FEASIBILITY STUDY REPORT
INDUSTRIAL OVERALL SERVICES
OPERABLE UNIT 1 – ON-SITE
SITE # 360109

WORK ASSIGNMENT NO. D007619-07

Prepared for:

New York State Department of Environmental Conservation
Albany, New York

Prepared by:

MACTEC Engineering and Consulting, P.C.
Portland, Maine

MACTEC: 3612112221

MARCH 2017
Revision 1

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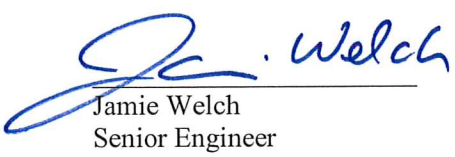

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GLOSSARY OF ACRONYMS AND ABBREVIATIONS

1,1,1-TCA	1,1,1- Trichloroethane
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
cy	cubic yard
DER	Division of Environmental Remediation
DNAPL	dense non-aqueous phase liquid
EC	engineering control
ERH	electrical resistivity heating
FS	Feasibility Study
IC	institutional control
IRM	interim remedial measure
ISCO	in-situ chemical oxidation
ISTT	in-situ thermal treatment
K	calculated transmissivity
MACTEC	MACTEC Engineering and Consulting, P.C.
µg/L	microgram(s) per liter
MNR	Metro North Railroad
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health

GLOSSARY OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

O&M	operation and maintenance
OM&M	operation, maintenance, and monitoring
OMB	Office of Management and Budget
OU	operable unit
PCE	tetrachloroethene
PNOD	permanganate natural oxidant demand
ppm	part(s) per million
PW	present worth
RAO	Remedial Action Objective
RI	Remedial Investigation
SCGs	standards, criteria, and guidance values
SCOs	Soil Cleanup Objectives
sf	square feet
Site	Industrial Overall Services Corporation site
SMP	site management plan
SRI	Supplemental Remedial Investigation
SVI	soil vapor intrusion
TCE	Trichloroethene
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WA	work assignment

1.0 INTRODUCTION

This Feasibility Study (FS) Report has been prepared by MACTEC Engineering and Consulting, P.C. (MACTEC), in response to Work Assignment (WA) No. D007619-07 from the New York State (NYS) Department of Environmental Conservation (NYSDEC) for the Industrial Overall Services Corporation site (Site) in New Rochelle, Westchester County, New York (Figure 1.1). The Site is listed as a Class 2 Inactive hazardous waste site; NYSDEC Site Number 360109, in the Registry of Hazardous Waste Sites in NYS.

1.1 REPORT ORGANIZATION

This FS report has been conducted in accordance with the WA, as well as the applicable portions of the following documents:

- NYSDEC Division of Environmental Remediation (DER)-10 "Technical Guidance for Site Investigation and Remediation" (NYSDEC, 2010)
- 6 New York Codes, Rules, and Regulations Part 375 "Environmental Remediation Programs"
- United States Environmental Protection Agency (USEPA) "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (USEPA, 1988)

The approach to this FS involves integration of data and conclusions presented in the Remedial Investigation (RI) and Supplemental Remedial Investigation (SRI) Reports (MACTEC, 2016a; MACTEC, 2016b), with development, screening, and evaluation of proposed remedial action alternatives from engineering, environmental, public health, and economic perspectives. This FS has been prepared to address contaminant source areas located on or close to the site property located at 10 Bartels Place in New Rochelle, Westchester County, New York. This FS report is structured as follows:

- Section 1.0 – Introduction
- Section 2.0 – Summary and Conclusions of Remedial Investigation
- Section 3.0 – Development of Remedial Action Goals and Objectives
- Section 4.0 – Identification of General Response Actions and Extent of Contamination Requiring Remedial Action

- Section 5.0 – Identification / Screening of Technologies and Development of Alternatives
- Section 6.0 – Detailed Description of Alternatives
- Section 7.0 – Detailed Analysis and Comparison of Alternatives
- Section 8.0 – Summary of the Proposed Remedy
- Section 9.0 – References

1.2 PURPOSE OF REPORT

The purpose of this FS Report is to develop and evaluate remedial alternatives for Operable Unit (OU) No. 1 (OU1), on-site remedial program to remove, reduce, or control the primary sources of contamination. OU1 includes site-related contaminants in vicinity of the site within the following media:

- vadose-zone soil (i.e., above the groundwater table)
- saturated soil (soil and highly weathered bedrock below the water table)
- overburden and shallow bedrock groundwater.

Contaminants in off Site groundwater (bedrock and overburden) that have migrated from the immediate site vicinity will be addressed in future FS reports under OU2. Additionally, off-site soil vapor intrusion impacts have been mitigated separately; investigations and mitigation measures are summarized in the *Confidential February/March 2016 Soil Vapor Intrusion Evaluation Letter Report* (MACTEC, 2016a).

2.0 SUMMARY AND CONCLUSIONS OF THE REMEDIAL INVESTIGATION

2.1 SITE BACKGROUND

The Site is a 0.42 acre slightly sloping irregular shaped parcel located at 10 Bartels Place in New Rochelle, Westchester County, New York (Figure 1.1). The area surrounding the site is an urban mix of commercial and residential structures. The main site features include a six-sided building which occupies the majority of the property and a small parking area located to the south and southwest of the building, as shown in Figure 2.1.

The Site began operations in the 1950s as a uniform and industrial clothing cleaning facility (Industrial Overall Services) for heavily soiled clothing from auto body and gasoline dispensing businesses. In 1980, Workingman's Closet, a direct factory sales division of Industrial Overall Services which sells new and reclaimed work clothes, was opened. The Site reportedly operated as a dry cleaning laundering facility between the 1960s and the 1980s. Apparel + Plus currently operates at the Site, laundering linens and uniforms for restaurants and other businesses.

2.2 REMEDIAL INVESTIGATION ACTIVITIES

RI field investigations completed at the Site between March 2012 and October 2015 consisted of:

- on-Site and off-Site soil sampling
- groundwater monitoring well installation
- groundwater sampling and groundwater elevation measurements at monitoring wells
- bedrock sampling and downhole geophysics
- soil vapor intrusion (SVI) sampling at 15 off-Site structures
- pore water sampling at Burling Brook, the closest downgradient surface water body and presumed groundwater discharge location
- an Interim Remedial Measure (IRM) implemented during the RI to address soil on the Residential Use property west of the site parking lot containing contamination exceeding Residential Soil Cleanup Objectives (SCOs)

2.3 REMEDIAL INVESTIGATION CONCLUSIONS

This subsection briefly summarizes the current understanding of the geology, hydrogeology, and nature and extent of vadose-zone soil, saturated soil, and groundwater contamination on and near the Site based on data from RI. For additional information refer to the RI and SRI Reports (MACTEC, 2016a; MACTEC 2016b).

2.3.1 Geology and Hydrogeology

Based on RI field observations, overburden at the Site ranges in thickness from 2.2 to 32 feet, overlying highly weathered gneissic/schistosic bedrock. Overburden in the vicinity of the Site generally consisted of varied amounts of fine to coarse sand with varying amounts of silt. Fill-material is present at the site, varying in thickness from one to five feet.

Deeper overburden (generally greater than 12 feet below ground surface [bgs]) at the Site is described as having till-like characteristics, including but not limited to olive to olive-brown color; presence of fine gravel with sub-angular to well-rounded edges; dense and well consolidated strata; and relatively low moisture content.

The Site and surrounding area is covered primarily with impervious surfaces (roads, buildings and parking lots); therefore, infiltration of precipitation is anticipated to be minimal and limited to the vicinity of the western and northwest debris pile and railroad tracks on the Metro North Railroad (MNR) property. Surface water runoff from the Site flows in a general southwest direction from Bartels Place, and the majority is collected in the municipal storm water and sanitary system.

Overburden groundwater is present ranging between 0.2 (beneath the Site building) to approximately 10 feet bgs. Groundwater in the overburden flows southwest, following a topographic valley and bedrock trough towards Burling Brook, ultimately discharging to New Rochelle Harbor. Calculated transmissivity (K) values in overburden range between 1.1 feet per day and 2.9 feet per day, with mean value estimated at 1.8 feet per day (MACTEC, 2016a). Based on a horizontal gradient of 0.031 feet per foot and an assumed overburden porosity of 0.25, the seepage velocity for overburden groundwater is calculated to be approximately 80 feet per year.

Bedrock encountered at the Site contains two distinctly different physical properties:

- Highly weathered bedrock – contains the mineralization and structure similar to weathered bedrock, but shows characteristics of a medium coarse sand (i.e. can be pulverized by hand) which is consistent with a highly weathered gneiss. In some locations, drilling investigations did not provide data sufficient to evaluate a difference between the dense deep overburden (till) and the highly weathered bedrock unit, however, the highly weathered bedrock unit was evaluated to be to be more transmissive than the till-like overburden material above it. Highly weathered bedrock was encountered at the Site ranging in thickness from one-foot (PZ-23) to 15 feet (BR-101) and was observed to increase in thickness east to west across the Site.
- Weathered bedrock – more competent than the highly weathered zone, with weathering observed along fracture zones.

Shallow bedrock groundwater also flows to the southwest, following the same trough feature. The calculated K values in bedrock ranged from 0.09 feet per day to 2.28 feet per day, with a mean value estimated at 0.6 feet per day. Based on a horizontal gradient of 0.03 feet per foot and an assumed porosity of the bedrock at 0.01, the average seepage velocity for bedrock groundwater is calculated to be approximately 300 feet per year.

Differences in transmissivity between the overburden (80 feet per year) and the highly weathered bedrock (300 feet per year) aquifers is likely the result of the dense till-like material that lies on top of the highly weathered transmissive bedrock unit. However, based on volatile organic compound (VOC) concentrations detected in groundwater (e.g., tetrachloroethene (PCE) concentrations in MW24 and MW24B are 6.2 parts per million [ppm] and 5.2 ppm respectively) and the changes in vertical gradients (ranging from -0.6 to 1.5 feet at the site), there does not appear to be a confining layer for vertical groundwater movement between the overburden and bedrock.

2.3.2 Nature and Extent of Contamination

Results of the RI indicate that:

- Two primary sources of contamination (primarily PCE) have been identified at the Site, including (1) the lint trap and (2) the debris disposal areas
- PCE concentrations in soil on the Site and MNR property adjacent to the Site exceed the NYS standards, criteria, and guidance values (SCGs)
- Surface soil (0-2 inches) on portions of the MNR property exceed SCGs, however, on-site surface soils are covered by paved surfaces or the site-building limiting exposure.

- Concentrations of PCE in overburden and bedrock groundwater exceed the NYS groundwater criteria (5 micrograms per liter [µg/L]) on the Site, and extend approximately 1,900 feet downgradient of the Site.
- Other VOCs, specifically PCE daughter products, including trichloroethene (TCE), cis-1,2-dichloroethene, and vinyl chloride were also detected on-site, indicative of reductive dechlorination.
- 1,1,1-trichloroethane (TCA) has been detected in groundwater on and downgradient from the site at concentrations that exceed NYS groundwater criteria, however, samples collected in October 2015 indicates the source of the 1,1,1-TCA is likely upgradient of the site and therefore will not be addressed in this FS.
- Cadmium, chromium, lead and silver were each detected in one sample at concentrations exceeding the protection of groundwater SCO located in subsurface soil within the lint trap.
- PCE in residential sub-slab soil vapor and indoor air exceed the NYS Department of Health (NYSDOH) recommended guidance values at two residential structures, and mitigation measures have been implemented.
- Four additional residential structures require ongoing SVI monitoring based on the NYSDOH SVI matrix.
- The Qualitative Exposure Assessment indicated ecological receptors are not present; however; completed exposure pathways exist for:
  - direct exposure to soil exceeding the residential, commercial, and industrial SCOs
  - direct exposure from the sub-surface in the vicinity of the identified contaminated soil, groundwater, or soil vapor, should work in those areas occur
  - SVI into nearby structures.

Surface water was not evaluated during the RI; however, three pore water samples were collected at the presumed groundwater/surface water interface at Burling Brook located approximately one mile south of the site, which is a potential discharge point for groundwater. VOCs were not detected in pore water; therefore, direct contact with contaminated shallow groundwater potentially discharging to surface water is not anticipated to be a complete exposure pathway for the Site and remedial action for surface water is not necessary.

An on-site vapor intrusion investigation was not conducted due to ongoing operations as a laundry facility. In addition the facility used PCE, the apparent source of the environmental contamination, at the Site during the 1960s through the early 1980s.

Based on these findings, MACTEC has prepared this FS to evaluate alternatives for remediating on-site source areas and to address off-site migration of contaminated groundwater which, in turn, will further reduce potential off-site contaminated soil vapor exposure.

3.0 DEVELOPMENT OF REMEDIAL ACTION GOALS AND OBJECTIVES

The RI concluded that under current and projected future use scenarios, complete exposure pathways for soil, groundwater, and soil vapor include:

1. Current potential of direct exposure with VOC-impacted surface soils
2. Current potential direct exposure with VOC-impacted soil vapor that has migrated into existing residential structures in the vicinity of the site
3. Future potential of direct exposure with VOC-impacted overburden and saturated soils, including highly weathered bedrock, and groundwater during future excavation or redevelopment
4. Future SVI potential in structures in the vicinity of the Site.

Groundwater at and in the vicinity of the Site is contaminated above NYS drinking water standards. However, the area is serviced by public water, and therefore groundwater is not believed to be used as a source of drinking water. Therefore, the groundwater pathway as a drinking water source is not a complete exposure pathway of concern under existing land uses.

Therefore, the Remedial Action Objectives (RAOs) for groundwater at the site are:

- prevent ingestion of groundwater with contaminant levels exceeding drinking water standards
- prevent contact with, or inhalation of volatiles, from contaminated groundwater
- to the extent practicable, restore groundwater aquifer to pre-disposal/pre-release conditions
- remove the source of groundwater contamination.

The RAOs for vadose soil, and saturated soil, including highly weathered bedrock (herein collectively referred to as saturated soil or saturated media) are:

- to the extent practicable, prevent ingestion/direct contact with contaminated surface soil
- prevent inhalation and exposure from contaminants volatilizing from contaminants in soil
- prevent migration of contaminants that would result in groundwater or surface water contamination
- prevent impacts to biota from ingestion/direct contact with soil having potential to cause toxicity or impacts from bioaccumulation through the terrestrial food chain.

The RAOs for soil vapor are:

- mitigate SVI in off-site structures as necessary.

Remediation goals for the Site include attainment, to the extent practicable, of the following chemical-specific SCGs:

- Protection of Groundwater SCOs (NYS, 2006) for soil in the vadose zone
- Commercial SCOs (NYS, 2006) for soil to a depth of 12 inches bgs
- GA Groundwater Quality Standards (NYS, 1999)
- NYSDOH Guidance Values (NYSDOH, 2006) for SVI

4.0 IDENTIFICATION OF GENERAL RESPONSE ACTIONS AND EXTENT OF CONTAMINATION REQUIRING REMEDIAL ACTION

Site-specific RAOs, presented in Section 3.0, were developed to address media with contamination requiring remedial action at OU-1, including:

- surface and vadose zone soil on the MNR property located northwest of the site building
- vadose zone soil located under the parking area to the west of the site building
- saturated soil located on-site, on the MNR property and to some extent on the sidewalk and street (Bartel Place)

General response actions describe those actions that will satisfy the RAOs (USEPA, 1988). General response actions may include treatment, containment, removal, institutional actions, or a combination of these. Like RAOs, general response actions are medium-specific. The general response actions presented in the following subsections have been developed to address surface and vadose-zone soil, saturated media, and soil vapor contamination at the Site. For each media, No Action will included as a general response action for comparing baseline conditions to remedial alternatives.

4.1 GENERAL RESPONSE ACTIONS

The following general response actions would address the RAOs identified for vadose and saturated soil, and are appropriate for the contamination requiring remediation:

- Access Restrictions
- Natural Attenuation
- In-situ Treatment
- Containment
- Removal

The following general response actions would address the RAOs identified for groundwater, and are appropriate for the contamination requiring remediation:

- Access Restrictions

- Monitored Natural Attenuation
- In-situ Treatment
- Containment
- Collection and Treatment

The following general response actions could address the RAOs identified for soil gas, and are appropriate for the contamination requiring remediation:

- Access Restrictions
- Engineering controls (ECs)

4.2 CONTAMINATION REQUIRING REMEDIAL ACTION

The presence and concentration distribution of VOC contamination (primarily PCE and TCE) suggest that two primary source areas are present at the Site: (1) the lint trap, located at the southeastern corner of the Site building, and (2) the Site debris areas, located west and northwest of the Site building on Site and MNR property.

The lint trap is a four foot by six foot by 9.5 foot deep subsurface structure located inside the Site building; the trap is used to collect solid materials from process wastewater, and is part of the Site building's sanitary sewer system. Due to the age and condition of the lint trap, it has provided a direct entry point for source material to subsurface soils, including highly weathered bedrock, and groundwater. PCE in the lint trap area has travelled vertically via gravity into the underlying soils and then into the highly weathered bedrock immediately below the lint trap. A direct push investigation beneath the lint trap identified soils containing what appear to be free-phase product (dense non-aqueous phase liquid [DNAPL]), based on visual observations. Once in the subsurface soils and highly weathered bedrock, the contamination appears to have migrated horizontally within these layers, as well as vertically into the fractures of the weathered bedrock below. In addition to PCE, select metals were also detected in the soil within the lint trap.

Debris disposed on the ground surface west and northwest of the Site represents the second primary source of VOC contamination. Concentrations of VOCs in surface soil, vadose-zone soil and saturated soil exceeding the SCOs correspond with surface disposal areas, including the western debris pile, northwestern debris pile, and along the MNR tracks (Figure 2.1). The distribution of

contaminants both above and within the groundwater table is consistent with would be expected to result from disposal of materials from the lint trap and other laundry related waste containing PCE on the pervious ground surface in this area. Precipitation and surficial overland run-off is the main transport mechanism for migration of surface or shallow contamination to deeper soils and groundwater.

As discussed in the RI report, the following conclusions can be made regarding soil, highly weathered bedrock, groundwater, and soil vapor contamination:

- PCE concentrations in surface soil, vadose-zone soil, and saturated soil on the Site and the adjacent MNR property exceed the NYS SCGs
- VOC concentrations in overburden and bedrock groundwater, extending approximately 1,600 feet downgradient of the Site, exceed the NYS groundwater criteria of 5 µg/L on the Site.

Remedies proposed in this FS address surface soil, vadose-zone soil, saturated soils (including the highly weathered bedrock), groundwater, and resulting contaminated Site soil vapor within OU1.

4.3 ASSUMPTIONS FOR THE FEASIBILITY STUDY

This FS is limited to contamination within and adjacent to the Site boundary, therefore, assumptions have been made to streamline the FS. The following is a list of assumptions made that are carried through from the screening of technologies phase to the comparison of remedial alternatives.

- NYSDEC will coordinate with the property owner, the public, adjacent landowners, and MNR to provide access to areas needed to implement the remedial action including storage of construction equipment, temporary treatment systems, and stockpiling areas.
- Based on the permanganate natural oxidant demand (PNOD) result of 0.74 grams per kilogram determined during recent laboratory analysis of on-site soil samples (Appendix A), PNOD in the overburden is favorable for in situ chemical oxidation.
- Additional design considerations may need to be implemented, depending on results of a future pre-design investigation to determine the extent of DNAPL and/or soil contamination along the sanitary sewer line within close proximity to the site property. Impacts along the sanitary sewer line downgradient from the site property will be addressed separately.

5.0 IDENTIFICATION/SCREENING OF TECHNOLOGIES AND DEVELOPMENT OF ALTERNATIVES

This section presents the identification and screening of potential remedial technologies. Technologies are identified for the purpose of attaining the RAOs established in Section 3.0.

Following the identification of remedial technologies, candidate technologies are screened based on their applicability to site-limiting characteristics and their potential effectiveness based on contaminant-limiting characteristics. The purpose of the screening is to produce an inventory of suitable technologies that can be assembled into remedial alternatives capable of mitigating actual or potential risks at the Site. Potential technologies representing a range of general response actions (i.e., no action, limited action, containment, removal, treatment, and disposal) are considered. The result of technology screening is a list of potential remedial technologies that may be developed into candidate remedial alternatives.

5.1 TECHNOLOGY IDENTIFICATION AND SCREENING

Table 5.1 lists the remedial technologies and associated process options identified for screening. These technologies were identified based on USEPA's Guidance for Conducting RI/FS (USEPA, 1988). The screening focuses on the general response actions, presented in Subsection 4.1, capable of remediating the contaminants of concern (COCs) present in OU1 surface soils, vadose-zone soil, saturated soil and groundwater, and soil vapor.

The technology screening process reduces the number of potentially applicable technologies and process options by evaluating factors that may influence process-option effectiveness and implementability. This overall screening is consistent with guidance for conducting an FS under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (USEPA, 1988). Effectiveness and implementability are incorporated into two screening criteria: site- and waste-limiting characteristics. Site-limiting characteristics consider the effect of site-specific physical features on the implementability of a technology, such as site topography and geology, the location of buildings and underground utilities, available space, and proximity to sensitive operations. Waste-limiting characteristics consider the suitability of a technology based on

contaminant types, individual compound properties (e.g., volatility, solubility, specific gravity, adsorption potential, and biodegradability), and interactions that may occur between mixtures of compounds. Technology screening serves a two-fold purpose of screening out technologies whose applicability is limited by site-specific waste or site considerations, while retaining as many potentially applicable technologies as possible.

5.2 DEVELOPMENT AND SCREENING OF REMEDIAL COMPONENTS

Retained technologies from Table 5.1 are considered technically feasible and applicable to the waste types and physical conditions at the Site. These technologies were assembled into potential media-specific remedial components capable of achieving the RAOs for the contaminated media.

Table 5.2 presents a screening of the remedial components which are divided into three matrices:

1) surface and vadose-zone soil,
2) saturated media and groundwater, and
3) soil vapor.

Remedial components for saturated media and groundwater were combined because each technology will address the contamination in the identified matrices (i.e., groundwater, saturated soil, and highly weathered bedrock). As shown on Table 5.2, no remedial components to address soil vapor were retained for further analysis because the remedial components selected to address vadose-zone soil and saturated media will also result in soil vapor treatment.

Consistent with DER-10, the developed medium-specific remedial components were screened on the basis of whether they have the ability to meet the RAOs (Effectiveness) and whether they are technically implementable (Implementability). Additionally, based upon available information, the relative cost of each remedial components is also evaluated. Those remedial components which are not technically implementable, would not achieve RAOs for the Site, or would incur costs significantly higher than other remedial components without providing greater effectiveness or implementability, will not be evaluated further.

5.3 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Retained remedial components presented in Table 5.2 for each media were compiled into site-wide remedial action alternatives that address OU1. The remedial action alternatives are summarized in the table below. A description of each alternative is included in the following sub-sections and in Section 6.0.

	Proposed Alternatives				
Alternative Components	**1**	**2**	**3**	**4**	**5**
No Action	X				
Site-Wide Soil Excavation to Pre-Disposal Conditions		X			
Soil Capping on MNR property, with minor excavation (remove soil > commercial SCOs)			X		
Excavation of vadose-zone soil on MNR property to meet protection of GW standards				X	X
Repave western parking area to provide direct-contact barrier and inspect paved area annually.			X	X	X
Source Area Removal (Lint trap soil via vacuum excavation)			X	X	X
In-situ chemical oxidation (ISCO) injections in vicinity of lint trap and debris piles (MNR property)			X	X	
Groundwater Extraction, Treatment and Recirculation and associated operation, maintenance, and monitoring (OM&M)			X		
Passive ISCO treatment (cylinders)				X	
In-Situ Thermal Treatment (ISTT)					X

5.3.1 Alternative 1

This alternative will be used as a baseline for comparison to other remedial alternatives. No action would be taken to address contamination at OU1.

5.3.2 Alternative 2

Alternative 2 will address impacted media at OU1 to pre-release conditions by excavating surface and vadose-zone soil as well as saturated soil and weathered bedrock. This will in turn remediate groundwater and soil vapor to pre-release conditions.

5.3.3 Alternative 3

Alternative 3 will address surface and vadose zone soil by:

- providing a soil cap on impacted soil on the MNR property
- re-paving the parking area over the on-site impacted soil.

Saturated media will be addressed by:

- removing soil beneath the lint trap to the extent possible
- conducting ISCO injections in the two source areas
- installing a perimeter groundwater extraction system that will treat extracted groundwater with oxidants prior to reinjecting it upgradient to minimize further off-site migration.

5.3.4 Alternative 4

Alternative 4 will address surface and vadose zone soil by:

- excavating soil with concentrations of contaminants greater than the Protection of Groundwater SCO on the MNR property.
- re-paving the parking area over the on-site impacted soil.

Saturated media will be addressed by:

- removing soil in the lint trap to the extent possible
- conducting ISCO injections in the two source areas
- initiating passive ISCO treatment at the perimeter of the site to minimize off-site migration.

5.3.5 Alternative 5

Alternative 5 will address surface and vadose zone soil by:

- excavating impacted soil on the MNR property
- re-paving the parking area over the on-site impacted soil.

Alternative 5 will address saturated media by:

- removing soil in the lint trap to the extent possible
- conducting ISTT throughout the source area from the top of the groundwater table to the top of competent bedrock.

6.0 DETAILED DESCRIPTION OF ALTERNATIVES

This section provides a detailed description of the alternatives retained in Section 5.0. These conceptual designs were used to estimate the associated costs for each alternative.

6.1 ALTERNATIVE 1

This alternative does not include any actions to address surface soil contamination.

6.2 ALTERNATIVE 2

Alternative 2 includes the following components, subsequently described in detail and depicted on Figure 6.1:

- pre-design investigation
- mobilization and temporary facilities and controls
- demolition of the existing on-site building
- excavation of impacted soil from surface to the top of competent bedrock
- site restoration

Pre-Design Investigation: Pre-design investigations and/or studies conducted to support the remedial design will include:

- delineation of horizontal extents of impacted vadose and saturated soil
- investigations of the slope, bank, and storm water drainage pathways on the MNR property to support slope stability design and drainage design for final restoration
- subsurface investigation to evaluate the potential for DNAPL and/or soil contamination along the sanitary sewer line
- ground-penetrating radar survey to support subsurface utility/obstruction clearance of the proposed treatment areas
- overall constructability review to evaluate, at a minimum, space restrictions and implications to MNR, the adjacent residential property, and the road
- geotechnical investigations for excavation support systems
- pump test to estimate quantity of water that will be recovered during excavation dewatering activities
- building materials survey to support demolition cost estimate

- hazardous building material survey
- composite soil samples for pre-characterization of soil

Mobilization and Temporary Facilities and Controls: Site preparation, mobilization, and temporary facilities and controls will include activities required to prepare the Site for construction including, but not limited to:

- delivery and setup of site trailers
- installation of temporary utilities
- installation of a decontamination pad
- implementation of erosion and sediment control measures
- placement of temporary fencing around work areas
- preparation of work plans

Building Demolition: It is assumed for cost estimating purposes that the on-site building will not require hazardous building material abatement prior to demolition. Conventional equipment will be used to demolish the building, and demolition debris will be transported and disposed or recycled as appropriate.

Soil Excavation: Impacted soil on-site and on the MNR property with detectable concentrations of site-related COCs will be excavated and transported off-site for disposal. First, steel sheeting will be installed around the perimeter of the area to be excavated. For cost estimating purposes, it is assumed that steel sheets will be driven to approximately 40 feet bgs, which is 15 feet into competent bedrock. Groundwater extraction, treatment through a temporary treatment system, and discharge to a storm sewer is assumed to keep the excavation area dry during excavation. Soil excavation will be conducted with conventional earthmoving equipment (e.g., backhoes and front-end loaders). Excavated soils will be loaded directly onto trucks for off-site transportation and disposal or, if needed, temporarily stockpiled on impervious liners in a designated area of the Site. Impervious liners will also be used to cover the soil stockpiles to prevent the infiltration and runoff of precipitation. Transportation of soils from the Site to the landfill will be conducted in accordance with applicable regulations for the transport of contaminated waste materials. An estimated 32,000 cubic yards (cy) of soil will be excavated and transported off-site. It has been assumed that 10% of the excavated soil will be determined to be hazardous, and 90% will be disposed as non-hazardous. As the soil excavation progresses, confirmatory samples will be collected from the bottom of the excavation to verify that

Site remediation goals have been achieved. Samples will be analyzed for VOCs, which include the site COCs.

Once the sample results confirm that RAOs have been achieved, the excavated areas will be backfilled with certified clean backfill and compacted in 6-inch lifts until pre-existing grades have been achieved.

6.3 ALTERNATIVE 3

Alternative 3 consists of the following components, subsequently described in detail and depicted on Figure 6.2:

- pre-design investigation
- mobilization of temporary facilities and controls
- excavation on the MNR property to removal soil in excess of commercial SCOs
- grading and placement of soil cover on the MNR property
- replace parking area asphalt
- vacuum excavation inside the lint trap
- ISCO injections in the vicinity of the lint trap and lint piles (MNR property)
- installation of the groundwater extraction/treatment/recirculation system
- Institutional Controls (ICs)
- long-term monitoring and reporting

Pre-Design Investigations and Studies. The predesign investigation and studies for Alternative 3 will include the following:

- delineation of horizontal extents of impacted vadose soil on the MNR property
- investigations of the slope, bank, and storm water drainage pathways on the MNR property to support slope stability design and drainage design for final restoration
- subsurface investigation to evaluate the potential for DNAPL and/or soil contamination along the sanitary sewer line
- ground-penetrating radar survey to support subsurface utility/obstruction clearance of the proposed treatment areas
- subsurface soil and groundwater sampling and analysis to provide additional characterization for ISCO injections and pump/treat/recirculation process
- water injection test to determine the applicability of ISCO injections
- treatability/pilot studies for delivery approach of ISCO injection

- overall constructability review to evaluate, at a minimum, space restrictions and structural stability of the lint trap.

Mobilization and Temporary Facilities and Controls. Site preparation, mobilization, and temporary facilities and controls will be similar to those described in Alternative 2.

Placement of Soil Cover and Asphalt Replacement. Rough surface grading within the impacted area will be conducted to provide a smooth area for capping. However, given the existing site surface topography and to maintain the functionality and aesthetics in the area, some of the soil will need to be excavated and transported off-site for disposal before adding the soil cover. The excavation area will focus on soil exceeding Commercial SCOs (estimated to be 135 cy), which will be removed from the Site and managed and disposed in accordance with applicable requirements. Following excavation of these areas, the entire area to be covered will be prepared by surface grading throughout the estimated 550 square-foot (sf) area.

For cost estimating purposes, it has been assumed that the soil cover will include 6 inches of compacted, low permeable clean fill (90 cy) overlain by six inches of topsoil (90 cy). The capped area will be seeded and erosion control blankets installed on sloped areas as needed.

There is approximately 4,600 sf of asphalt parking area overlying the impacted vadose-zone soil. A small portion of this asphalt parking area (880 sf) is located on the MNR property, and the remainder is located on the site property. Following completion of other remedial activities, existing asphalt both on and off-site will be removed and replaced for the purposes of minimizing direct exposure to shallow soils.

Limited Excavation: VOC-contaminated saturated soil beneath the lint trap will be excavated to the extent practicable and transported to an off-site treatment and/or disposal facility to minimize the volume and potential migration of DNAPL at the Site. The bottom of the lint trap, which is comprised of stones, bricks, cinders and mortar, will first be removed to provide access to the impacted soil. Excavation will be conducted using vacuum excavation equipment. The vacuum truck will be located outside the building with the vacuum intake inside the building. Hand probes or probe attachments on the vacuum intake will be used to loosen dense soil to enable vacuum excavation until refusal is met. The estimated volume of soil to be removed from the lint trap area is 42 cy. The area to be excavated

is where DNAPL was observed and where select metals have been detected above SCOs. The excavated material will be shipped off-site to a licensed facility as hazardous waste.

The excavation area will be backfilled with crushed stone, and a perforated riser pipe will be installed within the crushed stone to enable chemical oxidation injections. A geotextile fabric will be placed over the crushed stone and concrete will be poured to seal the bottom of the lint trap.

ISCO Injection Treatment: ISCO will be implemented to provide treatment in the two overburden / highly weathered bedrock source contamination areas at the Site. It is assumed for cost estimating purposes that implementation will involve the injection of RemOx® S ISCO (potassium permanganate reagent produced by Carus Corporation).

First, a pilot test will be conducted just outside of the lint trap as well as in the former debris pile source area. In both areas, injections will take place starting at the groundwater table and extending to the interface of highly weathered bedrock and competent bedrock (approximately 30-35 feet bgs) with injections occurring at depths of every two to four feet. It is estimated that five injection locations at each source area (including adding permanganate to the aforementioned perforated pipe in the lint trap) will be conducted. Additional borings and/or monitoring wells will be installed after injections to evaluate the radii of influence of the injections and to enable post-injection monitoring. At six months to one year following the pilot test, full scale injections will take place.

The full scale permanganate reagent injection program is anticipated to include a total of 30 injection points, however the total number of points will depend on the results of the pilot test. As previously described for the pilot test, injections will be conducted every two to four vertical feet starting at the groundwater table and extend to the interface of highly weathered bedrock and weathered bedrock (approximately 30-35 feet bgs, or as established in the pre-design investigations and pilot test). A total of 35,500 lbs of potassium permanganate has been estimated for full scale remediation, 33,500 lbs in lint trap zone and 2,000 lbs in debris piles zone. Monitoring wells will also be installed to evaluate the effectiveness of the remedy.

Within one year of injections, a second round of injections is anticipated. In has been assumed that the second round of injections will incur half as much permanganate as the first round.

Installation of the Perimeter Groundwater Extraction and Recirculation System: A groundwater extraction and recirculation system will be installed to minimize off-site migration of groundwater while the source area continues to be treated by permanganate. Groundwater extraction will consist of a series of groundwater extraction wells placed downgradient of the source areas. Although the actual number of extraction wells will depend on the pump test conducted during pre-design, six extraction wells have been assumed for cost estimating purposes. Four injection wells will be installed upgradient of the source areas, and the lint trap pipe will also be used for reinjection. Extracted groundwater will be conveyed through below grade conveyance piping to a treatment system.

The treatment system will include, at a minimum, a groundwater collection tank, bag filters for sediment removal, a tank for sodium permanganate solution, and a chemical feed pump to dose the extracted groundwater with permanganate in-line prior to reinjection. Four injection wells will be installed within or upgradient of the source areas to assist with flushing of the source area in the overburden and highly weathered bedrock. The lint trap pipe will also be used for reinjection for continuous treatment within this highly impacted area. Conveyance lines for reinjection may be below ground or above ground where located inside the building (i.e., on the ceiling or along walls).

The flow rate for each extraction well and injection well will be determined following the pre-design investigations, and adjusted as needed during start-up. Wells will be installed to extract and reinject water from both the overburden and highly weathered bedrock aquifers. The location of the proposed extraction wells, proposed injection wells, and proposed location of treatment system is shown on Figure 6.1.

Institutional Controls: ICs will likely include implementation of land-use restrictions to control subsurface activity in order to maintain the soil cover and paved areas, and to prohibit changes in zoning of the Site. Land-use restrictions will be implemented through legal instruments such as deeds and/or permitting processes, and a Site Management Plan (SMP) will be required.

Long Term Monitoring and Reporting. It is assumed that after the placement of the soil cap, replacement of the asphalt parking area, and remedial activities for the groundwater saturated zone, site monitoring and long-term groundwater sampling will be carried out for a total of up to 30 years. It is assumed that semi-annual groundwater sampling will occur for the first 5 years at 12 monitoring locations. Annual sampling will be conducted thereafter at six monitoring locations.

Annual inspections of the soil cap and asphalt cover will be conducted for 30 years. Operations, maintenance, and monitoring of the recirculation system will take place for 10 years. Monitoring results will be presented in an annual report.

6.4 ALTERNATIVE 4

Alternative 4 consists of the following components, subsequently described in detail and depicted on Figure 6.3:

- pre-design investigation
- mobilization and temporary facilities and controls
- excavation on the MNR property to remove vadose-zone soil in excess of protection of groundwater standards
- replace parking area asphalt
- vacuum excavation inside the lint trap
- ISCO injections in the vicinity of the lint trap and lint piles (MNR property)
- Installation of permanganate cylinders along the perimeter of the site
- ICs
- long-term monitoring and reporting

Pre-Design Investigation: Pre-design investigations will be similar to that of Alternative 3, with additional sampling required to delineate the depth of the excavation area at the MNR property.

Mobilization and Temporary Facilities and Controls: Site preparation, mobilization, and temporary facilities and controls will be similar to those described in Alternative3.

Excavation of Impacted Vadose Zone Soil on MNR Property: VOC-contaminated vadose-zone soil on the MNR property within an estimated 5,400 sf area will be excavated and transported to an off-site treatment and/or disposal facility. The total estimated volume of soil to be removed is 1,300 cy ranging in depth from 2 to 10 feet, with an average depth of 6.5 feet. A portion of the excavation is located under asphalt that will require removal prior to excavation. It is assumed that trench box excavation support will be required adjacent to the railroad tracks and adjacent to the railroad utility building.

Soil excavation will be conducted with conventional earthmoving equipment (e.g., backhoes and front-end loaders). Excavated soils will be loaded directly onto trucks for off-site transportation and disposal or, if needed, temporarily stockpiled on impervious liners in a designated area of the Site. Impervious liners will also be used to cover the soil stockpiles to prevent the infiltration and runoff of precipitation. The transportation of the soils from the Site to the landfill will be in accordance with applicable regulations for the transport of contaminated waste materials. As the soil excavation progresses, confirmatory samples will be collected from the bottom and sidewalls of the excavation to verify that Site remediation goals have been achieved. Samples will be analyzed for VOCs which include the site COCs.

Once the sample results confirm the RAOs have been achieved, the excavated areas will be backfilled to pre-existing grades. It is assumed for costing purposes that crushed stone would be used as backfill. The portion of the excavation that is under asphalt will be re-paved.

In addition to excavating, similar to Alternative 3, the on-site parking area that overlies impacted vadose-zone soil will be repaved for the purposes of minimizing direct exposure to shallow soils.

Limited Excavation of Saturated Soils: VOC-contaminated saturated soil beneath the lint trap will be excavated to the extent practicable as described in Alternative 3.

ISCO Injection Treatment: ISCO will be implemented to provide treatment in the two overburden / highly weathered bedrock source contamination areas, similar to Alternative 3.

Perimeter Passive ISCO Treatment: Perimeter passive ISCO treatment will involve installation of slow-release paraffin permanganate cylinders produced by Carus Corporation, REMOX® SR ISCO. Fist, a pilot test will be conducted which will include the installation of solid paraffin cylinders composed of approximate 80% solid potassium permanganate that will slowly release into groundwater over several years. Cylinders will be tested as a reactive barrier wall, placed immediately downgradient of one of the two on-Site source zones to prevent off-Site contaminant migration. Emplacement will include two off-set linear series of cylinders, spaced approximately 15 feet apart, totaling approximately six locations. Within each linear distribution, cylinders will be 8 to 10 feet apart, with multiple cylinders stacked above one another at each location to treat groundwater within the overburden and highly weathered bedrock zones prior to off-site migration. Cylinders may be

placed in an open borehole or inside monitoring wells. For costing purposes it has been assumed that half of the locations will be completed as monitoring wells to enable replacement of cylinders as needed. Monitoring wells will also be placed downgradient of the cylinders to monitor effectiveness.

Full-scale remedial design will occur following the installation of the pilot test cylinders and up to one year of monitoring. For costing purposes it is assumed that that two rows of 30 locations will be placed at the downgradient perimeter of the source areas as shown in Figure 6.3. Similarly to the pilot test, approximately half of the borings will be completed as monitoring wells, which will enable replacement of half the cylinders when needed. Cylinder replacement is assumed to occur after three years and will be re-evaluated thereafter.

Institutional Controls: ICs will likely include implementation of land-use restrictions to control subsurface activity beneath the on-site parking area and below the groundwater table and to prohibit changes in zoning of the Site. Land-use restrictions will be implemented through legal instruments such as deeds and/or permitting processes, and an SMP will be required.

Long-term Monitoring and Reporting: Long-term monitoring and reporting will be similar to Alternative 3, with the exception that it will not require routine OM&M of the recirculation system.

6.5 ALTERNATIVE 5

Alternative 5 is similar to Alternative 4 with the exception that it includes ISTT instead of ISCO to remediate saturated media. This alternative consists of the following components, subsequently described in detail and depicted on Figure 6.4:

- pre-design investigation
- mobilization and temporary facilities and controls
- excavation on the MNR property to remove vadose-zone soil in excess of protection of groundwater standards
- replace parking area asphalt
- vacuum excavation inside the lint trap
- full-scale implementation of ISTT
- long-term monitoring and reporting

Pre-Design Investigation: Pre-design investigations will be similar to that of Alternative 4.

Mobilization and Temporary Facilities and Controls: Site preparation, mobilization, and temporary facilities and controls will be similar to those described in Alternative 4. Additional contractor laydown areas may be required for excess materials and supplies required for ISTT.

Excavation of Impacted Vadose Zone Soil on MNR Property: Excavation of impacted vadose zone soil on the MNR property, and replacement of the asphalt parking area will be conducted as described in Alternative 4.

Limited Excavation of Saturated Soils: VOC-contaminated saturated soil beneath the lint trap will be excavated to the extent practicable similarly to that described for Alternatives 3 and 4.

Full-scale ISTT Implementation. Several techniques for ISTT are available. For the purpose of cost estimating it is assumed that electrical resistivity heating (ERH) will be used. To streamline the cost estimate it has been assumed that co-located ERH electrodes, vapor recovery wells and temperature/pressure probes will be spaced at an 15 feet spacing throughout the treatment area, regardless of any structures, for a total of 35 locations. The average depth of the electrodes will be from approximately 4.5 feet bgs to the bottom of the highly weathered bedrock at approximately 25 feet bgs. A total of six temperature monitoring points will also be installed, each containing five temperature sensors. Drilling activities will be completed over approximately three weeks, and will include disposal of drill cuttings. A crew will be tasked to mobilize and install the utility upgrades, thermal treatment equipment, off-gas treatment system, and liquid effluent treatment systems. The drilling, installation, start-up, and operation of the treatment system will be conducted over a 180-day duration, and an estimated 1,430,000 kilowatt-hours of energy will be needed during the operation of the system. At completion of treatment, confirmatory soil and groundwater samples will be collected, wells abandoned, and a final completion report produced.

OM&M of the thermal system will include weekly site visits at a minimum for up to one year. Effluent air and water samples (from vapor condensate) will be collected in accordance with acquired discharge permits. Subsequent to full-scale implementation, monitoring of groundwater conditions will be conducted to determine the effectiveness of the ISTT. Based on results from the initial sampling rounds, the system may be turned back on or otherwise modified for additional treatment prior to complete decommissioning. For costing purposes, it is assumed that system operation will

successfully meet remedial action objectives and will not need to be turned back on or modified, and that the system will be decommissioned approximately within one year after initial shut down.

At the completion of ISTT, the parking area will be repaved to provide a barrier to direct exposure to any remaining contaminants in the vadose zone.

Long-term Monitoring and Reporting: Long-term groundwater monitoring for this alternative has been assumed to be semi-annual for 2 years following completion of ISTT and then annually for 3 years. Groundwater monitoring results will be summarized in an annual report. Annual inspections of the paved parking area will continue for 30 years.

7.0 DETAILED ANALYSIS AND COMPARISON OF ALTERNATIVES

7.1 DETAILED ANALYSIS EVALUATION CRITERIA

Detailed analysis of each remedial component for addressing surface and vadose zone soil, saturated soil, and groundwater was performed using the evaluation criteria identified in DER-10 (NYSDEC, 2010) and Subpart 375-1.8(f) (NYS, 2006). Table 7.1 provides the detailed evaluation using the following evaluation criteria:

- Compliance with Standards, Criteria and Guidance
- Overall Protection of Public Health and the Environment
- Short-term Impacts
- Short-term Effectiveness
- Long-term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume with Treatment
- Implementability
- Land Use
- Sustainability / Green Remediation (DER-31)
- Cost-Effectiveness

Compliance with Standards, Criteria, and Guidance. Compliance with SCGs addresses whether or not a remedy will meet applicable environmental laws, regulations, standards, and guidance. SCGs for the Site are listed along with a discussion of whether or not the remedy will achieve compliance. For those SCGs that will not be met, there is a discussion and evaluation of the impacts of each, and whether waivers are necessary. Chemical-specific SCGs were discussed in Section 3.0. Table 7.2 summarizes the list of applicable SCGs used in the evaluation of alternatives.

Overall Protection of Public Health and the Environment. This criterion is an evaluation of the remedy's ability to protect public health and the environment, assessing how risks posed through each existing or potential pathway of exposure are eliminated, reduced or controlled through removal, treatment, ECs or ICs. The remedy's ability to achieve each of the RAOs is evaluated.

Short-term Impacts and Effectiveness. The potential short-term adverse impacts and risks of the remedy upon the community, the workers, and the environment during the construction and/or implementation are evaluated. A discussion of how the identified adverse impacts and health risks to the community or workers at the Site will be controlled, and the effectiveness of the controls, are presented, along with a discussion of ECs that will be used to mitigate short term impacts (e.g., contaminant migration/odor control measures). The length of time needed to achieve the remedial objectives is estimated.

Long-term Effectiveness and Permanence. This criterion evaluates the long-term effectiveness of the remedy after implementation. If wastes or treated residuals remain on-site after the selected remedy has been implemented, the following items will be evaluated:

1. magnitude of remaining risks
2. adequacy of the engineering and ICs intended to limit the risk
3. reliability of these controls
4. ability of the remedy to continue to meet RAOs in the future

Effectiveness of alternatives in protecting human health and the environment after implementation of the remedy. This includes an evaluation of the permanence of the alternative, the magnitude of residual risk, and the adequacy and reliability of controls required to manage wastes or residuals remaining at the Site.

Reduction of Toxicity, Mobility, or Volume with Treatment. The remedy's ability to reduce the toxicity, mobility or volume of site contamination is evaluated. Preference is given to remedies that permanently and significantly reduce the toxicity, mobility, or volume of the wastes at the Site.

Implementability. The technical and administrative feasibility of implementing the remedy is evaluated. Technical feasibility includes the difficulties associated with the construction and the ability to monitor the effectiveness of the remedy. For administrative feasibility, the availability of the necessary personnel and material is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, or other issues.

Land Use. The current, intended, and reasonably anticipated future land uses of the Site and its surroundings is considered in the evaluation of remedial alternatives.

Sustainability / Green Remediation (DER-31). Evaluating compliance with DER-31 (NYSDEC, 2011) this includes: applying green remediation concepts, such as minimizing energy consumption; reducing greenhouse gas emissions; maximizing the reuse of land and the recycling of materials; and conserving natural resources such as soil, water and habitat to the extent possible while still implementing remedies that are protective of public health and the environment.

Cost-Effectiveness. Capital and Site Management costs, including OM&M costs, were estimated based on the conceptual designs described in Section 6.0 for each remedial alternative and are compared on a present worth (PW) basis.

7.1.1 Cost Analysis Procedures

Estimated costs presented in this FS Report are intended to be within the target accuracy range of minus 30 to plus 50 percent of actual cost (USEPA, 1988). Costs are presented as a PW and as a total cost for up to a 30-year period.

A summary of the costs for each alternative identifying capital and PW costs are included in each alternative's cost description. Each cost estimate includes a PW analysis to evaluate expenditures that occur over different time periods. The analysis discounts future costs to a PW and allows the cost of remedial alternatives to be compared on an equal basis. PW represents the amount of money that, if invested now and disbursed as needed, will be sufficient to cover costs associated with the remedial action over its planned life. A discount rate of 3.5 percent, as published by the Office of Management and Budget (OMB), was used to prepare the cost estimates (OMB, 2016).

Consistent with USEPA FS cost estimating guidance (USEPA, 2000), the remedial alternative cost estimates include costs for project management, remedial design, construction management, technical support, and scope contingency.

Project management includes planning and reporting, community relations support during construction or OM&M, bid or contract administration, permitting (not already provided by the

construction or OM&M contractor), and legal services outside of ICs. Project management costs are generally between 5 and 10 percent of total direct costs.

Remedial design cost includes cost for pre-design collection and analysis of field data, engineering survey for design, treatability study/pilot-scale testing, and the various design components such as design analysis, plans, specifications, cost estimate, and schedule. Remedial design cost is generally between 6 and 20 percent of total direct costs.

Construction management cost includes cost associated with services to manage construction or installation of the remedial action, except any similar services provided as part of regular construction activities. Activities include review of submittals, design modifications, construction observation or oversight, engineering survey for construction, preparation of an operation and maintenance (O&M) manual, documentation of quality control/quality assurance, and record drawings. Construction management cost is generally between 6 and 15 percent of total direct costs.

Technical support during O&M includes services to monitor, evaluate, and report progress of remedial action. This includes oversight of O&M activities, updates to the O&M manual, and progress reporting and is generally between 10 percent and 20 percent of total annual O&M costs depending on complexity of the remedial action (USEPA, 2000).

Scope contingency represents project risks associated with the feasibility-level of design presented in this FS Report. This type of contingency represents costs, unforeseeable at the time of estimate preparation, which are likely to become known as the remedial design proceeds. Scope contingency ranges from 10 to 25 percent, with higher values appropriate for alternatives with greater levels of cost growth potential (USEPA, 2000). A contingency of 20% was added to each of the alternatives described herein.

Project management, remedial design, and construction management costs, related to implementation of the chosen remedial alternative, presented in this FS Report are based upon the following matrix presented in the USEPA FS cost estimating guidance (USEPA, 2000).

Professional and Technical Costs as Percentage of Direct Costs					
Indirect Cost	< $100K (%)	$100K-$500K (%)	$500K-$2M (%)	$2M-$10M (%)	>$10M (%)
Project Management	10	8	6	5	5
Remedial Design	20	15	12	8	6
Construction Management	15	10	8	6	6

7.2 COMPARATIVE ANALYSIS OF ALTERNATIVES

The comparative analysis evaluates the relative performance of each alternative using the same criteria by which the detailed analysis of each remedial component was conducted. A supplemental detailed analysis of the remedial alternatives and their respective remedial components, using the evaluation criteria identified in DER-10 (NYSDEC, 2010) and Subpart 375-1.8(f) (NYS, 2006), is provided in Table 7.1. The purpose of the comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another to aid in selecting an overall remedy for the Site.

The comparative analysis presented in this document uses a qualitative approach to comparison, with the exceptions of comparing alternative costs to implement each alternative. A comparison of the capital and long-term costs associated with the remedial alternatives is presented in Table 7.3. Detailed cost analysis backup is provided in Appendix B.

Alternative 1 has been eliminated from this comparison as it does not meet the criteria for compliance with SCGs, it is not protective of public health and it is not compatible with current land uses, and it does not reduce toxicity, mobility or volume of contamination.

7.2.1 Comparative Analysis of Alternatives

Compliance with Standards, Criteria and Guidance. Alternatives 2 through 5 are compliant with site specific and chemical specific SCGs, however, Alternative 3 requires a soil cover, and associated ICs on an off-site property that is not likely to be enforceable. Therefore, Alternatives 2, 4, and 5 rate equally for meeting site-specific and chemical-specific SCGs.

Overall Protection of Public Health and the Environment. With the exception of Alternative 1, each of the proposed alternatives will result in overall protection of public health and the Environment. However, Alternative 2 rates highest for this criteria since it will not require maintenance of soil or asphalt caps for continued protection.

Short Term Impacts and Effectiveness. Although engineering controls would be used, and health and safety plans would be prepared and followed, there is potential for short-term adverse impacts and risks upon the community, the workers, and the environment during the construction and implementation for Alternatives 2 through 5. Alternative 4 rates highest for this criteria followed by Alternative 3. Alternative 2, followed by Alternative 5, rates lowest for this criteria based on the duration of the remedy implementation and degree of remedy intrusiveness.

Long-term Effectiveness and Permanence. Alternative 2 rates highest for long-term effectiveness because impacted vadose soils will not be left on-site, saturated soil and groundwater are expected to meet RAOs in within a short period of time, and the remedy will be permanent. Alternative 5 rates second for long-term effectiveness and permanence.

Alternatives 3 and 4, although protective of human health and the environment, will leave impacted soil in place below either a soil cover or asphalt parking area. The caps will require periodic inspections to ensure continued effectiveness and may require maintenance to maintain long-term effectiveness and permanence. Alternatives 3 and 4 also include removal of contaminant mass through ISCO, and will minimize downgradient migration via interception of the groundwater plume. The permanence of these alternatives are dependent on long-term operations and maintenance.

Reduction of Toxicity, Mobility, or Volume with Treatment. Toxicity, mobility and volume will be reduced through a combination of excavation and in-situ chemical treatment for Alternatives 3 and 4, and through excavation only through Alternative 2. Alternative 5 will most effectively reduce the toxicity, mobility and volume of site contamination through treatment using ISTT.

Implementability. Alternative 4 rates highest for ease of implementability followed by Alternative 3. Each of these alternatives will require coordination with MNR; both are fairly easy to implement. Alternatives 2 and 5 have complications regarding implementation, with each numerically ascending alternative being progressively more difficult than the previous. Alternative 2 requires demolition of the existing building and a deep excavation throughout the Site requiring excavation structural support and dewatering, and likely closure of the railroad tracks adjacent to the Site. Alternative 5's implementation difficulties include installing ERH wells beneath the building and set up of on-site treatment systems. ERH may also require additional monitoring and controls to ensure vapors are safely captured from the system and not entering the site building. Alternative 3 will require set-up and operation of a treatment facility, and will require ICs on the MNR property which may not be acceptable to the MNR.

Land Use. Alternatives 2, 4, and 5 are equally compatible with current and foreseeable land use. Alternative 3 is not compatible with current or future land use, as it would require ICs on the MNR property.

Sustainability / Green Remediation (DER 31). Alternative 4 rates highest for green remediation because it uses passive ISCO treatment for the longer term remedy and minimizes the amount of soil disposed off-site. Alternative 3 does not require transportation and disposal of vadose zone soil, however, the recirculation system will require electricity throughout operations as well as routine OM&M visits. Alternatives 2 and 5 rate lowest for green remediation. Alternative 2 requires significant off-site transportation and disposal of soil and groundwater extraction, treatment, and discharge during implementation. Alternative 5 requires a significant amount of electricity to heat the saturated zone.

Cost. The estimated capital cost and present worth of the remedial action alternatives are presented in the table below. A summary of the costs associated with these alternatives are presented in Tables 7.4 through 7.7. Detailed cost analysis backup is provided in Appendix B.

Surface Soil Alternatives	Capital Cost	Average Annual Cost	Present Worth
Alternative 1	$ 0	$ 0	$ 0
Alternative 2	$ 18,900,000	$ 0	$ 18,900,000
Alternative 3	$ 1,830,000	$ 40,000	$ 3,030,000
Alternative 4	$ 2,320,000	$ 16,400	$ 2,810,000
Alternative 5	$ 5,460,000	$ 5,730	$ 5,630,000

8.0 SUMMARY OF THE PROPOSED REMEDY

The proposed remedy for the Site based on the evaluation of alternatives is Alternative 4. Alternative 4 includes the following components:

- Off-Site Source Soil Excavation: Excavation and off-site disposal of impacted vadose-zone soil that exceeds protection of groundwater SCOs. This is an approximately 5,400 Square foot area located on the MNR property. Depth of excavation will not exceed 10 feet, which is the approximate depth to groundwater. The area will be backfilled to current grades.
- Re-pave On-Site Parking Area: Other vadose-zone soil that exceeds GW SCOs is located on-site under the existing parking area. The asphalt in the parking area will be replaced to minimize potential to direct exposure to this soil. Inspections and repair will be required under a SMP.
- Source removal: Excavation of contaminant source soils and sludges (estimated at 42 cy) in and around the lint trap to the extent practicable. The area will be backfilled with crushed stone around a perforated riser pipe to enable addition of chemical oxidants. Chemical oxidants will be placed into the perforated pipe.
- ISCO Injections: ISCO injections will be conducted in two areas: (1) throughout an approximate 900 square foot area on the MNR property to address any remaining contamination below the source soil excavation, (2) throughout an approximate 1,000 square foot area in the vicinity of the lint trap, which includes locations beneath and outside of the site building. ISCO injections will be located every two to four feet from the top of the water table to a depth of approximately 30-35 feet (top of competent bedrock).
- Passive ISCO Treatment: A series of permanganate cylinders will be installed downgradient of the source areas. It is assumed that two rows of 30 cylinders would be installed approximately 10 feet apart, staggered. The purpose of the cylinders is to treat groundwater prior to its migration off-site.

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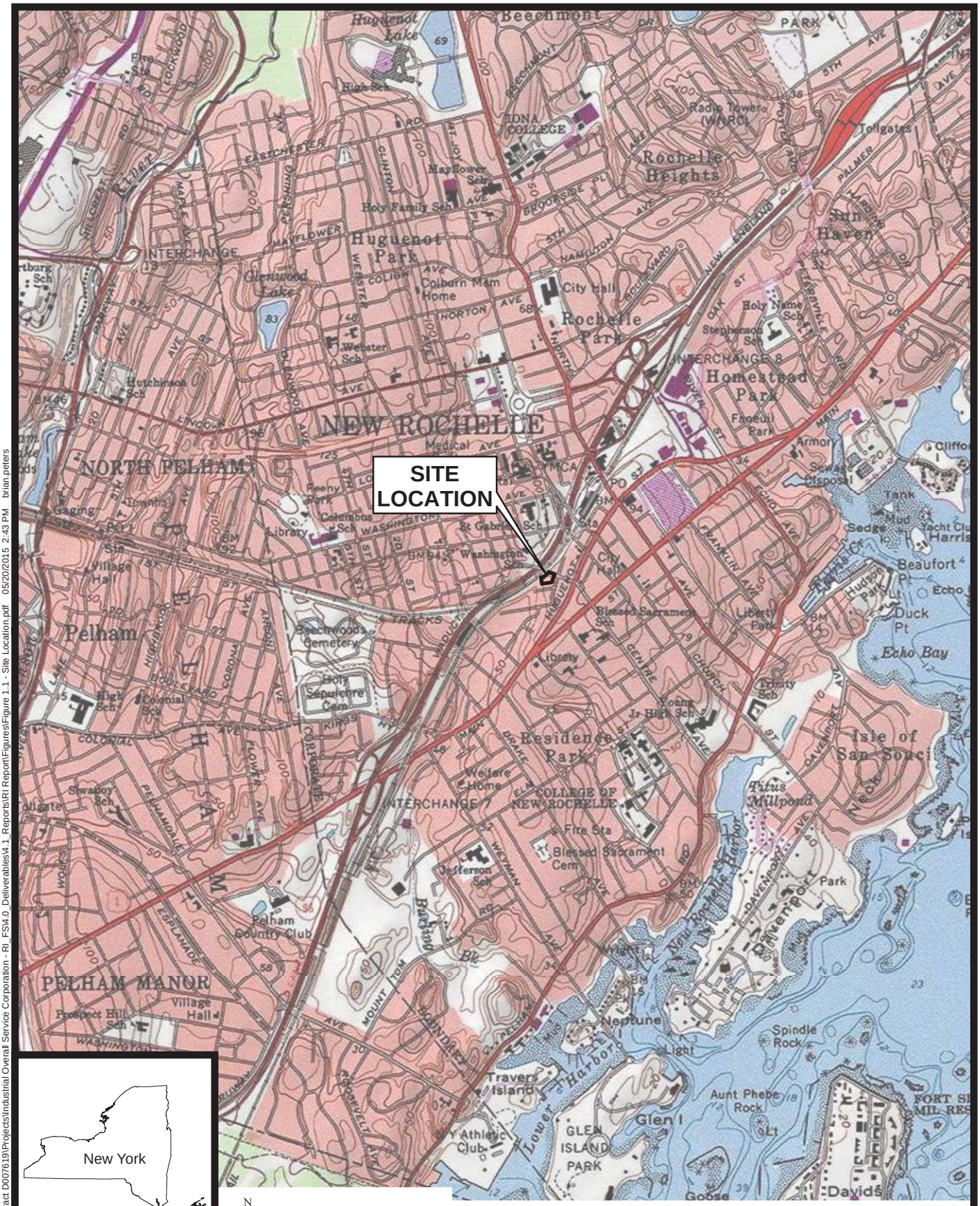
FIGURES



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REMEDIAL INVESTIGATION
INDUSTRIAL OVERALL SERVICES
NEW ROCHELLE, NEW YORK

MACTEC

SITE LOCATION

Project 3612112221 Figure 1.1

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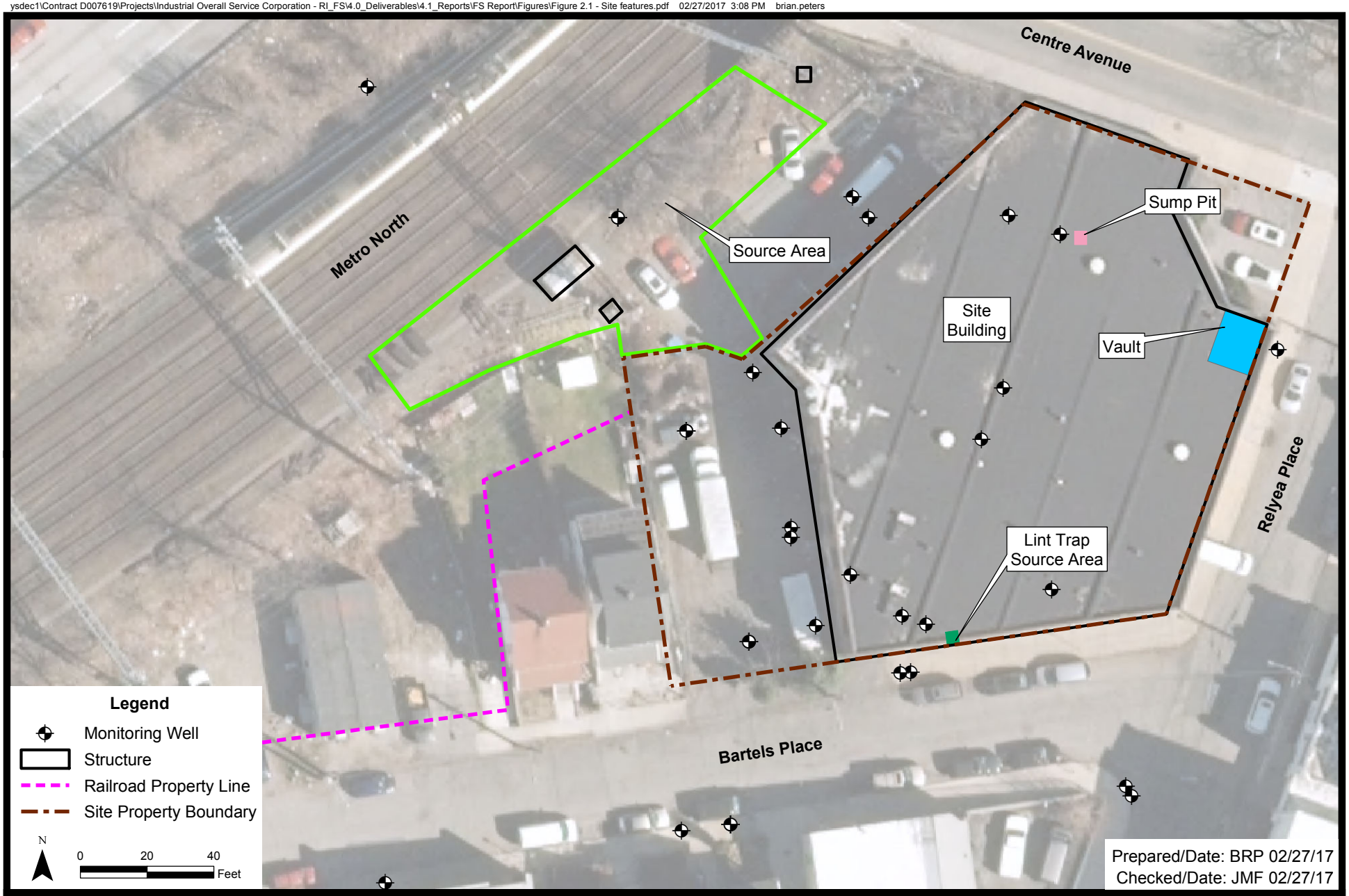

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INDUSTRIAL OVERALL SERVICES
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Site Features

Project 3612112221 Figure 2.1

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Remedial Alternative 2 includes:

Site-wide Excavation Area

Legend

Overburden/Bedrock Groundwater Flow Direction

PCE in Groundwater:

- < 5 µg/L
- 5 - 100 µg/L
- 100 - 1,000 µg/L
- 1,000 - 10,000 µg/L
- > 10,000 µg/L

Property Line

Railroad Property Line

Structure

Site-wide Excavation Area
34489 sf
31934 cy

Centre Avenue

Metro North

Bartels Place

Relyea Place

PZ-29
GS-32
GS-31
B-2
D-2
C-2B
GS-30
MW-25
GS-3
PZ-23
PZ-15
Sump Pit (SP-001)
SP-001
GS-1
Site Building
Demolish Building
GS-25
C-4
Vault (SP-005)
MW-21
SP-5
SP-005
PZ-19
PZ-28
SP-2
SD-2
E-5
PZ-22
PZ-20
C-6
GS-27
GS-4
MW-24
C-8
PZ-36
GS-37
PZ-35
PZ-33
SP-003
PZ-21
PZ-34
SP-004
SP-3
PZ-39
PZ-38
GS-40
MW-22
MW-23
MW-13

Prepared/Date: BRP 02/27/17
Checked/Date: JMF 02/27/17

N

0 15 30 Feet

PCE = Tetrachloroethene
Results Shown in µg/L from 2012-2015
µg/L = micrograms per Liter
MW-26 = Groundwater Sampling Location

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Remedial Alternative 2

Project 3612112221 Figure 6.1

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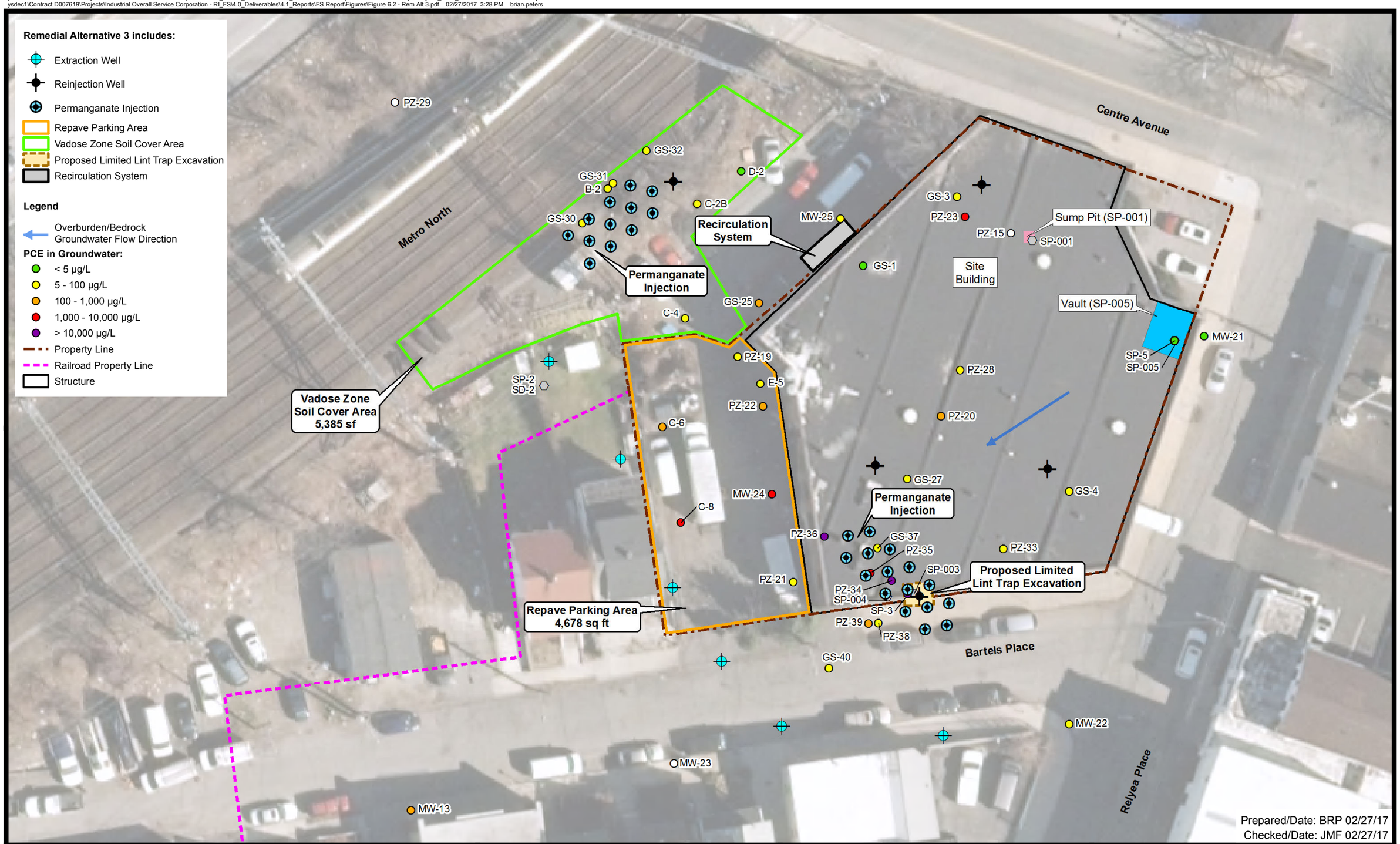

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Remedial Alternative 3

Project 3612112221 Figure 6.2

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Remedial Alternative 4 includes:

- Proposed Limited Lint Trap Excavation
- Permanganate Injection
- Permanganate Cylinder Installation
- Repave Parking Area
- Vadose Zone Excavation Area

Legend

- Overburden/Bedrock Groundwater Flow Direction

PCE in Groundwater:

- < 5 µg/L
- 5 - 100 µg/L
- 100 - 1,000 µg/L
- 1,000 - 10,000 µg/L
- > 10,000 µg/L
- Non-Detect
- Sump
- Property Line
- Railroad Property Line
- Structure

PZ-29
GS-32
GS-31
B-2
D-2
C-2B
GS-30
Metro North
Permanganate Injection
Vadose Zone Excavation Area 5,385 sf 1,300 cy
GS-25
C-4
PZ-19
SP-2
SD-2
E-5
PZ-22
C-6
C-8
MW-24
Repave Parking Area 4,592 sf
PZ-21
MW-23
MW-13
Centre Avenue
MW-25
GS-3
PZ-23
PZ-15
Sump Pit (SP-001)
SP-001
GS-1
Site Building
Vault (SP-005)
MW-21
SP-5
SP-005
PZ-28
PZ-20
GS-27
GS-4
Permanganate Injection
PZ-36
GS-37
PZ-35
PZ-33
SP-003
Proposed Limited Lint Trap Excavation
PZ-34
SP-004
SP-3
PZ-39
PZ-38
Bartels Place
GS-40
Permanganate Cylinder Installation
MW-22
Relyea Place

Prepared/Date: BRP 02/27/17
Checked/Date: JMF 02/27/17

N
0 15 30 Feet

PCE = Tetrachloroethene
Results Shown in µg/L from 2012-2015
µg/L = micrograms per Liter
MW-26 = Groundwater Sampling Location

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Remedial Alternative 4

Project 3612112221 Figure 6.3

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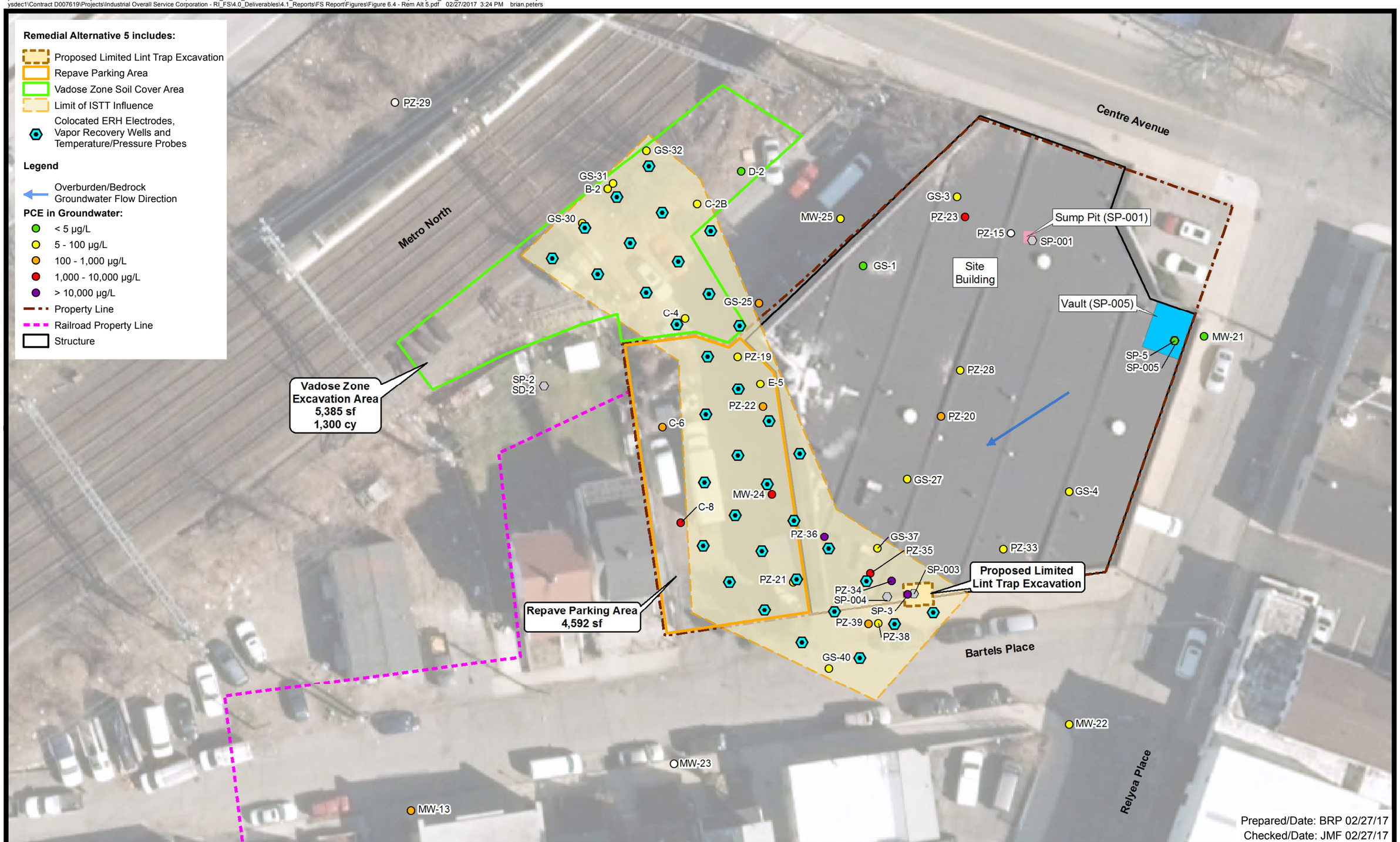
ysdec1\Contract D007619\Projects\Industrial Overall Service Corporation - RI_FS\4.0_Deliverables\4.1_Reports\FS Report\Figures\Figure 6.4 - Rem Alt 5.pdf 02/27/2017 3:24 PM brian.peters



TABLES

Table 5.1: Identification and Screening of Potential Remedial Technologies and Process Options

Environmental Media	General Response Action	Remedial Technology	Process Option	Applicability to		Screening Status	Comments
				Site-Limiting Characteristics	Waste-Limiting Characteristics		
Surface and Vadose-Zone Soil (Railroad Property and West of Site Building)	No Action	Not Applicable	Not Applicable	Not Applicable	Will not reduce toxicity, mobility, or volume of Site related contaminants.	Retained	Does not meet SCOs, but will be carried through as a baseline comparison for detailed analysis of alternatives.
	Institutional Controls	Land Use Restrictions	Land Use Restrictions	None	Will not reduce toxicity, mobility, or volume of Site related contaminants.	Eliminated	Eliminated as a stand-alone alternative, however, institutional controls may be required in conjunction with other remedial action alternatives.
		Fencing	Fencing	None	Will not reduce toxicity, mobility, or volume of VOC contaminants.	Eliminated	Eliminated as a stand-alone alternative, however, institutional controls may be required in conjunction with other remedial action alternatives.
	In-Situ Treatment	Biological Treatment	Enhanced Biodegradation	Presence of active railroad racks may limit the ability to implement this technology.	Not effective for surface soils.	Eliminated	
		Physical Treatment	Solidification/ Stabilization	Presence of active railroad tracks may limit the ability to implement this technology.	Solidification / stabilization has limited ability to effectively treat VOC contamination in soil. It may, however, reduce migration of contaminants to groundwater.	Eliminated	
		Vapor Extraction	Soil Vapor Extraction	Presence of active railroad tracks may limit the ability to implement and maintain this technology. In addition, the limited space available may not be sufficient for the equipment needed to operate the system.	Will not eliminate the direct contact exposure pathway.	Eliminated	
		Thermal Treatment	Electrical Resistance Heating	Presence of active railroad tracks may limit the ability to implement and maintain this technology. In addition, the limited space available may not be sufficient for the equipment needed to operate the system. Some of the impacted soil is too shallow to effectively implement this technology without adding a surface barrier.	None	Eliminated	The cost to implement this alternative will be prohibitive.
	Containment	Capping	Soil Cover	Presence of active railroad tracks may limit the ability to implement this technology.	Will prevent direct exposure but will not reduce toxicity, mobility, or volume of VOC contaminants.	Retained	
	Removal	Excavation	Soil Excavation	Presence of active railroad tracks may limit the ability to implement this technology. Excavated soil will need to be transported off-Site for disposal because there is no room on-Site to conduct ex-situ treatment.	None	Retained	Unlikely to reach pre-disposal conditions due to the presence of the railroad.

Table 5.1: Identification and Screening of Potential Remedial Technologies and Process Options

Environmental Media	General Response Action	Remedial Technology	Process Option	Applicability to		Screening Status	Comments
				Site-Limiting Characteristics	Waste-Limiting Characteristics		
Saturated Soil and Weathered Bedrock (Beneath Lint Trap and Former Debris Piles)	No Action	Not Applicable	Not Applicable	Not Applicable	Will not reduce toxicity, mobility, or volume of Site related contaminants.	Retained	Does not meet SCOs, but will be carried through as a baseline comparison for detailed analysis of alternatives.
	Institutional Controls	Land Use Restrictions	Land Use Restrictions	None	Will not reduce toxicity, mobility, or volume of Site related contaminants.	Eliminated	Eliminated as a stand-alone alternative, however institutional controls may be required in conjunction with other remedial action alternatives.
	In-Situ Treatment	Biological Treatment	Enhanced Biodegradation	Injecting biological amendments under the building and into the weathered bedrock may be difficult and result in unpredictable injection placement.	Concentrations of VOCs are too high for biological treatment to be effective in the short term.	Eliminated	
		Chemical Oxidation	In-Situ Chemical Oxidation	Injecting chemical oxidants under the building and into the weathered bedrock may be difficult and result in unpredictable injection placement. Underground utilitie materials may not be compatible with the injected chemicals.	High VOC concentrations will require multiple injection rounds, however in-situ chemical oxidation should be effective at treating both overburden/saturated soil and groundwater.	Retained	
		Vapor Extraction	Soil Vapor Extraction	The Site is located in a highly populated urban area and there are limited locations and space available to implement this technology.	Vapor extraction may effectively limit the indoor air exposure pathway, but the extracted vapors will require treatment.	Retained	Retained as a combined remedy with sub-slab depressurization.
		Thermal Treatment	Electrical Resistance Heating	Electrical resistance probes may be difficult to install beneath the building. ERH will include vapor collection and will likely require vapor treatment equipment. In addition, the limited space available may not be sufficient for the equipment needed to operate the system.	Will require capture and treatment of vapors.	Retained	This technology is energy intensive but it effectively removes VOC contaminants from the soil in the vadose and saturated zone to reach pre-disposal conditions.
	Containment	Vertical Barriers	Slurry wall, sheet piling	A vertical barrier will not prevent migration of groundwater through impacted soil or beneath the barrier within the weathered bedrock.	Will not reduce toxicity or volume of VOC contamination unless combined with another technology.	Eliminated	
	Removal	Excavation	Soil Excavation	Excavation of subsurface soil contaminated in some areas of the Site is not practical (e.g., access under the building requires building demolition, depth of excavation). However, some areas may be easily accessed.	None	Retained	Complete removal to pre-disposal conditions is cost prohibitive and impractical. Retained to be carried through detailed analysis of alternatives for a portion of the subsurface soil.

Table 5.1: Identification and Screening of Potential Remedial Technologies and Process Options

Environmental Media	General Response Action	Remedial Technology	Process Option	Applicability to		Screening Status	Comments
				Site-Limiting Characteristics	Waste-Limiting Characteristics		
Groundwater	No Action	Not Applicable	Not Applicable	Not Applicable	Will not reduce toxicity, mobility, or volume of Site related contaminants.	Retained	Does not meet RGs, but will be carried through as a baseline comparison for detailed analysis of alternatives.
	Institutional Controls	Ground Water Use Restrictions	Restrict use/drilling of production wells	None	Will not reduce toxicity, mobility, or volume of VOC contaminants.	Eliminated	Eliminated as a stand-alone alternative, however institutional controls may be required in conjunction with other remedial action alternatives.
	Monitored Natural Attenuation	Groundwater Monitoring	Monitored Natural Attenuation	None	Will not reduce toxicity, mobility, or volume of VOC contaminants in the short term.	Eliminated	Eliminated for this FFS but may be a viable option for downgradient areas in a future FFS once source areas are controlled.
	In-Situ Treatment	Biological Treatment	Enhanced Biodegradation	Injecting biological amendments under the building and into the weathered bedrock may be difficult and result in unpredictable injection placement.	Concentrations of VOCs are too high for biological treatment to be effective in the short term.	Eliminated	
		Chemical Oxidation	Oxidant Injections	May be difficult to inject chemical oxidants under the building. The weathered bedrock may result in unpredictable injection placement. Will also need to ensure chemical compatibility with underground utilities.	High VOC concentrations will require multiple injection rounds, however in-situ chemical oxidation should be effective at treating both groundwater and overburden/saturated soil.	Retained	Will also address soil contamination in the saturated zone.
		Physical Treatment	Permeable Reactive Barrier	This technology will be limited by the weathered bedrock, which may be difficult to excavate and will potentially allow seepage of contaminated groundwater beneath the reactive barrier.	None	Eliminated	
			Air Sparging	Proximity of buildings, utilities, and roads will make implementation of this technology challenging, as it will increase potential for soil vapor intrusion into nearby residential buildings.	Will need to be combined with a vapor extraction system and associated vapor treatment facilities.	Eliminated	
		Thermal Treatment	Electrical Resistance Heating	Electrical resistance probes may be difficult to install beneath the building. ERH will include vapor collection and will likely require vapor treatment equipment. In addition, the limited space available may not be sufficient for the equipment needed to run the system.	Will require capture and treatment of vapors.	Retained	This technology is energy intensive but it effectively removes VOC contaminants from the soil in the vadose and saturated zone.
	Containment	Capping	Low Permeability Cover System	Presence of active railroad tracks may limit the ability to implement this technology.	Will not reduce toxicity, mobility, or volume of VOC contaminants.	Eliminated	

Table 5.1: Identification and Screening of Potential Remedial Technologies and Process Options

Environmental Media	General Response Action	Remedial Technology	Process Option	Applicability to		Screening Status	Comments
				Site-Limiting Characteristics	Waste-Limiting Characteristics		
Groundwater (continued)	Containment	Vertical Barriers	Slurry wall, sheet piling	Sealing the barrier into the weathered bedrock may be difficult.	Will reduce mobility of impacted groundwater, but will not reduce toxicity or volume of VOC contamination unless combined with another treatment.	Eliminated	
		Surface Controls	Diversion/collection, grading, soil stabilization	The Site is small and paved, therefore, there will be no benefit realized by this option.	Will not reduce toxicity, mobility, or volume of VOC contaminant.	Eliminated	
	Collection and Treatment	OnSite Pumping, Treatment, and Discharge.	Groundwater Extraction with Ex-situ treatment	The Site is small and located in a populated area with a high volume of traffic. Well headers and conveyance piping will all need to be installed underground, and the space available may be insufficient for ex-situ treatment equipment.	Ex-situ treatment equipment such as air strippers and granular activated carbon will effectively treat the VOCs.	Eliminated	Pump and treat systems require long-term operation and maintenance and although effective in preventing migration, the SCGs will not be met in a timely manner.
			Dual-Phase Extraction (DPE)	The Site is small and located in a populated area with a high volume of traffic. Well headers and conveyance piping will all need to be installed underground, and the space available may be insufficient for ex-situ treatment equipment for both liquid and vapor phase waste streams.	Ex-situ treatment equipment such as air strippers and granular activated carbon will effectively treat the VOCs. However, DPE systems require long-term operation and maintenance and although effective in preventing migration, the SCGs will not be met in a timely manner.	Eliminated	
		OnSite Pumping, Treatment, and Recirculation	Reinjection after treatment	The Site is small and located in a populated area with a high volume of traffic. Well headers and conveyance piping will all need to be installed underground, and the space available may be insufficient for ex-situ treatment equipment.	Ex-situ treatment equipment such as air strippers and granular activated carbon will effectively treat the VOCs. However, pump and treat systems require long-term operation and maintenance and although effective in preventing migration, the SCGs will not be met in a timely manner.	Retained	Eliminated as a traditional pump/treat/reinject system due to the required long-term operation and maintenance and because SCGs will not be met in a timely manner, but is retained for evaluation as a combined remedy with chemical oxidation.
Soil Vapor (Off-Site Impacts)	No Action	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Retained	Carried through as a baseline comparison for detailed analysis of alternatives.
	Engineering Controls	Sub-Slab Depressurization	Sub-Slab Depressurization	This would be conducted in off-site structures as applicables. Limiting characteristics would be structure specific and could include condition of the structure floor and space restrictions.	None	Retained	

Notes:
DPE - Dual-Phase Extraction
ERH - Electrical Resistance Heating
RGs - Remedial Goals
SCOs - Soil Cleanup Objectives
VOC - volatile organic compounds

Table 5.2: Development of Remedial Components by Media

Matrix	Remedial Alternative	Effectiveness	Implement ability	Relative Cost	Retained Remedial Components
Surface and Vadose-Zone Soil	**No Action**	This alternative is not effective for reducing contamination concentrations or addressing the identified exposure pathways.	There are no technical issues with implementing this alternative.	No cost associated with this alternative.	**No Action - Retained** **For use as a baseline for comparison to other alternatives.**
	Capping	Soil capping addresses identified exposure pathways on the Metro North Railroad property, but would not remove or treat contamination beneath the cap and would require institutional controls. On-Site soil impacts under the parking area is already considered to be capped, however, the asphalt is in poor condition and would need to be replaced.	Soil capping includes tree removal prior to capping and grading after clean soil has been placed. This alternative requires a staging area for capping equipment and materials. The small area and nearby residential properties limit available space.	Relative costs for this alternative are low to medium. The primary items contributing to costs include tree clearing, equipment and materials for capping, and grading.	**Soil Cover on MNR Property - Retained** **Replace Asphalt on On-site Parking Area - Retained.**
	Excavation with Off-Site Disposal	Excavation is an effective way to remove contaminated soil which is a continuing source to downgradient groundwater contamination.	Contaminated soil in close proximity to the railroad tracks may be difficult to remove and will require coordination with the Metro North Railroad. This alternative requires a staging area for equipment and materials. The small area and nearby residential properties limit available space.	Relative costs for this alternative are medium to high. The primary items contributing to costs include tree clearing, equipment and materials for excavation and backfill, grading, and transportation and disposal of excavated soil.	**Excavation - Retained**
Groundwater / Saturated Soil / Weathered Bedrock	**No Action**	This alternative is not effective for reducing contamination concentrations or addressing the identified exposure pathways.	There are no technical issues with implementing this alternative.	No cost associated with this alternative.	**No Action - Retained** **For use as a baseline for comparison to other alternatives.**
	Source Area Removal (Soil Removal Inside Lint Trap).	Limited excavation will effectively eliminate the direct exposure pathway for VOC contamination in the Site Building Sump Pit.	Limited excavation in the Site Building Sump Pit would be conducted via vacuum excavator and the amount of soil that could effectively be removed may be limited.	Relative costs for this remedial component in low, but it would only address a small area of contamination.	**Source Area Removal - Retained**
	In-Situ Chemical Oxidation (ISCO) in Source Areas.	Chemical Oxidation (specifically permanganate) is an effective way to reduce VOC concentrations in groundwater and saturated media. Will require multiple injections to significantly reduce concentrations.	Oxidant injections can be difficult to implement beneath structures. The weathered bedrock may also make oxidant injections unpredictable. Permanganate must also be compatible with existing subsurface structures / utilities. Existing wells and direct push technology can be used for permanganate injections. Additional monitoring wells may be required for post-injection monitoring.	The primary items contributing to costs include geoprobe rental and operator for injections and post-injection monitoring.	**ISCO Injections in Source Areas - Retained.**

Table 5.2: Development of Remedial Components by Media

Matrix	Remedial Alternative	Effectiveness	Implement ability	Relative Cost	Retained Remedial Components
Groundwater / Saturated Soil / Weathered Bedrock (Continued)	**Passive ISCO at Site Boundary.**	Slow release permanganate cylinders could be an effective way at eliminating continued migration of impacted groundwater at the site boundary.	Permanganate must also be compatible with existing subsurface structures / utilities. Direct push technology can be used for permanganate cylinders. Additional monitoring wells may be required for post-injection monitoring.	The primary items contributing to costs include geoprobe rental and operator for cylinder installation, permanganate materials, and post-injection monitoring.	**Passive ISCO Treatment - Retained**
	Groundwater extraction / Recirculation.	Perimeter groundwater extraction and recirculation is an effective way to further reduce VOC concentrations in on-site groundwater and to establish hydraulic containment following the completion of permanganate injections.	The recirculation system requires installation of subsurface conveyance piping and space for well headers and the installation of new extraction and injection wells. There is limited space available for a treatment system.	Relative costs for this alternative are medium to high. The primary items contributing to costs include installation of injection/extraction wells and subgrade conveyance piping, permanganate materials, operation, maintenance and monitoring of the recirculation system.	**Perimeter Groundwater Recirculation System - Retained**
	Electrical Resistance Heating	ERH effectively volatilizes VOCs in the saturated zone and includes vapor recovery wells with off-gas treatment to effectively remove VOC contamination from the subsurface.	It is difficult to install electrical resistance probes beneath buildings. ERH would include vapor collection and would likely require off-gas treatment equipment. There is limited space available for equipment, therefore electrical wiring, vapor conveyance piping, and each electrode / recovery wellhead must be installed below ground surface.	Relative costs for this alternative are high. The primary items contributing to costs include installation of subsurface electrical, conveyance piping, electrodes and recovery wells, operation and maintenance of the system, and powering the system.	**In-Situ Thermal Treatment - Retained**
Soil Vapor (Off-Site Impacts)	**No Action**	This alternative is not effective for reducing contamination concentrations or addressing the identified exposure pathways.	There are no technical issues with implementing this alternative.	No cost associated with this alternative.	**No Action - Retained** **Viable Option considering soil vapor may not be an issue depending on remedial components chosen for other media.**
	Sub-Slab Depressurization	SSD effectively eliminates direct vapor exposure by establishing a vacuum beneath the floor of a structure and preventing any contaminated vapor from flowing into the building.	Installation of an SSD system in an occupied building will require coordination with the building owners.	Relative costs for this soil vapor alternative are medium.	**Eliminated - Mitigation of off-site structures are being addressed separately.**

Notes:
ERH - Electrical Resistance Heating
ISCO - In-Situ Chemical Oxidation
SSD - sub-slab depressurization
VOC - volatile organic compounds

Table 7.1: Detailed Analysis and Comparison of Remedial Alternatives

Remedial Alternative	Breakdown of Remedy Components[1]	Compliance with Standards, Criteria and Guidance[2] (Meets / Partially Meets / Does Not Meet)	Overall Protection of Public Health and the Environment (Is / Partially / Is Not Protective)	Short-term Impacts[3] (Will / Will Not Result)	Short-term Effectiveness[3] (Not/ Partially/ Effective)	Long-term Effectiveness and Permanence[4] (Not/ Partially /Effective)	Reduction of Toxicity, Mobility, or Volume with Treatment[4] (Will Not / Will Partially / Will Reduce)	Implementability[4] (No / Some Technical Difficulties / Difficult)	Land Use (Compatible / Not Compatible)	Sustainability / Green Remediation (DER-31) (High / Medium / Low Compliance)	Cost (Numerically Ranked, 1=Lowest cost)
Alternative 1	**No Action for all Media**	Does not meet	Not Protective	Will not result	Not effective	Not effective or permanent	Will not reduce	No technical difficulties	Not compatible	High	1: There are no costs associated with this alternative.
Alternative 2	**Vadose Zone: Excavation**	Meets	Is protective	Will result	Effective	Effective	Will reduce	Some technical difficulties	Compatible	Low	5
	Saturated Zone: Excavation	Meets	Is protective	Will result	Effective	Will maintain	Will reduce	Difficult	Compatible	Low	
Alternative 3	**Vadose Zone: Soil Cover (MNR) & Repair Existing Asphalt**	Partially Meets	Is protective	Will result	Effective	Partially effective	Will partially reduce	Some technical difficulties	Compatible	High	3
	Saturated Zone: Limited Excavation with In Situ Chemical Oxidation & Hydraulic Control (recirculation system)	Meets	Is protective	Will result	Partially	Effective	Effective	Some technical difficulties	Compatible	Medium	
Alternative 4	**Vadose Zone: Soil Excavation (MNR) & Repair Existing Asphalt**	Meets	Is protective	Will result	Effective	Partially effective	Will partially reduce	Some technical difficulties	Compatible	Medium	2
	Saturated Zone: Limited Excavation with In-Situ Chemical Oxidation & Perimeter Permanganate Cylinders	Meets	Is protective	Will result	Partially	Effective	Effective	Some technical difficulties	Compatible	High	
Alternative 5	**Vadose Zone: Soil Excavation (MNR) & Repair Existing Asphalt**	Meets	Is protective	Will result	Effective	Partially effective	Will partially reduce	Some technical difficulties	Compatible	Medium	4
	Saturated Zone: Limited Excavation with In-Situ Thermal Treatment	Meets	Is protective	Will result	Effective	Will maintain	Will reduce	Difficult	Compatible	Low	

Notes:
(1) Remedial action components are broken down by media.

(2) For alternatives where standards, criteria, and guidance values (SCGs) will not be met, contamination in excess of SCG values will remain onsite, leading to potential adverse human health and environmental impacts. It is possible that SCGs may be met at some time in the future due to natural attenuation processes.

(3) Adverse short-term impacts and health risks will be managed using temporary controls to prepare the Site for remedial action implementation, including but not limited to installation of an equipment decontamination area, implementation of erosion and sediment control measures, and the placement of temporary fencing around work areas. Implementation will also include preparation of and adherence to a construction work plan and a health and safety plan.

(4) A narrative discussion of the strengths and weaknesses of the remedial action alternatives relative to one another with respect to these evaluation criteria are included in Section 8.0 of the Focused Feasibility Study.

Color indicates relative ranking of the remedial option based on the evaluation criteria. Green indicates the most desirable result , orange indicates an somewhat less desirable result, and pink indicates an negative result for the evaluation criteria.

Prepared by: DF 6/22/2015
Checked by: JW 1/18/2017
Revised by: JW 2/22/2017

Table 7.2: Applicable Location- and Action-Specific Standards, Criteria, and Guidance

Requirement	Consideration in the Remedial Response Process
29 CFR Part 1910.120 - Hazardous Waste Operations and Emergency Response	Applicable to Health and Safety implementation, enforcement, and emergency response.
6 NYCRR Part 371 - Identification and Listing of Hazardous Wastes (November 1998)	Applicable to the characterization, handling, transportation, and treatment/disposal of investigative derived waste and other soils/liquids generated that require removal from the Site.
6 NYCRR Part 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities (November 1998)	Applicable to the handling, transportation, and treatment/disposal of investigative derived waste and other soils/liquids generated that require removal from the Site.
6 NYCRR Part 375 - Environmental Remediation Programs (as amended December 2006)	Applicable to the development and implementation of remedial programs.
6 NYCRR Part 376 - Land Disposal Restrictions	Applicable to disposal of hazardous wastes. Identifies those wastes that are restricted from land disposal.
6 NYCRR Parts 700-706 - Water Quality Standards (June 1998)	Applicable to construction in and adjacent to surface water bodies. Not likely applicable for activities described in this focus feasibility study.
6 NYCRR Part 750 through 758 - Implementation of NPDES Program in NYS (“SPDES Regulations”)	Applicable to construction that requires discharge of treated wastewater, if needed.
DER-10 Technical Guidance for Site Investigation and Remediation	Applicable to the development and implementation of remedial programs.
Citizen Participation in New York’s Hazardous Waste Site Remediation Program: A Guidebook (June 1998)	Applicable to the development and implementation of remedial programs.
Solidification/Stabilization and its Application to Waste Materials	May be applicable to disposal of wastes generated during implementation of remedial program.
DER-31 - Green Remediation (August 2010)	Applicable to the development and implementation of remedial programs.

Table 7.3: Summary of Remedial Alternative Costs

Description	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Total Present Worth of Remedial Alternatives	$ -	$ 18,900,000	$ 3,030,000	$ 2,810,000	$ 5,640,000
Capital Costs	$ -	$ 18,900,000	$ 1,830,000	$ 2,320,000	$ 5,460,000
Average Annual Cost	$ -	$ -	$ 40,000	$ 16,400	$ 5,900
Total Non-Discounted Cost	$ -	$ 18,900,000	$ 3,430,000	$ 3,060,000	$ 5,710,000

Notes:
Alternative 1: No Action
Alternative 2: Site-Wide Excavation to Pre-Release Conditions
Alternative 3: Soil Capping, Source Area Removal, ISCO Injections, Groundwater Extraction & Reinjection
Alternative 4: Soil Excavation at MNR, Source Area Removal, ISCO Injections, Perimeter ISCO Cylinders
Alternative 5: Soil Excavation at MNR, Source Area Removal, In-Situ Thermal

Table 7.4: Cost Summary for Alternative 2
Site-Wide Excavation of Impacted Vadose Zone Soil, Saturated Soil and Weathered Bedrock

Item No.	Item Description	COST
DIRECT CAPITAL COSTS		
6	Pre-Design Investigations for Excavation	$ 216,000
17	Excavation Implementation (Includes Building Demo, Sheet Piling, Dewatering, Transported & Disposal, etc.)	$ 13,400,000
	Direct Cost Subtotal	$ 13,600,000
INDIRECT CAPITAL COSTS		
	Project Management (@ 5 Percent)	$ 681,000
	Remedial Design (@ 8 Percent)	$ 1,090,000
	Construction Management (@ 6 Percent)	$ 817,000
	Contingency (@ 20 Percent)	$ 2,720,000
	Indirect Cost Subtotal	$ 5,310,000
TOTAL CAPITAL COSTS		**$ 18,900,000**
No Long-Term Annual Costs for this Alternative		
PRESENT WORTH OF ANNUAL AND PERIODIC COSTS (30 yrs)		**$ -**
TOTAL PRESENT WORTH OF ALTERNATIVE 2 (30 yrs)		**$ 18,900,000**
TOTAL NON-DISCOUNTED COST OF ALTERNATIVE 2 (30 yrs)		**$ 18,900,000**

NOTES:
Costs have been rounded to the nearest thousand. Costs details are provided in Appendix B.
* - Costs include additional 10 percent for technical support and 25 percent contingency for unforeseen project complexities, including insurance, taxes, and licensing costs. Costs include annual inspection and reporting.

Prepared by: JW 1/13/2017
Checked by: SB 1/20/2017
Revised by: JW 2/13/2017

Table 7.5: Cost Summary for Alternative 3
Soil Capping, Source Area Removal, ISCO Injections, Groundwater Extraction & Reinjection

Item No.	Item Description		COST
DIRECT CAPITAL COSTS			
1	Pre-Design for Capping	$	35,900
2	Initiate Institutional Controls	$	14,100
5	Pre-Design for Saturated Soil Remedy	$	66,600
7	Pilot for ISCO Injections	$	49,500
9	Implement Capping	$	215,000
11.1	Repave Western Parking Area for Cap	$	93,300
12	Implement Source Removal	$	38,100
13	Implement ISCO Injections	$	292,000
15	Install Pump/Treat Extraction System	$	450,000
	Direct Cost Subtotal	$	1,250,000
INDIRECT CAPITAL COSTS			
	Project Management (@ 6 Percent)	$	75,200
	Remedial Design (@ 12 Percent)	$	150,000
	Construction Management (@ 8 Percent)	$	100,000
	Contingency (@ 20 Percent)	$	251,000
	Indirect Cost Subtotal	$	577,000
TOTAL CAPITAL COSTS		**$**	**1,830,000**
Long-Term Annual Costs*			
18	Periodic Institutional Control Inspections and Reporting (Years 1 through 30)	$	5,400
19.1	Long-Term Monitoring & Reporting (Years 1 through 5)	$	19,600
19.2	Long-Term Monitoring & Reporting (Years 6 through 30)	$	15,700
21	OM&M (Years 1 through 10)	$	95,000
PRESENT WORTH OF ANNUAL AND PERIODIC COSTS (30 yrs)		**$**	**1,200,000**
TOTAL PRESENT WORTH OF ALTERNATIVE (30 yrs)		**$**	**3,030,000**
TOTAL NON-DISCOUNTED COST OF ALTERNATIVE (30 yrs)		**$**	**3,430,000**

NOTES:
Costs have been rounded to the nearest thousand. Costs details are provided in Appendix B.
* - Costs include additional 10 percent for technical support and 25 percent contingency for unforeseen project complexities, including insurance, taxes, and licensing costs. Costs include annual inspection and reporting.

Table 7.6: Cost Summary for Alternative 4
Soil Excavation at MNR, Source Area Removal, ISCO Injections, Perimeter ISCO Cylinders

Item No.	Item Description		COST
DIRECT CAPITAL COSTS			
2	Initiate Institutional Controls	$	14,100
4	Pre-Design for Excavation at MNR Property	$	52,000
5	Pre-Design for Saturated Soil Remedy	$	66,600
7	Pilot for ISCO Injections	$	49,500
8	Pilot for ISCO Cylinders	$	28,000
10	Implement Excavation at MNR	$	736,000
11.1	Repave Western Parking Area for Cap	$	93,300
12	Implement Source Removal	$	38,100
13	Implement ISCO Injections	$	292,000
14	Install Slow Release Cylinders	$	218,000
	Direct Cost Subtotal	$	1,590,000
INDIRECT CAPITAL COSTS			
	Project Management (@ 6 Percent)	$	95,200
	Remedial Design (@ 12 Percent)	$	190,000
	Construction Management (@ 8 Percent)	$	127,000
	Contingency (@ 20 Percent)	$	317,000
	Indirect Cost Subtotal	$	730,000
TOTAL CAPITAL COSTS		**$**	**2,320,000**
Long-Term Annual Costs*			
18	Periodic Institutional Control Inspections and Reporting (Years 1 through 30)	$	5,400
19.1	Long-Term Monitoring & Reporting (Years 1 through 5)	$	19,600
19.2	Long-Term Monitoring & Reporting (Years 6 through 30)	$	15,700
20	Replace Permanganate Cylinders (Year 3)	$	42,800
PRESENT WORTH OF ANNUAL AND PERIODIC COSTS (30 yrs)		**$**	**491,000**
TOTAL PRESENT WORTH OF ALTERNATIVE (30 yrs)		**$**	**2,810,000**
TOTAL NON-DISCOUNTED COST OF ALTERNATIVE (30 yrs)		**$**	**3,060,000**

NOTES:
Costs have been rounded to the nearest thousand. Costs details are provided in Appendix B.
* - Costs include additional 10 percent for technical support and 25 percent contingency for unforeseen project complexities, including insurance, taxes, and licensing costs. Costs include annual inspection and reporting.

Prepared by: JW 1/13/2017
Checked by: SB 1/20/2017
Revised by: JW 2/13/2017

Table 7.7: Cost Summary for Alternative 5
Soil Excavation at MNR, Source Area Removal, In-Situ Thermal

Item No.	Item Description		COST
DIRECT CAPITAL COSTS			
2	Initiate Institutional Controls	$	14,100
4	Pre-Design for Excavation at MNR Property	$	52,000
5	Pre-Design for Saturated Soil Remedy	$	66,600
10	Implement Excavation at MNR	$	736,000
11.1	Repave Western Parking Area for Cap	$	93,300
12	Implement Source Removal	$	38,100
16	Implement In-Situ Thermal	$	2,930,000
	Direct Cost Subtotal	$	3,930,000
INDIRECT CAPITAL COSTS			
	Project Management (@ 5 Percent)	$	196,000
	Remedial Design (@ 8 Percent)	$	314,000
	Construction Management (@ 6 Percent)	$	236,000
	Contingency (@ 20 Percent)	$	785,000
	Indirect Cost Subtotal	$	1,530,000
TOTAL CAPITAL COSTS		**$**	**5,460,000**
Long-Term Annual Costs*			
18	Periodic Institutional Control Inspections and Reporting (Years 1 through 30)	$	5,400
19.1	Long-Term Monitoring & Reporting (Years 1 and 2)	$	19,600
19.2	Long-Term Monitoring & Reporting (Years 3 through 5)	$	15,700
PRESENT WORTH OF ANNUAL AND PERIODIC COSTS (30 yrs)		**$**	**177,000**
TOTAL PRESENT WORTH OF ALTERNATIVE (30 yrs)		**$**	**5,640,000**
TOTAL NON-DISCOUNTED COST OF ALTERNATIVE (30 yrs)		**$**	**5,710,000**

NOTES:
Costs have been rounded to the nearest thousand. Costs details are provided in Appendix B.
* - Costs include additional 10 percent for technical support and 25 percent contingency for unforeseen project complexities, including insurance, taxes, and licensing costs. Costs include annual inspection and reporting.

APPENDIX A

PNOD RESULTS

Carus Remediation Technologies
Remediation Report

February 20th, 2015

Customer: TestAmerica Buffalo
10 Hazelwood Drive
Amherst, NY

Cc: T. Lizer

Attention: Brain J. Fischer

From: L. Mueller

TECH # 15-023

Subject: RemOx® S ISCO Reagent Permanganate Natural Oxidant Demand

Summary
The overall average RemOx® S ISCO reagent permanganate natural oxidant demand (PNOD) at 48 hours for the soil samples was determined to be 0.74 g/kg. The average demands ranged from 0.10 g/kg to 1.62 g/kg. These values are calculated on a weight as potassium permanganate ($KMnO_4$) per dry weight of soil.

Background
Two soil samples were received from TestAmerica Buffalo from Industrial Overall Service Site project located in Amherst, NY. The soil sample designations were 360109-GS03812xx and 360109-GS037014xx. The samples were analyzed for permanganate natural oxidant demand. The measurement of the permanganate natural oxidant demand is used to estimate the concentration of permanganate that will be consumed by the natural reducing agents during a given time period of 48 hours.

Experimental
The samples were analyzed for permanganate natural oxidant demand following ASTM D7262-07 Test Method A. A brief summary is as follows:

To determine the PNOD, the soil was baked at 105°C for 24 hours then allowed to cool to room temperature. The soil was then blended and passed through a U.S. 10 sieve (2 mm). Reactors were loaded with 50 grams of soil and 100 mL of 20 g/L $KMnO_4$ for an initial dose of 40 g/kg $KMnO_4$ on a dry soil weight basis at a 1:2 soil to aqueous reagent ratio. Each soil dose was performed in triplicate. The reaction vessels were inverted once to mix the reagents. Residual permanganate (MnO_4^-) was determined at 48 hours. The demands were calculated on a dry weight basis.

Results

The permanganate demand is the amount of permanganate consumed in a given amount of time. It should be noted that in a soil or groundwater sample, the oxidation of any compound by permanganate is dependent on the initial dose of permanganate and the reaction time available. As the permanganate dose is increased, the reaction rate and oxidant consumption may also increase. Some compounds that are not typically oxidized by permanganate under low doses can become reactive with permanganate at higher concentrations. The 48-hour PNOD results can be seen in Table 1 (on a dry soil basis).

Table 1: 48-Hour PNOD *

Soil Sample Identification	Average and Standard Deviation (g/kg)	Replicate 1 (g/kg)	Replicate 2 (g/kg)	Replicate 3 (g/kg)
360109-GS03812xx	1.27 ± 0.33	0.96	1.23	1.62
360109-GS03714xx	0.21 ± 0.10	0.30	0.25	0.10
Overall Average	0.74			

*Demands were calculated on a weight $KMnO_4$/dry soil weight basis from an initial dose of 40.0 g/kg $KMnO_4$ initial dose at a 1:2 soil to aqueous solution ratio

Conclusions

For this application the amount of permanganate needed will be dependent on the reaction time allowed. On average, the soil samples had a 48-hour permanganate demand value of 0.74 g/kg. The average demands ranged from 0.10 g/kg to 1.62 g/kg. Generally, remediation sites with a soil demand of less than 20.0 g/kg at the time of interest are favorable for *in situ* chemical oxidation with permanganate (see Table 2 for additional information).

Table 2: Correlation of Permanganate Natural Oxidant Demand Results*

PNOD (g/kg)	**Rank**	Comment
<10	Low	ISCO with MnO_4^- is recommended. Soil contribution to MnO_4^- demand is low.
10-20	Moderate	ISCO with MnO_4^- is recommended. Soil contribution to MnO_4^- demand is moderate. Economics should be considered.
>20	High	ISCO with MnO_4^- is technically feasible. Other technologies may provide lower cost alternatives.

*Dry Weight Basis

APPENDIX B

COST ESTIMATE BACK-UP

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
		PRE-DESIGN / PILOT TESTING FOR ALL ALTERNATIVES					
1	***Alt.3***	***Pre-Design for Soil Capping on MNR Property***				***$ 35,850***	
		Sampling Crew					
		Two People, 6 Days	6	Days	$ 2,000.00	$ 12,000	Includes 10 hrs each person per day and per diem and office support (hand borings)
		Geotech Engineer	2	Days	$ 1,000.00	$ 2,000	Two days for geotech
		Drill Rig for Geotech Samples	2	Days	$ 2,300.00	$ 4,600	Drill Rig and Operators
		Surface Soil Sampling on MNR Property					
		Sampling Equipment	5	Days	$ 75.00	$ 375	
		Lab Analysis - VOCs / Soil	15	EA	$ 75.00	$ 1,125	To delineate lateral extents in top two feet.
		Composite Sample for Characterization	1	EA	$ 1,000.00	$ 1,000	Collect one composite sample for the ~100 CY that will be removed
		Geotech Analysis	10	EA	$ 150.00	$ 1,500	
		Metro North Railroad Flagger	2	Days	$ 5,000.00	$ 10,000	Day rate based on past experience
		Surveying					
		Ground penetrating radar	3	Days	$ 250.00	$ 750	
		Surveying Test locations	2	Days	$ 1,250.00	$ 2,500	
2	***Alt. 3, 4, 5***	***Initiate Institutional Controls (Maintain Cap, etc.)***				***$ 14,149***	
		Project Manager	40	hr	$ 66.47	$ 2,659	
		Project Engineer	40	hr	$ 52.09	$ 2,084	
		Staff Engineer	80	hr	$ 32.77	$ 2,622	
		QA/QC Officer	30	hr	$ 32.77	$ 983	
		Word Processing/Clerical	80	hr	$ 22.80	$ 1,824	
		Draftsman/CADD	60	hr	$ 32.77	$ 1,966	
		Computer Data Entry	40	hr	$ 22.80	$ 912	
		Attorney, Real Estate	4	hr	$ 175.00	$ 700	
		Paralegal, Real Estate	4	hr	$ 100.00	$ 400	
3	***None***	***Pre-Design: Vadose Soil Excavation Beneath Western Parking Lot***				***$ 25,975***	
		Sampling Crew					
		Geologist, 5 Days	5	Days	$ 1,000.00	$ 5,000	Includes 10 hrs per day and per diem and office support
		Geoprobe and Crew	5	Days	$ 1,500.00	$ 7,500	Includes 10 hrs per day and per diem and office support
		Geotech Engineer	2	Days	$ 1,000.00	$ 2,000	Collect Samples for Excavation Support
		Drill Rig for Geotech Samples	2	Days	$ 2,300.00	$ 4,600	Collect Samples for Excavation Support
		Surface Soil Sampling on MNR Property					
		Sampling Equipment	10	Days	$ 75.00	$ 750	One set of sampling equipment for geologist and one for geotech
		Lab Analysis - VOCs / Soil	25	EA	$ 75.00	$ 1,875	
		Composite Sample for Characterization	2	EA	$ 1,000.00	$ 2,000	Collect one composite / 500 CYs for disposal characterization for direct loading
		Geotech Analysis	5	EA	$ 150.00	$ 750	
		Surveying					
		Ground penetrating radar	1	Days	$ 250.00	$ 250	
		Surveying Test locations	1	Days	$ 1,250.00	$ 1,250	
4	***Alt. 4, 5***	***Pre-Design: Vadose Soil Excavation on MNR Property***				***$ 51,975***	
		Sampling Crew					
		Geologist, 5 Days	5	Days	$ 1,000.00	$ 5,000	Includes 10 hrs per day and per diem and office support
		Geoprobe and Crew	5	Days	$ 1,500.00	$ 7,500	Includes 10 hrs per day and per diem and office support
		Geotech Engineer	2	Days	$ 1,000.00	$ 2,000	Collect Samples for Excavation Support
		Drill Rig for Geotech Samples	2	Days	$ 2,300.00	$ 4,600	Collect Samples for Excavation Support
		Surface Soil Sampling on MNR Property					
		Sampling Equipment	10	Days	$ 75.00	$ 750	One set of sampling equipment for geologist and one for geotech
		Lab Analysis - VOCs / Soil	25	EA	$ 75.00	$ 1,875	
		Composite Samples for Characterization	3	EA	$ 1,000.00	$ 3,000	Collect one composite / 500 CYs for disposal characterization for direct loading
		Geotech Analysis	5	EA	$ 150.00	$ 750	
		Metro North Railroad Flagger	5	Days	$ 5,000.00	$ 25,000	
		Surveying					
		Ground penetrating radar	1	Days	$ 250.00	$ 250	
		Surveying Test locations	1	Days	$ 1,250.00	$ 1,250	

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
5	***Alt. 3, 4, 5***	***Pre-Design for Saturated Soil Investigation***				***$ 66,610***	
		Sampling Crew					
		Two People, 10 Days	10	Days	$ 2,000.00	$ 20,000	Includes 10 hrs each person per day and per diem and office support
		Soil & GW Sampling					
		Lab Analysis - VOCs / Groundwater	15	EA	$ 65.00	$ 975	
		Lab Analysis - VOCs / Soil	20	EA	$ 75.00	$ 1,500	
		Soil Sampling Equipment	5	days	$ 75.00	$ 375	
		GW sampling Equipment	2	weeks	$ 219.00	$ 438	
		Soil PNOD Bench Test	2	EA	$ 1,500.00	$ 3,000	
		Surveying					
		Ground penetrating radar	3	DAY	$ 250.00	$ 750	
		Surveying Test Locations	2	DAY	$ 1,250.00	$ 2,500	
		Direct Push Rig					
		Geoprobe mob/demob	1	LS	$ 525.00	$ 525	
		Geoprobe and Crew	5	DAYS	$ 1,500.00	$ 7,500	80' per day, six sample locations to 30' deep
		Core Drill Rental with 6" Thin Wall	5	DAYS	$ 125.00	$ 625	Necessary to bore through pavement/concrete
		Driller's Per Diem	5	DAYS	$ 245.00	$ 1,225	
		Move Rig/Equipment Around	10	EA	$ 58.75	$ 588	
		Portland Cement Grout	360	LF	$ 9.78	$ 3,521	
		Decontaminate Rig, Augers,	5	DAY	$ 17.64	$ 88	
		Pumping Test					
		Test and Report	1	LS	$ 13,000.00	$ 13,000	
		IDW Disposal					
		IDW Disposal	1	LS	$ 10,000.00	$ 10,000	Soil cuttings and water from pump test
6	***Alt. 2***	***Pre-Design for Full Excavation Including Demolition***				***$ 216,040***	
		Sampling Crew					
		Two People, 10 Days	20	Days	$ 2,000.00	$ 40,000	Includes 10 hrs each person per day and per diem and office support
		Soil & GW Sampling					
		Various Groundwater Analysis	5	EA	$ 350.00	$ 1,750	For Pump/Treat Design during excavation
		Lab Analysis - VOCs / Soil	40	EA	$ 75.00	$ 3,000	
		Composite Samples for Characterization	50	EA	$ 1,000.00	$ 50,000	Collect one composite / 1,000 CYs for disposal characterization for direct loading
		Soil Sampling Equipment	20	days	$ 75.00	$ 1,500	
		GW sampling Equipment	1	weeks	$ 219.00	$ 219	
		Surveying					
		Ground penetrating radar	3	DAY	$ 250.00	$ 750	
		Site-Wide Survey	3	DAY	$ 1,250.00	$ 3,750	
		Demolition and Hazardous Building Material Survey					
		Two People, 4 Days	4	Days	$ 2,000.00	$ 8,000	Includes 10 hrs each person per day and per diem and office support
		Asbestos Sampling	40	EA	$ 71.00	$ 2,840	
		Demolition Survey Report	1	LS	$ 10,000.00	$ 10,000	
		Hazardous Building Material Report	1	LS	$ 10,000.00	$ 10,000	
		Direct Push Rig					
		Geoprobe mob/demob	1	LS	$ 525.00	$ 525	
		Geoprobe and Crew	10	DAYS	$ 1,500.00	$ 15,000	
		Core Drill Rental with 6" Thin Wall	10	DAYS	$ 125.00	$ 1,250	Necessary to bore through pavement/concrete
		Driller's Per Diem	10	DAYS	$ 245.00	$ 2,450	
		Move Rig/Equipment Around	20	EA	$ 58.75	$ 1,175	
		Portland Cement Grout	500	LF	$ 9.78	$ 4,890	
		Decontaminate Rig, Augers,	5	DAY	$ 17.64	$ 88	
		Drill Rig for Geotech Samples					
		Drill Rig mob/demob	1	LS	$ 1,000.00	$ 1,000	
		Drill Rig and Crew	10	DAYS	$ 2,300.00	$ 23,000	80' per day, six sample locations to 30' deep
		Core Drill Rental with 6" Thin Wall	10	DAYS	$ 125.00	$ 1,250	Necessary to bore through pavement/concrete
		Driller's Per Diem	10	DAYS	$ 245.00	$ 2,450	
		Move Rig/Equipment Around	20	EA	$ 58.75	$ 1,175	
		Portland Cement Grout	500	LF	$ 9.78	$ 4,890	Necessary to bore through pavement/concrete
		Decontaminate Rig, Augers,	5	DAY	$ 17.64	$ 88	
		Pumping Test					
		Test and Report	1	LS	$ 15,000.00	$ 15,000	
		IDW Disposal					
		IDW Disposal	1	LS	$ 10,000.00	$ 10,000	Soil cuttings and water from pump test

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
7	***Alt. 3, 4***	***Pilot Test for Permanganate Injections***				***$ 49,490***	
		Injection Program					
		Geoprobe mob/demob	1	LS	$ 525.00	$ 525	Use geoprobe to conduct injections
		Geoprobe, Crew & Equipment	5	DAYS	$ 1,500.00	$ 7,500	
		Concrete/Pavement Demo	5	EACH	$ 65.00	$ 325	
		Pavement Restoration	2	SY	$ 25.00	$ 50	
		Oversight	10	DAYS	$ 1,000.00	$ 10,000	
		Materials					
		Pump / Equipment for injection	5	DAYS	$ 250.00	$ 1,250	
		Potassium Permanganate	5,000	LBS	$ 2.40	$ 12,000	
		Shipping	5,000	LBS	$ 0.60	$ 3,000	
		IDW Disposal					
		IDW Disposal	1	LS	$ 5,000.00	$ 5,000	
		Monitor Results					
		Labor & Per Diem	8	Days	$ 1,000.00	$ 8,000	Conduct 4 rounds of monitoring, quarterly
		Monitoring Well Equipment	8	Days	$ 100.00	$ 800	
		Lab Analysis - VOCs / Groundwater	16	EA	$ 65.00	$ 1,040	4 locations each event, 2 new, 2 existing
8	***Alt. 4***	***Pilot Test for Permanganate Cylinders***				***$ 28,010***	
		Injection Program					
		Geoprobe mob/demob	1	LS	$ 525.00	$ 525	Same mobilization as Pilot for Permanganate Injections
		Geoprobe, Crew & Equipment	5	DAYS	$ 1,500.00	$ 7,500	
		Concrete/Pavement Demo	8	EACH	$ 65.00	$ 520	6 injection points, two monitoring points
		Pavement Restoration	2	SY	$ 25.00	$ 50	
		Oversight	5	DAYS	$ 1,000.00	$ 5,000	
		Materials					
		Potassium Permanganate Cylinders	60	units	$ 75.00	$ 4,500	Install 10 cylinders in each boring to cover the saturated zone
		Shipping	5	boxes	$ 15.00	$ 75	12 cylinders in each box
		Monitor Results					
		Labor & Per Diem	8	Days	$ 1,000.00	$ 8,000	Conduct 4 rounds of monitoring, quarterly
		Monitoring Well Equipment	8	Days	$ 100.00	$ 800	
		Lab Analysis - VOCs / Groundwater	16	EA	$ 65.00	$ 1,040	4 locations each event, 2 new, 2 existing

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
		FULL SCALE IMPLEMENTATION FOR ALL ALTERNATIVES					
9	***Alt. 3***	***Implement Capping on MNR Property***				***$ 214,577***	
		MOBILIZATION					
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	1	LS	$ 7,500.00	$ 7,500	
		Health & Safety Plan	1	LS	$ 5,000.00	$ 5,000	
		QA/QC Plan	1	LS	$ 5,000.00	$ 5,000	
		Pre-Construction and As-built Survey	1	LS	$ 6,000.00	$ 6,000	
		Equipment Mobilization/Demobilization	1	LS	$ 5,000.00	$ 5,000	
		Temporary Facilities and Controls					
		Temporary Storage Trailer 16' x 8'	1	MO	$ 2,000.00	$ 2,000	
		Portable Toilets	1	MO	$ 360.00	$ 360	
		Rented chain link, 6' high, to 1,000'	1,000	LF	$ 4.13	$ 4,130	
		Silt Fence 3 ft High	10	Rolls	$ 51.75	$ 518	
		Stockpile Area	1	LS	$ 2,000.00	$ 2,000	
		Decontamination Area	1	LS	$ 5,500.00	$ 5,500	
		Dumpster, weekly rental, 1 dump/week	4	WK	$ 420.00	$ 1,680	
		Cap Installation					
		Excavation of soil in excess of Commercial SCOs	135	CY	$ 30.00	$ 4,050	
		Transport and Dispose of Soil	203	TON	$ 210.00	$ 42,525	Assume VOC concentrations greater than 180 ppm
		Lab Analysis - VOCs / Soil	8	EA	$ 75.00	$ 600	Documentation sampling 20X20 grid on bottom and every 40 feet on sidewalls.
		General grading	500	SY	$ 55.00	$ 27,500	
		Imported Soil approval/certification	1	LS	$ 4,250.00	$ 4,250	Engineer's Estimate
		Import, place, and compact low permeable soil	90	CY	$ 80.00	$ 7,200	0.5 ft clean fill (4.5 ft in excavated area)
		Import, place, and compact Topsoil	90	CY	$ 80.00	$ 7,200	0.5 inches topsoil
		Seed and mulch	500	SY	$ 15.00	$ 7,500	
		16 oz/sy Geotextile/Drainage	500	SY	$ 4.00	$ 2,000	
		Replace Asphalt and Curbs					
		Replace Asphalt	100	SY	$ 108.00	$ 10,800	Small portion of asphalt on MNR property overlying impacted soil
		Replace Drainage Curb	50	LF	$ 100.00	$ 5,000	
		Construction Oversight					
		Labor & Per Diem	3	weeks	$ 10,000.00	$ 30,000	Assume 10 hour days, office support and per diem
		Payment and Performance Bonds				$ 1,933	Assume 1% of cost
		Subcontractor Profit				$ 19,331	Assume 10% of cost

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
10	***Alt. 4, 5***	***Implement Excavation on MNR Property***				***$ 735,706***	
		MOBILIZATION					
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	1	LS	$ 7,500.00	$ 7,500	
		Health & Safety Plan	1	LS	$ 5,000.00	$ 5,000	
		QA/QC Plan	1	LS	$ 5,000.00	$ 5,000	
		Pre-Construction and As-built Survey	1	LS	$ 6,000.00	$ 6,000	
		Equipment Mobilization/Demobilization	1	LS	$ 5,000.00	$ 5,000	
		Temporary Facilities and Controls					
		Temporary Storage Trailer 16' x 8'	1	MO	$ 2,000.00	$ 2,000	
		Portable Toilets	1	MO	$ 360.00	$ 360	
		Rented chain link, 6' high, to 1,000'	1,000	LF	$ 4.13	$ 4,130	
		Silt Fence 3 ft High	10	Rolls	$ 51.75	$ 518	
		Stockpile Area	1	LS	$ 1,500.00	$ 1,500	
		Decontamination Area	1	LS	$ 4,300.00	$ 4,300	
		Dumpster, weekly rental, 1 dump/week	4	WK	$ 420.00	$ 1,680	
		EXCAVATION					
		Demolish Asphalt					
		Remove & Dispose of Asphalt	98	SY	$ 51.48	$ 5,045	
		Excavation Support					
		Trench boxes	1	LS	$ 75,000.00	$ 75,000	Assume trench boxes for areas close to MNR building and Railroad tracks.
		Surface Soil Excavation & Backfill					
		Soil excavation and loading	1,587	CY	$ 30.00	$ 47,610	
		Transportation and Disposal, VOCs	1,904	TON	$ 120.00	$ 228,528	Assume 80% non-hazardous
		Transportation and Disposal, VOCs	476	TON	$ 210.00	$ 99,981	Assume 20% Hazardous
		Lab Analysis - VOCs / Soil	25	EA	$ 75.00	$ 1,875	Documentation sampling. 20X20 grid on bottom and every 40 feet on sidewalls.
		Imported Soil approval/certification	1	LS	$ 4,250.00	$ 4,250	
		Importation, placement, and compaction of backfill	1,587	CY	$ 75.00	$ 119,025	Assume Gravel for easy compaction and no topsoil required.
		Bank Stabilization (riprap)	20	TON	$ 105.00	$ 2,100	
		Replace Asphalt and Curbs					
		Replace Asphalt	100	SY	$ 108.00	$ 10,800	Small portion of asphalt on MNR property overlying impacted soil
		Replace Drainage Curb	50	LF	$ 100.00	$ 5,000	
		Construction Oversight					
		Oversight	20	Days	$ 1,000.00	$ 20,000	
		Payment and Performance Bonds				$ 6,622	
		Subcontractor Profit				$ 66,882	
11	***none***	***Implement Excavation on-site (beneath western parking area)***				***$ 515,849***	
		MOBILIZATION				***$ -***	***All items under mobilization covered under cost items 9 or 10***
		EXCAVATION					
		Demolish Asphalt					
		Remove & Dispose of Asphalt	520	SY	$ 51.48	$ 26,770	
		Excavation Support					
		Trench boxes	1	LS	$ 25,000.00	$ 25,000	Assume trench boxes will be require for areas close to building.
		Surface Soil Excavation & Backfill					
		Soil excavation and loading	1,033	CY	$ 30.00	$ 30,990	
		Transportation and Disposal, VOCs	1,240	TON	$ 120.00	$ 148,800	Assume 80% non-hazardous
		Transportation and Disposal, VOCs	312	TON	$ 210.00	$ 65,436	Assume 20% hazardous
		Lab Analysis - VOCs / Soil	21	EA	$ 75.00	$ 1,575	Confirmation/Documentation sampling
		Imported Soil approval/certification	1	LS	$ 4,250.00	$ 4,250	
		Importation, placement, and compaction of backfill	1,033	CY	$ 70.00	$ 72,310	Backfill suitable for compaction under pavement
		Bank Stabilization (riprap)	20	TON	$ 105.00	$ 2,100	
		Replace Asphalt and Curbs					
		Replace Asphalt	510	SY	$ 108.00	$ 55,080	
		Replace Drainage Curb	120	LF	$ 100.00	$ 12,000	
		Construction Oversight					
		Oversight	20	Days	$ 1,000.00	$ 20,000	
		Payment and Performance Bonds				$ 4,643	
		Subcontractor Profit				$ 46,895	

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
11.1	***Alt. 3, 4, 5***	***Re-Pave Western Parking Area - Cap***				***$ 93,335***	
		Remove & Dispose of Asphalt	510	SY	$ 51.48	$ 26,255	
		Replace Asphalt	510	SY	$ 108.00	$ 55,080	
		Replace Drainage Curb	120	LF	$ 100.00	$ 12,000	
12	***Alt. 3, 4, 5***	***Source Area (Lint Trap) Vacuum Excavation***				***$ 38,107***	
		MOBILIZATION				***$ -***	***All items under mobilization covered under cost items 14, 15 or 16***
		Limited Lint Trap Soil Excavation					
		Vacuum Soil excavation and loading.	2	Days	$ 4,650.00	$ 9,300	7
		Transport and Dispose of Soil	60	TON	$ 210.00	$ 12,600	Assume VOC concentrations greater than 180 ppm
		Imported Soil approval/certification	1	LS	$ 4,250.00	$ 4,250	
		Excavation Oversight	2	Days	$ 1,000.00	$ 2,000	Includes travel & per diem
		Lab Analysis - VOCs / Soil	2	EA	$ 75.00	$ 150	Confirmation/Documentation sampling
		Importation, placement of crushed stone	40	LCY	$ 80.00	$ 3,200	
		Install slotted pipe for future permanganate injections	1	EA	$ 200.00	$ 200	
		Seal bottom with Concrete	24	SF	$ 25.00	$ 600	Assume hand mix concrete and poor in
		Oversight	2	Days	$ 1,000.00	$ 2,000	Assume 10 hour days, office support and per diem
		Payment and Performance Bonds				$ 343	
		Subcontractor Profit				$ 3,464	
13	***Alt. 3, 4***	***ISCO Injections in Vicinity of Debris Pile & Lint Trap***				***$ 291,833***	
		MOBILIZATION				***$ -***	***All items under mobilization covered under cost items 14 or 15***
		Injection Program					
		Geoprobe mob/demob	1	LS	$ 525.00	$ 525	
		Geoprobe, Crew & Equipment	15	DAYS	$ 1,500.00	$ 22,500	15 days for injection, 10 hour days
		Concrete/Pavement Demo	30	EACH	$ 65.00	$ 1,950	
		Pavement Restoration	2	SY	$ 25.00	$ 50	
		Oversight	15	DAYS	$ 1,000.00	$ 15,000	Assume 10 hour days, office support and per diem
		Materials					
		Pump / Equipment for injection	15	DAYS	$ 250.00	$ 3,750	35,500 near lint trap, 5,000 in debris pile area
		Potassium Permanganate	40,500	LBS	$ 2.40	$ 97,200	
		Shipping	40,500	LBS	$ 0.60	$ 24,300	
		IDW Disposal					
		IDW Disposal	1	LS	$ 10,000.00	$ 10,000	
		Reinjection Event (within 1 yr)	1	LS	$ 87,637.50	$ 87,638	Assume reinject half as much as initial injection
		Payment and Performance Bonds				$ 2,629	
		Subcontractor Profit				$ 26,291	

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
14	***Alt. 4***	***ISCO Via Installation of Slow Release Permanganate Cylinders***				***$ 217,800***	
		MOBILIZATION					
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	1	LS	$ 10,000.00	$ 10,000	
		Health & Safety Plan	1	LS	$ 7,500.00	$ 7,500	
		QA/QC Plan	1	LS	$ 7,500.00	$ 7,500	
		Pre-Construction and As-built Survey	1	LS	$ 9,500.00	$ 9,500	
		Equipment Mobilization/Demobilization	1	LS	$ 15,000.00	$ 15,000	
		Temporary Facilities and Controls					
		Temporary Storage Trailer 16' x 8'	1	MO	$ 2,000.00	$ 2,000	
		Portable Toilets	1	MO	$ 360.00	$ 360	
		Rented chain link, 6' high, to 1,000'	1,000	LF	$ 4.13	$ 4,130	
		Decontamination Area	1	LS	$ 4,300.00	$ 4,300	
		Dumpster, weekly rental, 1 dump/week	4	WK	$ 420.00	$ 1,680	
		Full Scale Installation of Slow Release Permanganate Cylinders					
		Cylinder Placement					
		Auger Rig mob/demob	1	LS	$ 750.00	$ 750	
		Auger Rig, Crew & Equipment	20	DAYS	$ 2,000.00	$ 40,000	20 days for injection, 10 hour days
		Complete boring as Well	30	EACH	$ 200.00	$ 6,000	To enable future replacement of cylinders
		Concrete/Pavement Demo	60	EACH	$ 65.00	$ 3,900	
		Pavement Restoration	2	SY	$ 25.00	$ 50	
		Oversight	20	DAYS	$ 1,000.00	$ 20,000	Assume 10 hour days, office support and per diem
		Materials					
		Potassium Permanganate Cylinders	700	Units	$ 75.00	$ 52,500	
		Shipping	58	Boxes	$ 15.00	$ 870	
		IDW Disposal					
		IDW Disposal	1	LS	$ 10,000.00	$ 10,000	
		Payment and Performance Bonds				$ 1,960	
		Subcontractor Profit				$ 19,800	

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
15	***Alt. 3***	***Groundwater Extraction / Treatment / Re-Injection***				***$ 449,823***	
		MOBILIZATION					
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	1	LS	$ 10,000.00	$ 10,000	
		Health & Safety Plan	1	LS	$ 7,500.00	$ 7,500	
		QA/QC Plan	1	LS	$ 7,500.00	$ 7,500	
		Pre-Construction and As-built Survey	1	LS	$ 9,500.00	$ 9,500	
		Equipment Mobilization/Demobilization	1	LS	$ 15,000.00	$ 15,000	
		Temporary Facilities and Controls					
		Temporary Storage Trailer 16' x 8'	1	MO	$ 2,000.00	$ 2,000	
		Portable Toilets	1	MO	$ 360.00	$ 360	
		Rented chain link, 6' high, to 1,000'	1,000	LF	$ 4.13	$ 4,130	
		Decontamination Area	1	LS	$ 4,300.00	$ 4,300	
		Dumpster, weekly rental, 1 dump/week	4	WK	$ 420.00	$ 1,680	
		Groundwater Extraction / Treatment / Reinjection					
		Extraction Well Installation					
		Install Extraction Well	6	EA	$ 2,500.00	$ 15,000	Total of 6 extraction wells.
		Excavation for vaults/manholes	12	CY	$ 99.26	$ 1,191	
		Manholes and covers	6	EA	$ 4,500.00	$ 27,000	
		Backfill	6	LS	$ 525.55	$ 3,153	
		Re-Injection Well Installation					
		Install Injection Well	4	EA	$ 2,500.00	$ 10,000	Total of 4 injection wells and tie-in lint trap.
		Excavation	8	CY	$ 99.26	$ 794	
		Manholes/covers or above ground controls	4	EA	$ 4,500.00	$ 18,000	
		Backfill	4	LS	$ 525.55	$ 2,102	
		Trenching					
		Trench Excavation	70	CY	$ 25.00	$ 1,750	
		Dewatering (if necessary)	5	DAY	$ 498.70	$ 2,494	
		Install Pipe and Conduit	1	LS	$ 6,000.00	$ 6,000	
		Backfill Trench (include asphalt)	70	CY	$ 105.00	$ 7,350	
		Construction Water T&D	330	GAL	$ 4.55	$ 1,502	
		Trailer & Major Equipment					
		Treatment Trailer	1	LS	$ 60,000.00	$ 60,000	
		Groundwater treatment system	1	LS	$ 35,000.00	$ 35,000	
		Installation	10	DAYS	$ 2,000.00	$ 20,000	bag filters, chem mixing tank, chem dosing pump
		Start up/Commissioning	3	DAYS	$ 2,000.00	$ 6,000	
		Shipping Costs	1	LS	$ 5,000.00	$ 5,000	
		Construction Oversite					
		Labor & Per Diem	25	DAY	$ 1,000.00	$ 25,000	
		Soil Disposal					
		Trenching & Drilling Soils	162	Tons	$ 120.00	$ 19,440	Assume non-hazardous
		Payment and Performance Bonds				$ 3,093	
		Subcontractor Profit				$ 33,184	
		1st Year Operations					
		Material					
		Sodium Permanganate (40%)	7,500	lb	$ 2.98	$ 22,350	Estimated amt for first year of recirculation well injections, 40% solution
		Shipping	7,500	lb	$ 0.06	$ 450	
		Misc Maintenance	1	LS	$ 10,000.00	$ 10,000	
		Operations					
		Weekly Inspections	52	Days	$ 1,000.00	$ 52,000	

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
16	***Alt. 5***	***In-Situ Thermal Treatment***				***$ 2,926,952***	
		MOBILIZATION					
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	1	LS	$ 15,000.00	$ 15,000	
		Health & Safety Plan	1	LS	$ 10,000.00	$ 10,000	
		QA/QC Plan	1	LS	$ 10,000.00	$ 10,000	
		Pre-Construction and As-built Survey	1	LS	$ 9,500.00	$ 9,500	
		Equipment Mobilization/Demobilization	1	LS	$ 25,000.00	$ 25,000	
		Temporary Facilities and Controls					
		Temporary Storage Trailer 16' x 8'	1	MO	$ 2,000.00	$ 2,000	
		Portable Toilets	1	MO	$ 360.00	$ 360	
		Rented chain link, 6' high, to 1,000'	1,000	LF	$ 4.13	$ 4,130	
		Decontamination Area	1	LS	$ 4,300.00	$ 4,300	
		Dumpster, weekly rental, 1 dump/week	4	WK	$ 420.00	$ 1,680	
		In-situ Thermal Treatment					
		Subcontractor Design Effort					Based on quotes from similar projects, scaled for size of impacted area
		Design, Work Plans, and Permits	1	LS	$ 132,000.00	$ 132,000	
		Borehole Drilling					
		Drilling and Soil Sampling	1	LS	$ 650,000.00	$ 650,000	Vertical drilling only
		Directional Drilling Contingency	1	LS	$ 150,000.00	$ 150,000	Directional drilling likely needed beneath building
		Drill Cuttings and Waste Disposal	1	LS	$ 30,000.00	$ 30,000	
		Trenching and Restoration	1	LS	$ 205,000.00	$ 205,000	
		Electrode/Well Construction					
		Electrode materials mobilization	1	LS	$ 107,000.00	$ 107,000	
		Subsurface installation	1	LS	$ 30,500.00	$ 30,500	
		Surface installation and start-up	1	LS	$ 210,000.00	$ 210,000	ERH and vapor treatment equipment and connections
		Demobilization and final report	1	LS	$ 55,000.00	$ 55,000	
		Construction Oversight					
		Oversight	50	DAYS	$ 1,000.00	$ 50,000	10 hr days, includes per diem and office support
		Payment and Performance Bonds				$ 16,515	
		Subcontractor Profit				$ 171,798	
		Operational Costs					Operate for one year
		Remediation System Operation	1	LS	$ 490,000.00	$ 490,000	OM&M - carbon changeouts, vapor sampling, labor
		Electrical Permit & Utility Connection	1	LS	$ 140,000.00	$ 140,000	
		Electrical Energy Usage	1,430,000	kWh	$ 0.15	$ 214,500	TRS estimate for Dinaburg - $0.15/kWh for 1.3 Mill + 10%
		Other Operational Costs/Electrical Upgrades	1	LS	$ 93,000.00	$ 93,000	
		System Decommissioning					
		System Decommissioning	1	LS	$ 21,000.00	$ 21,000	
		Well Abandonment	1	LS	$ 40,000.00	$ 40,000	
		Oversight	15	DAYS	$ 1,000.00	$ 15,000	10 hr days, includes per diem and office support
		Post-Treatment Groundwater Monitoring Event					Immediately following system shut-down after 180 days
		GW sampling equipment	1	WK	$ 219.00	$ 219	
		Lab Analysis - VOCs / Groundwater	20	EA	$ 65.00	$ 1,300	
		DOT steel drums, 55 gal., open,	5	EA	$ 450.00	$ 2,250	
		Geoprobe mob/demob	1	LS	$ 525.00	$ 525	Geoprobe for Injections
		Geoprobe, Crew & Equipment	5	DAYS	$ 1,500.00	$ 7,500	
		Lab Analysis - VOCs / Soil	20	EA	$ 75.00	$ 1,500	
		Soil Sampling Equipment	5	days	$ 75.00	$ 375	
		Labor and Per Diem	10	DAY	$ 1,000.00	$ 10,000	

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
17	***Alt. 2***	***Excavation Entire Site to Predisposal Conditions***				***$ 13,396,204***	
		MOBILIZATION					
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	1	LS	$ 10,000.00	$ 10,000	
		Health & Safety Plan	1	LS	$ 7,500.00	$ 7,500	
		QA/QC Plan	1	LS	$ 7,500.00	$ 7,500	
		Pre-Construction and As-built Survey	1	LS	$ 9,500.00	$ 9,500	
		Equipment Mobilization/Demobilization	1	LS	$ 15,000.00	$ 15,000	
		Temporary Facilities and Controls					
		Temporary Storage Trailer 16' x 8'	1	MO	$ 2,000.00	$ 2,000	
		Portable Toilets	1	MO	$ 360.00	$ 360	
		Rented chain link, 6' high, to 1,000'	1,000	LF	$ 4.13	$ 4,130	
		Decontamination Area	1	LS	$ 4,300.00	$ 4,300	
		Dumpster, weekly rental, 1 dump/week	4	WK	$ 420.00	$ 1,680	
		Implementation					
		Demolition	1	LS	$ 75,000.00	$ 75,000	Assumes no hazardous building materials
		Sheet piling	32,000	SF	$ 40.00	$ 1,280,000	Around entire property, sidewalk, MNR property, to 40 feet.
		Pump and Treat	1	LS	$ 50,000.00	$ 50,000	
		Excavation and Loading	38,000	CY	$ 30.00	$ 1,140,000	
		Transportation & Disposal (non-haz)	51,750	Ton	$ 120.00	$ 6,210,000	Assume 90% non-hazardous
		Transportation & Disposal (hazardous)	5,750	Ton	$ 210.00	$ 1,207,500	Assume 10% hazardous
		Imported Soil approval/certification	5	EA	$ 4,500.00	$ 22,500	Multiple approvals for large quantity
		Importation, placement, and compaction of backfill	38,000	CY	$ 65.00	$ 2,470,000	
		Lab Analysis - VOCs / Soil	90	EA	$ 75.00	$ 6,750	Bottom samples every 400 SF, no sidewall due to shoring
		Oversight	80	Days	$ 1,000.00	$ 80,000	
		Railroad Coordination	40	Days	$ 5,000.00	$ 200,000	Assume complete railroad side in 1/2 the time as total project.
		Payment and Performance Bonds (1%)				$ 53,862	Performance Bond does not include cost of T&D
		Subcontractor Profit (1%)				$ 538,622	Subcontractor Profit does not include cost of T&D

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
		PERIODIC AND ANNUAL COSTS FOR ALL ALTERNATIVES					
18	***Alt. 3, 4, 5***	***Annual - Institutional Controls Inspection & Reporting***				***$ 4,000***	
		Institutional Controls Inspection					
		Inspection (Field tech, mobilization, equipment)	1	LS	$ 2,000.00	$ 2,000	
		Annual Report	1	LS	$ 2,000.00	$ 2,000	
19	***Alt. 3, 4, 5****	***Annual - Long-term Monitoring & Reporting***					
19.1		***Long-Term Monitoring***				***$ 14,499***	
		Groundwater Sampling (12 wells, semi-annual years 1 - 5)					
		Labor and Per Diem	5	Days	$ 1,000.00	$ 5,000	
		Monitor well sampling equipment	1	WK	$ 219.00	$ 219	
		Lab Analysis - VOCs / Groundwater	12	EA	$ 65.00	$ 780	
		DOT steel drums, 55 gal., open,	2	EA	$ 500.00	$ 1,000	
		Annual Report	1	LS	$ 1,500.00	$ 7,500	
19.2		***Groundwater Sampling(6 wells, 15 month, years 6 through 30)***				***$ 11,609***	
		Labor and Per Diem	3	Days	$ 1,000.00	$ 3,000	
		Monitor well sampling equipment	1	WK	$ 219.00	$ 219	
		Lab Analysis - VOCs / Groundwater	6	EA	$ 65.00	$ 390	
		DOT steel drums, 55 gal., open,	1	EA	$ 500.00	$ 500	
		Annual Report	1	LS	$ 1,500.00	$ 7,500	
	Alt 5*	**For Alternative 5 assume Semi-Annual Sampling (19.1) for 2 years, Annual Sampling (19.2) for 3 years**					
20	***Alt. 4***	***Periodic Cost - Replace Cylinders***				***$ 31,685***	
		Replace Cylinders - Year 3					Will require evaluating in year 5 to see if needed to replace again in year 6
		Labor and Per Diem	5	DAYS	$ 1,000.00	$ 5,000	Replace cylinders in 30 wells, assume 5 days
		Potassium Permanganate Cylinders	350	Units	$ 75.00	$ 26,250	
		Shipping	29	Boxes	$ 15.00	$ 435	
21	***Alt. 3***	***Operations, Maintenance & Monitoring of GW pump/inject system***				***$ 70,400***	
		OM&M - Assume Years 1-10					
		Weekly Inspections	52	Days	$ 500.00	$ 26,000	Assume 1/2 days by someone local
		Sodium Permanganate (40%)	5,000	lb	$ 2.98	$ 14,900	Estimated amount per year
		Shipping	5,000	lb	$ 0.60	$ 3,000	
		Quarterly Extraction Sampling (VOC)	20	ea	$ 75.00	$ 1,500	Sample 5 extraction wells quarterly, conduct during weekly inspection
		Misc Maintenance	1	LS	$ 25,000.00	$ 25,000	

APPENDIX B: PRESENT VALUE OF PERIODIC COSTS ALTERNATIVE 3

Year	Cost	Number of Annual Periods	Annual Discount Rate	Number of 3-Year Periods	3-Year Discount Rate	Number of 10-Year Periods	10-Year Discount Rate	Total Non-Discounted Cost	Present Value Cost
Capital (Year 0)	$ 1,830,509	1	0.000	NA	NA	NA	NA	$ 1,830,508.99	$ 1,830,508.99
Periodic Inspections and Reporting (Years 1-30)	$ 5,400	30	0.035	NA	NA	NA	NA	$ 162,000.00	$ 99,317.05
Long-Term Monitoring (Years 1 through 5)	$ 19,574	5	0.035	NA	NA	NA	NA	$ 97,868.25	$ 88,376.05
Long-Term Monitoring (Years 6 through 30)	$ 15,672	25	0.035	NA	NA	NA	NA	$ 391,803.75	$ 217,482.32
OM&M (Years 1 through 10)	$ 95,040	10	0.035	NA	NA	NA	NA	$ 950,400.00	$ 790,410.17
Totals								**$ 3,432,580.99**	**$ 3,026,094.58**

Note:
Discount rate of 3.5% was used, as published by the Office of Management and Budget (OMB) in February 2016

APPENDIX B: PRESENT VALUE OF PERIODIC COSTS ALTERNATIVE 4

Year	Cost	Number of Annual Periods	Annual Discount Rate	Number of 3-Year Periods	3-Year Discount Rate	Number of 10-Year Periods	10-Year Discount Rate	Total Non-Discounted Cost	Present Value Cost
Capital (Year 0)	$ 2,317,042	1	0.000	NA	NA	NA	NA	$ 2,317,042.08	$ 2,317,042.08
Periodic Inspections and Reporting (Years 1-30)	$ 5,400	30	0.035	NA	NA	NA	NA	$ 162,000.00	$ 99,317.05
Long-Term Monitoring (Years 1 through 5)	$ 19,574	5	0.035	NA	NA	NA	NA	$ 97,868.25	$ 88,376.05
Long-Term Monitoring (Years 6 through 30)	$ 15,672	25	0.035	NA	NA	NA	NA	$ 391,803.75	$ 217,482.32
Replace Cylinders (Year 3)	$ 95,040	1	0.035	1	0.109	NA	NA	$ 95,040.00	$ 85,720.63
Totals								**$ 3,063,754.08**	**$ 2,807,938.14**

Note:
Discount rate of 3.5% was used, as published by the Office of Management and Budget (OMB) in February 2016

APPENDIX B: PRESENT VALUE OF PERIODIC COSTS ALTERNATIVE 5

Year	Cost	Number of Annual Periods	Annual Discount Rate	Number of 3-Year Periods	3-Year Discount Rate	Number of 10-Year Periods	10-Year Discount Rate	Total Non-Discounted Cost	Present Value Cost
Capital (Year 0)	$ 5,458,299	1	0.000	NA	NA	NA	NA	$ 5,458,299.23	$ 5,458,299.23
Periodic Inspections and Reporting (Years 1-30)	$ 5,400	30	0.035	NA	NA	NA	NA	$ 162,000.00	$ 99,317.05
Long-Term Monitoring (Years 1 and 2)	$ 19,574	2	0.035	NA	NA	NA	NA	$ 39,147.30	$ 37,183.95
Long-Term Monitoring (Years 3 through 5)	$ 15,672	3	0.035	NA	NA	NA	NA	$ 47,016.45	$ 40,988.28
Totals								**$ 5,706,462.98**	**$ 5,635,788.51**

Note:
Discount rate of 3.5% was used, as published by the Office of Management and Budget (OMB) in February 2016

Job No.	3612112221	Sheet	1	of	1
Phase	4	Task	****		
Job Name	Industrial Overall FS				
By	DF	Date	06/24/2015		
Checked By	JW	Date	07/06/2015		
Revised By	JW	Date	01/25/2017		

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Purpose: To provide quantity of vadose soil that would be removed from the Industrial Overall site, stockpiled on-site, transported and disposed of, and used for backfilling for each remedial alternative.

Method: An interpreted area of vadose soil containing PCE-impacted soil was estimated using analytical results from the Remedial Investigation (RI) where protection of groundwater standards were exceeded. These results were imported into TecPlot. This quantity was split up between portion that are on the MRN property and that are on-site. An additional area of vados soil was estimated to quantify the amount of material that exceeds Commercial SCO of PCE on the MNR property. The areas requiring remediation were based on lab data overlying an aerial photo and calculated using GIS. The depths requiring remediation vary, but the average depths were calculated based on the volumes and areas.

Assumptions: The volume of PCE-impacted vadose soil exceeding 5.5 µg/L was an estimated 2,184 cubic yards (cy), which includes 861 cy under the on-site parking area, and 1,323 by on the MNR property.

Due to the uncertainty of the extent of PCE-impacted vadose zone soil a contingency of 20% additional soil volume has been added for costing purposes.

Calculations: **Treatment Areas, Volumes and Average Depths**

MRN Property (Alt.3, 4 and 5):	**Non-Paved**	**Paved**	**Total**	
Area	4,507	787	5,294	sq ft
Volume (cy)	1,192	131	1,323	cy (TecPlot)
Volume (cy)	1,430	157	1,588	cy (with 20% contingency)
Volume (cf)	32,184	3,537	35,721	cf
Thickness	8.6	5.4	NA	ft
Weight (tons)	2,146	236	2,381	ton (1.5 tons / cy)

On-Site Parking Area (Alt.4 & 5)		
Area	4,592	sq ft
Volume (cy)	861	cy (TecPlot)
Volume (cy)	1,033	cy (with 20% contingency)
Volume (cf)	23,247	cf
Thickness	6.1	ft
Weight (tons)	1,550	ton (1.5 tons / cy)

MRN Property Cap (Alt.2): Minor Excavation of soil > Commercial SCOs		
Area	600	sq ft
Volume (cy)	111	cy (based on average depth of 5 feet)
Volume (cy)	133	cy (with 20% contingency)
Volume (cf)	3,000	cf
Thickness	5.0	ft
Weight (tons)	200	ton (1.5 tons / cy)

Conclusion: The above soil volume and weight calculations were used for cost estimating for soil excavation, transportation and disposal, as well as backfilling provided in both the text and in Appendix B.

References: MACTEC Engineering and Consulting, P.C., 2015. *Remedial Investigation Report – Industrial Overall Services Site.* Prepared for New York State Department of Environmental Conservation, Albany, New York.

Job No.	3612112221	Sheet	1	of	1
Phase	4	Task	****		
Job Name	Industrial Overall FS				
By	DF	Date	06/24/2015		
Checked By	JW	Date	07/06/2015		
Revised By	JW	Date	01/25/2015		

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Purpose: To calculate the quantity of saturated soils that would be removed from the Lint Trap source area at the Industrial Overall site, transported and disposed of, and used for backfilling for each remedial alternative.

Method: An interpreted area containing PCE-impacted soil was estimated using analytical results from the Remedial Investigation (RI). Based on these results, an additional 20 percent of soil removal has been assumed to achieve the Commerical SCO of PCE in the subsurface soil below ground surface at the Lint Trap source area. These estimated volumes were used to establish the extent of surface soil removal and for cost estimating purposes for Groundwater / Sub Surface Soil / Highly Weathered Bedrock Remedial Alternatives 2, 3, 4 and 5.

Assumptions: The volume of PCE-impacted soil exceeding 150 mg/L was an estimated 35 cubic yards (cy), at a depth of approximately 20 ft bgs (10 ft below the Lint Trap), and applies to Groundwater / Sub Surface Soil / Highly Weathered Bedrock Remedial Alternatives 2, 3 and 4.

Due to the uncertainty of the extent of PCE-impacted soil, a contingency of 20% additional soil volume has been added for costing purposes.

Constants and Inputs:

Soil volume for Alternatives 2, 3, 4, 5:	35	cubic yards	
Average depth of Excavation for Alternatives 2, 3 and 4:	20.0	feet	
Soil volume contingency factor:	1.2	Additional 20% for uncertainty	
Bulking factor:	1.15		
Conversion factor from cubic yards to tons:	1.5		

Calculations:

Quantity of excavated soil for Alternatives 2, 3, 4, 5	42	cubic yards		
Quantity of soil to be transported and disposed of after bulking for Alternatives 2, 3, 4, 5	48	cubic yards	100	tons

	Total	Clean Fill
Quantity of backfill for Alternatives 2, 3, 4, 5	42	42

Conclusion: The above soil volume and weight calculations can be used to verify the basis costing for soil excavation, transportation and disposal, as well as backfilling provided in both the text and in Appendix B.

References: MACTEC Engineering and Consulting, P.C., 2015. *Remedial Investigation Report – Industrial Overall Services Site.* Prepared for New York State Department of Environmental Conservation, Albany, New York.

RemOx® S and L ISCO Reagents Estimation Spreadsheet

Input data into boxes with blue font.

Proj/Area: Industrial Overall Services - Lint Trap Area

	Estimates	Units
Treatment Area Volume		
Length	40	ft
Width	24	ft
Area	960	sq ft
Thickness	20	ft
Total Volume	711	cu yd
Soil Characteristics/Analysis		
Porosity	25	%
Total Plume Pore Volume	35906	gal
Avg Contaminant Conc	1000	ppm
Mass of Contaminant	299.65	lb
PNOD	0.74	g/kg
Effective PNOD	3	%
Effective PNOD Calculated	0.0222	
PNOD Oxidant Demand	46.8864	lb
Avg Stoichiometric Demand	2.4	lb/lb
Contaminant Oxidant Demand	719.17	lb
Theoretical Oxidant Demand	766.05	lb
Confidence Factor	1.1	
Calculated Oxidant Demand	842.6597368	
Injection Volumes for RemOx S		
RemOx S Injection Concentration	2.5%	%
Total Volume of Injection Fluid	4,039	gal
Pore Volume Replaced	11.25	%

Amount of RemOx S ISCO Reagent Estimated — **843 pounds**

Injection Volumes for RemOx L		
RemOx L Injection Concentration	10.0%	%
Calculated Specific Gravity	1.091623	g/ml
Total Volume of Injection Fluid	831	gal
Pore Volume Replaced	2.31	%

Amount of RemOx L ISCO Reagent Estimated — **1,892 pounds** / **166 gallons** ***

Prepared by: DF 06/25/15
Checked by: SB 07/16/15

RemOx® S and L ISCO Reagents Estimation Spreadsheet

Input data into boxes with blue font.

Proj/Area: Industrial Overall Services - Lint Trap Area

	Estimates	Units
Treatment Area Volume		
Length	30	ft
Width	60	ft
Area	1800	sq ft
Thickness	20	ft
Total Volume	1333	cu yd
Soil Characteristics/Analysis		
Porosity	25	%
Total Plume Pore Volume	67325	gal
Avg Contaminant Conc	10000	ppm
Mass of Contaminant	5618.50	lb
PNOD	0.74	g/kg
Effective PNOD	3	%
Effective PNOD Calculated	0.0222	
PNOD Oxidant Demand	87.912	lb
Avg Stoichiometric Demand	2.4	lb/lb
Contaminant Oxidant Demand	13484.40	lb
Theoretical Oxidant Demand	13572.31	lb
Confidence Factor	1.1	
Calculated Oxidant Demand	14929.54127	
Injection Volumes for RemOx S		
RemOx S Injection Concentration	2.5%	%
Total Volume of Injection Fluid	71,562	gal
Pore Volume Replaced	106.29	%

Amount of RemOx S ISCO Reagent Estimated — **14,930 pounds**

Injection Volumes for RemOx L		
RemOx L Injection Concentration	10.0%	%
Calculated Specific Gravity	1.091623	g/ml
Total Volume of Injection Fluid	14,717	gal
Pore Volume Replaced	21.86	%

Amount of RemOx L ISCO Reagent Estimated — **33,517 pounds** / **2,932 gallons** ***

Job No.	3612112221	Sheet	1	of	1
Phase	4	Task	****		
Job Name	Industrial Overall FS				
By	JW	Date	01/25/2017		
Checked By	SB	Date	01/30/2017		
Revised By		Date			

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Purpose: To provide quantity of Site-Wide soil that would be removed from the Industrial Overall site to reach pre-disposal conditions. Applicable to Alternative 6.

Method: An interpreted area of vadose soil containing PCE-impacted soil was estimated using analytical results from the Remedial Investigation (RI) where contaminants of concerns (COC) were detected. GIS was used to estimate the square area and an assumed average depth of 25 feet was used.

Calculations: **Treatment Areas, Volumes and Average Depths**

Site-Wide: Includes Vadose Zone and Saturated Media (soil and highly weathered bedrock)

Area	34,489	sq ft
Volume (cy)	31,934	cy (Based on depth and area)
Volume (cy)	38,321	cy (with 20% contingency)
Thickness	25.0	ft
Weight (tons)	57,482	ton (1.5 tons / cy)

Conclusion: The above soil volume and weight calculations were used for cost estimating for soil excavation, transportation and disposal, as well as backfilling provided in both the text and in Appendix B. See Figure 6.5 for approximate area.

References: MACTEC Engineering and Consulting, P.C., 2015. *Remedial Investigation Report – Industrial Overall Services Site.* Prepared for New York State Department of Environmental Conservation, Albany, New York.

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
		PRE-DESIGN / PILOT TESTING FOR ALL ALTERNATIVES					
1	***Alt.2***	***Pre-Design for Soil Capping on MNR Property***				***$ 35,850***	
		Sampling Crew					
		Two People, 6 Days	6	Days	$ 2,000.00	$ 12,000	Includes 10 hrs each person per day and per diem and office support (hand borings)
		Geotech Engineer	2	Days	$ 1,000.00	$ 2,000	Two days for geotech
		Drill Rig for Geotech Samples	2	Days	$ 2,300.00	$ 4,600	Drill Rig and Operators
		Surface Soil Sampling on MNR Property					
		Sampling Equipment	5	Days	$ 75.00	$ 375	
		Lab Analysis - VOCs / Soil	15	EA	$ 75.00	$ 1,125	To delineate lateral extents in top two feet.
		Composite Sample for Characterization	1	EA	$ 1,000.00	$ 1,000	Collect one composite sample for the ~100 CY that will be removed
		Geotech Analysis	10	EA	$ 150.00	$ 1,500	
		Metro North Railroad Flagger	2	Days	$ 5,000.00	$ 10,000	Day rate based on past experience
		Surveying					
		Ground penetrating radar	3	Days	$ 250.00	$ 750	
		Surveying Test locations	2	Days	$ 1,250.00	$ 2,500	
2	***Alt. 2, 3, 4***	***Initiate Institutional Controls (Maintain Cap, etc.)***				***$ 14,149***	
		Project Manager	40	hr	$ 66.47	$ 2,659	
		Project Engineer	40	hr	$ 52.09	$ 2,084	
		Staff Engineer	80	hr	$ 32.77	$ 2,622	
		QA/QC Officer	30	hr	$ 32.77	$ 983	
		Word Processing/Clerical	80	hr	$ 22.80	$ 1,824	
		Draftsman/CADD	60	hr	$ 32.77	$ 1,966	
		Computer Data Entry	40	hr	$ 22.80	$ 912	
		Attorney, Real Estate	4	hr	$ 175.00	$ 700	
		Paralegal, Real Estate	4	hr	$ 100.00	$ 400	
3	***Alt. 4, 5***	***Pre-Design: Vadose Soil Excavation Beneath Western Parking Lot***				***$ 25,975***	
		Sampling Crew					
		Geologist, 5 Days	5	Days	$ 1,000.00	$ 5,000	Includes 10 hrs per day and per diem and office support
		Geoprobe and Crew	5	Days	$ 1,500.00	$ 7,500	Includes 10 hrs per day and per diem and office support
		Geotech Engineer	2	Days	$ 1,000.00	$ 2,000	Collect Samples for Excavation Support
		Drill Rig for Geotech Samples	2	Days	$ 2,300.00	$ 4,600	Collect Samples for Excavation Support
		Surface Soil Sampling on MNR Property					
		Sampling Equipment	10	Days	$ 75.00	$ 750	One set of sampling equipment for geologist and one for geotech
		Lab Analysis - VOCs / Soil	25	EA	$ 75.00	$ 1,875	
		Composite Sample for Characterization	2	EA	$ 1,000.00	$ 2,000	Collect one composite / 500 CYs for disposal characterization for direct loading
		Geotech Analysis	5	EA	$ 150.00	$ 750	
		Surveying					
		Ground penetrating radar	1	Days	$ 250.00	$ 250	
		Surveying Test locations	1	Days	$ 1,250.00	$ 1,250	
4	***Alt. 3, 4, 5***	***Pre-Design: Vadose Soil Excavation on MNR Property***				***$ 51,975***	
		Sampling Crew					
		Geologist, 5 Days	5	Days	$ 1,000.00	$ 5,000	Includes 10 hrs per day and per diem and office support
		Geoprobe and Crew	5	Days	$ 1,500.00	$ 7,500	Includes 10 hrs per day and per diem and office support
		Geotech Engineer	2	Days	$ 1,000.00	$ 2,000	Collect Samples for Excavation Support
		Drill Rig for Geotech Samples	2	Days	$ 2,300.00	$ 4,600	Collect Samples for Excavation Support
		Surface Soil Sampling on MNR Property					
		Sampling Equipment	10	Days	$ 75.00	$ 750	One set of sampling equipment for geologist and one for geotech
		Lab Analysis - VOCs / Soil	25	EA	$ 75.00	$ 1,875	
		Composite Samples for Characterization	3	EA	$ 1,000.00	$ 3,000	Collect one composite / 500 CYs for disposal characterization for direct loading
		Geotech Analysis	5	EA	$ 150.00	$ 750	
		Metro North Railroad Flagger	5	Days	$ 5,000.00	$ 25,000	
		Surveying					
		Ground penetrating radar	1	Days	$ 250.00	$ 250	
		Surveying Test locations	1	Days	$ 1,250.00	$ 1,250	

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
5	***Alt. 2, 3, 4, 5***	***Pre-Design for Saturated Soil Investigation***				***$ 66,610***	
		Sampling Crew					
		Two People, 10 Days	10	Days	$ 2,000.00	$ 20,000	Includes 10 hrs each person per day and per diem and office support
		Soil & GW Sampling					
		Lab Analysis - VOCs / Groundwater	15	EA	$ 65.00	$ 975	
		Lab Analysis - VOCs / Soil	20	EA	$ 75.00	$ 1,500	
		Soil Sampling Equipment	5	days	$ 75.00	$ 375	
		GW sampling Equipment	2	weeks	$ 219.00	$ 438	
		Soil PNOD Bench Test	2	EA	$ 1,500.00	$ 3,000	
		Surveying					
		Ground penetrating radar	3	DAY	$ 250.00	$ 750	
		Surveying Test Locations	2	DAY	$ 1,250.00	$ 2,500	
		Direct Push Rig					
		Geoprobe mob/demob	1	LS	$ 525.00	$ 525	
		Geoprobe and Crew	5	DAYS	$ 1,500.00	$ 7,500	80' per day, six sample locations to 30' deep
		Core Drill Rental with 6" Thin Wall	5	DAYS	$ 125.00	$ 625	Necessary to bore through pavement/concrete
		Driller's Per Diem	5	DAYS	$ 245.00	$ 1,225	
		Move Rig/Equipment Around	10	EA	$ 58.75	$ 588	
		Portland Cement Grout	360	LF	$ 9.78	$ 3,521	
		Decontaminate Rig, Augers,	5	DAY	$ 17.64	$ 88	
		Pumping Test					
		Test and Report	1	LS	$ 13,000.00	$ 13,000	
		IDW Disposal					
		IDW Disposal	1	LS	$ 10,000.00	$ 10,000	Soil cuttings and water from pump test
6	***Alt. 6***	***Pre-Design for Full Excavation Including Demolition***				***$ 216,040***	
		Sampling Crew					
		Two People, 10 Days	20	Days	$ 2,000.00	$ 40,000	Includes 10 hrs each person per day and per diem and office support
		Soil & GW Sampling					
		Various Groundwater Analysis	5	EA	$ 350.00	$ 1,750	For Pump/Treat Design during excavation
		Lab Analysis - VOCs / Soil	40	EA	$ 75.00	$ 3,000	
		Composite Samples for Characterization	50	EA	$ 1,000.00	$ 50,000	Collect one composite / 1,000 CYs for disposal characterization for direct loading
		Soil Sampling Equipment	20	days	$ 75.00	$ 1,500	
		GW sampling Equipment	1	weeks	$ 219.00	$ 219	
		Surveying					
		Ground penetrating radar	3	DAY	$ 250.00	$ 750	
		Site-Wide Survey	3	DAY	$ 1,250.00	$ 3,750	
		Demolition and Hazardous Building Material Survey					
		Two People, 4 Days	4	Days	$ 2,000.00	$ 8,000	Includes 10 hrs each person per day and per diem and office support
		Asbestos Sampling	40	EA	$ 71.00	$ 2,840	
		Demolition Survey Report	1	LS	$ 10,000.00	$ 10,000	
		Hazardous Building Material Report	1	LS	$ 10,000.00	$ 10,000	
		Direct Push Rig					
		Geoprobe mob/demob	1	LS	$ 525.00	$ 525	
		Geoprobe and Crew	10	DAYS	$ 1,500.00	$ 15,000	
		Core Drill Rental with 6" Thin Wall	10	DAYS	$ 125.00	$ 1,250	Necessary to bore through pavement/concrete
		Driller's Per Diem	10	DAYS	$ 245.00	$ 2,450	
		Move Rig/Equipment Around	20	EA	$ 58.75	$ 1,175	
		Portland Cement Grout	500	LF	$ 9.78	$ 4,890	
		Decontaminate Rig, Augers,	5	DAY	$ 17.64	$ 88	
		Drill Rig for Geotech Samples					
		Drill Rig mob/demob	1	LS	$ 1,000.00	$ 1,000	
		Drill Rig and Crew	10	DAYS	$ 2,300.00	$ 23,000	80' per day, six sample locations to 30' deep
		Core Drill Rental with 6" Thin Wall	10	DAYS	$ 125.00	$ 1,250	Necessary to bore through pavement/concrete
		Driller's Per Diem	10	DAYS	$ 245.00	$ 2,450	
		Move Rig/Equipment Around	20	EA	$ 58.75	$ 1,175	
		Portland Cement Grout	500	LF	$ 9.78	$ 4,890	
		Decontaminate Rig, Augers,	5	DAY	$ 17.64	$ 88	

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
		Pumping Test					
		Test and Report	1	LS	$ 15,000.00	$ 15,000	
		IDW Disposal					
		IDW Disposal	1	LS	$ 10,000.00	$ 10,000	Soil cuttings and water from pump test
7	***Alt. 2, 3, 4***	***Pilot Test for Permanganate Injections***				***$ 49,490***	
		Injection Program					
		Geoprobe mob/demob	1	LS	$ 525.00	$ 525	Use geoprobe to conduct injections
		Geoprobe, Crew & Equipment	5	DAYS	$ 1,500.00	$ 7,500	
		Concrete/Pavement Demo	5	EACH	$ 65.00	$ 325	
		Pavement Restoration	2	SY	$ 25.00	$ 50	
		Oversight	10	DAYS	$ 1,000.00	$ 10,000	
		Materials					
		Pump / Equipment for injection	5	DAYS	$ 250.00	$ 1,250	
		Potassium Permanganate	5,000	LBS	$ 2.40	$ 12,000	
		Shipping	5,000	LBS	$ 0.60	$ 3,000	
		IDW Disposal					
		IDW Disposal	1	LS	$ 5,000.00	$ 5,000	
		Monitor Results					
		Labor & Per Diem	8	Days	$ 1,000.00	$ 8,000	Conduct 4 rounds of monitoring, quarterly
		Monitoring Well Equipment	8	Days	$ 100.00	$ 800	
		Lab Analysis - VOCs / Groundwater	16	EA	$ 65.00	$ 1,040	4 locations each event, 2 new, 2 existing
8	***Alt. 3, 4***	***Pilot Test for Permanganate Cylinders***				***$ 28,010***	
		Injection Program					
		Geoprobe mob/demob	1	LS	$ 525.00	$ 525	Same mobilization as Pilot for Permanganate Injections
		Geoprobe, Crew & Equipment	5	DAYS	$ 1,500.00	$ 7,500	
		Concrete/Pavement Demo	8	EACH	$ 65.00	$ 520	6 injection points, two monitoring points
		Pavement Restoration	2	SY	$ 25.00	$ 50	
		Oversight	5	DAYS	$ 1,000.00	$ 5,000	
		Materials					
		Potassium Permanganate Cylinders	60	units	$ 75.00	$ 4,500	Install 10 cylinders in each boring to cover the saturated zone
		Shipping	5	boxes	$ 15.00	$ 75	12 cylinders in each box
		Monitor Results					
		Labor & Per Diem	8	Days	$ 1,000.00	$ 8,000	Conduct 4 rounds of monitoring, quarterly
		Monitoring Well Equipment	8	Days	$ 100.00	$ 800	
		Lab Analysis - VOCs / Groundwater	16	EA	$ 65.00	$ 1,040	4 locations each event, 2 new, 2 existing

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
		FULL SCALE IMPLEMENTATION FOR ALL ALTERNATIVES					
9	***Alt. 2***	***Implement Capping on MNR Property***				***$ 208,294***	
		MOBILIZATION					
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	1	LS	$ 7,500.00	$ 7,500	
		Health & Safety Plan	1	LS	$ 5,000.00	$ 5,000	
		QA/QC Plan	1	LS	$ 5,000.00	$ 5,000	
		Pre-Construction and As-built Survey	1	LS	$ 6,000.00	$ 6,000	
		Equipment Mobilization/Demobilization	1	LS	$ 5,000.00	$ 5,000	
		Temporary Facilities and Controls					
		Temporary Storage Trailer 16' x 8'	1	MO	$ 2,000.00	$ 2,000	
		Portable Toilets	1	MO	$ 360.00	$ 360	
		Rented chain link, 6' high, to 1,000'	1,000	LF	$ 4.13	$ 4,130	
		Silt Fence 3 ft High	10	Rolls	$ 51.75	$ 518	
		Stockpile Area	1	LS	$ 1,500.00	$ 1,500	
		Decontamination Area	1	LS	$ 4,300.00	$ 4,300	
		Dumpster, weekly rental, 1 dump/week	4	WK	$ 420.00	$ 1,680	
		Cap Installation					
		Excavation of soil in excess of Commercial SCOs	135	CY	$ 30.00	$ 4,050	
		Transport and Dispose of Soil	203	TON	$ 210.00	$ 42,525	Assume VOC concentrations greater than 180 ppm
		Lab Analysis - VOCs / Soil	8	EA	$ 75.00	$ 600	Documentation sampling 20X20 grid on bottom and every 40 feet on sidewalls.
		General grading	500	SY	$ 50.00	$ 25,000	
		Imported Soil approval/certification	1	LS	$ 4,250.00	$ 4,250	Engineer's Estimate
		Import, place, and compact low permeable soil	90	CY	$ 75.00	$ 6,750	0.5 ft clean fill (4.5 ft in excavated area)
		Import, place, and compact Topsoil	90	CY	$ 75.00	$ 6,750	0.5 inches topsoil
		Seed and mulch	500	SY	$ 15.00	$ 7,500	
		16 oz/sy Geotextile/Drainage	500	SY	$ 2.88	$ 1,440	
		Replace Asphalt and Curbs					
		Replace Asphalt	100	SY	$ 108.00	$ 10,800	Small portion of asphalt on MNR property overlying impacted soil
		Replace Drainage Curb	50	LF	$ 100.00	$ 5,000	
		Construction Oversight					
		Labor & Per Diem	3	weeks	$ 10,000.00	$ 30,000	Assume 10 hour days, office support and per diem
		Payment and Performance Bonds				$ 1,877	Assume 1% of cost
		Subcontractor Profit				$ 18,765	Assume 10% of cost

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
10	***Alt. 3, 4, 5***	***Implement Excavation on MNR Property***				***$ 735,706***	
		MOBILIZATION					
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	1	LS	$ 7,500.00	$ 7,500	
		Health & Safety Plan	1	LS	$ 5,000.00	$ 5,000	
		QA/QC Plan	1	LS	$ 5,000.00	$ 5,000	
		Pre-Construction and As-built Survey	1	LS	$ 6,000.00	$ 6,000	
		Equipment Mobilization/Demobilization	1	LS	$ 5,000.00	$ 5,000	
		Temporary Facilities and Controls					
		Temporary Storage Trailer 16' x 8'	1	MO	$ 2,000.00	$ 2,000	
		Portable Toilets	1	MO	$ 360.00	$ 360	
		Rented chain link, 6' high, to 1,000'	1,000	LF	$ 4.13	$ 4,130	
		Silt Fence 3 ft High	10	Rolls	$ 51.75	$ 518	
		Stockpile Area	1	LS	$ 1,500.00	$ 1,500	
		Decontamination Area	1	LS	$ 4,300.00	$ 4,300	
		Dumpster, weekly rental, 1 dump/week	4	WK	$ 420.00	$ 1,680	
		EXCAVATION					
		Demolish Asphalt					
		Remove & Dispose of Asphalt	98	SY	$ 51.48	$ 5,045	
		Excavation Support					
		Trench boxes	1	LS	$ 75,000.00	$ 75,000	Assume trench boxes for areas close to MNR building and Railroad tracks.
		Surface Soil Excavation & Backfill					
		Soil excavation and loading	1,587	CY	$ 30.00	$ 47,610	
		Transportation and Disposal, VOCs	1,904	TON	$ 120.00	$ 228,528	Assume 80% non-hazardous
		Transportation and Disposal, VOCs	476	TON	$ 210.00	$ 99,981	Assume 20% Hazardous
		Lab Analysis - VOCs / Soil	25	EA	$ 75.00	$ 1,875	Documentation sampling. 20X20 grid on bottom and every 40 feet on sidewalls.
		Imported Soil approval/certification	1	LS	$ 4,250.00	$ 4,250	
		Importation, placement, and compaction of backfill	1,587	CY	$ 75.00	$ 119,025	Assume Gravel for easy compaction and no topsoil required.
		Bank Stabilization (riprap)	20	TON	$ 105.00	$ 2,100	
		Replace Asphalt and Curbs					
		Replace Asphalt	100	SY	$ 108.00	$ 10,800	Small portion of asphalt on MNR property overlying impacted soil
		Replace Drainage Curb	50	LF	$ 100.00	$ 5,000	
		Construction Oversight					
		Oversight	20	Days	$ 1,000.00	$ 20,000	
		Payment and Performance Bonds				$ 6,622	
		Subcontractor Profit				$ 66,882	
11	***Alt. 4 & 5***	***Implement Excavation on-site (beneath western parking area)***				***$ 515,849***	
		MOBILIZATION				***$ -***	***All items under mobilization covered under cost items 9 or 10***
		EXCAVATION					
		Demolish Asphalt					
		Remove & Dispose of Asphalt	520	SY	$ 51.48	$ 26,770	
		Excavation Support					
		Trench boxes	1	LS	$ 25,000.00	$ 25,000	Assume trench boxes will be require for areas close to building.
		Surface Soil Excavation & Backfill					
		Soil excavation and loading	1,033	CY	$ 30.00	$ 30,990	
		Transportation and Disposal, VOCs	1,240	TON	$ 120.00	$ 148,800	Assume 80% non-hazardous
		Transportation and Disposal, VOCs	312	TON	$ 210.00	$ 65,436	Assume 20% hazardous
		Lab Analysis - VOCs / Soil	21	EA	$ 75.00	$ 1,575	Confirmation/Documentation sampling
		Imported Soil approval/certification	1	LS	$ 4,250.00	$ 4,250	
		Importation, placement, and compaction of backfill	1,033	CY	$ 70.00	$ 72,310	Backfill suitable for compaction under pavement
		Bank Stabilization (riprap)	20	TON	$ 105.00	$ 2,100	
		Replace Asphalt and Curbs					
		Replace Asphalt	510	SY	$ 108.00	$ 55,080	
		Replace Drainage Curb	120	LF	$ 100.00	$ 12,000	
		Construction Oversight					

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
		Oversight	20	Days	$ 1,000.00	$ 20,000	
		Payment and Performance Bonds				$ 4,643	
		Subcontractor Profit				$ 46,895	
11.1	***Alt. 2, 3***	***Re-Pave Western Parking Area - Cap***				***$ 93,335***	
		Remove & Dispose of Asphalt	510	SY	$ 51.48	$ 26,255	
		Replace Asphalt	510	SY	$ 108.00	$ 55,080	
		Replace Drainage Curb	120	LF	$ 100.00	$ 12,000	
12	***Alt. 2, 3, 4, 5***	***Source Area (Lint Trap) Vacuum Excavation***				***$ 38,107***	
		MOBILIZATION				***$ -***	***All items under mobilization covered under cost items 14, 15 or 16***
		Limited Lint Trap Soil Excavation					
		Vacuum Soil excavation and loading.	2	Days	$ 4,650.00	$ 9,300	7
		Transport and Dispose of Soil	60	TON	$ 210.00	$ 12,600	Assume VOC concentrations greater than 180 ppm
		Imported Soil approval/certification	1	LS	$ 4,250.00	$ 4,250	
		Excavation Oversight	2	Days	$ 1,000.00	$ 2,000	Includes travel & per diem
		Lab Analysis - VOCs / Soil	2	EA	$ 75.00	$ 150	Confirmation/Documentation sampling
		Importation, placement of crushed stone	40	LCY	$ 80.00	$ 3,200	
		Install slotted pipe for future permanganate injections	1	EA	$ 200.00	$ 200	
		Seal bottom with Concrete	24	SF	$ 25.00	$ 600	Assume hand mix concrete and poor in
		Oversight	2	Days	$ 1,000.00	$ 2,000	Assume 10 hour days, office support and per diem
		Payment and Performance Bonds				$ 343	
		Subcontractor Profit				$ 3,464	
13	***Alt. 2, 3, 4***	***ISCO Injections in Vicinity of Debris Pile & Lint Trap***				***$ 291,833***	
		MOBILIZATION				***$ -***	***All items under mobilization covered under cost items 14 or 15***
		Injection Program					
		Geoprobe mob/demob	1	LS	$ 525.00	$ 525	
		Geoprobe, Crew & Equipment	15	DAYS	$ 1,500.00	$ 22,500	15 days for injection, 10 hour days
		Concrete/Pavement Demo	30	EACH	$ 65.00	$ 1,950	
		Pavement Restoration	2	SY	$ 25.00	$ 50	
		Oversight	15	DAYS	$ 1,000.00	$ 15,000	Assume 10 hour days, office support and per diem
		Materials					
		Pump / Equipment for injection	15	DAYS	$ 250.00	$ 3,750	35,500 near lint trap, 5,000 in debris pile area
		Potassium Permanganate	40,500	LBS	$ 2.40	$ 97,200	
		Shipping	40,500	LBS	$ 0.60	$ 24,300	
		IDW Disposal					
		IDW Disposal	1	LS	$ 10,000.00	$ 10,000	
		Reinjection Event (within 1 yr)	1	LS	$ 87,637.50	$ 87,638	Assume reinject half as much as initial injection
		Payment and Performance Bonds				$ 2,629	
		Subcontractor Profit				$ 26,291	

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
14	***Alt. 3, 4***	***ISCO Via Installation of Slow Release Permanganate Cylinders***				***$ 217,800***	
		MOBILIZATION					
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	1	LS	$ 10,000.00	$ 10,000	
		Health & Safety Plan	1	LS	$ 7,500.00	$ 7,500	
		QA/QC Plan	1	LS	$ 7,500.00	$ 7,500	
		Pre-Construction and As-built Survey	1	LS	$ 9,500.00	$ 9,500	
		Equipment Mobilization/Demobilization	1	LS	$ 15,000.00	$ 15,000	
		Temporary Facilities and Controls					
		Temporary Storage Trailer 16' x 8'	1	MO	$ 2,000.00	$ 2,000	
		Portable Toilets	1	MO	$ 360.00	$ 360	
		Rented chain link, 6' high, to 1,000'	1,000	LF	$ 4.13	$ 4,130	
		Decontamination Area	1	LS	$ 4,300.00	$ 4,300	
		Dumpster, weekly rental, 1 dump/week	4	WK	$ 420.00	$ 1,680	
		Full Scale Installation of Slow Release Permanganate Cylinders					
		Cylinder Placement					
		Auger Rig mob/demob	1	LS	$ 750.00	$ 750	
		Auger Rig, Crew & Equipment	20	DAYS	$ 2,000.00	$ 40,000	20 days for injection, 10 hour days
		Complete boring as Well	30	EACH	$ 200.00	$ 6,000	To enable future replacement of cylinders
		Concrete/Pavement Demo	60	EACH	$ 65.00	$ 3,900	
		Pavement Restoration	2	SY	$ 25.00	$ 50	
		Oversight	20	DAYS	$ 1,000.00	$ 20,000	Assume 10 hour days, office support and per diem
		Materials					
		Potassium Permanganate Cylinders	700	Units	$ 75.00	$ 52,500	
		Shipping	58	Boxes	$ 15.00	$ 870	
		IDW Disposal					
		IDW Disposal	1	LS	$ 10,000.00	$ 10,000	
		Payment and Performance Bonds				$ 1,960	
		Subcontractor Profit				$ 19,800	

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
15	***Alt. 2***	***Groundwater Extraction / Treatment / Re-Injection***				***$ 449,823***	
		MOBILIZATION					
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	1	LS	$ 10,000.00	$ 10,000	
		Health & Safety Plan	1	LS	$ 7,500.00	$ 7,500	
		QA/QC Plan	1	LS	$ 7,500.00	$ 7,500	
		Pre-Construction and As-built Survey	1	LS	$ 9,500.00	$ 9,500	
		Equipment Mobilization/Demobilization	1	LS	$ 15,000.00	$ 15,000	
		Temporary Facilities and Controls					
		Temporary Storage Trailer 16' x 8'	1	MO	$ 2,000.00	$ 2,000	
		Portable Toilets	1	MO	$ 360.00	$ 360	
		Rented chain link, 6' high, to 1,000'	1,000	LF	$ 4.13	$ 4,130	
		Decontamination Area	1	LS	$ 4,300.00	$ 4,300	
		Dumpster, weekly rental, 1 dump/week	4	WK	$ 420.00	$ 1,680	
		Groundwater Extraction / Treatment / Reinjection					
		Extraction Well Installation					
		Install Extraction Well	6	EA	$ 2,500.00	$ 15,000	Total of 6 extraction wells.
		Excavation for vaults/manholes	12	CY	$ 99.26	$ 1,191	
		Manholes and covers	6	EA	$ 4,500.00	$ 27,000	
		Backfill	6	LS	$ 525.55	$ 3,153	
		Re-Injection Well Installation					
		Install Injection Well	4	EA	$ 2,500.00	$ 10,000	Total of 4 injection wells and tie-in lint trap.
		Excavation	8	CY	$ 99.26	$ 794	
		Manholes/covers or above ground controls	4	EA	$ 4,500.00	$ 18,000	
		Backfill	4	LS	$ 525.55	$ 2,102	
		Trenching					
		Trench Excavation	70	CY	$ 25.00	$ 1,750	
		Dewatering (if necessary)	5	DAY	$ 498.70	$ 2,494	
		Install Pipe and Conduit	1	LS	$ 6,000.00	$ 6,000	
		Backfill Trench (include asphalt)	70	CY	$ 105.00	$ 7,350	
		Construction Water T&D	330	GAL	$ 4.55	$ 1,502	
		Trailer & Major Equipment					
		Treatment Trailer	1	LS	$ 60,000.00	$ 60,000	
		Groundwater treatment system	1	LS	$ 35,000.00	$ 35,000	
		Installation	10	DAYS	$ 2,000.00	$ 20,000	bag filters, chem mixing tank, chem dosing pump
		Start up/Commissioning	3	DAYS	$ 2,000.00	$ 6,000	
		Shipping Costs	1	LS	$ 5,000.00	$ 5,000	
		Construction Oversite					
		Labor & Per Diem	25	DAY	$ 1,000.00	$ 25,000	
		Soil Disposal					
		Trenching & Drilling Soils	162	Tons	$ 120.00	$ 19,440	Assume non-hazardous
		Payment and Performance Bonds				$ 3,093	
		Subcontractor Profit				$ 33,184	
		1st Year Operations					
		Material					
		Sodium Permanganate (40%)	7,500	lb	$ 2.98	$ 22,350	Estimated amt for first year of recirculation well injections, 40% solution
		Shipping	7,500	lb	$ 0.06	$ 450	
		Misc Maintenance	1	LS	$ 10,000.00	$ 10,000	
		Operations					
		Weekly Inspections	52	Days	$ 1,000.00	$ 52,000	

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
16	***Alt. 5***	***In-Situ Thermal Treatment***				***$ 2,926,952***	
		MOBILIZATION					
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	1	LS	$ 15,000.00	$ 15,000	
		Health & Safety Plan	1	LS	$ 10,000.00	$ 10,000	
		QA/QC Plan	1	LS	$ 10,000.00	$ 10,000	
		Pre-Construction and As-built Survey	1	LS	$ 9,500.00	$ 9,500	
		Equipment Mobilization/Demobilization	1	LS	$ 25,000.00	$ 25,000	
		Temporary Facilities and Controls					
		Temporary Storage Trailer 16' x 8'	1	MO	$ 2,000.00	$ 2,000	
		Portable Toilets	1	MO	$ 360.00	$ 360	
		Rented chain link, 6' high, to 1,000'	1,000	LF	$ 4.13	$ 4,130	
		Decontamination Area	1	LS	$ 4,300.00	$ 4,300	
		Dumpster, weekly rental, 1 dump/week	4	WK	$ 420.00	$ 1,680	
		In-situ Thermal Treatment					
		Subcontractor Design Effort					Based on quotes from similar projects, scaled for size of impacted area
		Design, Work Plans, and Permits	1	LS	$ 132,000.00	$ 132,000	
		Borehole Drilling					
		Drilling and Soil Sampling	1	LS	$ 650,000.00	$ 650,000	Vertical drilling only
		Directional Drilling Contingency	1	LS	$ 150,000.00	$ 150,000	Directional drilling likely needed beneath building
		Drill Cuttings and Waste Disposal	1	LS	$ 30,000.00	$ 30,000	
		Trenching and Restoration	1	LS	$ 205,000.00	$ 205,000	
		Electrode/Well Construction					
		Electrode materials mobilization	1	LS	$ 107,000.00	$ 107,000	
		Subsurface installation	1	LS	$ 30,500.00	$ 30,500	
		Surface installation and start-up	1	LS	$ 210,000.00	$ 210,000	ERH and vapor treatment equipment and connections
		Demobilization and final report	1	LS	$ 55,000.00	$ 55,000	
		Construction Oversight					
		Oversight	50	DAYS	$ 1,000.00	$ 50,000	10 hr days, includes per diem and office support
		Payment and Performance Bonds				$ 16,515	
		Subcontractor Profit				$ 171,798	
		Operational Costs					Operate for one year
		Remediation System Operation	1	LS	$ 490,000.00	$ 490,000	OM&M - carbon changeouts, vapor sampling, labor
		Electrical Permit & Utility Connection	1	LS	$ 140,000.00	$ 140,000	
		Electrical Energy Usage	1,430,000	kWh	$ 0.15	$ 214,500	TRS estimate for Dinaburg - $0.15/kWh for 1.3 Mill + 10%
		Other Operational Costs/Electrical Upgrades	1	LS	$ 93,000.00	$ 93,000	
		System Decommissioning					
		System Decommissioning	1	LS	$ 21,000.00	$ 21,000	
		Well Abandonment	1	LS	$ 40,000.00	$ 40,000	
		Oversight	15	DAYS	$ 1,000.00	$ 15,000	10 hr days, includes per diem and office support
		Post-Treatment Groundwater Monitoring Event					Immediately following system shut-down after 180 days
		GW sampling equipment	1	WK	$ 219.00	$ 219	
		Lab Analysis - VOCs / Groundwater	20	EA	$ 65.00	$ 1,300	
		DOT steel drums, 55 gal., open,	5	EA	$ 450.00	$ 2,250	
		Geoprobe mob/demob	1	LS	$ 525.00	$ 525	Geoprobe for Injections
		Geoprobe, Crew & Equipment	5	DAYS	$ 1,500.00	$ 7,500	
		Lab Analysis - VOCs / Soil	20	EA	$ 75.00	$ 1,500	
		Soil Sampling Equipment	5	days	$ 75.00	$ 375	
		Labor and Per Diem	10	DAY	$ 1,000.00	$ 10,000	

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
17	***Alt. 6***	***Excavation Entire Site to Predisposal Conditions***				***$ 13,396,204***	
		MOBILIZATION					
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	1	LS	$ 10,000.00	$ 10,000	
		Health & Safety Plan	1	LS	$ 7,500.00	$ 7,500	
		QA/QC Plan	1	LS	$ 7,500.00	$ 7,500	
		Pre-Construction and As-built Survey	1	LS	$ 9,500.00	$ 9,500	
		Equipment Mobilization/Demobilization	1	LS	$ 15,000.00	$ 15,000	
		Temporary Facilities and Controls					
		Temporary Storage Trailer 16' x 8'	1	MO	$ 2,000.00	$ 2,000	
		Portable Toilets	1	MO	$ 360.00	$ 360	
		Rented chain link, 6' high, to 1,000'	1,000	LF	$ 4.13	$ 4,130	
		Decontamination Area	1	LS	$ 4,300.00	$ 4,300	
		Dumpster, weekly rental, 1 dump/week	4	WK	$ 420.00	$ 1,680	
		Implementation					
		Demolition	1	LS	$ 75,000.00	$ 75,000	Assumes no hazardous building materials
		Sheet piling	32,000	SF	$ 40.00	$ 1,280,000	Around entire property, sidewalk, MNR property, to 40 feet.
		Pump and Treat	1	LS	$ 50,000.00	$ 50,000	
		Excavation and Loading	38,000	CY	$ 30.00	$ 1,140,000	
		Transportation & Disposal (non-haz)	51,750	Ton	$ 120.00	$ 6,210,000	Assume 90% non-hazardous
		Transportation & Disposal (hazardous)	5,750	Ton	$ 210.00	$ 1,207,500	Assume 10% hazardous
		Imported Soil approval/certification	5	EA	$ 4,500.00	$ 22,500	Multiple approvals for large quantity
		Importation, placement, and compaction of backfill	38,000	CY	$ 65.00	$ 2,470,000	
		Lab Analysis - VOCs / Soil	90	EA	$ 75.00	$ 6,750	Bottom samples every 400 SF, no sidewall due to shoring
		Oversight	80	Days	$ 1,000.00	$ 80,000	
		Railroad Coordination	40	Days	$ 5,000.00	$ 200,000	Assume complete railroad side in 1/2 the time as total project.
		Payment and Performance Bonds (1%)				$ 53,862	Performance Bond does not include cost of T&D
		Subcontractor Profit (1%)				$ 538,622	Subcontractor Profit does not include cost of T&D

Appendix B
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Comment
		PERIODIC AND ANNUAL COSTS FOR ALL ALTERNATIVES					
18	***Alt. 2, 3***	***Annual - Institutional Controls Inspection & Reporting***				***$ 3,000***	
		Institutional Controls Inspection					
		Inspection (Field tech, mobilization, equipment)	1	LS	$ 1,500.00	$ 1,500	
		Annual Report	1	LS	$ 1,500.00	$ 1,500	
19	***Alt. 2, 3, 4, 5****	***Annual - Long-term Monitoring & Reporting***					
19.1		***Long-Term Monitoring***				***$ 14,399***	
		Groundwater Sampling (12 wells, semi-annual years 1 - 5)					
		Labor and Per Diem	5	Days	$ 1,000.00	$ 5,000	
		Monitor well sampling equipment	1	WK	$ 219.00	$ 219	
		Lab Analysis - VOCs / Groundwater	12	EA	$ 65.00	$ 780	
		DOT steel drums, 55 gal., open,	2	EA	$ 450.00	$ 900	
		Annual Report	1	LS	$ 1,500.00	$ 7,500	
19.2		***Groundwater Sampling(6 wells, 15 month, years 6 through 30)***				***$ 11,565***	
		Labor and Per Diem	3	Days	$ 1,000.00	$ 3,000	
		Monitor well sampling equipment	1	WK	$ 219.00	$ 219	
		Lab Analysis - VOCs / Groundwater	6	EA	$ 65.00	$ 390	
		DOT steel drums, 55 gal., open,	1	EA	$ 456.14	$ 456	
		Annual Report	1	LS	$ 1,500.00	$ 7,500	
	Alt 5*	**For Alternative 5 assume Semi-Annual Sampling (19.1) for 2 years, Annual Sampling (19.2) for 3 years**					
20	***Alt. 3, 4***	***Periodic Cost - Replace Cylinders***				***$ 31,685***	
		Replace Cylinders - Year 3					Will require evaluating in year 5 to see if needed to replace again in year 6
		Labor and Per Diem	5	DAYS	$ 1,000.00	$ 5,000	Replace cylinders in 30 wells, assume 5 days
		Potassium Permanganate Cylinders	350	Units	$ 75.00	$ 26,250	
		Shipping	29	Boxes	$ 15.00	$ 435	
21	***Alt. 2***	***Operations, Maintenance & Monitoring of GW pump/inject system***				***$ 70,400***	
		OM&M - Assume Years 1-10					
		Weekly Inspections	52	Days	$ 500.00	$ 26,000	Assume 1/2 days by someone local
		Sodium Permanganate (40%)	5,000	lb	$ 2.98	$ 14,900	Estimated amount per year
		Shipping	5,000	lb	$ 0.60	$ 3,000	
		Quarterly Extraction Sampling (VOC)	20	ea	$ 75.00	$ 1,500	Sample 5 extraction wells quarterly, conduct during weekly inspection
		Misc Maintenance	1	LS	$ 25,000.00	$ 25,000	

APPENDIX B - PRESENT VALUE OF PERIODIC COSTS ALTERNATIVE 2

Year	Cost	Number of Annual Periods	Annual Discount Rate	Number of 3-Year Periods	3-Year Discount Rate	Number of 10-Year Periods	10-Year Discount Rate	Total Non-Discounted Cost	Present Value Cost
Capital (Year 0)	$ 1,828,000	1	0.000	NA	NA	NA	NA	$ 1,828,000.00	$ 1,828,000.00
Periodic Inspections and Reporting (Years 1-30)	$ 5,000	30	0.035	NA	NA	NA	NA	$ 150,000.00	$ 91,960.23
Long-Term Monitoring (Years 1 through 5)	$ 20,000	5	0.035	NA	NA	NA	NA	$ 100,000.00	$ 90,301.05
Long-Term Monitoring (Years 6 through 30)	$ 16,000	25	0.035	NA	NA	NA	NA	$ 400,000.00	$ 222,031.89
OM&M (Years 1 through 10)	$ 96,000	10	0.035	NA	NA	NA	NA	$ 960,000.00	$ 798,394.11
Totals								**$ 3,438,000.00**	**$ 3,030,687.27**

Note:
Discount rate of 3.5% was used, as published by the Office of Management and Budget (OMB) in February 2016

APPENDIX B - PRESENT VALUE OF PERIODIC COSTS ALTERNATIVE 3

Year	Cost	Number of Annual Periods	Annual Discount Rate	Number of 3-Year Periods	3-Year Discount Rate	Number of 10-Year Periods	10-Year Discount Rate	Total Non-Discounted Cost	Present Value Cost
Capital (Year 0)	$ 2,324,000	1	0.000	NA	NA	NA	NA	$ 2,324,000.00	$ 2,324,000.00
Periodic Inspections and Reporting (Years 1-30)	$ 5,000	30	0.035	NA	NA	NA	NA	$ 150,000.00	$ 91,960.23
Long-Term Monitoring (Years 1 through 5)	$ 20,000	5	0.035	NA	NA	NA	NA	$ 100,000.00	$ 90,301.05
Long-Term Monitoring (Years 6 through 30)	$ 16,000	25	0.035	NA	NA	NA	NA	$ 400,000.00	$ 222,031.89
Replace Cylinders (Year 3)	$ 96,000	1	0.035	1	0.109	NA	NA	$ 96,000.00	$ 86,586.50
Totals								**$ 3,070,000.00**	**$ 2,814,879.66**

Note:
Discount rate of 3.5% was used, as published by the Office of Management and Budget (OMB) in February 2016

APPENDIX B - PRESENT VALUE OF PERIODIC COSTS ALTERNATIVE 4

Year	Cost	Number of Annual Periods	Annual Discount Rate	Number of 3-Year Periods	3-Year Discount Rate	Number of 10-Year Periods	10-Year Discount Rate	Total Non-Discounted Cost	Present Value Cost
Capital (Year 0)	$ 2,816,000	1	0.000	NA	NA	NA	NA	$ 2,816,000.00	$ 2,816,000.00
Periodic Inspections and Reporting (Years 1-30)	$ 5,000	30	0.035	NA	NA	NA	NA	$ 150,000.00	$ 91,960.23
Long-Term Monitoring (Years 1 through 5)	$ 20,000	5	0.035	NA	NA	NA	NA	$ 100,000.00	$ 90,301.05
Long-Term Monitoring (Years 6 through 30)	$ 16,000	25	0.035	NA	NA	NA	NA	$ 400,000.00	$ 222,031.89
Replace Cylinders (Year 3)	$ 16,000	1	0.035	1	0.109	NA	NA	$ 16,000.00	$ 14,431.08
Totals								**$ 3,482,000.00**	**$ 3,234,724.25**

Note:
Discount rate of 3.5% was used, as published by the Office of Management and Budget (OMB) in February 2016

APPENDIX B - PRESENT VALUE OF PERIODIC COSTS ALTERNATIVE 5

Year	Cost	Number of Annual Periods	Annual Discount Rate	Number of 3-Year Periods	3-Year Discount Rate	Number of 10-Year Periods	10-Year Discount Rate	Total Non-Discounted Cost	Present Value Cost
Capital (Year 0)	$ 5,972,000	1	0.000	NA	NA	NA	NA	$ 5,972,000.00	$ 5,972,000.00
Long-Term Monitoring (Years 1 and 2)	$ 20,000	2	0.035	NA	NA	NA	NA	$ 40,000.00	$ 37,993.89
Long-Term Monitoring (Years 3 through 5)	$ 16,000	3	0.035	NA	NA	NA	NA	$ 48,000.00	$ 41,845.73
Totals								**$ 6,060,000.00**	**$ 6,051,839.62**

Note:
Discount rate of 3.5% was used, as published by the Office of Management and Budget (OMB) in February 2016