15.5	
Pipe OD, FT:	1.29	
Circumference, FT:	4.1	
Area per unit, SF/FT:	4.1	

US EPA ARCHIVE DOCUMENT

Description: Quantities for construction of treatment system building.

Treatment System Building

Estimated width of building, FT:	20	
Estimated length of building, FT:	20	
Estimated building height, FT:	14	
Building, SF:	400	
Perimeter, LF:	80	
Footing width, IN:	24	
Footing depth, IN:	12	
Footing, CF:	160	
Footing, CY:	6	*Rounded up to nearest whole number*
Excavation width, IN:	36	
Excavation depth, IN:	12	
Exacavation, CF:	240	
Exacavation, BCY:	9	*Rounded up to nearest whole number*
Exacavation, LCY:	11	*Rounded up to nearest whole number*
Exacavation, ECY:	9	*Rounded up to nearest whole number*
Exacavation, TON:	17	*Assumes 1.5 tons per CY*
Base course, IN:	6	
Base course, CF:	200	
Base course, BCY:	8	*Rounded up to nearest whole number*
Base course, LCY:	10	*Rounded up to nearest whole number*
Base course, ECY:	8	*Rounded up to nearest whole number*
Base course, TON:	15	*Assumes 1.5 tons per CY*
Rebar spacing, IN OC:	6	
Number of bars width, EA:	38	
Width length, FT:	19	
Number of bars length, EA:	38	
Bar length along length, FT/EA:	19	
Total length, FT:	1444	
64 rebar unit weight, LBS/FT:	**1.502**	
Reinforcing steel, LBS:	2168.888	
Reinforcing steel, TON:	1.1	
Forms, LF:	80	
Concrete slab thickness, IN:	6	
Concrete, CF:	200	
Concrete, CY:	8	*Rounded up to nearest whole number*
Insulation, SF:	1120	

US EPA ARCHIVE DOCUMENT

Description: Quantities for installation and abandonment of re-injection wells.

Re-injection Well Installation		
Number of Re-injection Wells:	6	
Re-injection Well Depth, VLF:	210	
Estimated time to install re-injection well, HR:	30	
Estimated time to develop re-injection well, HR:	8	
Re-injection Well Quantities		
Well casing, OD:	6.75	
Borehole diameter, OD:	13.75	
Drilling – 8-inch nominal borehole, VLF:	210	
Stainless Steel Screen - 6", VLF:	20	
Filter Pack, 6" Screen, VLF:	22	*Assumes 2 feet more than screen*
Steel Casing, VLF:	190	
Bentonite Seal, VLF:	2	
Well Grout, VLF:	186	
Filter Pack, CF:	12	
Filter Pack, BCY:	1	*Rounded up to nearest whole number*
Filter Pack, LCY:	2	*Rounded up to nearest whole number*
Filter Pack, TON:	3	*Assumes 1.5 tons per CY*
Bentonite Seal, CF:	2	
Well Grout, CF:	110	
Hauling Drill Cuttings to Landfill, LCY:	9.7	
Drill Cuttings Disposal, TON:	14.6	
Roll Off Rental for Drill Cuttings, DY:	30	
Well Development, HR:	8	
Geologist oversight, HR:	30	
Geologist mobilization and demobilization, HR	10	
Geologist, HR:	40	
Pickup Truck Rental, DY:	3	
Fuel for Rental Truck, DY:	3	
Total Re-injection Well Quantities		
Drilling – 8-inch nominal borehole, VLF:	1260	
Stainless Steel Screen - 6", VLF:	120	
Steel Casing, VLF:	1140	
Filter Pack, TON:	18	*Assumes 1.5 tons per CY*
Bentonite Seal, CF:	12	
Well Grout, CF:	660	
Hauling Drill Cuttings to Landfill, LCY:	58.2	
Transportation of Drill Cuttings to Landfill, EA:	3	
Drill Cuttings Disposal, TON:	87.6	
Roll Off Rental for Drill Cuttings, DY:	23	
Pressure Transducer, LF:	1320	
Pressure Transducer, EA:	6	
Well Development, HR:	48	
Geologist oversight, HR:	180	
Geologist mobilization and demobilization, HR	10	
Geologist, HR:	190	
Pickup Truck Rental, DY:	23	
Fuel for Rental Truck, DY:	23	

US EPA ARCHIVE DOCUMENT

Description: Quantities for installation and abandonment of re-injection wells.

Well Abandonment

Number of Re-injection Wells:	6
Well diameter, IN:	6
Re-injection Well Depth, VLF:	210
Estimated time to abandon re-injection well, HR:	15
Estimated length of work day, HR:	10
Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	1260
Cement-grout, CF:	248
Geologist, HR:	90
Pickup Truck Rental, DY:	9
Fuel for Rental Truck, DY:	9
Per diem, DY:	9

US EPA ARCHIVE DOCUMENT

CALCULATION WORKSHEET INDEX - ALTERNATIVE G4

Wrksht No.	Description
C-01	Calculations for determination of quantities for preparing groundwater monitoring reports
C-02	Calculations for determination of quantities for groundwater monitoring per sampling event
C-03	Calculations for determination of quantities for abandonment of monitoring and injection wells
C-04	Calculations for determination of quantities for injection well installation
C-05	Calculations for determination of quantities for maintenance of monitoring wells
C-06	Quantities for equipment for injection
C-07	Calculations for determination of quantities for pilot-test monitoring event
C-08	Quantities for EOS injection at Pilot Test
C-09	Calculations for determination of quantities for bioaugmentation
C-10	Quantities for EOS injection at Line 1
C-11	Quantities for installation and abandonment of re-injection wells
C-12	Quantities for installation and abandonment of recovery wells
C-13	Quantities for equipment for trenching for GET piping and installation of recovery and re-injection well vaults
C-14	Quantities for O&M of groundwater extraction treatment systems
C-15	Quantities for construction of treatment system building
C-16	Calculations for determination of quantities for installation of monitoring wells

Description: Calculations for determination of quantities for preparing groundwater monitoring reports.

Monitoring Report Generation

Assumed CAD hours per well, HR:	1.25	
Assumed Geologist hours per well, HR:	4	*Includes data review and tabulation, report, figures, etc.*
Number of wells:	57	
Project Manager, HR:	8	
CAD Drafter, HR:	72	
Geologist, HR:	228	
Quality Assurance Director, HR:	4	
Clerks, Typist, Bookkeeper & Receptionist, HR:	10	
Reproduction, LS:	1	

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for monitoring per sampling event.

Groundwater Monitoring		
No. of monitoring wells to be sampled for general analysis	**57**	
Analytical Requirements		
Samples, including VOCs, EA:	66	*Includes QC samples*
Metals, Dissolved, EPA Method 6010, Field Filtered, EA:	66	
Nitrate/Nitrite (NO3/NO2), EA:	66	
Sulfate, EPA MCAWW, 300, Field Filtered, EA:	66	
Sulfide, SM 4500S2 E, EA:	66	
Total Iron (Fe), EA:	3	*25 per kit, rounded up to nearest kit*
Total Manganese (Mn), EA:	66	
Chloride, EPA MCAWW, 300, Field Filtered, EA:	66	
Alkalinity, EPA MCAWW, 310.1, Field Filtered, EA:	66	
Dissolved Total Organic Carbon (TOC), EA:	66	
Carbon Dioxide (CO2), EA:	66	
Volatile Fatty Acids (VFAs), EA:	66	
Methane/Ethane/Ethene, EA:	66	
Dissolved Oxygen, Colormetic Test Kits, 0 to 1 ppm, EA:	2	*30 per kit, rounded up to nearest kit*
Dissolved Oxygen, Colormetic Test Kits, 1 to 12 ppm, EA:	2	*30 per kit, rounded up to nearest kit*
Field Filter, 0.45 micron filter, EA:	66	
Sampling Equipment		
Water Quality Meter and Flow Through Cell, WK:	3	*Rounded up to nearest week*
Photoionization Detector (PID), WK:	3	*Rounded up to nearest week*
Water Level Meter, WK:	3	*Rounded up to nearest week*
Turbidimeter, WK:	3	*Rounded up to nearest week*
Portable Bladder Pump, WK:	3	*Rounded up to nearest week*
Replacement Poly Bladders, EA:	59	*Assumes 2 extra bladders*
Bladder Pump Controller, WK:	3	*Rounded up to nearest week*
Compressed Nitrogen Gas Rental, WK:	3	*Rounded up to nearest week*
Combination Tubing, LF:	5700	*Assume 100 feet per well. Rounded up to nearest 100.*
Shipping Rental Equipment, EA:	**2**	
55-gallon Open Head Steel Drum, EA:	**9**	*Assume 500 mL per minute for 60 minutes per well*
Miscellaneous Sampling Equipment, LS:	**1**	
Labor Requirements		
Assumed length of time per day, HR:	**8**	
Time assumed to sample a well, HR:	**1**	*Includes setup, purging, and sample collection*
Number of sampling team members:	**2**	
Prepartory time, HR:	8	
Time to collect water level measurements, HR:	15	*Assume 15 minutes per well. Rounded up to nearest hour*
Time to sample all wells for general analysis, HR:	57	*Rounded up to nearest hour*
Time for decon, HR:	19	*Assume 20 minutes per well. Rounded up to nearest hour*
Time for sample management, HR:	15	*Assume 15 minutes per well. Rounded up to nearest hour*
Total, HR:	**114**	
Time to sample all wells for general analysis, DY:	**15**	*Rounded up to nearest day*
Project Manager, HR:	5	*5 minutes per sample, rounded up to nearest hour*
General Operator/Technician, HR:	228	*Two member team*
Contracting/Procurement Specialist, HR:	10	*10 minutes per sample, rounded up to nearest hour*
Pickup Truck Rental, DY:	15	*Rounded up to nearest week*
Fuel for Pickup Truck, DY:	15	

US EPA ARCHIVE DOCUMENT

Description: Quantities for abandonment of monitoring and injection wells. Assumes all monitoring and injection wells will be abandoned when site is closed.

Well Abandonment

Number of Shallow Monitoring Wells:	18	Number of Deep Monitoring Wells:	24
Well diameter, IN:	2	Well diameter, IN:	2
Shallow Monitoring Well Depth, VLF:	125	Deep Monitoring Well Depth, VLF:	200
Estimated time to abandon shallow well, HR:	5	Estimated time to abandon deep well, HR:	8
Number of Middle Monitoring Wells:	15	Number of Injection Wells:	39
Well diameter, IN:	2	Well diameter, IN:	2
Middle Monitoring Well Depth, VLF:	150	Injection Well Depth, VLF:	150
Estimated time to abandon middle well, HR:	6	Estimated time to abandon injection well, HR:	3
Estimated length of work day, HR:	10		

Shallow Well Quantities		Middle Well Quantities		Deep Well Quantities	
Geologist, HR:	90	Geologist, HR:	90	Geologist, HR:	192
Geologist, DY:	9	Geologist, DY:	9	Geologist, DY:	20
Abandonment, VLF:	2250	Abandonment, VLF:	2250	Abandonment, VLF:	4800
Cement-grout, CF:	50	Cement-grout, CF:	50	Cement-grout, CF:	105

Injection Well Quantities	
Geologist, HR:	117
Geologist, DY:	12
Abandonment, VLF:	5850
Cement-grout, CF:	128

Total	Monitoring Well Quantities	Injection Well Quantities	
Mobilization and Demobilization of DPT Rig, LS:	1	Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	9300	Well Abandonment, VLF:	5850
Cement-grout, CF:	205	Cement-grout, CF:	128
Geologist, HR:	372	Geologist, HR:	117
Pickup Truck Rental, DY:	38	Pickup Truck Rental, DY:	12
Fuel for Rental Truck, DY:	38	Fuel for Rental Truck, DY:	12
Per diem, DY:	38	Per diem, DY:	12

US EPA ARCHIVE DOCUMENT

Description: Quantities for installation of injection wells.

Injection Well Installation

	Line 1
No. of injection wells installed:	**39**

Injection Well Quantities, per well

Well casing inner diameter, IN:	2
Well casing outer diameter, IN:	2.375

Line 1 Quantities, per Well

Well Drilling, LF:	210
Well Screen, LF:	70
Gravel Pack, LF:	70
PVC Casing, LF:	140
Well Grout, CF:	10
Well Plug, EA:	1
8" Vault, EA:	1
55-gallon drum, EA:	1
Geologist, HR:	4
Truck Rental, DY:	0.4
Fuel for Truck, DY:	0.4

Total Injection Well Quantities

Hollow Stem Drilling, LF:	8,190
Well Screen - PVC Slotted, LF:	2,730
Gravel Pack, LF:	2,730
PVC Casing, LF:	5,460
Well Grout, CF:	390
Well Plug, EA:	39
8" Vault, EA:	39
55-gallon drum, EA:	39
Geologist, HR:	156
Pickup Truck Rental, DY:	16
Fuel for Rental Truck, DY:	16

US EPA ARCHIVE DOCUMENT

Description: Quantities for maintenance of monitoring wells. Assumes all monitoring wells will require replacement of vault and development.

Monitoring Well Maintenance

Number of wells requiring maintenance, EA:	57
Estimated time to complete well head repairs per well, HR	1
Estimated time to develop well, HR:	1
Total time per well, HR:	2
Total time for all wells, HR:	114
Estimated length of work day, HR:	10
Locking J-Plug, EA:	57
8" Vault, EA:	57
Geologist, HR:	114
Pickup Truck Rental, DY:	12
Fuel for Rental Truck, DY:	12

US EPA ARCHIVE DOCUMENT

Description: Quantities for equipment for injection.

Injection Equipment	
Plastic Tank - 1,000 gallon, EA:	2
Mechanical Mixer, EA:	2
Transfer Pump, EA:	2
Pressure Gauge - Injection Point, EA:	1
Pressure Gauge - Water to Frac Tank, EA:	1
1-1/2" Ball Valve, EA:	2
1-1/2" Steel Piping, LF:	20
1-1/2" Tee, EA:	4
1-1/2" Elbow, EA:	2
1-1/2" Female Camlock, EA:	5
1-1/2" Male Camlock, EA:	5
Hose, LF:	1000
Health and Safety Allowance, EA:	1

US EPA ARCHIVE DOCUMENT

Description: Calculations for determination of quantities for monitoring per sampling event.

Pilot Test Monitoring Event		
No. of monitoring wells to be sampled for MNA analysis:	**25**	
Analytical Requirements		
VOCs, EPA Method SW-846 8260, EA:	30	*Includes QC samples*
Metals, Dissolved, EPA Method 6010, Field Filtered, EA:	30	
Nitrate/Nitrite (NO3/NO2), EA:	30	
Sulfate, EPA MCAWW, 300, Field Filtered, EA:	30	
Sulfide, SM 4500S2 E, EA:	30	
Total Iron (Fe), EA:	1	*25 per kit, rounded up to nearest kit*
Total Manganese (Mn), EA:	30	
Chloride, EPA MCAWW, 300, Field Filtered, EA:	30	
Alkalinity, EPA MCAWW, 310.1, Field Filtered, EA:	30	
Dissolved Total Organic Carbon (TOC), EA:	30	
Carbon Dioxide (CO2), EA:	30	
Volatile Fatty Acids (VFAs), EA:	30	
Methane/Ethane/Ethene, EA:	30	
Microbiological DNA Analysis, EA:	30	
Dissolved Oxygen, Colormetic Test Kits, 0 to 1 ppm, EA:	1	*30 per kit, rounded up to nearest kit*
Dissolved Oxygen, Colormetic Test Kits, 1 to 12 ppm, EA:	1	*30 per kit, rounded up to nearest kit*
Field Filter, 0.45 micron filter, EA:	30	
Sampling Equipment		
Water Quality Meter and Flow Through Cell, WK:	2	*Rounded up to nearest week*
Photoionization Detector (PID), WK:	2	*Rounded up to nearest week*
Water Level Meter, WK:	2	*Rounded up to nearest week*
Turbidimeter, WK:	2	*Rounded up to nearest week*
Portable Bladder Pump, WK:	2	*Rounded up to nearest week*
Replacement Poly Bladders, EA:	27	*Assumes 2 extra bladders*
Bladder Pump Controller, WK:	2	*Rounded up to nearest week*
Compressed Nitrogen Gas Rental, WK:	2	*Rounded up to nearest week*
Combination Tubing, LF:	2500	*Assume 100 feet per well. Rounded up to nearest 100*
Shipping Rental Equipment, EA:	**2**	
55-gallon Open Head Steel Drum, EA:	**4**	*Assume 500 mL per minute for 60 minutes per well*
Miscellaneous Sampling Equipment, LS:	**1**	
Labor Requirements		
Assumed length of time per day, HR:	**8**	
Time assumed to sample a well, HR:	**1**	*Includes setup, purging, and sample collection*
Number of sampling team members:	**2**	
Prepartory time, HR:	8	
Time to collect water level measurements, HR:	7	*Assume 15 minutes per well. Rounded up to nearest hour*
Time to sample all wells for general analysis, HR:	25	*Rounded up to nearest hour*
Time for decon, HR:	9	*Assume 20 minutes per well. Rounded up to nearest hour*
Time for sample management, HR:	7	*Assume 15 minutes per well. Rounded up to nearest hour*
Total, HR:	**56**	
Time to sample all wells for general analysis, DY:	**7**	*Rounded up to nearest day*
Project Manager, HR:	3	*5 minutes per sample, rounded up to nearest hour*
General Operator/Technician, HR:	112	*Two member team*
Contracting/Procurement Specialist, HR:	5	*10 minutes per sample, rounded up to nearest hour*
Pickup Truck Rental, DY:	7	
Fuel for Pickup Truck, DY:	7	

US EPA ARCHIVE DOCUMENT

Description: Determine an estimated mass and volume of EOS for injection into the contaminated portion of the groundwater plume. Calculation is per injection round. Highlighted cells are user input fields.

Calculation for EOS - Pilot Test

Assumptions

Estimated top of groundwater table, ft bgs:	140	
Estimated bottom of treatment of area, ft bgs:	210	
Saturated thickness, ft:	70	
Injection point spacing, ft:	20	
Assumed ROI, ft:	10	
Number of Injection Points:	15	
Effective porosity (normal):	0.35	*Based on sample results*
Effective porosity (injection):	0.10	

Determination of EOS Parameters Based on Volume of Ideal Cylinder

Assumed ROI, ft:	10	
Saturated thickness, ft:	70	
Ideal volume of per injection, ft^3:	2,200	*ROI squared x π x sat thick x effective porosity*
Volume of solution per injection point, gal:	16,458	
Concentration of EOS Solution Desired, %:	4	
Standard Concentration of EOS 598 Solution, %:	59.8	
Dilution Factor:	15	
Volume of EOS 598 per injection point, gal:	1,101	
Volume of water per injection point, gal:	15,357	

Determination of Preferred EOS Parameters

Volume of EOS 598 per injection point, gal:	1,101	
Volume of solution per injection point, gal:	16,458	
Volume of EOS 598 per injection event for area, gal:	16,514	
Volume of water per injection event for area, kgal:	230	
Volume of solution per injection event for area, gal:	246,870	
Estimated number of points per day, EA:	1	
Number of hours per work day, HR:	10	
Number of injection days, DY:	15	
Field Technician, DY:	30	*Two Member team*
Field Technician, HR:	300	
Truck Rental, DY:	15	
Fuel for Pickup Truck, DY:	15	
Estimated project management time per hour, HR/HR:	0.1	
Project Manager, HR:	15	
Geologist, HR:	150	
Per Diem, DY:	15	
Truck Rental, DY:	15	
Fuel for Pickup Truck, DY:	15	

US EPA ARCHIVE DOCUMENT

Description: Determine an estimated mass and volume of EOS for injection into the contaminated portion of the groundwater plume. Calculation is per injection round. Highlighted cells are user input fields.

Determination of Alternative Injection Materials

ISCO Quantities		
Concentration of Persulfate Solution Desired*, %:	4	
Pounds Persulfate per gallon (calculated), lbs/gal:	0.3356	
Volume of solution per injection point, gal:	16,458	
Mass of Persulfate per injection point, lbs:	5,523	*Assume 4 moles of NaOH per 1 mole of persulfate*
Mass of NaOH Activator Solution per injection point, lbs:	3,713	*Activator solution is 25% NaOH*
Volume of solution per injection event for area, gal:	246,870	
Volume of solution per injection event for area, kgal:	247	
Mass of Persulfate per event, lbs:	82,850	
Mass of NaOH per event, lbs:	55,693	
ISCR Quantities		
Concentration of Reductant Solution Desired*, %:	4	
Pounds Reductant per gallon (calculated), lbs/gal:	0.3356	
Volume of solution per injection point, gal:	16,458	
Mass of Reductant per injection point, lbs:	5,523	
Volume of solution per injection event for area, gal:	246,870	
Volume of solution per injection event for area, kgal:	247	
Mass of Reductant per event, lbs:	82,850	

US EPA ARCHIVE DOCUMENT

Description: Quantities for bioaugmentation.

Bioaugmentation		
Full Scale Bioaugmentation		
Number of biobarrier wells for bioaugmentation, EA:	10	*Assume 10 injection points per injection line*
Liters of bioaugmentation solution per well, L:	35	
Estimated number of wells per day, EA/DY:	5	
Estimated workday length, HR/DY:	10	
Estimated workweek length, DY/WK:	5	
Number of technicians per event, EA:	2	
Total bioaugmentation solution, L:	350	
Number of days for bioaugmentation, DY:	2	*Rounded up to the nearest whole number*
Project Manager, HR:	2	*Rounded up to the nearest whole number*
Operator/Tech, HR:	40	
Geologist, HR:	20	
Per Diem, DY:	6	
Pickup Truck Rental, DY:	4	
Fuel for Rental Truck, DY:	4	
Pilot Scale Bioaugmentation		
Number of biobarrier wells for bioaugmentation, EA:	20	*Assume 20 injection points*
Liters of bioaugmentation solution per well, L:	35	
Estimated number of wells per day, EA/DY:	5	
Estimated workday length, HR/DY:	10	
Estimated workweek length, DY/WK:	5	
Number of technicians per event, EA:	2	
Total bioaugmentation solution, L:	700	
Number of days for bioaugmentation, DY:	4	*Rounded up to the nearest whole number*
Project Manager, HR:	2	
Operator/Tech, HR:	80	
Geologist, HR:	40	
Per Diem, DY:	12	
Pickup Truck Rental, DY:	8	
Fuel for Rental Truck, DY:	8	

US EPA ARCHIVE DOCUMENT

Description: Determine an estimated mass and volume of EOS for injection into the contaminated portion of the groundwater plume. Calculation is per injection round. Highlighted cells are user input fields.

Calculation for EOS - Line 1

Assumptions

Estimated top of groundwater table, ft bgs:	140	
Estimated bottom of treatment of area, ft bgs:	210	
Saturated thickness, ft:	70	
Width of Plume at Line 1, ft:	1526	
Injection point spacing, ft:	40	
Assumed ROI, ft:	20	
Number of Injection Points:	39	
Effective porosity (normal):	0.35	*Based on sample results*
Effective porosity (injection):	0.10	

Determination of EOS Parameters Based on Volume of Ideal Cylinder

Assumed ROI, ft:	20	
Saturated thickness, ft:	70	
Ideal volume of per injection, ft^3:	8,797	*ROI squared x π x sat thick x effective porosity*
Volume of solution per injection point, gal:	65,806	
Concentration of EOS Solution Desired, %:	4	
Standard Concentration of EOS 598 Solution, %:	59.8	
Dilution Factor:	15	
Volume of EOS 598 per injection point, gal:	4,402	
Volume of water per injection point, gal:	61,404	

Determination of Preferred EOS Parameters

Volume of EOS 598 per injection point, gal:	4,402	
Volume of solution per injection point, gal:	65,806	
Volume of EOS 598 per injection event for area, gal:	171,668	
Volume of water per injection event for area, kgal:	2,395	
Volume of solution per injection event for area, gal:	2,566,434	
Estimated number of points per day, EA:	1	
Number of hours per work day, HR:	10	
Number of injection days, DY:	39	
Field Technician, DY:	78	*Two Member team*
Field Technician, HR:	780	
Truck Rental, DY:	39	
Fuel for Pickup Truck, DY:	39	
Estimated project management time per hour, HR/HR:	0.1	
Project Manager, HR:	39	
Geologist, HR:	390	
Per Diem, DY:	39	
Truck Rental, DY:	39	
Fuel for Pickup Truck, DY:	39	

US EPA ARCHIVE DOCUMENT

Description: Determine an estimated mass and volume of EOS for injection into the contaminated portion of the groundwater plume. Calculation is per injection round. Highlighted cells are user input fields.

Determination of Alternative Injection Materials

ISCO Quantities		
Concentration of Persulfate Solution Desired*, %:	4	
Pounds Persulfate per gallon (calculated), lbs/gal:	0.3356	
Volume of solution per injection point, gal:	65,806	
Mass of Persulfate per injection point, lbs:	22,084	*Assume 4 moles of NaOH per 1 mole of persulfate*
Mass of NaOH Activator Solution per injection point, lbs:	14,845	*Activator solution is 25% NaOH*
Volume of solution per injection event for area, gal:	2,566,434	
Volume of solution per injection event for area, kgal:	2,567	
Mass of Persulfate per event, lbs:	861,295	
Mass of NaOH per event, lbs:	578,973	
ISCR Quantities		
Concentration of Reductant Solution Desired*, %:	4	
Pounds Reductant per gallon (calculated), lbs/gal:	0.3356	
Volume of solution per injection point, gal:	65,806	
Mass of Reductant per injection point, lbs:	22,084	
Volume of solution per injection event for area, gal:	2,566,434	
Volume of solution per injection event for area, kgal:	2,567	
Mass of Reductant per event, lbs:	861,295	

US EPA ARCHIVE DOCUMENT

Description: Quantities for installation and abandonment of re-injection wells.

Re-injection Well Installation		
Number of Re-injection Wells:	3	
Re-injection Well Depth, VLF:	210	
Estimated time to install re-injection well, HR:	30	
Estimated time to develop re-injection well, HR:	8	
Re-injection Well Quantities		
Well casing, OD:	6.75	
Borehole diameter, OD:	13.75	
Drilling – 8-inch nominal borehole, VLF:	210	
Stainless Steel Screen - 6", VLF:	20	
Filter Pack, 6" Screen, VLF:	22	*Assumes 2 feet more than screen*
Steel Casing, VLF:	190	
Bentonite Seal, VLF:	2	
Well Grout, VLF:	186	
Filter Pack, CF:	12	
Filter Pack, BCY:	1	*Rounded up to nearest whole number*
Filter Pack, LCY:	2	*Rounded up to nearest whole number*
Filter Pack, TON:	3	*Assumes 1.5 tons per CY*
Bentonite Seal, CF:	2	
Well Grout, CF:	110	
Hauling Drill Cuttings to Landfill, LCY:	9.7	
Drill Cuttings Disposal, TON:	14.6	
Roll Off Rental for Drill Cuttings, DY:	30	
Well Development, HR:	8	
Geologist oversight, HR:	30	
Geologist mobilization and demobilization, HR	10	
Geologist, HR:	40	
Pickup Truck Rental, DY:	3	
Fuel for Rental Truck, DY:	3	
Total Re-injection Well Quantities		
Drilling – 8-inch nominal borehole, VLF:	630	
Stainless Steel Screen - 6", VLF:	60	
Steel Casing, VLF:	570	
Filter Pack, TON:	9	*Assumes 1.5 tons per CY*
Bentonite Seal, CF:	6	
Well Grout, CF:	330	
Hauling Drill Cuttings to Landfill, LCY:	29.1	
Transportation of Drill Cuttings to Landfill, EA:	2	
Drill Cuttings Disposal, TON:	43.8	
Roll Off Rental for Drill Cuttings, DY:	12	
Pressure Transducer, LF:	660	
Pressure Transducer, EA:	3	
Well Development, HR:	24	
Geologist oversight, HR:	90	
Geologist mobilization and demobilization, HR	10	
Geologist, HR:	100	
Pickup Truck Rental, DY:	12	
Fuel for Rental Truck, DY:	12	

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Description: Quantities for installation and abandonment of re-injection wells.

Well Abandonment

Number of Re-injection Wells:	3
Well diameter, IN:	6
Re-injection Well Depth, VLF:	210
Estimated time to abandon re-injection well, HR:	15
Estimated length of work day, HR:	10
Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	630
Cement-grout, CF:	124
Geologist, HR:	45
Pickup Truck Rental, DY:	5
Fuel for Rental Truck, DY:	5
Per diem, DY:	5

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Description: Quantities for installation and abandonment of Recovery wells.

Recovery Well Installation			
Number of Medial Recovery Wells:	3	Number of Deep Recovery Wells:	3
Recovery Well Depth, VLF:	175	Recovery Well Depth, VLF:	210
Estimated time to install well, HR:	25	Estimated time to install well, HR:	30
Estimated time to develop well, HR:	8	Estimated time to develop well, HR:	8
Pump Rate per Well, GPM:	75	Pump Rate per Well, GPM:	200
Total Flow Rate, GPM:	225	Total Flow Rate, GPM:	600
Recovery Well Quantities			
Well casing, OD:	6.75	Well casing, OD:	6.75
Borehole diameter, OD:	13.75	Borehole diameter, OD:	13.75
Drilling – 8-inch nominal borehole, VLF:	175	Drilling – 8-inch nominal borehole, VLF:	210
Stainless Steel Screen - 6", VLF:	20	Stainless Steel Screen - 6", VLF:	20
Filter Pack, 6" Screen, VLF:	22	Filter Pack, 6" Screen, VLF:	22
Steel Casing, VLF:	155	Steel Casing, VLF:	190
Bentonite Seal, VLF:	2	Bentonite Seal, VLF:	2
Well Grout, VLF:	151	Well Grout, VLF:	186
Filter Pack, CF:	12	Filter Pack, CF:	12
Filter Pack, BCY:	1	Filter Pack, BCY:	1
Filter Pack, LCY:	2	Filter Pack, LCY:	2
Filter Pack, TON:	3	Filter Pack, TON:	3
Bentonite Seal, CF:	2	Bentonite Seal, CF:	2
Well Grout, CF:	89	Well Grout, CF:	110
Hauling Drill Cuttings to Landfill, LCY:	8.1	Hauling Drill Cuttings to Landfill, LCY:	9.7
Drill Cuttings Disposal, TON:	12.2	Drill Cuttings Disposal, TON:	14.6
Roll Off Rental for Drill Cuttings, DY:	4	Roll Off Rental for Drill Cuttings, DY:	4
Well Development, HR:	8	Well Development, HR:	8
Geologist oversight, HR:	25	Geologist oversight, HR:	30
Geologist mob and demob, HR:	10	Geologist mob and demob, HR:	10
Geologist, HR:	35	Geologist, HR:	40
Pickup Truck Rental, DY:	4	Pickup Truck Rental, DY:	4
Fuel for Rental Truck, DY:	4	Fuel for Rental Truck, DY:	4

Total Recovery Well Quantities		
Drilling – 8-inch nominal borehole, VLF:	1155	
Stainless Steel Screen - 6", VLF:	120	
Steel Casing, VLF:	1035	
Filter Pack, TON:	18	*Assumes 1.5 tons per CY*
Bentonite Seal, CF:	12	
Well Grout, CF:	597	
Hauling Drill Cuttings to Landfill, LCY:	53.4	
Transportation of Drill Cuttings to Landfill, EA:	3	
Drill Cuttings Disposal, TON:	80.4	
Roll Off Rental for Drill Cuttings, DY:	22	
Pressure Transducer Cable, LF:	1215	
Pressure Transducer, EA:	6	
Medial Submersible Pump, EA:	3	*Assumes 5 hp pump*
Deep Submersible Pump, EA:	3	*Assumes 25 hp pump*
Well Development, HR:	48	
Geologist oversight, HR:	165	
Geologist mobilization and demobilization, HR	10	
Geologist, HR:	175	
Pickup Truck Rental, DY:	22	
Fuel for Rental Truck, DY:	22	

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Description: Quantities for installation and abandonment of Recovery wells.

Well Abandonment

Number of Medial Recovery Wells:	3	Number of Deep Recovery Wells:	3
Well diameter, IN:	6	Well diameter, IN:	6
Recovery Well Depth, VLF:	175	Recovery Well Depth, VLF:	210
Estimated time to abandon Recovery well, HR:	15	Estimated time to abandon Recovery well, HR:	15
Estimated length of work day, HR:	10	Estimated length of work day, HR:	10

Total Recovery Well Abandonment Quantities

Mobilization and Demobilization of DPT Rig, LS:	1
Well Abandonment, VLF:	1155
Cement-grout, CF:	227
Geologist, HR:	90
Pickup Truck Rental, DY:	9
Fuel for Rental Truck, DY:	9
Per diem, DY:	9

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Description: Quantities for equipment for trenching for GET piping and installation of recovery and re-injection well vaults Well vaults are assumed to be below grade vaults. All well vault pipe materials are assumed to be Schedule 80 PVC.

Assumed Material Properties		
Soil Expansion Factor:	**1.2**	*Conversion from BCY to LCY*
Soil Compaction Factor:	**1.1**	*Conversion from BCY to ECY*
Soil Compaction Factor:	**0.9**	*Conversion from LCY to ECY*
BCY - bank cubic yard - in place volume prior to excavation		
LCY - loose cubic yards - volume after excavation		
ECY - embankment cubic yards (aka compacted cubic yards) - volume after compaction		
Concrete Expansion Factor:	1.30	*Conversion from BCY to LCY*
Density of base course gravel, TN/LCY:	1.50	
Density of concrete, TN/LCY:	1.89	
Density of soil, TN/LCY:	1.50	
Recovery & Re-Injection Well Piping Installation		
Trench width, FT:	4	
Trench depth, FT:	5	
Trenching in Unpaved Area, LF:	13,450	*Assume 4 ft trench depth*
Trenching in Paved Area, LF:	30	
Total length of pipe to install, LF:	13,480	
Concrete sawing, LF:	68	
Excavation, BCF:	215,680	
Excavation, BCY:	7,989	*Rounded up to nearest whole number*
Excavation, LCY:	9,587	*Rounded up to nearest whole number*
Excavation, ECY:	7,263	*Rounded up to nearest whole number*
Excavation, TON:	14,381	*Rounded up to nearest whole number*
Minimum Pipe Diameter, IN:	**7**	*Rounded up to nearest whole number*
Pipe Diameter, IN:	8	
O.D. of Pipe, IN:	8.5	
Volume of Pipe Installed, CF:	5,301	
Depth of Aggregate under pipe, IN:	6	
Depth of Aggregate over pipe, IN:	6	
Depth of Aggregate (including pipe), FT:	2.0	
Volume of Aggregate Required, BCF:	102,299	
Volume of Aggregate Required, BCY:	3,789	
Volume of Aggregate Required, LCY:	4,547	*Rounded up to nearest whole number*
Volume of Aggregate Required, ECY:	3,445	*Rounded up to nearest whole number*
Volume of Aggregate Required, TON:	6,821	*Assumes 1.5 tons per CY*
Volume of Aggregate Required, SF:	53,920	
Volume of Backfill, BCF:	108,080	
Volume of Backfill, BCY:	4,003	
Volume of Backfill, LCY:	4,804	*Rounded up to nearest whole number*
Volume of Backfill, ECY:	3,640	*Rounded up to nearest whole number*
6" wide, 4-mil Detectable Tape, LF:	13,480	
6" wide, 4-mil Detectable Tape, CLF:	135	*Rounded up to nearest whole number*
Piping, LF:	13,480	
Tee, EA:	10	
Elbow, 90 Deg., EA:	2	
Joints Welded, EA:	340	*Assume 40 foot pipe sections*
Welding, DY:	7	*Assume 50 joints welded per day*
Parking and alley pavement thickness, IN:	**6**	
Topsoil thickness, IN:	**6**	

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Description: Quantities for equipment for trenching for GET piping and installation of recovery and re-injection well vaults Well vaults are assumed to be below grade vaults. All well vault pipe materials are assumed to be Schedule 80 PVC.

Topsoil, CF:	60	
Topsoil, BCY:	3	*Rounded up to nearest whole number*
Topsoil, LCY:	4	*Rounded up to nearest whole number*
Topsoil, ECY:	4	*Rounded up to nearest whole number*
Topsoil, TON:	6	*Assumes 1.5 tons per CY*
Seeding Disturbed Area, SY:	5,992	
Area of pavement disturbed, SF:	120	
Area of pavement disturbed, SY:	14	*Rounded up to nearest whole number*
Volume of pavement, CF:	60	
Volume of pavement, BCY:	3	*Rounded up to nearest whole number*
Volume of pavement, LCY:	4	*Rounded up to nearest whole number*
Volume of pavement, TON:	6	*Assumes 1.5 tons per CY*
Pipe Jacking under Railroad Tracks, LF:	110	
Horizontal Boring, LF:	110	
Boring Diameter, IN:	24	
O.D. of Pipe, IN:	8.5	
Volume of Aggregate, CF:	303	*Bedding between boring and piping*
Volume of Aggregate Required, BCY:	12	*Rounded up to nearest whole number*
Volume of Aggregate Required, LCY:	15	*Rounded up to nearest whole number*
Volume of Aggregate Required, TON:	18	*Assumes 1.5 tons per CY*
Volume of Soil for Disposal, CF:	107,600	
Volume of Soil for Disposal, BCY:	3,986	*Rounded up to nearest whole number*
Volume of Soil for Disposal, LCY:	4,784	*Rounded up to nearest whole number*
Volume of Soil for Disposal, TON:	7,176	*Assumes 1.5 tons per CY*
Well Vault		
Number of Well Vaults, EA:	9	
Depth of vault, FT:	4	
Width of vault, FT:	4	
Length of vault, FT:	4	
Excavation, CF:	64	
Excavation, BCY:	3	*Rounded up to nearest whole number*
Excavation, LCY:	4	*Rounded up to nearest whole number*
Depth of Bedding Material, FT:	1	
Total Volume of Bedding Material Required, CF:	16	
Total Volume of Bedding Material Required, BCY:	1	*Rounded up to nearest whole number*
Total Volume of Bedding Material Required, LCY:	2	*Rounded up to nearest whole number*
Total Volume of Bedding Material Required, ECY:	2	*Rounded up to nearest whole number*
Total Volume of Bedding Material Required, TON:	3	*Assumes 1.5 tons per CY*
Area of Compaction, SF:	16	
Well vault, 6'x6'x4', EA:	1	
Well vault door, EA:	1	
Number of Elbow, 90 Deg Required, EA:	4	
Number of Tees Required, EA:	1	
Length of PVC piping, LF:	10	
Number of flanged fittings, EA:	8	
Number of check valves, EA:	1	
Number of butterfly valves, EA:	2	
Bolt pack, EA:	5	
Flow meter, EA:	1	

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Description: Quantities for equipment for trenching for GET piping and installation of recovery and re-injection well vaults Well vaults are assumed to be below grade vaults. All well vault pipe materials are assumed to be Schedule 80 PVC.

Total Well Vault Quantities		
Excavation, BCY:	27	*Rounded up to nearest whole number*
Total Volume of Bedding Material Required, CF:	144	
Total Volume of Bedding Material Required, TON:	27	*Assumes 1.5 tons per CY*
Area of Compaction, SF:	144	
Well vault, 6'x6'x4', EA:	9	
Well vault door, EA:	9	
Number of Elbow, 90 Deg Required, EA:	36	
Number of Tees Required, EA:	9	
Length of PVC piping, LF:	90	
Number of flanged fittings, EA:	72	
Number of check valves, EA:	9	
Number of butterfly valves, EA:	18	
Bolt pack, EA:	45	
Flow meter, EA:	9	
Insulation and metal jacket		
Pipe ID, IN:	8.0	
Pipe OD, IN:	8.5	
Pipe Insulation Thickness, IN:	2.5	
Overall diameter, IN:	13.5	
Pipe OD, FT:	1.13	
Circumference, FT:	3.5	
Area per unit, SF/FT:	3.5	

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Description: Quantities for O&M of groundwater extraction treatment systems.

Electrical Consumption by Treatment System		
Energy equivalent, HP-HR to kW-HR:	0.746	
Assumed pump efficiency, %:	50%	
Number of hours per year, HR:	8,760	*Assumes 24/7 operation*
Number of submersible pumps, EA:	3	
HP for submersible pumps, HP:	5	
Submersible pumps, HP-HR:	131,400	
Equivalent electrical consumption, kW-HR:	196,100	*Assumes motor efficiency, rounded up to nearest hundred*
Number of deep submersible pumps, EA:	3	
HP for deep submersible pumps, HP:	25	
Deep submersible pumps, HP-HR:	657,000	
Equivalent electrical consumption, kW-HR:	440,300	*Assumes motor efficiency, rounded up to nearest hundred*
Assumed equivalent HP for remaining treatment system, HP:	17	
Remaining system, HP-HR:	148,920	
Equivalent electrical consumption, kW-HR:	222,200	*Assumes motor efficiency, rounded up to nearest hundred*
Estimated total electrical consumption, KW-HR:	**858,600**	
Treatment System Operation and Maintenance		
Number of site visits per year, EA:	52	
Number of hours per visit, HR:	5	*Includes travel to and from site.*
Total number of hours, HR:	260	

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Description: Quantities for construction of treatment system building.

Treatment System Building

Estimated width of building, FT:	20	
Estimated length of building, FT:	20	
Estimated building height, FT:	14	
Building, SF:	400	
Perimeter, LF:	80	
Footing width, IN:	24	
Footing depth, IN:	12	
Footing, CF:	160	
Footing, CY:	6	*Rounded up to nearest whole number*
Excavation width, IN:	36	
Excavation depth, IN:	12	
Exacavation, CF:	240	
Exacavation, BCY:	9	*Rounded up to nearest whole number*
Exacavation, LCY:	11	*Rounded up to nearest whole number*
Exacavation, ECY:	9	*Rounded up to nearest whole number*
Exacavation, TON:	17	*Assumes 1.5 tons per CY*
Base course, IN:	6	
Base course, CF:	200	
Base course, BCY:	8	*Rounded up to nearest whole number*
Base course, LCY:	10	*Rounded up to nearest whole number*
Base course, ECY:	8	*Rounded up to nearest whole number*
Base course, TON:	15	*Assumes 1.5 tons per CY*
Rebar spacing, IN OC:	6	
Number of bars width, EA:	38	
Width length, FT:	19	
Number of bars length, EA:	38	
Bar length along length, FT/EA:	19	
Total length, FT:	1444	
64 rebar unit weight, LBS/FT:	**1.502**	
Reinforcing steel, LBS:	2168.888	
Reinforcing steel, TON:	1.1	
Forms, LF:	80	
Concrete slab thickness, IN:	6	
Concrete, CF:	200	
Concrete, CY:	8	*Rounded up to nearest whole number*
Insulation, SF:	1120	

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Description: Quantities for installation of monitoring wells.

Monitoring Well Installation

		Top	Bottom
Number of Shallow Monitoring Wells:	10		
Shallow Monitoring Well Depth, VLF:	125	Top	Bottom
Screened Interval, FT:	10	115	125
Estimated time to install shallow monitoring well, HR	10		
Estimated time to develop shallow monitoring well, HR	4		
Number of Middle Monitoring Wells:	10		
Middle Monitoring Well Depth, VLF:	150	Top	Bottom
Screened Interval, FT:	10	140	150
Estimated time to install middle monitoring well, HR	12		
Estimated time to develop middle monitoring well, HR	4		
Number of Deep Monitoring Wells:	10		
Deep Monitoring Well Depth, VLF:	200	Top	Bottom
Screened Interval, FT:	10	190	200
Estimated time to install deep monitoring well, HR	16		
Estimated time to develop deep monitoring well, HR	4		

Shallow Monitoring Well Quantities		Middle Monitoring Well Quantities	
Hollow Stem Drilling, LF:	1,250	Hollow Stem Drilling, LF:	1,500
Well Screen - PVC Slotted, LF:	100	Well Screen - PVC Slotted, LF:	100
Gravel Pack, LF:	100	Gravel Pack, LF:	100
Bentonite Seal, LF:	20	Bentonite Seal, LF:	20
Well Grout, LF:	1,130	Well Grout, LF:	1,380
PVC Casing, LF:	1,150	PVC Casing, LF:	1,400
Pressure Transducer, EA:	10	Pressure Transducer, EA:	10
Pressure Transducer, LF:	1,150	Pressure Transducer, LF:	1,400
Bentonite Seal, CF:	2	Bentonite Seal, CF:	2
Well Grout, CF:	74	Well Grout, CF:	91
Monitoring Well Plug, EA:	10	Monitoring Well Plug, EA:	10
8" Vault, EA:	10	8" Vault, EA:	10
Hauling Drill Cuttings to Landfill, LCY:	4.9	Hauling Drill Cuttings to Landfill, LCY:	5.9
Drill Cuttings Disposal, TON:	8	Drill Cuttings Disposal, TON:	9
Roll Off Rental for Drill Cuttings, DY:	14	Roll Off Rental for Drill Cuttings, DY:	16
Well Development, HR:	40	Well Development, HR:	40
Geologist, HR:	100	Geologist, HR:	120
Pickup Truck Rental, DY:	14	Pickup Truck Rental, DY:	16
Fuel for Rental Truck, DY:	14	Fuel for Rental Truck, DY:	16

Deep Monitoring Well Quantities

Hollow Stem Drilling, LF:	2,000
Well Screen - PVC Slotted, LF:	100
Gravel Pack, LF:	100
Bentonite Seal, LF:	20
Well Grout, LF:	1,880
PVC Casing, LF:	1,900
Pressure Transducer, EA:	10
Pressure Transducer, LF:	1,900
Bentonite Seal, CF:	2
Well Grout, CF:	124
Monitoring Well Plug, EA:	10
8" Vault, EA:	10
Hauling Drill Cuttings to Landfill, LCY:	7.8
Drill Cuttings Disposal, TON:	12
Roll Off Rental for Drill Cuttings, DY:	20
Well Development, HR:	40
Geologist, HR:	160
Pickup Truck Rental, DY:	20
Fuel for Rental Truck, DY:	20

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Description: Quantities for installation of monitoring wells.

Total		
Hollow Stem Drilling, LF:	4,750	
Well Screen - PVC Slotted, LF:	300	
Gravel Pack, LF:	300	
PVC Casing, LF:	4,450	
Pressure Transducer, EA:	30	
Pressure Transducer, LF:	4,450	
Bentonite Seal, CF:	6	
Well Grout, CF:	289	
Monitoring Well Plug, EA:	30	
8" Vault, EA:	30	
Hauling Drill Cuttings to Landfill, LCY:	18.6	
Transportation of Drill Cuttings to Landfill, EA:	1	*Assume roll off capacity of 25 yd*
Drill Cuttings Disposal, TON:	29	
Roll Off Rental for Drill Cuttings, DY:	50	
Well Development, HR:	120	
Geologist, HR:	380	
Pickup Truck Rental, DY:	50	
Fuel for Rental Truck, DY:	50	

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