Certification

I, Christopher Gurr P.E., certify that I am currently a NYS registered professional engineer and that this Feasibility Study was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

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Date

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Acronyms and Abbreviations

BGS	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	contaminant/constituent of concern
CSM	conceptual site model
EPA	Environmental Protection Agency
ERH	electrical resistivity heating
ESA	Environmental Site Assessment
FS	Feasibility Study
GRA	General Response Action
ISTR	*In-Situ* Thermal Remediation
MNA	Monitored Natural Attenuation
NCP	National Contingency Plan
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	operations & maintenance
POTW	Publically Owned Treatment Works
ppb	parts per billion
ppm	parts per million
PRG	preliminary remediation goal
RAO	Remedial Action Objective
RCRA	Resource Control and Recovery Act
RIR	Remedial Investigation Report
SCG	Standard, Criteria and Guidance
SCO	Soil Cleanup Objectives
SVE	soil vapor extraction
SVOC	semi volatile organic compounds
TAGM	Technical and Administrative Guidance Memorandum
TCE	trichloroethylene
TOGS	Technical and Operational Guidance Series
TSCA	Toxic Substances Control Act

UCS	unconfined compressive strength
VOC	volatile organic compounds

Section 1

Introduction

This Feasibility Study (FS) Report for Shulman's Salvage Yard (herein referred to as the "Site") located at One Shulman Plaza, Elmira, Chemung County, New York was prepared by Camp Dresser McKee & Smith (CDM Smith) for the New York State Department of Environmental Conservation (NYSDEC) under Contract D007621. The Site is an active salvage yard located in a mixed residential and commercial area. A Site location map is provided in Figure 1-1 and a Site plan showing the individual parcels and areas at the Site is provided in Figure 1-2. The FS report was developed in accordance with New York State guidance documents "*DER-10 Technical Guidance for Site Investigation and Remediation*", dated May 2010 (NYSDEC 2010) and "*Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*", dated October 2006 (NYSDOH 2006).

1.1 Purpose

The objective of this FS is to develop and present remedial alternatives that are appropriate for addressing site contamination, as delineated in the September, 2014 Remedial Investigation Report (RIR). The FS serves as the mechanism for development, screening and detailed evaluation of remedial alternatives, and includes:

- The development of remedial action objectives (RAOs) for Site-related contamination
- The development of Site-specific remedial action criteria
- The identification, screening, and selection of remedial technologies and process options applicable to the contamination associated with the Site
- The combination of retained technologies and process options into remedial alternatives for evaluation and comparative analysis

1.2 Organization of Feasibility Study Report

This FS Report is comprised of nine sections, organized as follows:

Section 1: Introduction. This section provides information related to the purpose and the organization of this FS report.

Section 2: Site Description and History. This section provides Site background information, including the Site location and description, Site history, and a summary of previous investigations.

Section 3: Summary of Site Conditions. This section provides a description of the physical characteristics of the Site, a summary of RI activities, a discussion of the nature and extent of contamination, a summary of contaminant fate and transport mechanisms, a summary of the risk assessment and conclusions from the RI.

Section 4: Remedial Goals and Remedial Action Objectives. This section presents a list of remedial goals and RAOs by considering the characterization of contaminants and compliance with standards, criteria, and guidance (SCGs). Preliminary Remediation Goals (PRGs) and target remediation areas are also discussed in Section 4.

Section 5: General Response Actions. This section identifies and provides a discussion of general response actions.

Section 6: Identification and Screening of Remedial Technologies. This section identifies and screens remedial technologies and process options for each medium.

Section 7: Development and Analysis of Remedial Alternatives. This section presents the remedial alternatives, developed by combining the feasible technologies and process options. Section 7 also provides detailed descriptions of, and preliminary design assumptions for alternatives that were retained. This information was used to develop the cost estimates for each alternative. This section provides a detailed analysis of each alternative with respect to the following eight criteria:

- overall protection of public health and the environment;
- compliance with SCGs;
- long-term effectiveness and permanence;
- reduction of toxicity, mobility, or volume with treatment;
- short-term effectiveness;
- implementability;
- cost; and
- community acceptance.

An overall comparison between the various remedial alternatives is also examined in this section.

Section 8: Recommended Remedy. This section presents the recommended remedy for each medium.

Section 9: References. A complete list of the references cited in the FS Report is presented in this section.

Section 2

Site Description and History

The following sections describe the Site location and description, Site history and a summary of previous investigations.

2.1 Site Description

The Site is an active salvage yard located at One Shulman Plaza in a mixed residential and commercial area in the City of Elmira, Chemung County, New York (Figures 1-1 and 1-2). The 7.34-acre property is identified on tax maps as Lot 89.11-1-5 and is located the intersection of Eastern Washington Avenue and Clemens Center Parkway. The primary Site features include a single-story maintenance building and a larger two-story office building, a weigh station and a scale house trailer (Figure 1-2). With the exception of asphalt, along the southern portion of the property south of the office building, the Site is unpaved and used for the storage and handling of various metal and non-metal salvage materials.

The Site is bordered to the south by East Washington Avenue and to the east by a chain link fence and Clemens Center Parkway. The vegetated right-of-way between the chain link fence and the Parkway was not inspected during this study. North of the Site is a Chemung County Transit Systems office. A Norfolk Southern (NS) property is adjacent to the northwestern portion of the Site. To the southwest of the Site, the elevation rises abruptly to the former Triple Cities Metal Finishing property, which is also a NYSDEC site. The gated main entrance to the property is locked after business hours, and fencing surrounds much of the property. In the northern part of the property, the boundary with Norfolk Southern is not fenced.

The Site was divided into several areas to facilitate clear discussion of Site features, sampling locations and distribution of contamination. The areas are shown on Figure 1-2 and include the following:

- Recycling Area – asphalt drive and parking areas south of the office building. Cardboard and metal recycling piles are positioned to the east of the weigh station.
- Processing Area – the primary area that is currently used to process scrap metal and debris. Materials are dropped off and sorted into piles of various types of metal/ debris. Catch basins in this area direct runoff to the Chemung River (NYSDEC 1993).
- Rail Transit Area – northern portion of the property west of the fence line that separates it from the outlying parcel. The gravel drive and abandoned railroad sidings run through the area. An existing railroad spur in this section is used to transport processed scrap material off-Site. This area is sparsely vegetated with the exception of a small wooded gully near the northern boundary with NS property.

Outlying Parcel – northern portion of the property east of the fenceline that separates it from the rail transit area. This portion of the property contains scattered piles of miscellaneous debris, but was not actively used in scrapping operations during the 2013 field investigation. This area is largely vegetated with grass and brush, but is also lightly wooded in spots.

2.2 Operational History

The property has operated as the Shulman's Salvage Yard for various metal salvaging and recycling operations since the late 1960s/early 1970s. Prior to its current usage, the southern portion of the Site was a coal yard operated by C. A. Petrie Co. Inc. Several rail lines that were likely used to transport the coal are present in the central and northern portions of the Site.

Currently, processed scrap metal and paper goods are sorted on-Site and taken off-Site via tractor trailer, or by rail using a single spur located in the northwest section of the Site. Two large automobile crushers were previously operated in the area north of the main building, but these have since been removed. In 1982, a shipment of drained transformers was processed on-Site and sold as scrap (Malcolm Pirnie 1989; AFI 1990). It is believed that some of the polychlorinated biphenyl (PCB) contamination at the Site is derived from crushing the transformers.

2.2.1 Previous Investigations

Initial Site characterization activities were performed in the 1980s by Malcolm Pirnie for Shulman & Sons Company, Inc. (Shulman). A Remedial Investigation/Feasibility Study (RI/FS) work plan was prepared under the direction of NYSDEC, but the Responsible Party (RP) challenged their requirement to conduct the activities specified by the work plan. The RP's challenge was upheld, and the RI/FS was postponed.

The following list of the previous reports were reviewed for the FS and are summarized in this section:

- Malcolm Pirnie, Additional Scope of Work, 1987
- Malcolm Pirnie, Supplemental Field Investigation, 1987
- AFI, Workplan Remedial Investigation/Feasibility Study, 1989
- Malcolm Pirnie, Workplan Remedial Investigation/Feasibility Study, 1989
- Retroactive Justification for Class 2 listing, (Memo from E. Barcomb to M. O'Toole), 1993

Copies of the reports are included in Appendix A.

Initial Investigation: 1984

In 1984, Malcolm Pirnie conducted sampling of surface soils, soils from catch basins and a pool of oil on the northern portion of the Site. All samples were analyzed for PCBs, cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), nickel (Ni), selenium (Se) and zinc (Zn). The catch basin sample was also analyzed for all "priority pollutants" except asbestos, acrolein and acrylonitrile (Malcolm Pirnie 1987, 1989; AFI 1990).

Metals and PCBs were found in each media sampled. Due to the potential for vertical migration to groundwater and off-Site migration through the storm drainage network, it was determined that additional sampling of groundwater, soil and sediment was needed to determine the areal extent of impact (Malcolm Pirnie 1987, 1989; AFI 1990).

Follow Up Investigation 1986 and 1987

During a follow up investigation conducted in 1987, oil, soil and catch basin samples were collected to confirm previous results and to further define the extent of impacted soil. Four shallow (12 to 17 feet below ground surface [bgs]) wells and one deep (26.8 feet bgs) well were installed and sampled to determine any impact to groundwater. An additional sewer investigation was also completed to confirm the discharge point of stormwater drainage from the Site. Results from this study indicated that effluent from storm sewers on-Site eventually flows into the Chemung River (NYSDEC 1993).

2.2.1.1 Historic Oil, Catch Basin Soils, and Soil Sampling Results

During the previous investigations, PCB contamination was found throughout the Site, but the highest concentrations, up to 120 parts per million (ppm) in surface soil and 72 ppm in catch basin soils, were found in the processing area. The highest concentrations of metals observed in surface soil and catch basin soil samples were: Cd (27 milligrams per kilogram [mg/kg]), Cr (173 mg/kg), Cu (19,900 mg/kg), Fe (124,000 mg/kg), Ni (200 mg/kg), Pb (4050 mg/kg), and Zn (8830 mg/kg). Several priority pollutant compounds were also found in the catch basin sediment samples. Both initial and confirmatory oil sample results showed concentrations of PCBs less than 50 ppm. Appendix A of the RIR contains historic analytical results, maps of PCB concentrations, and excavation plans based on PCB results (Malcolm Pirnie 1989; AFI 1990).

2.2.1.2 Historic Groundwater Sampling Results

Groundwater samples were collected from the one deep (MW-1D) and four shallow (MW-1S through MW-4S) monitoring wells installed during the 1987 investigation. Chlorinated solvents, metals and volatile organic compounds (VOCs) were identified in shallow groundwater samples with varying distribution. PCBs were found in MW-3S at a concentration of 0.07micrograms per liter (µg/L). Metals concentrations exceeded Class GA standards in MW-3S (As and Pb) and MW-1S (Cd, Pb). Chlorinated volatile organic compounds (CVOC) were detected at levels exceeding class NYSDEC Class GA guidance standards at MW-2S and MW-1S. Several other VOCs were detected at MW-1S, MW-2S, and MW-3S. A trace concentration of toluene was detected at MW-1D (Malcolm Pirnie 1989; AFI 1990).

MW-2S exhibited concentrations of 1,2-Dichloroethylene (1,2-DCA) (520 µg/L), 1,1,1-Trichloroethane (1,1,1-TCA) (10,000 µg/L), and Trichloroethene (TCE) (7400 µg/L) that exceed NYSDEC Class GA standards. These compounds were also present in MW-1S in lesser concentrations. Analysis for metals in the shallow monitoring wells showed that Cu, Pb, and Cd concentrations increased in the downgradient direction while arsenic appeared to increase in the upgradient direction. Groundwater flow direction was found to be to the northeast (Malcolm Pirnie 1987, 1989; AFI 1990). See Appendix A of the RIR for historic groundwater data)

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Section 3

Summary of Site Conditions

The Remedial Investigation (RI) characterized the nature and extent of contamination and qualitatively evaluated risk. The RI, conducted in the spring of 2013, was initiated to augment previous investigations, to determine extent of contamination at the Site and to evaluate the potential for those contaminants to migrate off-Site. The results of the RI are presented in the Final RI Report (RIR) for the Site (CDM Smith 2014). This section presents a summary of the RIR including a description of physical characteristics of the Site, a summary of recent RI activities, a summary of the nature and extent of contamination, a summary of contaminant fate and transport and a summary of the qualitative risk assessment.

3.1 Physical Characteristics of the Site

The physical characteristics of the Site and its surrounding area are important to understanding the current nature and extent of contamination and contaminant transport mechanisms. These characteristics can be described in terms of the topography and drainage, geology and hydrogeology (both regional and at the Site), demography, land use and climate.

3.1.1 Topography and Drainage

A topographic map depicting the Site and surface drainage is included in Figure 3-1. The Site itself is largely flat with shallow undulations. However, there are relatively steep east facing slopes, 20 to 25 feet high, on the western margin of the southern half of the Site. There is also a low lying area near the boundary between the processing and rail transit areas, which receives surface runoff primarily from the rail transit area, but also from the processing area to a lesser extent. Shallow pools of water, up to a few inches deep, occupied this low area during March and April of 2013. The outlying parcel is largely flat, with some areas in the southern portion of the parcel sloping to the southeast. Storm water in the recycling area initially flows to a topographic low, located north and east of the scale house trailer, and ultimately to the catch basin in the area.

The majority of the surface drainage in the processing area is directed to a series of catch basins, which presumably empty into a sewer main that traverses the Site from the northeast to the southwest corner. Sewer maps obtained from Shulman and the City of Elmira during a previous investigation (Malcolm Pirnie 1987), show one main sewer line with numerous manholes, drainage inlets and sewer connections. As part of the investigation, a dye injection study confirmed that surface drainage from the Site is likely to flow off the property through the sewer main discharging to the city sewer south of the Site.

3.1.2 Regional Geology and Hydrogeology

The following subsections discuss the regional geologic and hydrogeologic conditions.

3.1.2.1 Bedrock

The bedrock in the Elmira area is comprised of sedimentary clastic deposits of the upper Devonian West Falls Group, which may reach a thickness of about 1000 feet (Broughton et al., 1962; Fisher et al., 1970). Bedrock beneath the Site is comprised of the Beers Hill Shale, a member of the West Falls Group (Fisher, D. W. et. al. 1970). The estimated depth to bedrock in this area of the valley is approximately 100 feet bgs, but the eroded bedrock surface dips sharply to the north where it has been observed to be four to five hundred feet bgs. Because these units have low primary porosity, groundwater sourced from bedrock wells is typically derived from fracture and bedding plane structures.

3.1.2.2 Unconsolidated Sedimentary Deposits

Glacial till deposits overlie bedrock throughout much of Chemung County. The till is comprised primarily of locally-derived material, but includes material carried by glacial ice from the north as well.

Overlying the till in the Horseheads-Elmira Valley are glacio-fluvial and glacio-lacustrine (glacial outwash) sand and gravels deposits with observed thicknesses varying from 30 to more than 400 feet. The USGS surficial geology map (Figure 3-2) shows the unconsolidated deposits below the Site being composed of outwash sands and gravels typically found in valley bottoms and stream terraces, but there is also an alluvial fan or Kame terrace deposit that makes up the raised topography along the southwestern margin of the Site. The alluvial fan silt, sand and gravel deposits are present where upland meltwater streams entered the proglacial valley. Throughout much of the Elmira-Horseheads valley more modern alluvium from the Newton and Chemung Creeks overlies the glacial material. The thickness of unconsolidated material on the western portion of the Site is likely to be on the order of 40 to 50 feet, and perhaps more to the east, based on boring observations and nearby well data presented in Miller (1982).

3.1.3 Site Geology and Hydrogeology

Figures depicting cross sections of the subsurface are presented in Figures 3-3 through 3-5. The cross section plan is provided in Figure 3-1.

3.1.3.1 Surface Soils

The National Cooperative Soil Survey classifies the surface soils at the Site as gravelly loam, which are derived from "loamy glaciofluvial deposits over sandy and gravelly glaciofluvial deposits, containing significant amounts of limestone". This roughly agrees with observations recorded during the RI. However, most of the surface soil on the Site appears to be reworked, imported or locally-derived fill material comprised of silt, sand, and gravel, with varying amounts of clay, cobbles, metal fragments and trash. Metal fragment and trash were generally sand to gravel sized, but were large enough in some spots that boring locations had to be shifted a few feet to avoid them.

3.1.3.2 Subsurface Soils

As noted above, much of the fill material appears to be reworked local material, which was exposed with shallow manual excavation below the thin colluvial deposits on the western boundary of the recycling area. Thicknesses of fill vary between 0 and 12 feet. Native soils below the fill were primarily poorly to moderately sorted silty sands, intermittent gravels and well sorted sand deposits. Fairly continuous clay and peat deposits were also observed. These peats and clays are likely glacio-lacustrine in nature deposited in proglacial lakes during glacial retreat.

Peat deposits were encountered over much of the northern half of the Site. Upper contacts were encountered at depths of 6.5 to 13.5 feet with apparent thicknesses up to 6.5 feet. In the field, this peat material was classified into two units, upper and lower, based on color and composition. At many locations, the upper peat is very dark brown to light brown with varying amounts of clay and silt, and intervals containing yellow wood particles (up to cobble sized). Some samples also contained green leaf fragments. Apparent thickness of this unit was up to 5.5 feet. The lower unit, a light gray or light brown peat/marl with fibrous inclusions and varying percentages of gastropod shells, was up to 3.4 feet thick. It was generally higher in clay content than the upper peat.

Clay and clay rich deposits were encountered at a similar depth intervals as the peat deposits. Shallow clay-rich deposits were observed in several soil borings. Below the peat, a massive unit of gray clay, up to seven feet in thickness, was encountered. Similar clay deposits were found alternating with thin beds of gray silty sand from 18-20 feet bgs at one location. Clay was also observed without the presence of peat at a few locations.

Refusal was encountered at depths of approximately 26 to 30 feet at a few locations. The very tightly packed deposits at the bottom of the boring suggest the presence of lodgement till, and may correspond to the lodgment till depicted in the USGS cross sections (Miller 1982).

3.1.3.3 Hydrogeology

The primary aquifer in the Site vicinity is comprised of outwash sands and gravels (USGS 1982). Clay and peat units may act as semi-confining units, dividing the aquifer into upper and lower zones over much of the Site, especially the processing area (Malcolm Pirnie 1989; AFI 1990; this study). The depth to water during the March/April 2013 activities was close to 12 feet over much of the Site, with variation near location GWS-02 due to the presence of an approximately seven foot thick clay layer described in more detail above. When the boring was advance through the clay layer, the water level recovered to a level consistent with those observed elsewhere on-Site. Previous investigations estimated the groundwater flow direction to be to the northwest, and generally following topography (Malcom Pirnie 1989; AFI Environmental (AFI) 1990).

3.1.4 Demography, Land Use, and Climate

The population of Elmira is approximately 28,987 (United States Census Bureau, 2012 estimate), and the general area of the Site is a mix of commercial and residential properties. Local temperature averages range from 28 degrees Fahrenheit (°F) in January to 78°F in July (New York State Climate Office) Mean average precipitation in the area is 33 to38 inches annually (United States Department of Agriculture [USDA] Soil Survey 2013).

3.2 Summary of RI Field Activities

RI activities conducted in the spring of 2013, were initiated to augment the results of previous investigations by evaluating the current horizontal and vertical extent of VOC, semi-volatile organic compound (SVOC), PCB, and metal contamination found at the Site, and evaluating the potential for those contaminants to migrate off-Site. Sampling activities covered the entire property shown within the red outline in Figure 1-2, with the exception of the right of way between the eastern fence and the Clemens Center Parkway, the area under large mulch piles in the processing area, and much of the paved recycling area. Sample locations are presented on Figure 3-6. Except where noted in the RIR, all field work conducted in 2013 was performed in accordance with the procedures detailed in the CDM Smith Generic QAPP for NYSDEC Contract D007621 and the Work Assignment Approval Letter (NYSDEC 2012).

The RI consisted of the following activities:

- Field reconnaissance and topographic survey and

- Field investigative activities that included:
  - Surface soil sampling
  - Subsurface soil investigation
  - Catch basin investigation
  - Groundwater investigation
  - NS property investigation

All the above activities are described in detail in the Final RIR submitted in September 2014. Solid and liquid investigation-derived waste (IDW), generated during the RI, were contained in 55 gallon drums and stored on-Site. Trash, dedicated sampling equipment, and personal protective equipment (PPE) were disposed of as municipal waste. As part of waste characterization, soil samples were analyzed for Resource Conservation and Recovery Act (RCRA) characteristics, Toxicity Characteristic Leaching Procedure (TCLP), and total PCBs. Aqueous waste samples were analyzed for RCRA characteristics, TCLP, and total PCBs, RCRA metals, total VOC, SVOC, herbicides, and pesticides. Both water and soil were classified as non-hazardous, based on the analytical results.

3.3 Nature and Extent of Contamination

3.3.1 RI Screening Criteria

The following NYSDEC Standards Criteria and Guidance (SCGs) were used for screening purposes during the RI:

Soils - Soil sampling results will be compared to two sets of soil cleanup objectives (SCOs); the unrestricted use (URU) SCOs listed in the NYSDEC Subpart 375.6.8(a) and the Final Restricted Use for Commercial Property (CU) SCOs listed in the NYSDEC Subpart 375.6.8(b).

Groundwater - Groundwater screening results will be compared to NYSDEC Part 703.5 Ambient Water Quality Standards for Class GA (Groundwater).

Catch Basin Soils – The soil sample collected from the bottom of a catch basin at the Site will be compared to two sets of SCOs; the URU SCOs as listed in the NYSDEC Subpart 375.6.8(a) and the Final Protection of Groundwater (PGW) SCOs as listed in the NYSDEC Subpart 375.6.8(b).

Catch Basin Water - water samples collected from within the catch basins will be compared to NYSDEC Part 703.5 Ambient Water Quality Standards for Classes A, A-S, AA, AA-S (Surface Water).

Only PCBs, primarily Aroclors 1016, 1242, 1248, 1254 and 1260, and metals, such as lead, cadmium, copper, arsenic and mercury, were evaluated in detail as part of the RIR. The RI identified the presence of additional organic compounds and metals at concentrations above the selected screening criteria for the Site. However, the limited group of contaminants were found at concentrations only marginally above screening criteria and are not considered to be Site-related constituents of concern in the RIR. These contaminants are discussed in more detail under Section 4.3 on Preliminary Remediation Goals (PRGs).

3.3.2 Summary of PCB Distribution in Soils

- PCBs were found throughout the Site, at concentrations well above both the URU and CU SCOs. The presence of PCBs is thought to be related to the crushing and disposal of drained transformers in the early 1980s. The widespread distribution of PCBs suggests that after initial deposition, they were likely redistributed throughout the shallow soils on-Site due to the day to day activities of heavy equipment at the property over the last 30 years.

- The highest concentrations of PCBs are found in the processing and rail transit areas, to a depth of 4-feet bgs. There were limited pockets of contamination deeper than 4 feet bgs in the processing and rail transit areas. Historic sampling by NYSDEC found a similar pattern of distribution. However, additional sampling shows the contamination extends further to the north into the outlying parcel. Three aroclors (Aroclors 1242, 1254 and 1260) were found throughout most of this area. One sample at SB-20 exhibited elevated concentrations of Aroclor 1016, which was not found elevated elsewhere at the Site. This sample was collected from a waste pile that contained miscellaneous debris including numerous tires.

- PCB aroclors that were detected in the outlying parcel were also found to be elevated in an area along the eastern fence line. In this area, PCB contamination was limited to the upper two feet of soils. Historical sampling also encountered PCBs in the area. Although currently inactive, this portion of the Site was previously active. The area is currently lightly wooded with small piles of miscellaneous waste scattered throughout the area.

- At the NS Property, total PCB concentrations above the CU SCO are limited to the area immediately adjacent to the Site. The distribution of lower levels of PCBs (above URU SCO), found at the NS Property, suggest they are related to activities at the Site. The long term use of the NS Property as a rail yard also suggests it may not be possible to perform a sufficient level of sampling to delineate PCB contamination to levels below the URU SCO.

- The limit of contamination was not delineated along the steep slope adjacent to the Triple Cities Metal Finishing property to the southwest of the Site. PCBs were also not delineated at depth in one location, SB-17, collected from the stockpile area. The deepest sample, collected from 10 to 12 feet bgs, had a total PCB concentration of 1,770 µg/kg. PCBs were not detected along the former railroad line that entered the Site from the southeast, or in areas of the Site north of the gulley near SB-87. This area appears to have been used to stage railroad supplies (piles of railroad ties, etc.)

3.3.3 Summary of Metals Distribution in Soils

- Metals were found throughout the Site, at concentrations above both the URU and CU SCOs. The presence of metals is likely due to the ongoing scrap metal crushing and sorting activities performed at the Site from the late 1960s to present. Metal constituents of concern (COCs) include lead, copper, cadmium, chromium, mercury and arsenic.

- The highest concentrations of PCBs and metals were found in the active and recently active portions of the scrap yard, in the processing and rail transit areas of the Site, to a depth of four feet bgs. Wrecked cars were crushed in these areas (near crusher #1 and #2) and the various scrap was sorted into piles for pickup. The fill in this area was noted to have metal debris intermixed with the soil.

- On the outlying parcel, metals were generally found at lower concentrations. However, in most cases, concentrations exceeded SCOs. Contamination was limited to the upper four feet of soils. Although currently inactive, this portion of the Site was previously active.
- The general distribution of metals in Site soils is similar to that of PCBs, suggesting that contamination has been redistributed throughout the shallow Site soils due to the day to day activities of heavy equipment at the property over the last 40 years.
- At the NS property, metals concentrations above the CU SCO are generally limited to the area immediately adjacent to the Site. The distribution of lower level metals (above URU SCO) found at the rest of the NS property suggest they may be related to activities at the Site, but the long term use of the NS property as a rail yard also may be a contributing factor.
- The extent of contamination was not delineated along the steep slope adjacent to the Triple Cities Metal Finishing property to the southwest of the Site. The vertical limit of contamination was not delineated in a small number of locations in the processing and rail transit areas.

3.3.4 Catch Basin Investigation Summary

- PCBs and metals were detected above SCGs in both the water and soil samples collected from the catch basins. The concentrations in catch basin soil were several orders of magnitude lower than the adjacent Site soils, and below the PGW SCO. Metals concentrations, found in catch basin water samples, were comparable to those found in Site groundwater. PCBs were not detected in Site groundwater samples.
- PAHs were also found above the selected screening criteria in both the catch basin soil and water samples. PAHs were not elevated in Site groundwater and were only found in a limited number of soil samples on-Site.

3.3.5 Groundwater Screening Summary

- Metal COCs (lead and arsenic) and chlorinated VOCs (primarily TCE) were detected above the NYS Class GA drinking water criteria (groundwater screening criteria) in the RI samples. PCBs, one of the primary COCs for the Site, were not detected in Site groundwater screening samples.
- Lead was elevated in the majority of samples, suggesting that it is related to the elevated concentrations in Site soils. However, the potential to impact offsite groundwater is limited as concentrations decrease quickly in the downgradient direction.
- The highest TCE concentrations were found along the upgradient edge of the Site (southwestern), adjacent to the former Triple Cities Metal Finishing property. Concentrations decrease quickly in downgradient samples. As discussed under Section 4.4 on PRGs, this contamination is believed to originate from off-Site sources and is not addressed in this FS.

3.3.6 Other VOCs

Only two VOCs and two SVOCs exceeded either their URU or CU SCOs in the Site soils. These included the VOCs 2-butanone and acetone, which were both detected above the URU SCO but below the CU SCO, along the western edge of the property, between debris piles and the NS Property. These two VOCs, often associated with laboratory contamination, were also detected at low levels in other Site media. Two SVOCs; 1,2-benzphenanthracene (detected at 1,800 ug/kg) and benzo(a)anthracene (detected at 1,200 ug/kg) both exceeded the URU SCO of 1,000 ug/kg but were below the commercial standards.

3.3.7 Summary of Nature and Extent of Contamination

Potential Sources:

- The presence of PCBs is thought to be largely related to the crushing and disposal of drained transformers in the early 1980s. The presence of metals is likely due to scrap metal crushing and ongoing sorting activities at the Site from the late 1960s to present.

Soil Contamination:

- The highest concentrations of Site COCs (PCBs and metals) in soil are found in the processing and rail transit areas of the Site to a depth of four feet bgs. The widespread distribution suggests that contaminants were likely deposited and then redistributed throughout the shallow on-Site soils due to the day to day activities of heavy equipment at the property over the last 40 years.
- Previous sampling by NYSDEC found a similar distribution, however, additional sampling shows the contamination extends further to the north into the rail transit area.
- On the outlying parcel, elevated concentrations of PCBs were also found in an area along the eastern margin of the Site. Contamination was limited to the upper two feet of soils. Historical sampling also encountered PCBs in the area. Metals were found at lower concentrations in this area, but were still above SCOs in most cases. Contamination was limited to the upper 4 feet of soils. Although currently inactive this portion of the Site was previously active.
- Supplemental sampling at the NS property found PCBs and metals above CU SCOs along the fence line adjacent to the Site with lower levels, but still above URU SCOs, of PCBs and metals throughout much of the rest of the property.
- The lateral extent of contamination was not delineated along the steep slope adjacent to the Triple Cities Metal Finishing property to the southwest of the Site. In addition, the bottom of contamination was not delineated at a limited number of locations in the active portions of the scrapyard (the processing and rail transit areas). PCBs were not found along the former railroad that entered the Site from the southeast or in areas of the Site north of the gulley near SB-87. This area appears to be used to stage railroad supplies (piles of railroad ties, etc.).

Catch Basin Soil and Water:

- PCBs and metals were detected above their respective SCGs in both the catch basin water and soil samples. The concentrations in catch basin soil were several orders of magnitude lower than the adjacent Site soils, and below the PGW SCO. Metals concentrations found in catch basin water samples were comparable to those found in Site groundwater. PCBs were not detected in Site groundwater.
- PAHs were also found above SCGs in both the catch basin soil and water samples.

Groundwater:

- Metal COCs (lead and arsenic) and chlorinated VOCs (primarily TCE) were detected above the NYS Class GA drinking water criteria (groundwater screening criteria) in the RI samples. PCBs, one of the primary COCs for the Site, were not detected in Site groundwater
- Lead was elevated in the majority of samples suggesting it is related to the elevated concentrations in Site soils, however the potential to impact off-Site groundwater is limited as concentrations decrease quickly in the downgradient direction.
- The highest concentrations of TCE was found along the upgradient edge of the Site (southwestern) adjacent to the former Triple Cities Metal Finishing property. Concentrations decrease quickly in downgradient samples.

3.4 Summary of Fate and Transport Mechanisms

- The majority of PCBs and metals contamination has been retained in the upper four feet of soils at the Site and has not migrated to deeper soil intervals.
- Metal contaminants at the Site are sparsely soluble to insoluble at neutral pH and tend to remain preferentially associated with the organic carbon, clay minerals, and iron and aluminum oxides in soil, thereby greatly reducing their potential for transport through percolating rainwater or groundwater pathways.
- PCBs are extremely to sparsely insoluble and have strong affinities for soil. They are expected to be immobile and persist in soil for a long time.
- The peat and clay deposits between the ground surface and water table across much of the Site likely helps prevent vertical migration of contaminants into underlying groundwater.
- The primary transport mechanisms, for constituents of concern at the Site, involve the physical transport of weathered particulates through vehicular traffic, wind disturbance and surface water runoff.

  A conceptual site model (CSM) developed to integrate all the different types of information collected during an RI, including geology, hydrogeology, Site background and setting, and the fate and transport of contamination associated with the Site is presented in Figure 3-7.

3.5 Summary of Qualitative Risk Assessment

Potential risks associated with exposure to contaminants in soil, groundwater, or air are qualitatively evaluated for each receptor through comparison of the maximum detected concentration with the applicable standard or guidance value. Results of this evaluation are discussed below.

- **Workers -** Eight metals and five aroclors in surface soil exceeded their respective restricted use SCOs for commercial properties. The maximum concentrations of Aroclor 1016, Aroclor 1242, and Aroclor 1254 in surface soil exceeded the less restrictive industrial SCO of 25,000 µg/kg for PCBs. Arsenic, cadmium, lead, mercury, and zinc have their maximum concentrations in surface soil exceeding the less restrictive industrial SCOs. These results indicate that exposure to these COCs in surface soil may be a potential concern for workers.

- **Visitors and Trespassers** - Eight metals and five aroclors in surface soil exceeded their respective restricted use SCOs for commercial properties. These results indicate that exposure to these COCs in surface soil may be a potential concern for visitors and trespassers. Child visitors are the most sensitive receptors to lead and PCB exposure.

- **Construction Workers** – Nine metals and five aroclors in surface and subsurface soils exceeded their respective commercial SCOs. The maximum concentrations of Aroclor 1016, Aroclor 1242, and Aroclor 1254 in soil exceeded the less restrictive industrial SCO of 25,000 µg/kg for PCBs. Arsenic, cadmium, copper, lead, manganese, mercury, and zinc have their maximum concentrations in soil exceeding the less restrictive industrial SCOs. Furthermore, five VOCs, two SVOCs, and six metals are present in groundwater at concentrations exceeding the water quality standards. Thus, exposure to these COCs in soil and groundwater may be of a concern for future construction workers.

Several VOCs, SVOCs, PCB aroclors, and metals are identified as COCs in soil and groundwater based on comparisons of the maximum detected chemical concentrations to their respective screening levels. The qualitative assessment indicates that exposure to these COCs may be a potential concern for workers, visitors, trespassers, and future construction workers at the Site. Potential exposure to lead and PCBs is of a special concern for child visitors since they are the most sensitive receptors.

3.6 Conclusions from RI

- Several PCB aroclors and metals are identified as COCs in soil and groundwater based on comparisons of the maximum detected chemical concentrations to their respective screening levels. The presence of PCBs is thought to be related to the crushing and disposal of drained transformers in the early 1980s. The presence of metals is likely due to ongoing scrap metal crushing and sorting activities at the Site from the late 1960s to present.

- The highest concentrations of Site COCs in soil are found in the processing and rail transit areas of the Site to a depth of four feet bgs. The widespread distribution suggests that contaminants were likely deposited and then redistributed throughout the shallow soils on-Site due to the day to day activities of heavy equipment at the property over the last 40 years.

- On the outlying parcel of the Site, PCBs were also found to be elevated in soils in an area near the eastern fence line. PCB contamination was limited to the upper two feet of soils. Metals were found at lower concentrations in this area, but were still above SCOs in most cases. Metals contamination was limited to the upper 4 feet of soils.

- Supplemental sampling at the NS property found PCBs and metals above CU SCOs along the fence line adjacent to the Site, with lower levels (but still above URU SCOs) of PCBs and metals throughout much of the rest of the property.

- The limit of soil contamination was not delineated along the steep slope adjacent to the Triple Cities Metals Finishing property to the southwest of the Site. In addition, the vertical extent of contamination was not delineated at a limited number of locations in the active portions of the scrapyard (the processing and rail transit areas).

- Site COCs (PCBs and metals) were detected above their respective screening criteria in both the catch basin water and soil samples, but the concentrations were several orders of magnitude lower than the adjacent Site soils. The concentrations found in catch basin water samples were comparable to those found in Site groundwater for metals.

- In groundwater, metal COCs (Lead and Arsenic) and chlorinated VOCs (primarily TCE) were detected above the NYS Class GA drinking water criteria. PCBs, a group of the primary COCs for the Site, were not detected in Site groundwater.
- Lead was elevated in the majority of groundwater samples, suggesting it is related to the elevated concentrations in Site soils. However, the concentrations are sporadic and the potential to impact off-Site groundwater is limited as concentrations decrease quickly in the downgradient direction.
- TCE was found most elevated along the upgradient Site border (southwestern), adjacent to the former Triple Cities Metal Finishing property. Concentrations decrease quickly in downgradient samples.
- The potential for vapor intrusion has not been assessed previously and hence should be evaluated.
- The qualitative risk assessment indicates that exposure to these COCs may be a potential concern for workers, visitors, trespassers, and future construction workers at the Site. Potential exposure to lead and PCBs is of a special concern for child visitors since they are the most sensitive receptors.

Section 4

Remedial Goals and Remedial Action Objectives

Remedial action objectives (RAOs) are media-specific goals for protecting human health and the environment that serve as guidance for the development of remedial alternatives. The process of identifying the RAOs follows the identification of affected media and contaminant characteristics, evaluation of exposure pathways, evaluation of contaminant migration pathways and exposure limits, and the evaluation of chemical concentrations that will result in acceptable exposure. The RAOs are based on regulatory requirements that may apply to the various remedial activities being considered for the Site. This section of the FS reviews the affected media and contaminant exposure pathways and identifies Federal, State, and local regulations that may affect remedial actions.

Preliminary remediation goals (PRGs) were selected based on federal or state SCGs, background concentrations, and with consideration given to other factors such as analytical detection limits. These PRGs were then used as a benchmark in the technology screening, alternative development, and detailed evaluation of alternatives presented in the subsequent sections of the FS report.

4.1 Remedial Action Objectives

Based on the evaluation of the nature and extent of contamination in soil, groundwater, the following preliminary RAOs were developed:

4.1.1 Remedial Action Objectives for Soil

The RAOs for soil at the Site are as follows:

- Prevent ingestion/direct contact with contaminated soils
- Prevent migration of contaminants that would result in groundwater contamination

4.1.2 Remedial Action Objectives for Groundwater

The RAOs for groundwater at the Site are as follows:

- Remove the source of groundwater contamination, to the extent practicable

There are no applicable RAOs at the Site for any other media such as soil vapor, surface water or sediment. However, the potential for vapor intrusion into the buildings at the Site should be evaluated.

4.2 Standards, Criteria, and Guidance

To determine whether the soil, groundwater, and soil vapor contain contamination at levels of concern, State and Federal SCGs were assessed for each medium. The regulatory SCGs identified for each medium and the applicability of these SCGs to the Site are summarized in the following sections.

Potential SCGs are divided into three groups:

- Chemical-specific SCGs
- Location-specific SCGs

- Action-specific SCGs

4.2.1 Chemical-specific Standards, Criteria, and Guidance

Chemical-specific SCGs are health- or technology-based numerical values that establish concentration or discharge limits for specific chemicals or classes of chemicals.

4.2.1.1 Federal Standards, Criteria, and Guidance

Federal Drinking Water Standards

- National Primary Drinking Water Standards (40 CFR 141). Potentially applicable if an action involves future use of groundwater as a public supply source.

4.2.1.2 New York Standards, Criteria, and Guidance

Soil Standards and Criteria

- NYSDEC 6 NYCRR Part 375 Subpart 375-6, Environmental Remediation Programs, Unrestricted Use and Restricted Use Soil Cleanup Objectives (SCOs), December 14, 2006. Used as the primary basis for setting numerical criteria for soil cleanups.

- NYSDEC CP-51 Supplemental SCOs are utilized when there are no Part 375 SCOs.

Groundwater Standards and Guidance

- There are no applicable RAOs other than source removal SCGs for groundwater at the Site. Hence there are no applicable SCGs for groundwater at the Site.

Drinking Water Standards

- Potentially applicable if an action involves future use of the Site groundwater as a public supply source. However, this is not anticipated and hence there are no SCGs for this media at the Site.

Soil Vapor Guidance

- Although there are no applicable RAOs currently for soil vapor, this media is of potential concern for any future vapor intrusion evaluations. Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH 2006) is considered relevant and appropriate to soil vapor at the Site. The 2006 NYSDOH Vapor Intrusion guidance indicates that the State of New York does not have any standards, criteria, or guidance values for subsurface vapors.

4.2.2 Location-specific Standards, Criteria, and Guidance

Location-specific SCGs are those which are applicable or relevant and appropriate due to the location of the Site or area to be remediated. Based on the historic Site information there are no location specific criteria that could be applicable. If a location-specific criterion exists, it may be superseded by chemical specific or action specific criteria listed in this section.

4.2.3 Action-specific Standards, Criteria, and Guidance

Action-specific SCGs are requirements which set controls and restrictions to particular remedial actions, technologies, or process options. These regulations do not define Site cleanup levels but do affect the implementation of specific remedial technologies. These action-specific SCGs are considered in the screening and evaluation of various technologies and process options in subsequent sections of this report.

4.2.3.1 Federal Standards, Criteria, and Guidance

General - Site Remediation

- Occupational Safety and Health Administration (OSHA) Worker Protection (29 CFR 1904, 1910, 1926)
- Federal Resource Conservation and Recovery Act - Identification and Listing of Hazardous Waste (40 CFR 261); Standards Applicable to Generators of Hazardous Waste (40 CFR 262); Standards Applicable to Owners and Operators of Treatment, Storage, and Disposal Facilities (40 CFR 264)

Transportation of Hazardous Waste

- Hazardous Materials Transportation Regulations (49 CFR 107, 171, 172, 177, and 179)
- Federal Resource Conservation and Recovery Act - Standards Applicable to Transporters of Hazardous Waste (40 CFR 263)

Disposal of Hazardous Waste

- Federal Resource Conservation and Recovery Act - Land Disposal Restrictions (40 CFR 268)

Discharge of Groundwater

- Federal Clean Water Act - National Pollutant Discharge Elimination System (40 CFR 100 et seq.); Effluent Guidelines and Standards for the Point Source Category (40 CFR 414); Ambient Water Quality Criteria (40 CFR 131.36)
- Federal Safe Drinking Water Act - Underground Injection Control Program (40 CFR 144, 146)

Off-Gas Management

- Federal Clean Air Act - National Ambient Air Quality Standards (40 CFR 50); National Emission Standards for Hazardous Air Pollutants (40 CFR 61)
- Federal Directive - Control of Air Emissions from Superfund Air Strippers (OSWER Directive 9355.0-28)

4.2.3.2 New York Standards, Criteria, and Guidance

New York Solid and Hazardous Waste Management Regulations (6 NYCRR)

- Hazardous Waste Management System - General (Part 370)
- Solid Waste Management Regulations (Part 360)
- Identification and Listing of Hazardous Waste (Part 371)

Transportation of Hazardous Waste (6 NYCRR)

- Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities (Part 372)
- Waste Transporter Permit Program (Part 364)

Disposal of Hazardous Waste (6 NYCRR)

- Standards for Universal Waste (Part 374-3)

- Land Disposal Restrictions (Part 376)

Discharge of Groundwater (6 NYCRR)

- The New York State Pollutant Discharge Elimination System (SPDES) (Part 750-757)
- New York State Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations (6 NYCRR Part 703)
- New York State Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (TOGS 1.1.1)

Off-Gas Management

- New York General Provisions (6 NYCRR Part 211)
- New York Air Quality Standards (6 NYCRR Part 257)
- New York State Department of Environmental Conservation (DAR-1) Air Guide 1, Guidelines for the Control of Toxic Ambient Contaminants
- New York State Department of Health Generic Community Air Monitoring Plan

4.3 Preliminary Remediation Goals

Preliminary remediation goals (PRGs) were selected based on federal or state promulgated SCGs, and with consideration also given to other requirements such as analytical detection limits and guidance values. Background concentrations for soil should also be considered, however, since there is no available data for Site-specific background concentrations, they are not considered in this FS. Background concentrations, specifically for metals, need to be determined and compared to the current or future data prior to the remedial design in order to fully determine the areas that exceed acceptable levels.

There are no chemical-specific Federal SCGs for cleanup of contaminated soil, but there are State SCGs for soil. Therefore, NYSDEC Unrestricted Use Soil Cleanup Objectives (SCOs) are applicable requirements according to NYSDEC Site Remedial Program under 6 NYCRR Part 375 Subpart 375-6. Other Restricted Use SCOs may also be used as long as institutional control measures are implemented to ensure that the receptors are not exposed to contamination exceeding Unrestricted Use SCOs. The primary Site-related COCs for soils are PCBs and metals. Two VOCs (acetone and 2-butanone) and two SVOCs (1,2-benzphenanthracene and benzo(a)anthracene) were also detected in soil. However, these detections are sparse and marginal; hence they are not considered as constituents of concern at the Site. Additionally, TCE was also detected in upgradient groundwater at the southwestern portions of the Site near Triple Cities property. This TCE contamination is believed to originate off-Site and therefore is also not considered as a constituent of concern. Hence, only PCBs and metals in soils are the only constituents of concern addressed in this FS. Groundwater at the Site was detected with metals contamination, but the concentration decreases quickly at downgradient locations. Hence, removal of soil contamination is likely to address the groundwater contamination. Therefore, there are no applicable PRGs for groundwater and source removal is the only RAO for groundwater at the Site.

4.3.1 Groundwater Preliminary Remediation Goals

As discussed above, there are no risks to groundwater due to the Site constituents of concern (PCBs and metals) if source removal (soil contamination) is addressed. Therefore no PRGs are proposed for the groundwater. TCE contamination in groundwater at a few upgradient locations are believed to occur due to off-Site sources and will be addressed related to the adjacent site. Hence they are not addressed under this FS.

4.3.2 Soil Preliminary Remediation Goals

Soil PRGs are based on the NYSDEC Unrestricted Use and Restricted Use SCOs in 6 NYCRR 375-6. They are included in Table 4-1. The Site is classified as a commercial property; hence the commercial standards under the Restricted Use SCOs would be used as PRGs if appropriate institutional controls are implemented. These commercial standards for Restricted Use SCOs are referred to simply as "commercial standards" in the remainder of this report. The presence of VOCs and SVOCs above Unrestricted Use SCOs are few and marginally above standards. Concentrations of these compound were also below the corresponding commercial standards. Hence these VOCs/SVOCs are not considered to be Site-related constituents of concern and no PRGs are proposed.

4.3.3 Soil Vapor Preliminary Remediation Goals

Potential for vapor intrusion at the Site has not been assessed and future investigations to evaluate vapor risks are recommended. This FS does not address potential vapor risks at the Site, other than action-specific risks that may arise due to the FS alternatives. Hence, no PRGs are proposed for this media at this time. However, they should be taken into consideration for future evaluation of potential vapor intrusion at the Site buildings.

4.4 Target Remediation Areas

The areas of the Site that exceed the applicable Unrestricted Use and Restricted Use (Commercial) SCOs are presented in Figure 4-1. The figure also shows the sample locations that exceed these SCOs. The target remediation areas include those impacted by both PCBs and metals. The total treatment volume for unrestricted use SCO is approximately 115,300 cubic yards (CY). The treatment volume for restricted use with commercial standards is approximately 44,100 CY. Under the treatment volume for commercial standards, about 25,400 CY of the soil treated are impacted by PCBs and the remainder are impacted with metals only. The breakdown of treatment volumes with respect to depths, contaminants (PCBs or metals) and whether they occur on-Site or off-Site are presented under detailed volume calculations in Appendix A.

It can be seen from the sample locations shown in Figure 4-1 that the contamination for depths less than 4 feet bgs has not been delineated at a few locations in the eastern portion of the outlying parcel, the southeastern portions of the processing area near the office building and the southwestern portions of the processing area near the Triple Cities property.

Although contamination is widespread at depths less than 4 feet bgs, this appears to decrease considerably at greater depths as shown in Figure 4-1. Hence, most locations that exceed commercial standards for metals at depths greater than 4 feet bgs are considered to be 'hot spots' of contamination. DER-10 Section 5.4 on Remedial Action Implementation Compliance generally stipulates a sampling frequency of 900 square feet for every compliance sample. Based on this guidance, a 30-foot square at each of these locations was assumed to represent areas that exceed commercial standards at depths greater than 4 feet bgs. However, due to limited sample frequency (several locations are spaced more than 100 feet apart in a few areas with no sample locations in between), this assumption will need to be confirmed during pre-design investigations.

Because the target remediation areas and volumes discussed in this FS were estimated, based on existing data, it is possible that they may be revised when additional data from future pre-design investigations are obtained. Pre-design investigations may also identify additional areas that are not fully delineated.

Since several on-Site and off-Site areas that are impacted by metals concentrations that marginally exceed the SCGs, and since occurrence of scrap metal is common due to the nature of the Site being a salvage yard, an approach that includes an assessment of Site-specific background concentrations for metals was discussed with NYSDEC. However, the areas in and around the Site vicinity are either known contaminated sites or have historic fill. Section 3.5.3 (c) 4 of the NYSDEC DER-10 deems that such locations with known contamination or historic fill are unsuitable for evaluation of soil background concentrations.

Section 5

General Response Actions

General response actions (GRAs) were identified based on the established RAOs and Site conditions. GRAs are those actions that, alone or in combination, satisfy the RAOs for the identified media by reducing the concentrations of hazardous substances or reducing the likelihood of contact with hazardous substances. The GRAs appropriate for addressing contamination at the Site include:

5.1 No Action

Section 4 of the NYSDEC DER-10 requires the evaluation of a No Action alternative as a basis for comparison with other remedial alternatives. Under the No Action alternative, remedial actions are not implemented, the current status of the Site remains unchanged, and no further action would be taken to reduce the potential for exposure to contamination.

5.2 Institutional Controls

Institutional/Engineering Controls typically are restrictions placed to minimize access (e.g., fencing) or future use of the Site (e.g., well drilling restriction). These limited measures are implemented to provide some protection of human health and the environment from exposure to Site contaminants. Institutional/Engineering Controls are generally used in conjunction with other remedial technologies; alone they are not effective in preventing contaminant migration or reducing contamination.

5.3 Monitoring

Periodic or one-time monitoring events are typically necessary to characterize the extent of contamination or the migration of contamination from one area of the Site to another. This may include long-term Site-wide monitoring events or simple inspections or checks at the Site. This GRA would not alter the extent or migration of contamination and would only help track the contamination.

5.4 Monitored Natural Attenuation

Monitored Natural Attenuation (MNA) is a response action by which the volume and toxicity of contaminants are reduced by naturally occurring processes. Processes that reduce contamination levels generally include dilution, dispersion, volatilization, adsorption, biodegradation, and chemical reactions with other subsurface constituents. This GRA is typically applicable only for groundwater or for organic contaminants in soils. Since the contaminants are PCBs and metals, this GRA is not applicable for this FS.

5.5 Containment

Containment actions use physical, low permeability barriers (such as capping) and/or hydraulic barriers (created by groundwater extraction) to minimize or eliminate contaminant migration and/or to prevent direct contact with contamination. Containment technologies do not involve treatment to reduce the toxicity or volume of contaminants. The response actions require long-term monitoring to determine whether containment actions are performing successfully. Containment response actions are generally less favored compared to other actions since they do not provide permanent remedies.

5.6 Removal

Removal response actions refer to methods typically used to excavate and handle soil, sediment, waste, and/or other solid materials. A removal-based response action provides reduction in mobility and volume of contaminants by removing the contaminated materials from the subsurface using appropriate excavation equipment. Removal is usually used in conjunction with other technologies, such as treatment or disposal options, to achieve the RAOs for the removed media. The removal response action does not reduce contaminant mass. It merely transfers the contaminants to be managed under another response action.

5.7 Treatment

Treatment involves the destruction of contaminants in the affected media, transfer of contaminants from one media to another, or alteration of the contaminants thereby making them innocuous. The result is a reduction in toxicity, mobility, or volume of the contaminants. Treatment technologies vary among environmental media and can consist of chemical, physical, thermal, and biological processes. Treatment can occur in-situ (in place) or ex-situ (above ground), which would require coupling with the removal GRA. This GRA is usually preferred unless Site- or contaminant-specific characteristics make it infeasible from an engineering or implementation perspective, or too costly.

5.8 Disposal/Discharge

Disposal of soils after removal or in conjunction with removal and treatment requires compliance with State and Federal Hazardous Waste Transportation and Disposal regulations if levels present in media require such compliance. Prior to off-Site disposal, the contaminated materials designated for disposal are analyzed to determine whether they are hazardous. If the materials are deemed hazardous, then they must be disposed of to an approved Subtitle C facility certified to accept hazardous waste. If not, the materials may be discharged to a Subtitle D facility.

In some cases, disposal or consolidation of contaminated materials can be performed on-Site without accompanying treatment. However, in such cases the contaminated material has to be contained/capped, or if there are low-level exceedances, it has to be demonstrated that the risks associated with on-Site disposal are acceptable.

Discharge response actions for groundwater involve the discharge of extracted groundwater via on-Site injection, on-Site surface recharge, surface water discharge or discharge to a publically owned treatment works (POTW), following removal and if necessary treatment to meet regulatory discharge and disposal requirements. Since groundwater treatment is not anticipated, discharge response action is not expected at this Site.

Section 6

Identification and Screening of Remedial Technologies

Potential remedial technologies and process options associated with each general response action for groundwater are identified and screened in this section. Representative remedial technologies and process options that have been retained are used to develop remedial action alternatives. The technology screening approach is based upon the procedures outlined in DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC 2010). The evaluation process uses three criteria: Effectiveness, Implementability, and Relative Cost. Among these three, the effectiveness criterion outweighs the implementability and relative cost criteria. These criteria are described below:

Effectiveness

This evaluation criterion focuses on the effectiveness of process options to reduce the toxicity, mobility, or volume of contamination for long term protection and for meeting the RAOs and PRGs. It also evaluates the potential impacts to human health and the environment during construction and implementation and how proven and reliable the process is with respect to Site specific conditions.

Implementability

This evaluation criterion encompasses both the technical and administrative feasibility of the technology or process option. It includes an evaluation of pretreatment requirements, residuals management, and the relative ease or difficulty in performing the operation and maintenance (O&M) requirements. Process options that are clearly ineffective or not executable at the Site are eliminated by this criterion.

Relative Cost

Cost plays a limited role in the screening process. Both capital costs and O&M costs are considered. The cost analysis is based on engineering judgment and each process is evaluated as to whether costs are low, moderate, or high relative to the other options within the same technology type.

Retained remedial technologies and process options are used to develop remedial action alternatives, either alone or in combination with other technologies. Lists of the remedial technologies evaluated are provided in **Table 6-1**.

6.1 Remedial Technologies

6.1.1 No Action

The No Action alternative is not a technology. The No Action alternative is considered as a basis for comparison.

Effectiveness - The No Action alternative is used as a baseline against which other technologies may be compared. It does not provide measures that would comply with SCGs, or otherwise meet RAOs.

Implementability - The No Action alternative is implementable given there is no action required.

Relative Cost - The No Action alternative involves no capital or O&M costs.

Conclusion – The No Action alternative is retained for further consideration as a basis for comparison.

6.1.2 Institutional/Engineering Controls

Institutional Controls do not reduce the toxicity, mobility, or volume of contamination, but can be implemented to reduce the probability of exposure to contaminants. Institutional controls consist of administrative actions that control Site use (e.g., well drilling restrictions), to reduce direct human contact to contaminated media. Institutional controls generally require long term monitoring of contaminant concentrations. A Periodic Review Report (PRR), in accordance with Section 6.3 of *DER-10 Technical Guidance for Site Investigation and Remediation* (NYSDEC 2010), will also be completed as required by the selected remedy. Typical institutional controls are discussed below.

6.1.2.1 Land Use Controls

Land use controls are regulatory actions that are used to prevent certain types of uses for properties where exposure pathways to contaminants may be created as a result of those uses. Deed restrictions are one such mechanism of control and may be used to prevent intrusive activities within the contamination plume.

Effectiveness - Land use controls could effectively restrict or eliminate use of contaminated media, thereby reducing risks to human health. These restrictions would not reduce the migration of or the associated environmental impact of the contaminated media.

Implementability - Deed restrictions or similar controls are implementable if the existing administrative system allows such restrictions to be instituted. There may be difficulty achieving such deed restrictions if there are objections from property owners. Land use controls may also be implemented in conjunction with other technologies, as a protective measure to prevent exposure to contaminants during remediation.

Relative Cost - The cost to implement deed restrictions is low. Some administrative, long-term monitoring and periodic assessment costs would be required.

Conclusion – Deed restrictions (example of land use control) will be retained for further consideration.

6.1.2.2 Well Drilling/Water Use Restrictions

Well drilling restrictions are regulatory actions that are used to regulate installation of groundwater drinking water wells, and are referred to in New York State as an Environmental Easement.

Effectiveness – Environmental easements may effectively meet RAOs through restriction of future Site uses or activities that would create human exposure pathways to contaminated groundwater. Well drilling restrictions will not reduce the migration of or the associated environmental impact of the contaminated groundwater.

Implementability - Implementation is possible based on the existing permitting process and may be implemented, in addition to remediation activities, as a protective measure to prevent future exposure to contaminants during remediation.

Relative Cost - The cost to implement environmental easements is low.

Conclusion – Environmental easements will be retained for further consideration.

6.1.2.3 Fencing and Signage

Fencing is an example of an engineering control to prevent unnecessary exposures of contaminants to human receptors. Signs can also be posted to warn visitors or others to keep them away from contaminated areas.

Effectiveness – Fencing and signage would effectively meet RAOs through restriction of future Site uses or activities that would create human exposure pathways to contaminated areas. These controls will not reduce the migration of or the associated environmental impact of the contaminated soils at the Site.

Implementability – Easily implementable and can be combined with other remediation activities. These can also be used as a protective measure to prevent exposure to contaminants during remediation.

Relative Cost - The cost to implement fencing and signage is low.

Conclusion – Fencing and signage will be retained for further consideration.

6.1.3 Monitoring

6.1.3.1 Sampling and Analysis or Inspections

Monitoring activities include periodic sampling and analysis at Site locations or Site inspection and maintenance and preparation of a PRR as required by Section 6.3 of the NYSDEC DER 10 Guidance. These activities would provide an indication of the movement of the contaminants and/or of the progress of remedial activities.

Effectiveness - Monitoring alone would not be effective in meeting the RAOs. It would not alter the effects of the contamination on human health and the environment. Monitoring is a proven and reliable process for tracking the migration of contaminants during and following treatment and is often coupled with additional technologies to determine their effectiveness.

Implementability - Long-term monitoring could be easily implemented. Monitoring wells are easily accessible for sample collection. Equipment, material, and sampling procedures are readily available. Site inspection, monitoring and reporting are easily implementable.

Relative Cost - Monitoring and /or inspections involve low capital and low O&M cost.

Conclusion - Long-term monitoring and/or inspections will be retained for further consideration to track the impact of the chosen remedial alternatives.

6.1.4 Monitored Natural Attenuation

MNA refers to the remedial action that relies on naturally occurring attenuation processes to achieve Site-specific RAOs within a reasonable time frame. Natural attenuation processes that reduce contaminant concentrations in groundwater include destructive (biodegradation and chemical reactions with other subsurface constituents) and nondestructive mechanisms (dilution, dispersion, volatilization, and adsorption). Biodegradation is typically the most significant destructive attenuation mechanism.

Effectiveness - MNA is an effective remediation approach for sites where natural mechanisms can be demonstrated to minimize or prevent the further migration of contamination. MNA is typically applicable to sites where VOCs are the primary contaminants and groundwater is the primary contaminated media. The Site contaminants (PCBs and metals) and the media of interest (soil) are generally not amenable to achieve RAOs via MNA. This process option is considered to be ineffective in addressing the Site contamination.

Implementability – When it is an effective strategy, natural attenuation is considered to be easily implementable. Materials and services necessary to model and monitor the contaminant dynamics are readily available. Site restrictions and/or institutional controls may be required as long-term control measures as part of the MNA option are also generally easily implementable.

Relative Cost - MNA involves low capital cost and moderate O&M cost for long term monitoring and periodic reassessment.

Conclusion - MNA is not effective for the Site contaminants, and is not retained for further consideration.

6.1.5 Containment/Barrier

Installation of a barrier across the Site, such as a concrete or asphalt cap, could be utilized to address the Site contamination. In addition to reducing groundwater infiltration and preventing migration of contamination, the barrier would also prevent direct contact between potential receptors and the contaminated soil.

6.1.2.4 Barrier: Asphalt or Concrete Cap

Paving the contaminated area with asphalt or concrete would provide an impervious barrier thereby reducing groundwater infiltration and preventing direct contact exposure.

Effectiveness – The installation of an asphalt or concrete cap is likely to be effective in the near-term. Long term effectiveness of the cap depends on proper maintenance, therefore inspection and maintenance would be required as part of the long term monitoring and documented in a PRR.

Implementability – Installation of an asphalt or concrete cap is easily implementable. However, maintenance of the cap is not possible, especially due to the damage to the cap from Site activities at the salvage yard.

Relative Cost – Capping has low capital costs and low O&M costs.

Conclusion – Capping will not be retained for further consideration, as long-term maintenance of the cap is not implementable due to the nature of Site operations.

6.1.6 Removal

Removal response actions refer to methods typically used to excavate and handle soil, sediment, waste, and/or solid materials. Excavation technologies provide no treatment of wastes, but may be used prior to treatment or disposal to remove wastes from designated areas.

6.1.6.1 Excavation

Excavation technologies use standard earthwork equipment to excavate contaminated materials for consolidation, treatment, and/or disposal. These contaminated materials include slag, battery casings/ associated wastes, and soil. Special equipment will likely be required to excavate, segregate, handle, and/or crush the slag materials prior to treatment or disposal. In general, heavy machinery can be utilized to remove large quantities of soil. A variety of equipment (e.g., backhoes, bulldozers, end-loaders) can be used for excavation. Manual excavation is useful for removal of small amounts of soil or when heavy machinery cannot be used in certain hard to access areas.

Effectiveness: Excavation is effective in removing contaminated materials from the designated area. However, excavation alone would not reduce T/M/V of the contamination. Excavation is a common construction technique and does not require long-term maintenance or monitoring.

Implementability: Excavation is technically and administratively feasible. The process uses commercially available equipment. Deep excavation would require sheet pile to provide structural support for excavating large quantities of material.

Relative Cost: Excavation has high capital costs, but it does not have O&M costs.

Conclusion: Excavation will be retained for further consideration in all areas of the Site.

6.1.7 Treatment

Treatment of the contaminated materials at the Site may successfully reduce the toxicity and/or mobility to acceptable levels. Treatment technologies can either be implemented in-situ (i.e. in place without removal of contaminated materials) or ex-situ by excavation of contaminated soils prior to treatment. Technologies can be based on either physical mechanisms (such as heating, volatilization etc.) or chemical mechanisms. Stabilization/Solidification (S/S) involves both physical and chemical mechanisms but since the predominant processes involved are chemical, S/S is discussed under chemical processes. Treatment process options can be categorized into four classes:

- Ex-situ chemical treatment
- Ex-situ physical treatment
- In-situ chemical treatment
- In-situ physical treatment

6.1.7.1 Ex-Situ Chemical Treatment

Several ex-situ chemical process options such as chemical dehalogenation, solvent extraction and S/S have been applied successfully to treat PCBs. However, among these options, only S/S has been effectively applied to treat metals. Neither stabilization nor solidification destroys metals or PCBs. Stabilization converts the contaminants (metals or PCBs) to an insoluble, less mobile or less toxic form that does not leach easily into aqueous phase upon contact with water. Solidification significantly reduces exposure to and the migration of contaminants by encapsulation, reduced porosity and reduced surface through addition of agents such as Portland cement, fly ash, cement kiln dust or materials with similar properties. The reduced hydraulic conductivity of contaminated material prevents migration through leaching and advective transport. Since S/S does not destroy contaminants, the success of this technology is not measured by the contaminant concentrations in the resulting solid mixtures, but is assessed based on the results of leachability, permeability, and unconfined compressive strength testing.

Effectiveness - S/S has been used effectively to treat PCBs and metals. The inert low-permeable material resulting from treatment with S/S needs to be disposed of or placed at an appropriate location on-Site. However, the degree of effectiveness can vary and needs to be confirmed through bench-scale studies.

Implementability – The implementation of this technology is complicated by the difficulty in handling the treated material and whether the material is disposed on-Site or off-Site. However, implementation is technically possible. Implementation is much easier if the process is implemented in-situ.

Relative Cost - The relative costs depend on the appropriate treatment agent and whether the treated material is placed off-Site or on-Site. The capital costs are generally medium to high with low to medium O & M costs if placed on-Site.

Conclusion – Since in-situ option easier to implement the ex-situ option is not retained for further consideration.

6.1.7.2 Ex-Situ Physical Treatment

This includes thermal desorption or vitrification processes that involve application of heat to varying degrees. Ex-situ thermal desorption processes involve application of heat to 1,000° Fahrenheit (F) and vitrification processes involve heat up to 2,000° F.

Effectiveness – Ex-situ physical processes are effective for PCBs but are ineffective in the treatment of metals. Hence these process options would be ineffective in addressing the metals contamination at the Site soils.

Implementability – The implementation of this technology is very difficult due to the large energy requirements and the logistics of heating several thousand CY of soils. However, it is technically implementable.

Relative Cost – Ex-situ physical treatment involves high capital costs and high O&M costs during treatment operations.

Conclusion – Ex-situ physical treatment will not be retained for further consideration in this FS.

6.1.7.3 In-Situ Chemical Treatment

Similar to ex-situ chemical processes, several in-situ chemical process options such as chemical dehalogenation, solvent extraction and S/S are potentially applicable to treat PCBs. However, among these options, only S/S has been effectively applied to treat metals. In addition to chemical effectiveness, the ability to mix and distribute the S/S agents effectively in the subsurface also plays a significant role in the success of this option. Other factors are similar to the discussion of this technology under ex-situ treatment option.

Effectiveness - This process option is considered to be effective. However, the degree of effectiveness can vary depending on the S/S agents and the ability to properly mix the contaminated soils with the agents. Hence, bench-scale studies and/or field pilot studies are necessary prior to full-scale field implementation. The S/S technology does not detoxify the PCBs, it simply renders the material immobile, thus greatly reducing the leachability. However, significant reduction in toxicity of metals is achieved under S/S.

Implementability – The implementation of this technology is difficult depending on the ability to mix the S/S agent to the contaminated soils. However, it is technically implementable and much easier compared to performing this process ex-situ.

Relative Cost - The costs depend on the S/S agent but the capital costs are generally expected to be medium to high with no accompanying O & M costs.

Conclusion - In-situ S/S will be retained for further consideration.

6.1.7.4 In-Situ Physical Treatment

The only applicable process option under this category is in-situ thermal treatment. In this technology, heat is applied to the subsurface soils and groundwater using technologies such as electrical resistivity heating, thermal conduction heating or steam enhanced extraction process. Vaporization is generally the primary driving mechanism for mass removal. This technology is typically applied in conjunction with soil vapor extraction to remove the vapors.

As stated earlier, although S/S involves physical mechanisms, it has been discussed under chemical process options due to the predominance of chemical mechanisms with S/S.

Effectiveness – In-situ thermal treatment may have limited applicability to PCBs, but it is not effective in treating metal contaminants in the soil.

Implementability – The implementation of this technology is complicated by the depth of the contaminants, the logistics of heating a large area and the energy requirements to achieve desired high temperatures. However, it is technically implementable.

Relative Cost – In-situ thermal treatment involves high capital costs and high O&M costs.

Conclusion – In-situ thermal treatment will not be retained for further consideration.

6.1.8 Disposal

Disposal response actions for contaminated soil involve the transportation and disposal of excavated materials at an off-Site facility permitted for the specific waste type, or backfill on-Site if treated to regulatory limits. Based on the disposal facility and the type of waste disposed, pre-treatment may be performed at the disposal facility prior to placement at the facility.

6.1.8.1 Hazardous Waste Disposal

If the contaminated waste material is deemed hazardous, it must be disposed in a RCRA Subtitle C landfill or Landfill Disposal Restrictions (LDR) treatment standards for contaminated soil at a hazardous treatment facility prior to disposal. The final determination on whether the excavated material is hazardous or non-hazardous will be based on TCLP testing of the materials disposed of to check whether they exceed RCRA criteria for hazardous materials and testing of PCBs in the material to check whether they exceed the TSCA criteria.

Effectiveness: Landfill disposal is effective in preventing direct contact and in reducing the mobility of contaminants. The overall volume and toxicity of the waste is not reduced but simply transferred from the Site to a different location. If treatment is conducted at the facility, toxicity and mobility of the treated material would be reduced.

Implementability: RCRA Subtitle C landfills that accept metal-contaminated materials are available.

Relative Cost: This process involves high capital and no O&M costs.

Conclusion: Off-Site hazardous waste landfill will be retained for further consideration.

6.1.8.2 Non-Hazardous Waste Disposal

This option involves disposing the contaminated material that is non-hazardous at an off-Site non-hazardous waste (RCRA Subtitle D) disposal facility. Off-Site landfills are commercially owned, permitted facilities that minimize potential environmental impacts of disposal waste. Landfilling is considered a non-treatment alternative and is considered less acceptable than treatment alternatives.

Effectiveness: Landfill disposal is effective in preventing direct contact and in reducing the mobility of contaminants. The volume and toxicity of the waste is not reduced.

Implementability: This technology is implementable.

Relative Cost: This process involves moderate to high capital and no O&M costs.

Conclusion: Off-Site non-hazardous waste landfill will be retained for further consideration.

6.1.8.3 On-Site Consolidation

This option involves consolidating the contaminated material at designated on-Site locations. This may be an acceptable option for materials of low-level exceedances especially if they are consolidated along with clean fill if it can be demonstrated that the consolidated wastes pose no other human health risks, direct contact risks or any other risks of impacts to groundwater. This alternative also avoids the risks associated with off-Site transportation of contaminated materials.

Effectiveness: On-Site consolidation can be an effective option for low-level wastes with demonstrated acceptable risks.

Implementability: This technology is easily implementable, especially compared to off-Site disposal options.

Relative Cost: This process involves low capital costs and low O&M costs.

Conclusion: On-Site consolidation will be retained for further consideration in this FS.

Section 7

Development and Analysis of Remedial Alternatives

Potential remedial technologies and process options associated with each general response action were identified and screened in the previous section. Representative remedial technologies and process options that have been retained are used to develop remedial action alternatives under this section.

7.1 Development of Remedial Alternatives

Remedial action alternatives have been developed based on the potential for these alternatives to meet the SCGs, RAOs, and PRGs described in Section 4. In Section 6, a preliminary screening of available remedial action technologies was performed. The following technologies and process options were retained for further evaluation to develop remedial action alternatives:

- No Action
- Institutional Controls (Government and Proprietary Controls)/Engineering Controls (Fencing, Signage)
- Monitoring
- Excavation
- In-Situ Stabilization and Solidification
- Off-Site Disposal
- On-Site Consolidation

The above technologies and process options retained after the screening step were combined into four alternatives. The No Action alternative was retained in accordance with the NYSDEC DER-10 to serve as a baseline for comparison with the other alternatives for the Site. The following alternatives are evaluated in this FS and are described in detail below:

1. **No Action**
2. **Excavation and Off-Site Disposal:** Excavation and off-Site disposal of all impacted soils that exceed unrestricted use SCOs. This is also a presumptive remedy.
3. **Excavation, Off-Site Disposal and On-Site Consolidation:** Excavation, off-Site disposal of all soils impacted by PCBs that exceed commercial standards; on-Site consolidation of soils in remaining areas that are impacted by metals exceeding commercial standards along with clean backfill and a one foot soil cover; institutional controls in areas that exceed unrestricted use SCOs but do not exceed commercial standards.

4. **In-Situ Stabilization and Solidification:** In-situ stabilization and solidification of all impacted soils that exceed commercial standards for PCBs and metals; institutional controls in areas that exceed unrestricted use SCOs but do not exceed commercial standards.

A breakdown of the treatment volumes addressed under each alternative and the approach under which the volumes are addressed are provided in Table 7-1.

7.1.1 Detailed Description of Alternative 1 – No Action

The No Action alternative is considered in accordance with DER-10 requirements and provides a baseline for comparison with the other alternatives. Under this alternative, no further action would be implemented, and the current status of the on-Site and off-Site impacted areas would remain unchanged. Contaminated soils would continue to impact receptors either through direct contact or via impacts to groundwater. This alternative does not include any institutional controls or monitoring.

7.1.2 Detailed Description of Alternative 2 – Excavation and Off-Site Disposal

This remedial alternative consists of the following major components:

- Pre-design investigation and remedial design
- Excavation of all impacted soils that exceed unrestricted use SCOs
- Off-Site disposal of excavated soils
- Post-excavation sampling
- Backfilling and restoration of excavated areas

This alternative addresses all areas that exceed unrestricted use SCOs. Hence this is a presumptive remedy as defined by the NYSDEC DER-10. This is the only presumptive remedy considered as part of this FS. This alternative does not include any cost allowances for disruption of any ongoing Site activities. However, effort would be made to minimize disruptions to Site activities through proper planning.

7.1.2.1 Pre-Design Investigation and Remedial Design

Prior to the completion of the remedial design and the subsequent implementation, a pre-design investigation would be performed to delineate and finalize the target remediation zones. Contamination has not been delineated with respect to unrestricted use SCOs at some locations. As discussed in Section 4.4, and as presented in Figure 4-1, these include locations in the eastern portion of the outlying parcel, southeastern portions of the processing area near the office building and southwestern portions of the processing area near the Triple Cities property. The delineation at these locations would be completed and the actual target remediation areas would be finalized as part of the remedial design.

7.1.2.2 Excavation of Impacted Soils

Once the areas targeted for remediation are finalized, the soils impacted at these locations would be removed by excavation. Figure 7-1 presents the conceptual design for this alternative, including the areas designated for excavation and the depths of excavation. An estimated total volume of about 115,000 CY of contaminated soil would be excavated.

Prior to excavation, Site preparation activities would be performed to demolish and/or remove existing Site structures (such as railroad tracks) or any debris piles or materials (such as tires) on the surface that would prevent excavation. Standard earthwork equipment, such as backhoes, bulldozers, end-loaders etc., would be used to perform the excavation. The excavation would be conducted in sections and the excavated soil would be stockpiled in a lined area surrounded by berms to control stormwater runon and runoff. All the required and appropriate health and safety protocols including dust control measures, shoring and/or sloping for deep excavations (if necessary) would be implemented. In accordance with section 1.9 of DER-10, health and safety plans would be prepared prior to implementation of the excavation activities.

Since disposal facilities have specific requirements for PCB-impacted soils, soils excavated from areas impacted by PCBs would be stockpiled separately to the extent possible. Since most of the excavation is above the water table, significant dewatering of the excavated soils is not expected. If necessary, dewatering may be performed via simple decantation or through limited addition of common drying agents to improve the ability to handle the excavated materials. For purposes of cost estimation, it is assumed that all excavation within the on-Site and off-Site areas would be completed within the same mobilization and that areas for stockpiling are available in off-Site locations.

7.1.2.3 Off-Site Disposal

The disposal requirements would depend on results of required regulatory TCLP tests on the soil to determine whether the soil is hazardous. Contaminated soils that fail TCLP testing would require treatment to meet Universal Treatment Standards prior to disposal in a Subtitle C landfill. Contaminated soil that passes TCLP tests can be disposed of in a Subtitle D landfill without treatment. For cost estimating purposes, it is assumed that 5% percent of the total excavated soil would be hazardous with regards to metals based on TCLP tests, additional 5% of the excavated soil would exceed the Toxic Substances Control Act (TSCA) parameters for PCBs and an additional 1% of the material would exceed both the TCLP tests for metals and the TSCA parameters for PCBs.

Once required regulatory tests are performed on the excavated soils and appropriate off-Site disposal facilities are chosen, the soils will be transported to these facilities in trucks and disposed. The trucks would be staged in the uncontaminated area as much as possible. A truck decontamination station would be constructed to decontaminate tires before each truck leaves the Site. All appropriate health and safety protocols would be followed to prevent spills or accidental exposures during the loading, transportation and disposal actions.

7.1.2.4 Post-Excavation Sampling

Post-excavation samples would be collected from the excavated areas to confirm that there is no contamination. One post-excavation sample would be collected every 900 square feet of excavation area or a DER-approved sampling frequency in accordance with DER-10. For purposes of cost estimation, it is assumed that 25% additional sampling would be required due to secondary excavations.

7.1.2.5 Backfill and Restoration

Once post-excavation samples confirm the removal of contamination, the excavated areas would be backfilled with certified clean fill to existing grade. If possible, backfilling would be coordinated with excavation activities to preclude separate mobilization of equipment. In such a scenario, all excavation equipment would be decontaminated prior to use for backfill. Surface capping is not considered necessary since all soils left behind are below the unrestricted use SCOs. For the same reason, no institutional controls or long-term maintenance or monitoring activities are required as part of this alternative.

7.1.3 Description of Alternative 3 – Excavation, Off-Site Disposal and On-Site Consolidation

This remedial alternative consists of the following major components:

- Pre-design investigation and remedial design
- Excavation of all impacted soils (PCBs and metals) that exceed commercial standards
- Off-Site disposal of PCB-impacted soils that exceed commercial standards
- Post-excavation sampling for PCB-impacted areas
- On-Site consolidation of remaining metals-impacted soils along with clean fill, a one foot soil cover, backfilling and restoration
- Institutional controls and monitoring for unexcavated areas that exceed unrestricted use SCOs

One of the significant differences between this alternative and Alternative 2 is that while Alternative 2 is a presumptive remedy that addresses all contamination that exceeds unrestricted use SCOs, this alternative addresses only areas with contamination above the commercial standards through remedial actions. Since the contaminated on-Site and off-Site areas are classified as commercial properties, remedial actions in these areas are sufficient as long as the zoning classification is maintained as commercial. Institutional controls would be necessary to ensure that this classification is maintained, specifically in on-Site and off-Site areas that exceed the unrestricted use SCOs but are not addressed through any removal or consolidation actions under this alternative. Hence, for discussions under this alternative, the terms "impacts" or "contamination" refers to areas that exceed the corresponding commercial standards. The areas that exceed commercial standards for PCBs and metals are shown in the conceptual design for this alternative (Figure 7-2).

Figure 7-2 presents the PCB-impacted areas (which also contain metals contamination) and the areas outside of the PCB-impacted areas that are impacted by metals only. These metals-impacted areas, outside of the PCB-impacted areas, contain low-level impacts that exceed the commercial standards only marginally. The approach under this alternative involves consolidation of soils impacted with low-levels of metals along with clean fill that is brought in to replace the PCB-impacted soils that are disposed of off-Site. The clean fill is necessary to restore the Site back to its original grade following excavation. The idea behind this approach is that these soils with low-level impacts will be removed from shallow soils and placed in excavated areas underneath a one foot soil cover to eliminate direct exposure. The impact of these soils will be further reduced through consolidation in the subsurface along with clean fill., This alternative assumes that the risks to groundwater due to leaching from these consolidated soils are acceptable. Similar to Alternative 2, this alternative does not include any cost allowances for disruption of any ongoing Site activities. However, effort would be made to minimize disruptions to Site activities through proper planning.

7.1.3.1 Pre-Design Investigation and Remedial Design

Prior to the completion of the remedial design and the subsequent implementation, pre-design investigation would be performed to:

- Assess Site-specific background concentrations for metals
- Delineate and finalize the target remediation areas.
- Assess impacts due to low-level contamination outside of PCB-impacted areas

As discussed under Alternative 2, additional sampling will be performed to delineate and finalize the target remediation areas. However, unlike Alternative 2 that uses unrestricted use SCOs, the remediation areas under this alternative would be determined based on commercial standards. Therefore, this alternative is not a presumptive remedy.

In addition to the determination of remediation areas, the appropriateness of on-Site consolidation of soils with low-level metals contamination would be confirmed as part of pre-design investigations. This would be performed via analysis of samples collected from the low-level metals-impacted areas outside of the PCB-impacted areas. Soil samples would be analyzed for total metals and leachable metals.

Existing groundwater data from the Site shows that there are no groundwater impacts for PCBs. Hence, the samples would be analyzed for metals only. Exceedance of commercial standards will not necessarily mean that the soils are unsuitable for on-Site consolidation. This decision would be made prior to the remedial design based on the following factors:

- Relative volumes of clean fill and low-impact soils used during on-Site consolidation
- Overall soil metals concentrations in the low-impact areas relative to commercial standards
- Leachate concentrations from the low-impact soils relative to restricted use SCOs applicable for protection of groundwater

The most appropriate type of leachate tests that would be performed during this assessment and the specific criteria that would need to be met for on-Site consolidation to be acceptable would be finalized during pre-design investigation and remedial design. It should be noted that following excavation, additional soil/leachate testing may be performed on the excavated stockpiles for additional confirmation on whether on-Site consolidation of soils are acceptable.

7.1.3.2 Excavation of PCB-Impacted Soils

This remedial component is similar in nature to the excavation component under Alternative 2, except that while under Alternative 2 all soils that exceed unrestricted use SCOs for PCBs and metals are excavated, under this alternative only the PCB-impacted soils that exceed commercial standards are excavated. The area is shown in Figure 7-2 which presents the conceptual design for Alternative 3. The excavation volume for PCB impacted soils is approximately 25,200 CY.

7.1.3.3 Post-Excavation Sampling

Post-excavation samples would be collected from the excavated PCB-impacted areas to confirm that there is no remaining contamination. One post-excavation sample would be collected every 900 square feet of excavation area or a DER-approved sampling frequency in accordance with DER-10. For purposes of cost estimation, it is assumed that 25% additional sampling would be required due to secondary excavations, similar to Alternative 2.

7.1.3.4 Off-Site Disposal of PCB-Impacted Soils

Once the post-excavation samples confirm the absence of PCB impacts, the excavated soils from the PCB-impacted areas would be disposed off-Site at an appropriate disposal facility. This remedial component is similar in nature to the off-Site disposal component under Alternative 2. All procedures and protocols such as waste characterization sampling, health and safety protocols to minimize exposures etc. discussed under Alternative 2 would also apply to this alternative. Similar to Alternative 2, 5% percent of the total excavated soil is assumed to be hazardous with regards to metals based on TCLP tests, additional 5% of the excavated soil is assumed to exceed the TSCA parameters for PCBs and an additional 1% of the materials are assumed to exceed both the TCLP tests for metals and the TSCA parameters for PCBs for purposes of cost estimation.

7.1.3.5 On-Site Consolidation of Metals-Impacted Soils and Clean Fill, Backfilling and Restoration

The soils remaining in the metals-impacted areas are excavated and tested to confirm that the risks due to leaching of metals into groundwater are acceptable. These tests would be similar to the tests discussed under the pre-design investigation component of this alternative. The approximate in-situ volume of these remaining soils is 22,000 CY. Once the tests confirm that the impacts to groundwater due to these soils are within acceptable limits, this soil will be consolidated along with certified clean backfill and placed areas that were previously excavated (Figure 7-2). It is assumed that the 22,000 CY (in place volume) of metals-impacted soil will be consolidated with approximately 25,000 CY of clean fill and placed in an area of about 260,000 square feet. A one foot soil cover of clean fill will be installed as part of the backfilling work. Currently, this FS assumes that there are no risks to groundwater due to the residual metals contamination in the soils that would be consolidated under this remedial component. However, if leaching tests during the pre-design investigations show that such risks exist, then the areas/volumes of disposal and consolidation would be adjusted accordingly during the remedial design based on the results from pre-design investigation.

Excavation of metals-impacted areas may be performed concurrently with excavation of PCB-impacted areas. However, careful planning should be performed to ensure that the PCB-impacted soils are stockpiled separately and labeled/marked clearly to ensure disposal of the correct stockpile.

7.1.3.6 Institutional Controls and Monitoring

Under Alternative 3, soils that exceed unrestricted use standards are left on-Site. This is acceptable since the on-Site and off-Site areas under this alternative are classified as commercial properties and all areas that exceed commercial standards are excavated. However, the areas that exceed unrestricted use standards should be maintained in the future under the same zonal classification for this alternative to be acceptable. Hence, administrative measures would be instituted to periodically ensure that the commercial classification is maintained in the future for these on-Site and off-Site areas. Environmental easements would be established if necessary. Limited groundwater monitoring would also be performed to confirm that there are no continued risks posed to the groundwater at the Site. For purposes of cost estimation, it is assumed that groundwater monitoring would be performed at the appropriate existing Site wells annually for five years after the implementation of consolidation, backfilling and restoration. The actual mechanism of implementation for this institutional control measures and details of groundwater monitoring would be determined during the remedial design and would be addressed in the Site management plan.

7.1.4 Description of Alternative 4 – In-Situ Stabilization and Solidification

This remedial alternative consists of the following major components:

- Pre-design investigation, treatability studies and remedial design
- In-situ stabilization and solidification of areas that exceed commercial standards
- Institutional controls and monitoring for untreated areas that exceed unrestricted use SCOs

Similar to Alternative 3, this alternative also addresses only impacts that exceed commercial standards for both PCBs and metals and hence is not a presumptive remedy. Hence institutional control measures similar to Alternative 3 are necessary to address the areas that exceed the unrestricted use standards but are within the commercial standards. Similar to Alternative 2 and Alternative 3, this alternative does not include any cost allowances for disruption of any ongoing Site activities. However, effort would be made to minimize disruptions to Site activities through proper planning. Due to the nature of the activities under this alternative, the extent of disruption to Site activities may be significant.

7.1.4.1 Pre-Design Investigation, Treatability Studies and Remedial Design

Prior to the completion of the remedial design and the subsequent implementation, pre-design investigation would be performed to delineate and finalize the target remediation zones.

Bench-scale treatability studies would be performed to select an appropriate mixture of treatment agents to achieve successful implementation S/S remedy. Based on the success of S/S technology in addressing PCB and metals contamination at other sites (EPA 2012), this FS assumes that such a mixture can be determined based on the results of treatability studies. For purposes of cost estimation, a generic mixture of 5% lime and 20% Portland cement is assumed as an appropriate S/S agent. However, this assumption can be verified only through treatability studies. Because of this, there is significant uncertainty associated with this assumption, not only in terms of effectiveness, protectiveness, implementability and cost, but also with regard to the ability of the treated mixtures to meet the Site use requirements with regards to material strength. Inability to meet these requirements may necessitate additional costs which, as previously discussed, can be evaluated only through treatability studies.

Also, as noted under the screening of technologies, S/S does not detoxify PCBs, it simply immobilizes the material thus greatly reducing the risks of leaching. However, significant detoxification of metals is achieved under S/S.

7.1.4.2 In-Situ Stabilization and Solidification

Once the treatability studies are completed, an appropriate mixture of S/S agents are finalized and remediation target zones are finalized based on pre-design investigation, the S/S remedy is implemented at the Site. Treatment areas, shown in the conceptual design for this alternative (Figure 7-3), are subdivided into convenient rectangular grids depending on the diameter of the rotomixer. Implementation of S/S in each grid is performed in sequence or per a predetermined schedule in order to ensure all areas are treated. Implementation of S/S requires dry subsurface conditions. Hence S/S below water table requires continuous dewatering. At this time, it is assumed that all targeted zones are above water table and that no dewatering would be required. However, this needs to be confirmed during the pre-design investigation.

The actual treatment consists of in-situ mixing of the S/S agents with soil in the contaminated areas. For shallow depths (<1 foot bgs), simple tools such as a backhoe, or agricultural tilling equipment may be sufficient. However, most impacted areas at the Site are at least 4 feet in depth, and medium-sized mixing equipment such as a Lang tool or similar rotomixers mounted on excavators would be needed to perform effective mixing and delivery of S/S agents for depths up to 10 to 12 feet. This process is more energy intensive and takes longer to implement compared to simple excavation, however the resulting soils mixed with the S/S agents are encapsulated and solidified in place and do not have to be disposed of or capped. As noted in Section 6, since the contaminants are not destroyed by this method, the success of performance is not measured by the contaminant concentrations in the resulting solids. Other metrics such as leachability, permeability and unconfined compressive strength are used to measure the method's performance.

Generally all on-Site health and safety protocols that apply to excavation also apply to in-situ mixing. Although no material is excavated out of the subsurface, the materials generally used in the application of S/S technology such as Portland cement, fly as, lime etc. tend to generate significant dust. Therefore dust control measures would be implemented, similar to excavation. Generally contaminated materials are not transported between locations, hence decontamination is not required between grid points. Once mixing for S/S is completed and the materials are allowed to set, a one-foot thick soil cover would be installed in the treated areas to prevent any potential exposures at the surface and to provide a more appropriate surface for the resumption of future Site activities that would likely involve the use of tracked vehicles.

7.1.4.3 Institutional Controls and Monitoring

This component is the same as the institutional controls component discussed under Alternative 3.

7.2 Evaluation Criteria for Detailed Analysis of Alternatives

The alternative analysis approach is based upon the procedures outlined in "*DER-10 Technical Guidance for Site Investigation and Remediation"* (NYSDEC 2010). These criteria are classified into the following three groups and are described below:

Threshold Criteria. Threshold criteria are requirements that each alternative must meet in order to be considered for selection.

- **Overall Protection of Human 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, engineering controls or institutional controls. The remedy's ability to achieve each of the RAOs is evaluated.

- **Compliance with New York State Standards, Criteria, and Guidance (SCGs)**. Compliance with SCGs addresses whether a remedy will meet environmental laws, regulations, and other standards and criteria. In addition, this criterion includes the consideration of guidance which the Department has determined to be applicable on a case-specific basis.

Primary Balancing Criteria. These criteria are used to distinguish the relative effectiveness of each alternative so that decision makers compare the positive and negative aspects of each of the remedial strategies.

- **Long-term Effectiveness and Permanence**. This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If wastes or treated residuals remain on-Site after the selected remedy has been implemented, the following items are evaluated: 1) the magnitude of the remaining risks, 2) the adequacy of the engineering and/or institutional controls intended to limit the risk, and 3) the reliability of these controls.

- **Reduction of Toxicity, Mobility or Volume**. Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility or volume of the wastes at the Site.
- **Short-term Effectiveness**. The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation are evaluated. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives.
- **Implementability**. The technical and administrative feasibility of implementing each alternative are evaluated. Technical feasibility includes the difficulties associated with the construction of the remedy and the ability to monitor its effectiveness. For administrative feasibility, the availability of the necessary personnel and materials is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, institutional controls, and so forth.
- **Cost-Effectiveness**. Capital costs and annual operation, maintenance, and monitoring costs are estimated for each alternative and compared on a present worth basis. Although cost-effectiveness is the last balancing criterion evaluated, where two or more alternatives have met the requirements of the other criteria, it can be used as the basis for the final decision.

Modifying Criterion. This criterion is taken into account after evaluating Threshold and Primary Balancing Criteria. Evaluation under this criterion, in this draft FS, is based on current expectations and will be re-evaluated after public comments on the FS and Proposed Remedial Action Plan (PRAP) are received.

Community Acceptance. Concerns of the community regarding the RI/FS reports and the PRAP will be evaluated and a responsiveness summary will be prepared that describes public comments received and the manner in which the Department will address the concerns raised. If the selected remedy differs significantly from the proposed remedy, notices to the public will be issued describing the differences and reasons for the changes.

7.3 Detailed Analysis of Remedial Action Alternatives

This section provides the detailed analysis of the four remedial alternatives based on the screening criteria described in Section 7.2.

7.3.1 Alternative 1 – No Action

The No Action alternative was retained for comparison purposes as required by the NYSDEC DER-10. No remedial actions would be implemented as part of the No Action alternative. Contaminated soils impacted by PCBs and metals would continue to pose threats to receptors in areas where they are currently present. Contaminants would continue to migrate and potentially impact groundwater at the Site. This alternative does not include institutional controls or long-term groundwater monitoring.

7.3.1.1 Overall Protection of Human Health and the Environment

The no action alternative does not provide overall protection of human health and the environment and does not meet the RAOs. Contaminated soils at the Site pose potential risks of exposure through direct contact, ingestion, and/or potential inhalation of dust particles. Because no remedial action would be implemented under this alternative, no means would be available to prevent current and future exposure. Risk of impacts to groundwater due to leaching from contaminated soils at the Site is also at levels that are unacceptable.

Since this alternative would not meet the criterion, it is not rated under this criterion.

7.3.1.2 Compliance with SCGs

Due to the presence of PCBs and metals above the unrestricted use SCO and commercial standards, this alternative would not comply with the chemical-specific SCGs for soil. As this alternative involves no action, location- and action-specific SCGs are not applicable. Since this alternative would not meet the criterion, it is not rated under this criterion.

7.3.1.3 Long-term Effectiveness and Permanence

No Action is not considered to be a permanent remedy. The contaminants would not be destroyed, except by gradual reductions through natural attenuation processes. These natural attenuation processes are practically non-existent at the Site for PCBs and metals. A decrease in contaminant concentrations may occur in some areas of the Site via leaching and migration to groundwater. This alternative, however, would not provide adequate control of risks to human health or the environment because there are no mechanisms to prevent current and future exposure. Under this alternative there would be no mechanism in place to prevent future risk to human health; therefore, this alternative would not be considered effective in the long term. Since this alternative would not meet the criterion, it is not rated under this criterion.

7.3.1.4 Reduction of Toxicity, Mobility or Volume through Treatment

The implementation of this alternative would not affect the toxicity, mobility, or volume of the contaminants. Since this alternative would not meet the criterion, it is not rated under this criterion.

7.3.1.5 Short-term Effectiveness

This alternative would not include a remedial action. Therefore, it would have no short-term impacts to workers or the community. There would be no adverse environmental impacts to habitats or vegetation as there is no remedial action under this alternative. Hence, this alternative is assigned a "High" rating under this criterion. However, it should be noted that the potential adverse impacts of any exposures due to Site contaminants would also be high.

7.3.1.6 Implementability

This alternative is easily implemented, since no services or permits would be required. Hence, this alternative is rated assigned a "High" rating under this criterion.

7.3.1.7 Cost

There would be no cost under this alternative. Hence, this alternative is rated assigned a "High" rating under this criterion.

7.3.1.8 Community Acceptance

Since potential risks of contaminant exposure would be high, this alternative is not expected to be deemed acceptable by the community. Hence, this alternative is rated assigned a "Low" rating under this criterion.

7.3.2 Detailed Analysis of Alternative 2 – Excavation and Off-Site Disposal

Alternative 2 consists of excavation and off-Site disposal of all PCB and metals contaminated areas on-Site and off-Site that exceed unrestricted use SCOs.

7.3.2.1 Overall Protection of Human Health and the Environment

Alternative 2 would be protective of human health and environment at the Site. This is achieved through the removal of all contaminated soils that exceed unrestricted use SCOs from the Site and disposing them of at an approved off-Site facility where exposures can be prevented. Removal of contamination is confirmed through post-excavation sampling.

Overall, with regards to this threshold criterion of protection of human health and environment, this alternative is rated “High”.

7.3.2.2 Compliance with SCGs

This alternative would decrease contaminant concentrations at the Site to levels below the SCGs. Contaminated soils that exceed the SCGs would simply be removed from the subsurface via excavation and disposed of off-Site. Results from post-excavation sampling would confirm compliance with the most stringent SCGs. Under this threshold criterion of compliance with SCGs, Alternative 2 is assigned a rating of “High”.

7.3.2.3 Long-term Effectiveness and Permanence

The technologies under this alternative such as excavation and off-Site disposal result in a permanent remedy at the Site that is effective. Hence, under this criterion, Alternative 2 is assigned an overall rating of “High”.

7.3.2.4 Reduction of Toxicity, Mobility or Volume through Treatment

The remedial components under Alternative 2 would not result in an overall decrease in toxicity or volume, but they are simply transferred from the Site to an approved off-Site facility where the risks of exposures to the toxic materials can be managed. The transfer of contaminants may however result in the decrease of the mobility of contamination. If the contaminated materials are deemed hazardous prior to disposal and require treatment at the approved facility, then this may result in the decrease of toxicity, volume or both. Under this criterion, Alternative 2 is not assigned a rating since no actual treatment may take place as part of this alternative, although on-Site T/M/V are removed completely.

7.3.2.5 Short-Term Effectiveness

The short-term impacts due to Alternative 2 are expected to be significant. Excavation, transportation and disposal would involve significant disruptions at the Site and potentially to the community. Excavation would affect the Site operations, transportation would increase traffic in the Site vicinity and would also increase risks of spreading and exposure of contamination. These impacts can be minimized both on-Site and off-Site with careful planning and coordination of activities prior to implementation and if proper procedures and protocols are followed during the implementation of this alternative. Under this criterion, Alternative 2 is assigned an overall rating of “Medium”.

7.3.2.6 Implementability

The technologies under this alternative (excavation, transportation and disposal) are implemented on a regular basis at several sites and are easily implementable. Under this criterion, Alternative 2 is assigned an overall rating of “High”.

7.3.2.7 Cost

The total present worth cost of this alternative is about $23.97 million. The total cost is all capital cost as there is no Operation and Maintenance (O & M) cost associated with this alternative. Under this criterion, Alternative 2 is assigned an overall rating of "Low" since the cost is high.

7.3.2.8 Community Acceptance

Alternative 2 is expected to be acceptable to the local community and all parties involved. Under this criterion, Alternative 2 is assigned an overall rating of "High".

7.3.3 Detailed Analysis of Alternative 3 – Excavation, Off-Site Disposal and On-Site Consolidation

7.3.3.1 Overall Protection of Human Health and the Environment

Alternative 3 would be protective of the human health and environment by addressing the on-Site PCB impacts that exceed commercial standards via excavation and disposal. The on-Site metals impacts in the remainder of the on-Site and off-Site areas that exceed commercial standards would be addressed via on-Site consolidation along with clean fill and a one foot soil cover. Leaching tests would be performed to demonstrate that the impacts to on-Site groundwater due to this consolidation would be at acceptable levels. Soil samples would be analyzed for metals to confirm the soil impacts are within acceptable limits.

There would be some risk of exposure in on-Site areas that exceed unrestricted use SCOs. However, these risks are acceptable, as the contamination does not exceed commercial standards and would be managed via institutional control measures. Overall, Alternative 3 is assigned a rating of "Medium to High" under this criterion, assuming that it can be demonstrated that the leaching of contamination into groundwater at the Site is at acceptable levels.

7.3.3.2 Compliance with SCGs

Alternative 3 would not achieve compliance with the most stringent SCGs (unrestricted use SCOs) but would be able to achieve compliance for the less stringent commercial standards. This is acceptable since the Site property is classified as a commercial facility. However, demonstration of acceptable impacts to groundwater is necessary to confirm compliance with groundwater SCGs. Under this threshold criterion of compliance with SCGs, Alternative 3 is assigned an overall rating of "Medium to High" assuming acceptable risks to groundwater impacts.

7.3.3.3 Long-term Effectiveness and Permanence

This alternative is an effective and permanent remedy although institutional controls are necessary to maintain the status of permanence. Effectiveness and permanence is high for PCBs since the PCB-impacted soils are disposed of off-Site. The metals impacts in the remainder of areas are at low levels and can be effectively addressed over the long-term via on-Site consolidation. However, this effectiveness needs to be confirmed through leachability testing to ensure acceptable groundwater impacts. Residual risks remain due to soils that are below commercial standards but exceed unrestricted use SCOs but the magnitude of these risks are acceptable and can be managed adequately through appropriate institutional controls. The overall rating of Alternative 3 under this criterion is "Medium to High" as long as acceptable risks to groundwater can be confirmed and commercial use status of the Site is maintained.

7.3.3.4 Reduction of Toxicity, Mobility or Volume through Treatment

Under Alternative 3, there is no overall reduction in toxicity and volume through treatment but it is simply transferred to off-Site locations where they can be managed or on-Site locations where they can be reduced to acceptable levels. There may be some reduction in toxicity and volume if the PCB-impacted soils that are disposed off-Site are deemed hazardous and require treatment at the disposal facility. Potential on-Site impacts related to the mobility of PCB would be reduced due to disposal at an off-Site location. The mobility of remaining low-level metals that are consolidated on-Site may likely be unchanged but would be acceptable. The overall rating of Alternative 3 under this criterion is "Medium to High".

7.3.3.5 Short-term Effectiveness

The short-term impacts off-Site property is much lower with this alternative compared to Alternative 2, due to the significantly lower volume of off-Site disposal. At the same time, on-Site impacts over the short-term are somewhat higher due to consolidation activities. The overall rating assigned to Alternative 3 under this criterion is "Medium to High".

7.3.3.6 Implementability

This alternative would not pose significant challenges with respect to implementation, as services are commonly provided by several vendors. Implementation is easier compared to Alternative 2, since excavation volumes and off-Site disposal are both much lower with this alternative. On-site consolidation would involve more on-Site activities compared to Alternative 2 but would involve significantly less disturbances outside of the Site due to the need to transport much lower volumes. An administrative mechanism to implement institutional controls is also necessary to maintain the status of the Site. The overall rating of Alternative 3 under this criterion is "High".

7.3.3.7 Cost

The total present worth cost of this alternative is about $6.39 million. This includes an Operation and Maintenance (O & M) cost of $73,000 for implementation of institutional controls and limited groundwater monitoring. Under this criterion, Alternative 3 is assigned an overall rating of "Medium to High".

7.3.3.8 Community Acceptance

Alternative 3 is expected to be acceptable to the local community and all parties involved, assuming that acceptable risks due to on-Site consolidation of low-impact soils can be demonstrated. Under this criterion, Alternative 3 is assigned an overall rating of "High".

7.3.4 Detailed Analysis of Alternative 4 – In-Situ Stabilization and Solidification

As noted under Section 7.1.4.1 under the description of this alternative, there is significant uncertainty associated with the evaluation of this alternative because some of the assumptions made in this FS can be confirmed only through treatability studies. These include the assumption that a S/S mixture of 5% lime and 20% Portland cement would be an appropriate treatment agent and that it would be effective in meeting the Site use requirements. This uncertainty would significantly impact the evaluations under criteria such as implementability, costs and short-term effectiveness and to a lesser extent, impact the evaluations under even some of the threshold criteria such as overall protection and long-term effectiveness.

7.3.4.1 Overall Protection of Human Health and the Environment

This alternative would provide adequate protection of human health and the environment. This would be confirmed based on treatability studies prior to the remedial design and through post treatment samples following implementation of the remedy. It should be noted that the contaminants are not destroyed but the exposures are limited due to the significant reduction in the leachability and permeability of the treated soils. There would be some risk of exposure in on-Site areas that exceed unrestricted use SCOs. However, these risks are acceptable as the contamination does not exceed commercial standards and would be managed via institutional control measures. Under this criterion, Alternative 4 is assigned an overall rating of "Medium to High" assuming an appropriate treatment agent can be determined and mixed effectively with contaminated soils.

7.3.4.2 Compliance with SCGs

This alternative may not be in compliance with the SCGs in the traditional sense since the contaminants may not necessarily be destroyed and may remain within the treated soils. However, the S/S technology renders the contamination within the treated materials immobile and significantly reduces the leachability upon contact with water. Hence, instead of the traditional SCGs, the performance of the remedy would be assessed by means of properties such as leachability, permeability and unconfined compressive strength (UCS). Based on these revised metrics, this alternative would be in compliance of the RAOs. Alternative 4 is assigned an overall rating of "Medium to High" under this criterion.

7.3.4.3 Long-term Effectiveness and Permanence

Alternative 4 is an effective and permanent remedy over the long term. As long as the appropriate S/S agent is selected based on the results from treatability studies and the agent is properly mixed and well distributed within the target remediation zones, the remedy is permanent and effective. Residual risks remain due to soils that are below commercial standards but exceed unrestricted use SCOs but the magnitude of these risks are acceptable and can be managed adequately through appropriate institutional controls. Alternative 4 is assigned an overall rating of "Medium to High" under this criterion.

7.3.4.4 Reduction of Toxicity, Mobility or Volume through Treatment

S/S technology reduces the mobility of contaminant greatly. The toxicity and volume of the metals contaminants are also likely to be reduced significantly albeit to varying degrees for different metals. The toxicity and volume of PCBs would not be reduced since the PCBs are not actually destroyed by S/S. However, the leachability and surface area of exposure are greatly reduced due to encapsulation. Hence the potential for exposures are also reduced significantly. The reduction in T/M/V can be confirmed through leachability and permeability tests. Under this criterion, Alternative 4 is assigned an overall rating of "Medium to High".

7.3.4.5 Short-term Effectiveness

This alternative would have a significant short term impact at the Site as a result of extensive soil mixing with S/S agents. This alternative would also take additional time for the on-Site operations compared to other alternatives. However, since there is no disposal or transportation requirement, the overall impacts to the community are much less compared to other alternatives. Alternative 4 is assigned an overall rating of "Medium to High" under this criterion.

7.3.4.6 Implementability

All the remedial components under this alternative are implementable. Services, equipment and material required under this alternative are available, although specialized equipment and careful planning and oversight would be required to ensure effective mixing of the S/S agent with the contaminated soils. The nature of the soils and the ability to handle them effectively would influence the ease of implementation. Based on previous case studies, this FS assumes that an effective mixture of treatment agents can be determined through bench-scale studies. However, it is possible that identification of an effective mixture that would address all the contaminants, may prove challenging. Under this criterion, Alternative 4 is assigned an overall rating of “Medium to High”.

7.3.4.7 Cost

The total present worth cost of this alternative is about $7.09 million. This includes an Operation and Maintenance (O & M) cost of $73,000 for implementation of institutional controls and limited groundwater monitoring. Under this criterion, Alternative 4 is assigned an overall rating of “Medium to High”.

7.3.4.8 Community Acceptance

Alternative 4 is expected to be acceptable to the local community and all parties involved assuming that an effective S/S agent is determined based on treatability studies and the contaminated soils can mixed effectively with the treatment agent. Under this criterion, Alternative 4 is assigned an overall rating of “High”.

7.4 Comparative Analysis of Alternatives

A summary of the detailed analysis of the four alternatives under the eight criteria is presented in Table 7-5. Please note that the analysis below does not take into account the uncertainty associated with the assumptions made for the evaluations and ratings described in the previous sections (particularly for Alternative 4).

7.4.1 Overall Protection of Human Health and the Environment

Under the protectiveness criterion, Alternative 1 is not rated as it does not meet the criteria. Alternatives 2 is rated as “High” and Alternatives 3 and 4 are rated as “Medium to High” under this criterion. It should be noted that the rating Alternative 3 assumes that acceptable risks to groundwater can be demonstrated. Also, Alternative 4 assumes that an appropriate treatment agent can be determined and mixed effectively with contaminated soils at the Site. Alternative 2 is the most protective followed by Alternatives 3 and 4 which are likely equally protective. Alternative 1 does not meet the criteria.

7.4.2 Compliance with SCGs

Alternative 1 would not meet this threshold criterion of compliance with SCGs. Alternative 2 would be in compliance of the most stringent SCG (unrestricted use SCOs) and is rated “High”. Alternatives 3 and 4 would not meet the most stringent SCGs but would still meet the RAOs for the less-stringent commercial standards. Alternatives 3 and 4 are rated “Medium to High” under this criterion.

7.4.3 Long-term Effectiveness and Permanence

Alternative 1 is not rated under this criterion as it does not meet the criteria. With regards to long-term effectiveness and permanence, Alternative 2 is rated as “High” since excavation and off-Site disposal of all contaminated soils above unrestricted use SCOs is a permanent and highly effective remedy. Under Alternatives 3 and 4, residual risks remain due to soils that exceed unrestricted use SCOs but are below commercial standards. These risks can be managed adequately with appropriate institutional controls. Hence Alternatives 3 and 4 are rated as “Medium to High” under this criterion.

7.4.4 Reduction of Toxicity, Mobility or Volume through Treatment

Alternative 1 is not rated under this criterion as it does not reduce the T/M/V through treatment. Overall reduction in T/M/V through treatment is not applicable to Alternative 2 since no actual treatment is performed. However, all on-Site T/M/V are removed completely under Alternative 2. Under Alternative 3, toxicity and volume are reduced somewhat through on-Site consolidation but mobility may not be affected significantly. However, it should be noted that the risks due to remaining volume of contaminants presents acceptable and manageable risks. Hence, Alternative 3 is rated as “Medium to High” under this criterion. Alternative 4 reduces the mobility of contaminants and somewhat reduces the toxicity of metals but the toxicity and the volume for PCBs are mostly unchanged. Alternative 4 is assigned as a rating of “Medium to High” under this criterion.

7.4.5 Short-term Effectiveness

Alternative 1 is rated as “High” as there are no short-term impacts under the No Action alternative, however the risks due to the Site contaminants would remain. Alternative 2 is rated “Medium” since it would involve significant disruption to Site and community. Alternative 3 would also involve significant disruption to Site and some disruption to the community outside of the Site but the volumes handled are much lower compared to Alternative 2. Alternative 3 is assigned a rating of “Medium to High” under this criterion. Alternative 4 would involve significant duration of disruption at the Site but the soils would be treated in-situ and there would be very little impacts outside of the treated areas. Hence Alternative is assigned a rating of “Medium to High” under this criterion.

7.4.6 Implementability

Alternative 1 is the most easily implementable but it would not meet the threshold and primary balancing criteria. Alternatives 2 and 3 are rated “High” with regard to implementability as they are the most easily implementable with services commonly provided by several vendors. Alternative 4 is the slightly more difficult to implement since services are not as commonly available and on-Site operations would involve higher duration and more careful oversight. Alternative 4 is rated “Medium to High” under this criterion.

7.4.7 Cost

Table 7-3 presents a summary of costs for all the remedial alternatives. Alternative 1 is not associated with any cost since it does not involve any remedial action or monitoring. The total present worth costs for Alternatives 2, 3 and 4 are about $23.97 million, $6.39 million, and $7.09 million respectively. Other than No Action alternative, Alternative 2 is rated “Low”, Alternative 3 is rated “Medium to High” and Alternative 4 is rated “Medium to High” under this criterion.

7.4.8 Community Acceptance

All the alternatives other than Alternative 1 are deemed as acceptable by the local community and all parties involved as long as the assumptions regarding risks under Alternative 3 and assumption under Alternative 4 regarding finding an appropriate agent that meets the Site use requirements are met.

Section 8

Recommended Remedy

A detailed summary of the comparative analysis of alternatives described in Section 7.4 is presented as Table 7-5. Based on this analysis, Alternative 3 – Excavation, Off-Site Disposal and On-Site Consolidation is deemed as the preferred alternative to address the contamination at the Site. The conceptual design for Alternative 3 is presented in Figure 7-2 and a detailed description is provided under Section 7.1.3. Under this alternative, contaminated soils from areas that exceed commercial standards for PCB would be excavated and disposed of at an appropriate approved off-Site facility. These soils are also contaminated with metals, although this will not change the handling, transportation or disposal of the soil. Soils from remainder of the impacted areas that have residual metals contamination, exceeding commercial standards, would be excavated and consolidated with clean fill. These consolidated soils would be placed in the areas that currently exceed the commercial standards for both PCBs and metals along with a one-foot soil cover. It is assumed that placement of consolidated soils would not pose any risks of contamination to the groundwater at the Site. This assumption would be verified during pre-design investigation. Based on current assumptions, the cost of this alternative is about $6.39 million.

Overall, Alternative 3 fares reasonably well with regards to all applicable criteria compared to other alternatives. Hence, Alternative 3 is recommended as the most appropriate action that would address Site contamination.

Section 9

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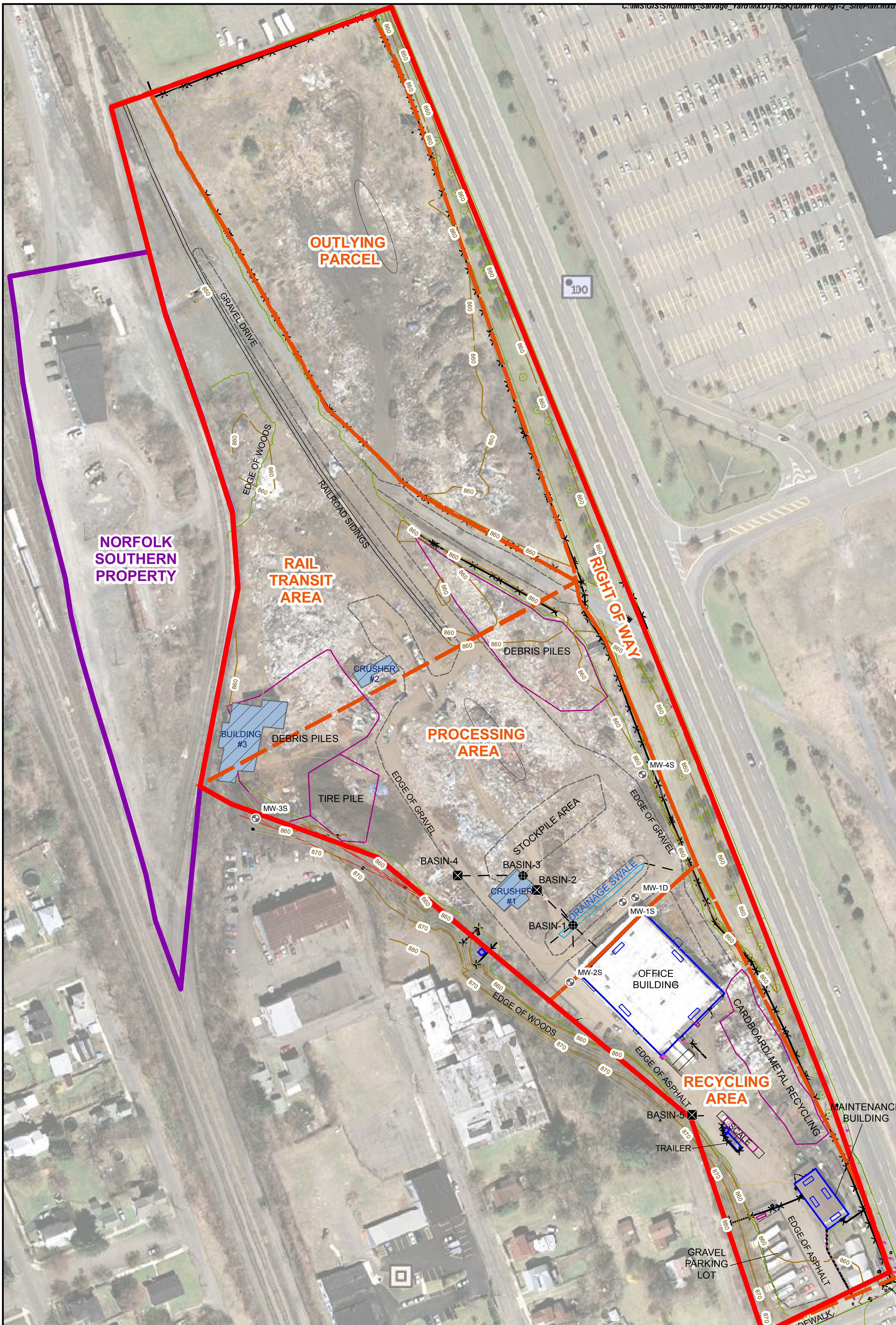
Site Boundary

N

0 | 0.25 | 0.5 | 1 Miles

Figure 1-1
Site Location Map
Shulman's Salvage Yard
Elmira, New York

CDM Smith



Site Boundary
Norfolk Southern Property
Site Areas (as defined for RI discussion)
Historical Structures
Catch Basin
Manhole
Former Wells
Debris Piles
Fenceline

Topographic Contours
Elevation (feet above mean sea level)
Index Contours
1-foot Contours

N

0 62.5 125 250 Feet

Figure 1-2
Site Plan
Shulman's Salvage Yard
Elmira, New York

CDM Smith

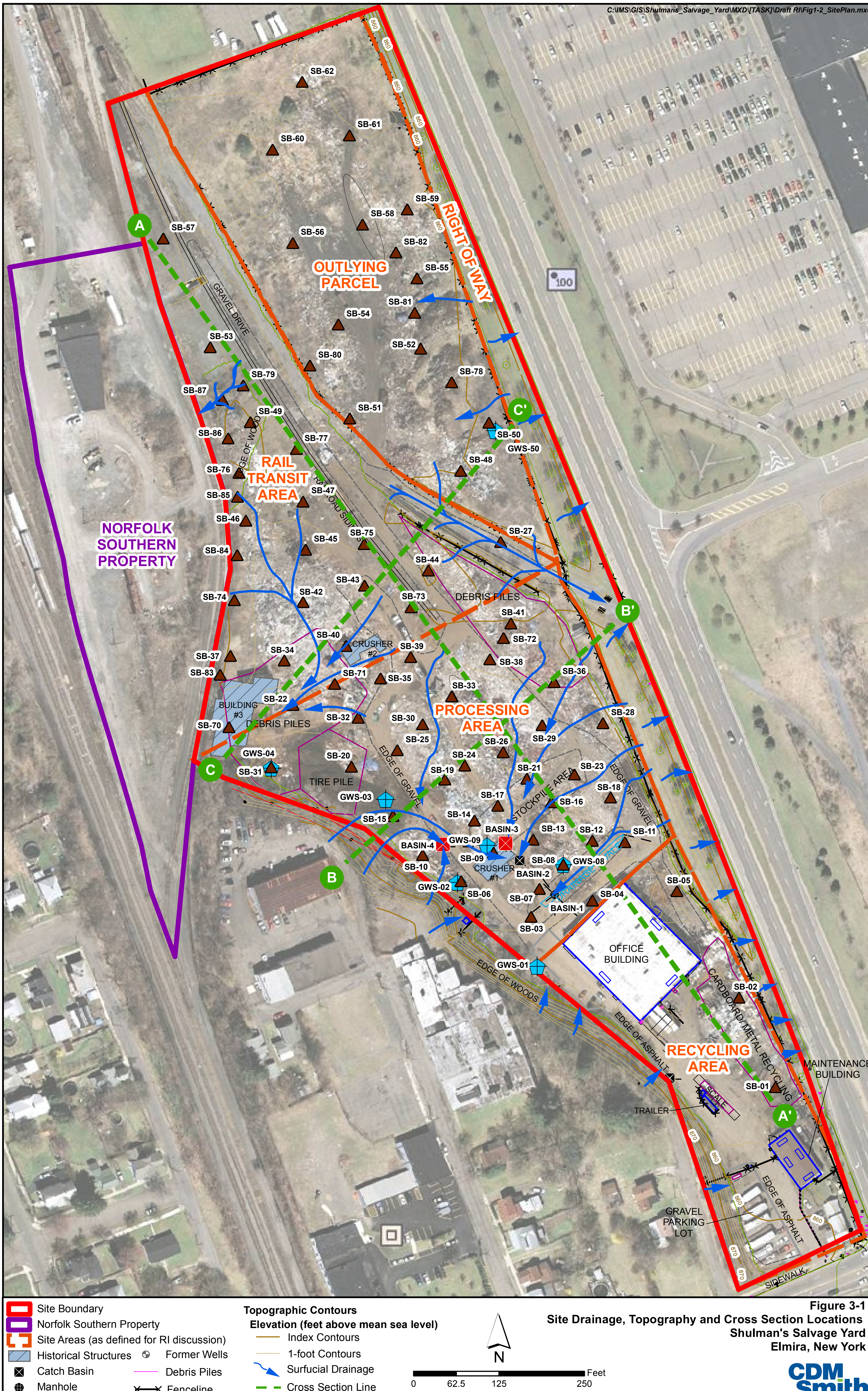


Figure 3-1
Site Drainage, Topography and Cross Section Locations
Shulman's Salvage Yard
Elmira, New York
CDM Smith

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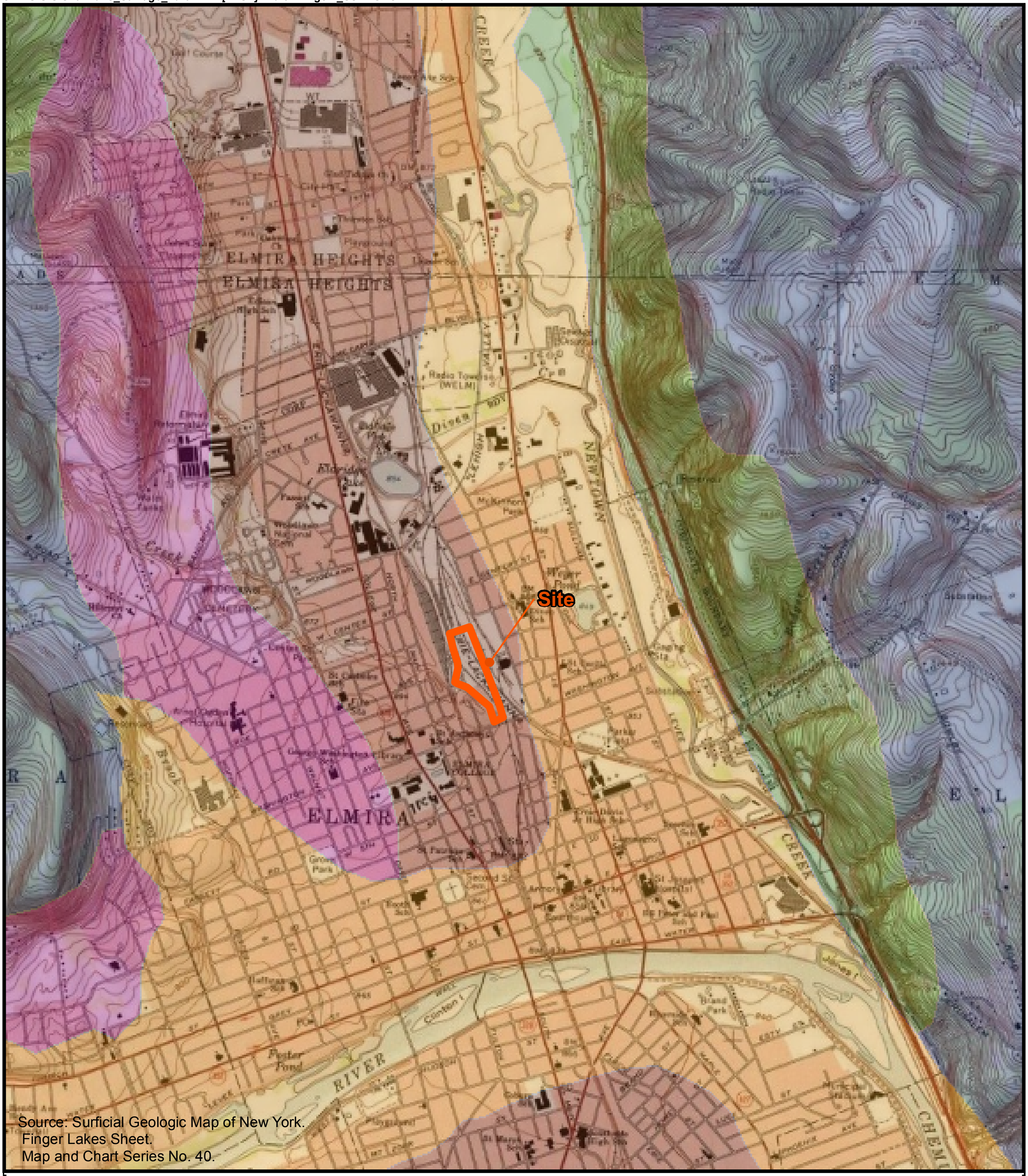


USGS Surficial Geology Units

- Alluvium
- Kame Deposits
- Glacial Outwash
- Exposed Bedrock
- Till

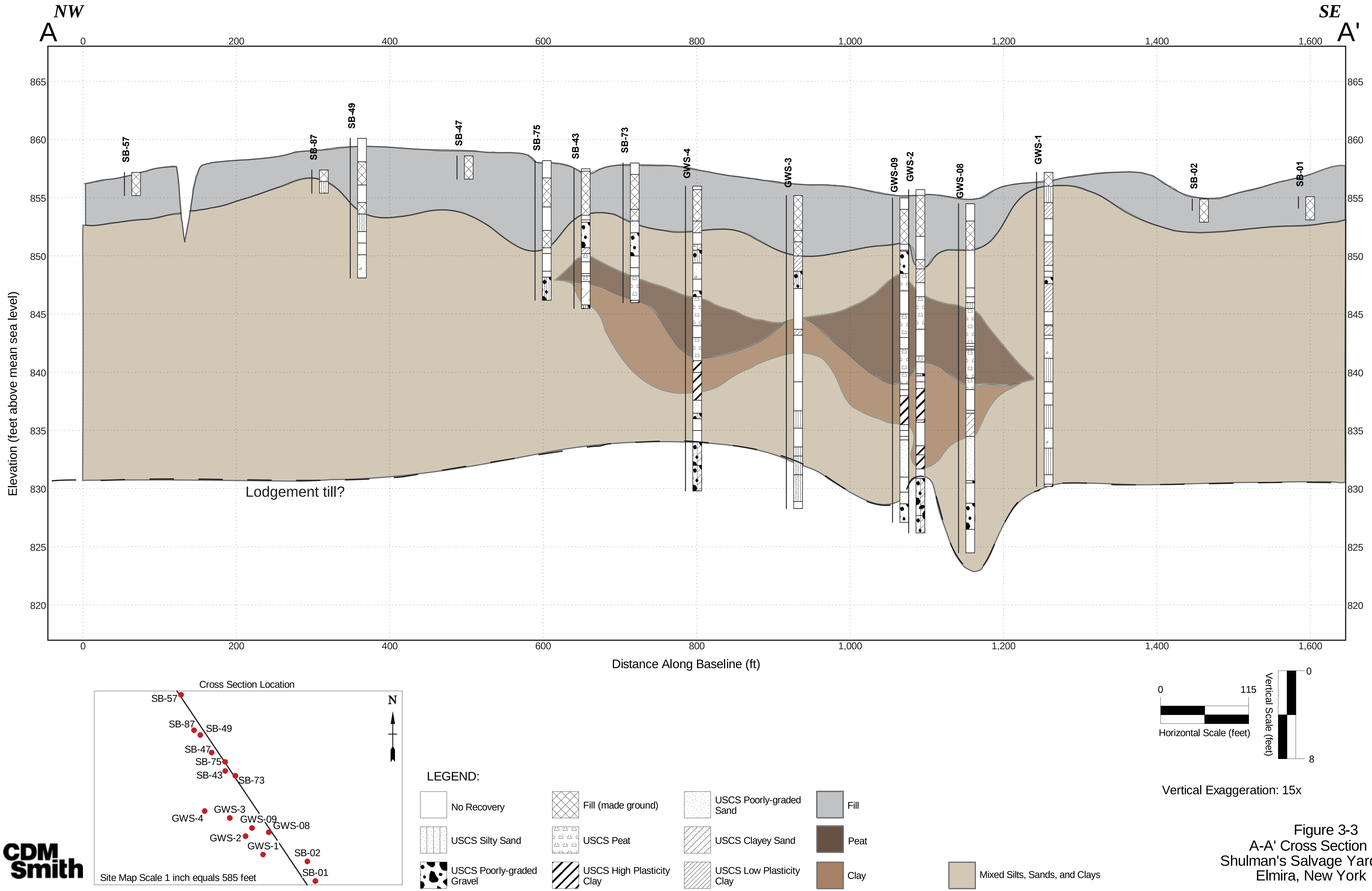
Site Boundary

N

0 0.25 0.5 1 Miles

Figure 3-2
Surficial Geology
Shulman's Salvage Yard
Elmira, New York

CDM Smith



CDM Smith

Figure 3-3
A-A' Cross Section
Shulman's Salvage Yard
Elmira, New York

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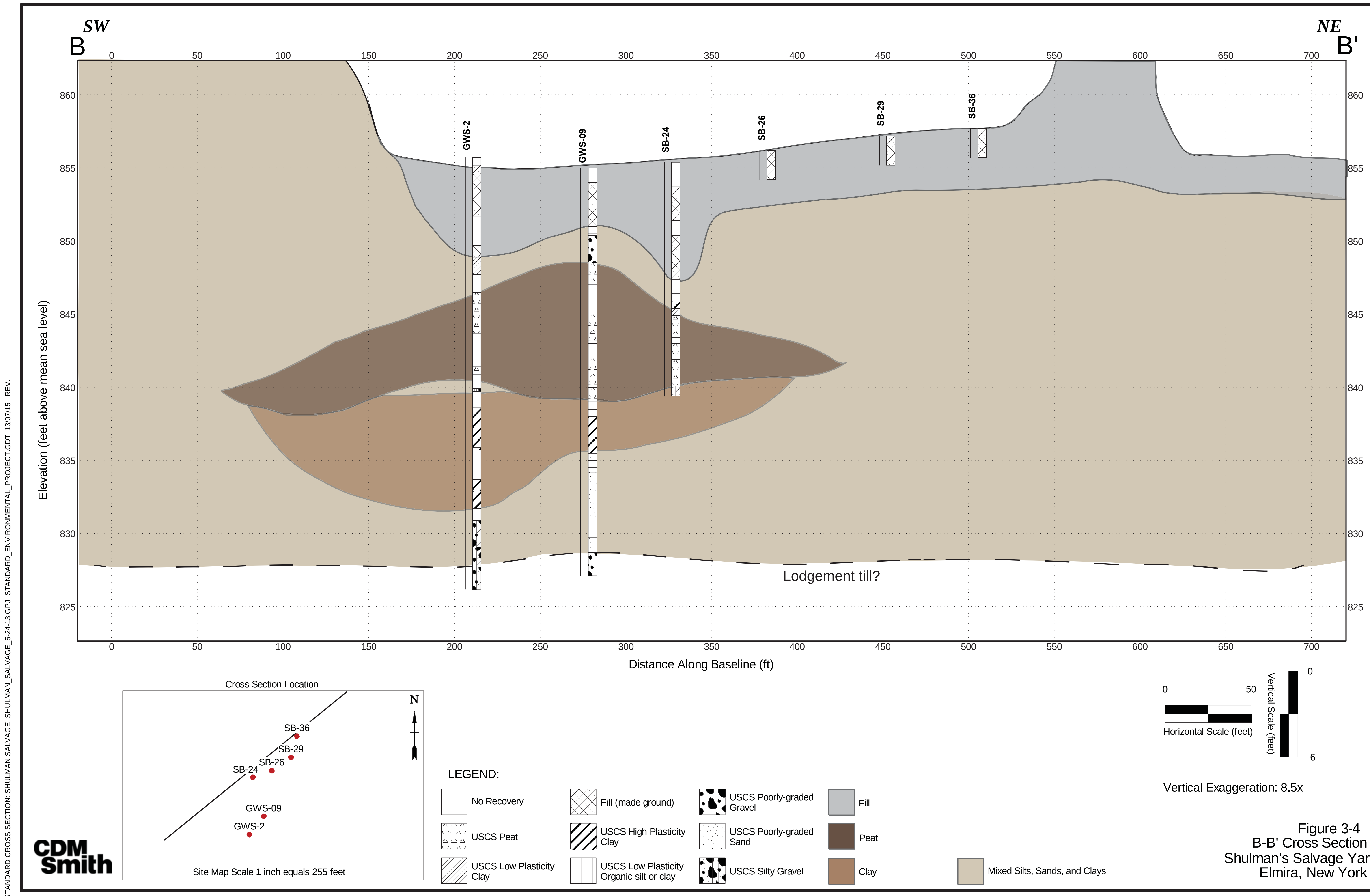


Figure 3-4
B-B' Cross Section
Shulman's Salvage Yard
Elmira, New York

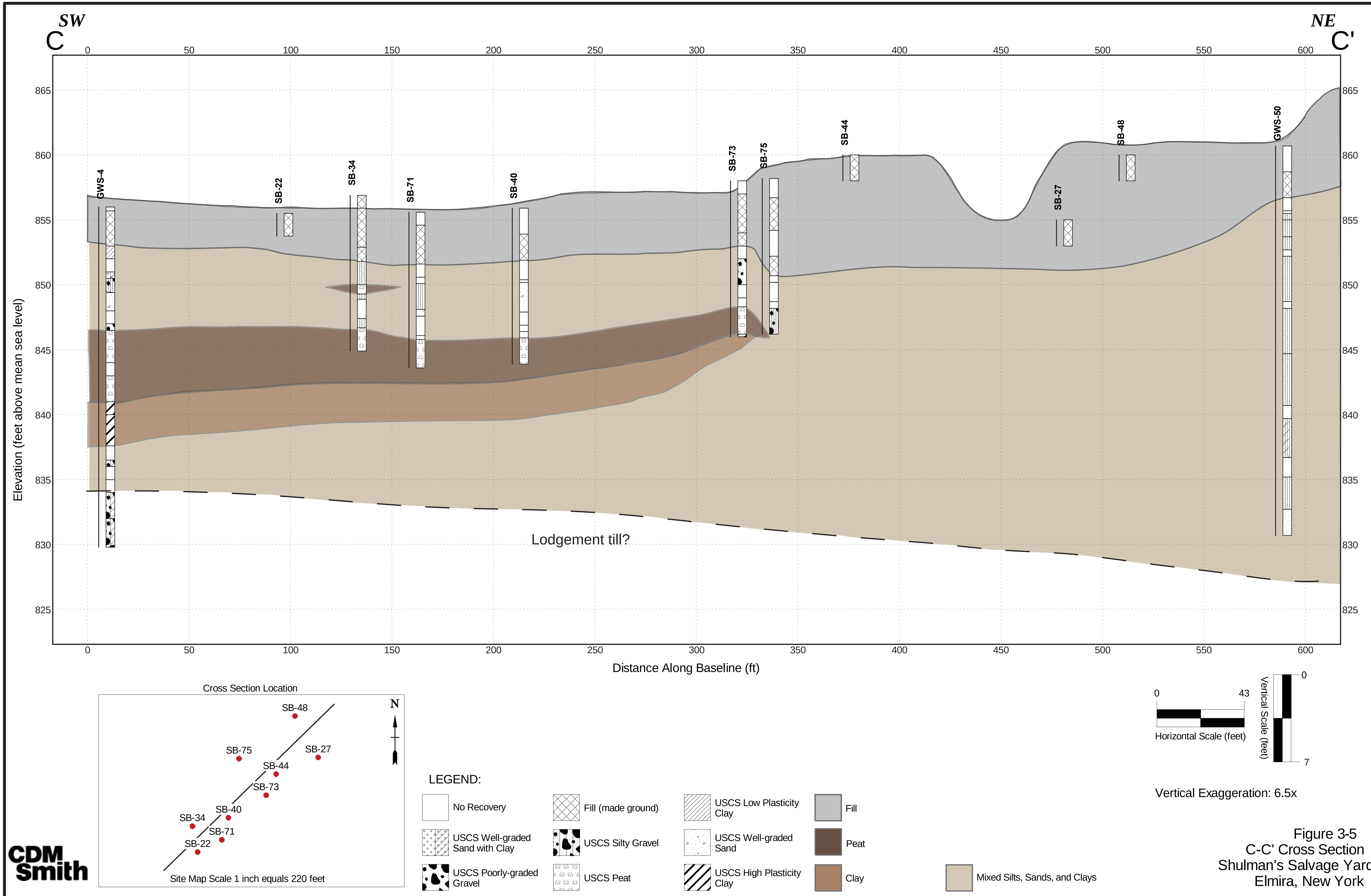
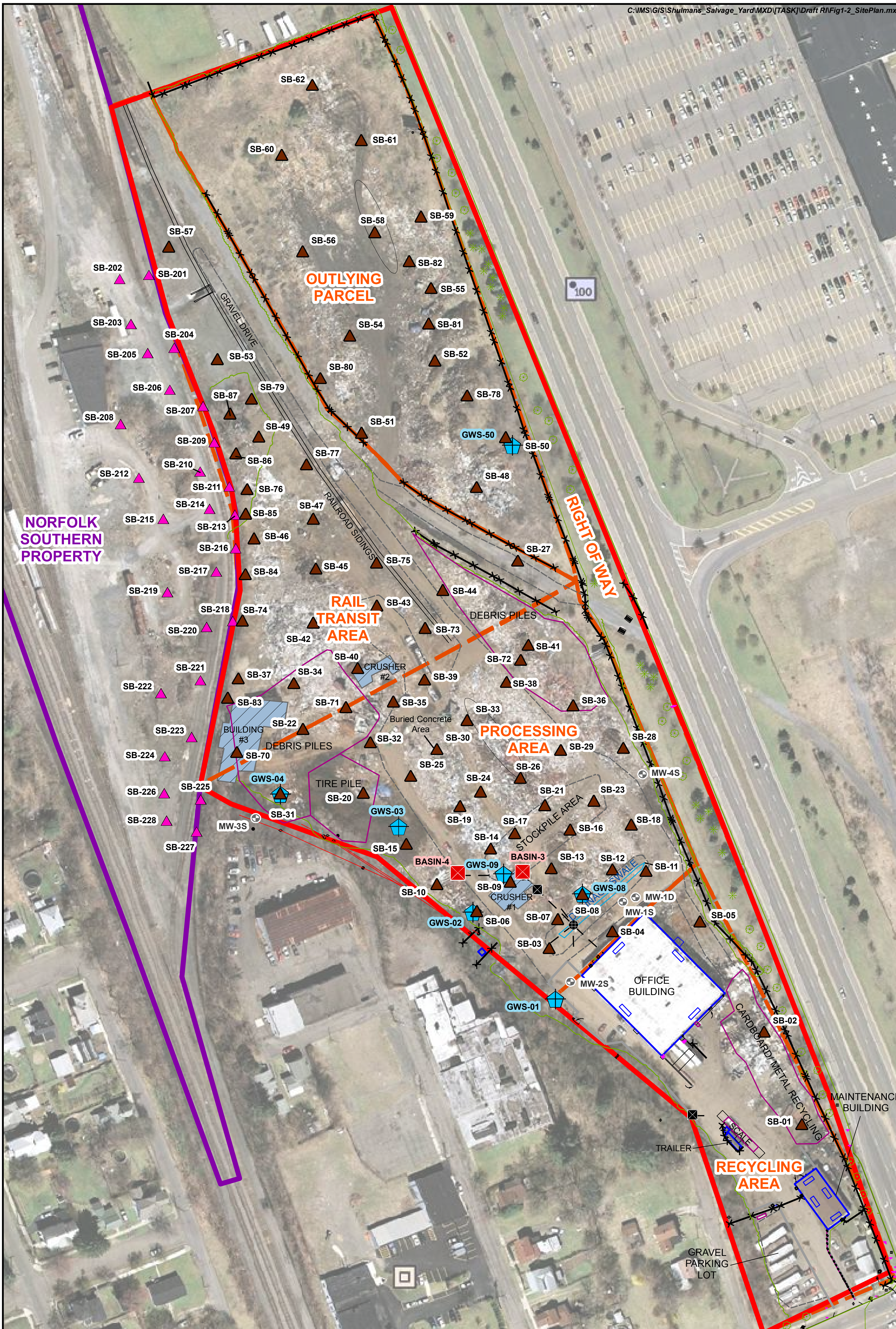


Figure 3-5
C-C' Cross Section
Shulman's Salvage Yard
Elmira, New York

STANDARD CROSS SECTION: SHULMAN SALVAGE SHULMAN_SALVAGE_5-24-13.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 13/07/15 REV.



Site Boundary
Norfolk Southern Property
Site Areas (as defined for RI discussion)
Historical Structures
Catch Basin
Manhole
Former Wells
Debris Piles
Fenceline

RI Sample Locations
Soil Boring
Groundwater Screening Soil Boring
Surface Water/ Sediment Location
Norfolk Southern Soil Boring

N
0 62.5 125 250 Feet

Figure 3-6
Sample Locations
Shulman's Salvage Yard
Elmira, New York

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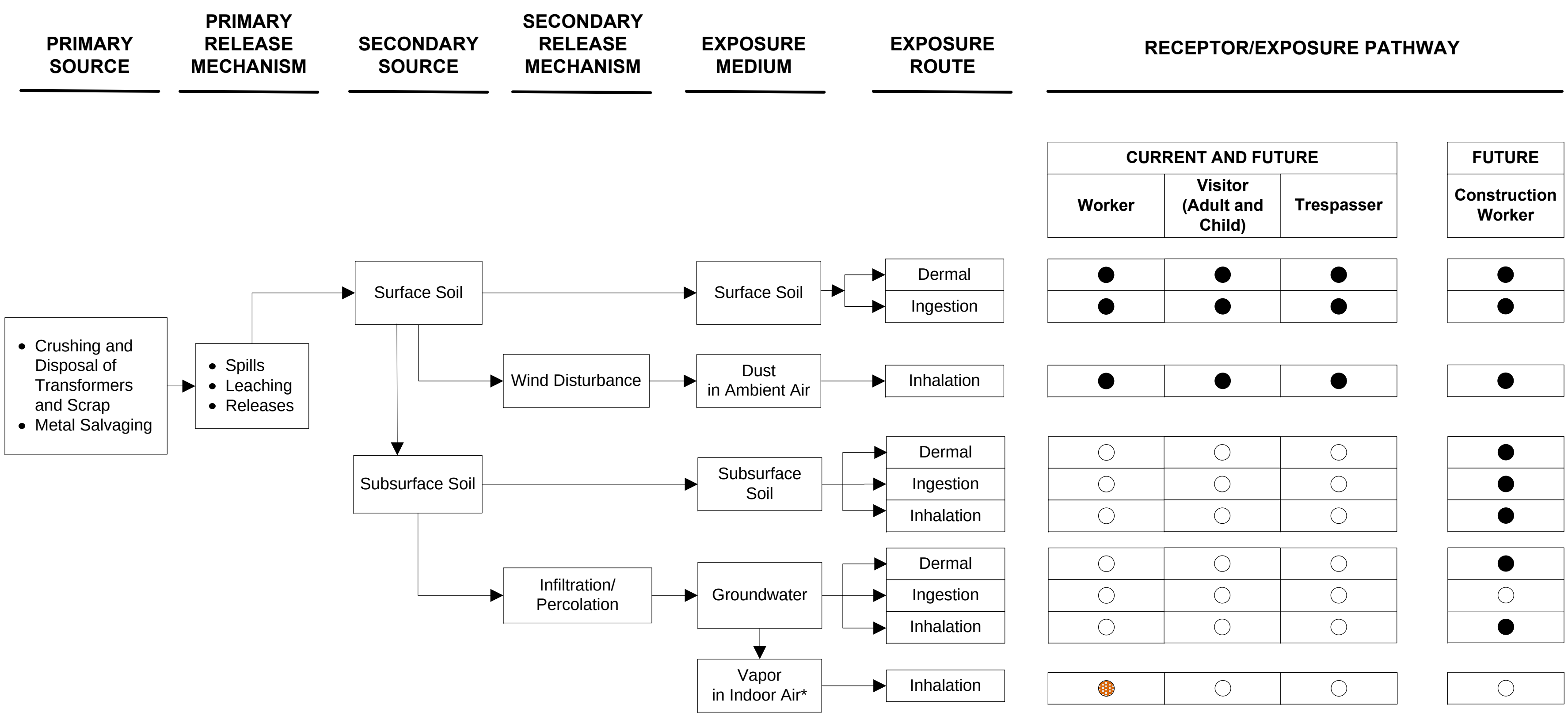

Legend:

- ● Complete exposure pathway
- ◍ Complete exposure pathway to be evaluated separately
- ○ Incomplete/Insignificant exposure pathway

* Volatile organic compounds in groundwater appear to originate from an offsite, upgradient source.
Vapor intrusion will be evaluated in a separate study.

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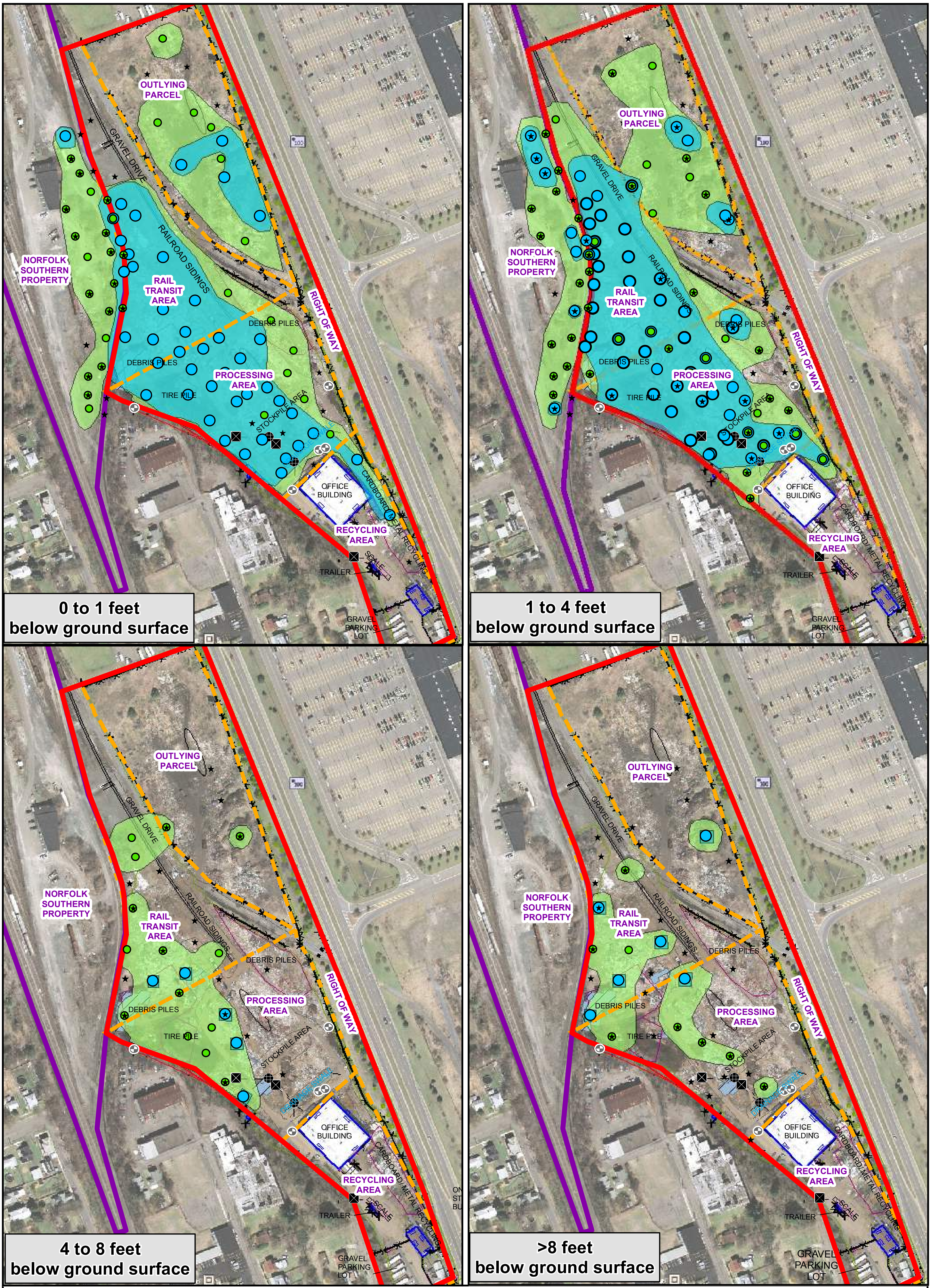
Figure 3-7
Conceptual Site Model
Shulman Salvage yard
Elmira, New York



Site Boundary
Norfolk Southern Property
Site Areas (as defined for RI discussion)
Former Structures
Former Wells
Catch Basin
Debris Piles
Manhole
Fenceline

Sample Results

- Samples below Unrestricted Use Standards
- Samples above Unrestricted Use Standards
- Samples above Commercial Standards

Remediation Areas

- Areas above Unrestricted Use Standards
- Areas above Commercial Standards

Notes:

1. The target remediation areas include site areas that are impacted by both PCBs and metals.
2. Areas that exceed unrestricted use standards would be addressed under presumptive remedy; other remedies would address areas that exceed commercial standards but would have to be combined with institutional control measures for areas that are below commercial standards but still exceed the unrestricted use standards.

N

0 125 250 500 Feet

Figure 4-1
Target Remediation Areas
Shulman's Salvage Yard
Elmira, New York

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Site Boundary	
Norfolk Southern Property	
Site Areas (as defined for RI discussion)	
Historical Structures	Former Wells
Catch Basin	Debris Piles
Manhole	Fenceline

N

0 125 250 500 Feet

Remediation Areas

Areas above Unrestricted Use Standards

Notes:

1. Alternative 2 is a presumptive remedy that would address all contaminated soils that exceed the unrestricted use standards.
2. This alternative consists of excavation and off-site disposal of all contaminated soils.
3. All excavated soils that meet the non-hazardous waste criteria would be disposed of at Subtitle D landfills.
4. All excavated soils that fail to meet the non-hazardous criteria would be deemed hazardous waste and disposed of at Subtitle C landfills.
5. All excavated areas would be backfilled with certified clean fill.

Figure 7-1
Conceptual Design for Alternative 2
Excavation and Off-Site Disposal
Shulman's Salvage Yard
Elmira, New York

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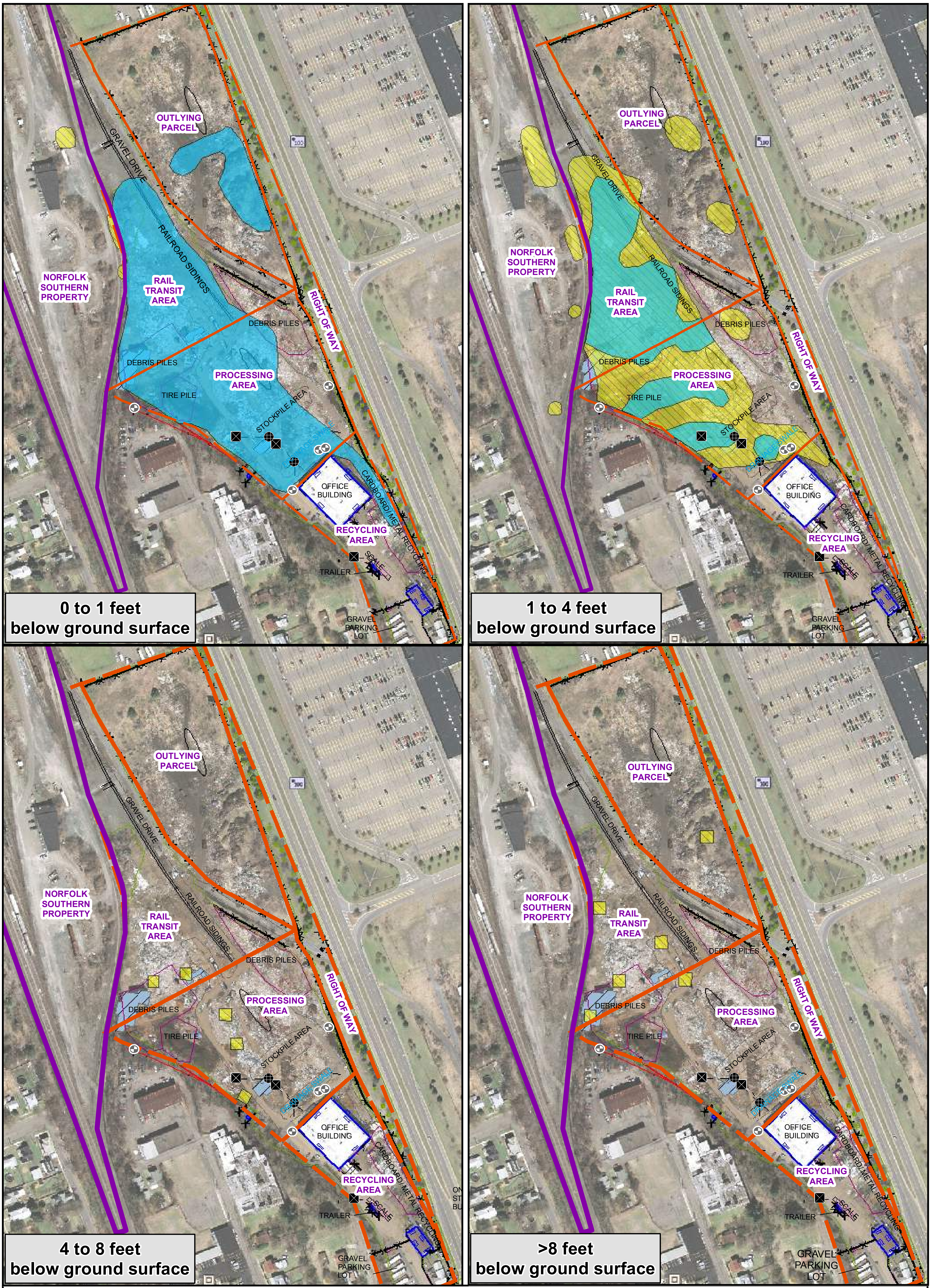

Site Boundary
Norfolk Southern Property
Site Areas (as defined for RI discussion)
Historical Structures
Catch Basin
Manhole
Former Wells
Debris Piles
Fenceline

N

0 125 250 500 Feet

Remediation Areas

PCB-Impacted Areas above Commercial Standards

Metals-Impacted Areas above Commercial Standards

Notes:

1. Alternative 3 would address all soils that exceed commercial standards; institutional controls would be implemented to maintain the zonal classification of the site property.
2. All PCB-impacted soils (shown in blue-colored areas) would be excavated and disposed of off-site.
3. All metals-impacted soils (shown in yellow-colored areas) outside of the PCB-impacted areas would be excavated, consolidated along with clean fill and backfilled in all area impacted by PCBs and metals.
4. Prior to consolidation, leachate testing would be performed to ensure that there are no risks to groundwater due to the metals-impacted soils that are consolidated on-site. If leachate testing indicates that on-site consolidation would pose risks to groundwater, then the metals-impacted soils would also be disposed of off-site.

Figure 7-2
Conceptual Design for Alternative 3
Excavation, Off-Site Disposal and On-Site Consolidation
Shulman's Salvage Yard
Elmira, New York

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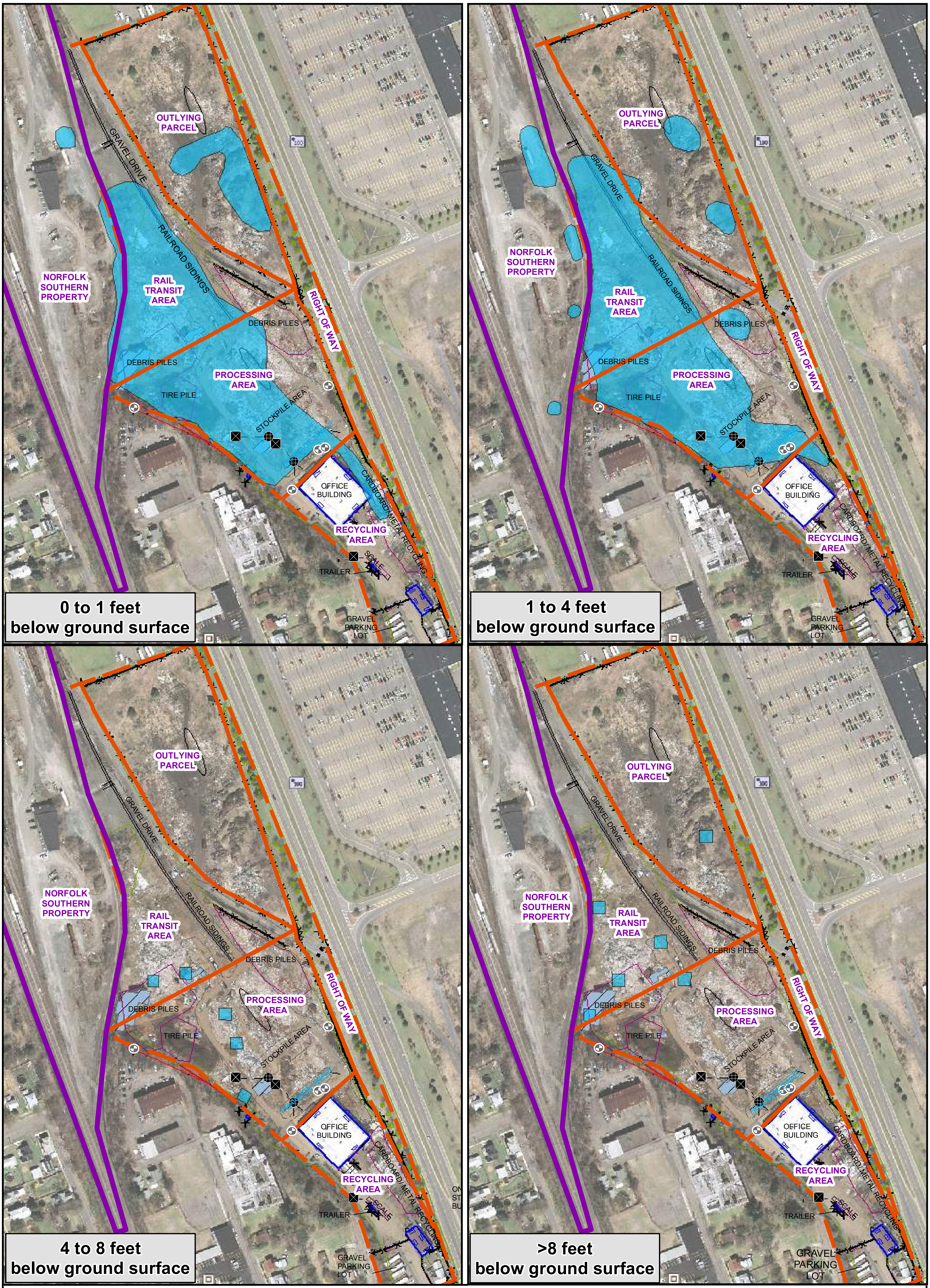

Site Boundary
Norfolk Southern Property
Site Areas (as defined for RI discussion)
Historical Structures
Former Wells
Catch Basin
Debris Piles
Manhole
Fenceline

N

0 125 250 500 Feet

Remediation Areas

Areas above Commercial Standards

Notes:

1. Alternative 4 would address all soils that exceed commercial standards; institutional controls would be implemented to maintain the zonal classification of the site property.
2. All soils impacted by PCBs and metals would be treated in-situ with appropriate mixture of stabilization/solidification (S/S) agents to prevent exposure within the site or migration of contamination off-site.
3. The appropriate mixture of agents would be determined based on bench-scale treatability studies that would be performed prior to the remedial design. A generic mixture of lime and Portland cement is assumed as the S/S agent for purposes of cost estimates.
4. Delivery of the S/S agent would be performed using a mixing device that precludes the need for excavation and stockpiling of impacted soils prior to mixing with the S/S agent.

Figure 7-3
Conceptual Design for Alternative 4
In-Situ Stabilization and Solidification
Shulman's Salvage Yard
Elmira, New York

CDM Smith

Table 4-1 Preliminary Remediation Goals
Shulman's Salvage Yard Feasibility Study
Elmira, NY

	Unrestricted Use SCOs	Restricted Use SCOs - Commercial
Metals		
Arsenic	13	16
Barium	350	400
Beryllium	7.2	590
Cadmium	2.5	9.3
Chromium, hexavalent	1	400
Chromium, trivalent	30	1500
Copper	50	270
Lead	63	1000
Manganese	1600	10000
Total Mercury	0.18	2.8
Nickel	30	310
Selenium	3.9	1500
Silver	2	1500
Zinc	109	10000
Poly Chlorinated Bipehnyls (PCBs)		
PCBs	0.1	Surface 1
		Subsurface 10

SCOs - Soil Cleanup Objectives
All SCO are in parts per million (ppm)

Table 6-1
Screening of Technologies
Feasibility Study
Shulman's Salvage Yard, Elmira, NY

General Response Action	Remedial Technology	Process Option	Description of Response Action	Effectiveness	Implementability	Relative Cost[a]	Retained?
No Action	None	No Action	No action would be implemented. The contaminated soils will remain at the Site and may act as source of groundwater contamination. The No Action alternative may include environmental monitoring to track contamination.	Ineffective. No Action alternative retained as baseline for comparison with other alternatives as required by NCP.	Implementable. No significant administrative difficulties anticipated.	No capital, operation, or maintenance costs. Would require some long- term costs for periodic reassessment.	Retained as a baseline per the NCP
Institutional/Engineering Controls	Land Use Controls	Government and/or Proprietary Controls	This process includes restriction of future site construction, well drilling activities and/or any other activities that will result in the potential exposure of receptors. These measures include deed restrictions for Site property.	May be effective from a human health standpoint through restriction of future site uses or activities which may result in direct contact with contamination. These activities, however, will not reduce the migration and the associated environmental impact of the contamination.	No significant difficulties are anticipated with land use controls at the Site but an enforcement mechanism for long-term implementation has to be in place.	Implementation cost is low. Some administrative cost may be required.	Retained only when contaminated materials remain on site.
	Groundwater Use Controls	Government and/or Proprietary Controls	Groundwater use restrictions would inhibit use of groundwater in the zone of contamination. Groundwater use at the Site is not expected.	These restrictions will prevent any potential future exposure of human receptors to contamination from groundwater use. Will not alter the extent or magnitude of contamination.	Implementation requires administrative measures by the township of Elmira similar to land use controls restrictions.	Implementation cost is low.	Retained only when contaminated materials remain on site.
	General Restrictions	Fencing and Signage	Fencing would limit access to contaminated areas and signs will be posted that the soils at the Site are contaminated.	Likely to significantly reduce exposure of human receptors to contamination. However, the effect of this measure on ecological receptors may be insignificant.	Implementable.	Low capital and O&M costs.	Retained
Monitoring	Sampling and Analysis	Long-Term Monitoring	Periodic environmental monitoring to determine extent or migration of contamination.	Long-term monitoring alone would not alter the effects of the contamination on human health and the environment. Monitoring is a proven and reliable process for tracking the migration of contaminants during and following treatment. It is also helpful in assessing the effectiveness of active remedial measures.	Easily implementable. A long-term commitment would be required to implement a long-term monitoring program.	Low capital costs. Medium operation and maintenance costs. Some long-term costs for periodic reassessment.	Retained only when contaminated materials remain on site.
	Site Inspection	Five-Year Site Review	Five-Year Reviews are generally required by CERCLA or program policy when hazardous substances remain on site above levels which permit unrestricted use and unlimited exposure.	Effective for long-term success.	Easily implementable.	Medium capital cost.	Retained
Monitored Natural Attenuation (MNA)	Monitored Natural Attenuation	Monitored Natural Attenuation	This process relies on on natural destructive (chemical/biological reactions) and nondestructive mechanisms (dilution, dispersion, volatilization, and adsorption) to reduce contaminant levels in the context of a long term monitoring program. This technology is typically not applicable for soils or inorganic contaminants.	Effectiveness of MNA depends highly on the ability to effectively remove source materials and the ability of contaminants to be degraded naturally. Unlikely to be effective since site contaminants (metals and PCBs) do not naturally degrade.	Easily implementable when effective. Multiple lines of evidence required to sufficiently demonstrate recovery.	Low capital costs. Medium O&M costs for long-term monitoring, and periodic reassessment costs.	Not retained
Containment	Barriers	Standard Capping	A standard concrete cap, asphalt cap or a cap made up of another low-permeability material will be installed over the contaminated soil and reduces risks to ecological receptors from potential exposures.	Likely to be effective if the cap can be maintained over the long term.	Easy to implement the installation but maintenance would be difficult due to damage from Site operations in a salvage yard.	Medium capital costs and low to medium O & M costs.	Not Retained.
Removal	Excavation	Excavation	Excavation technologies use standard earthwork equipment to excavate contaminated soil for consolidation, treatment, and/or disposal.	Highly effective.	Easily implementable. Necessary equipment and materials are readily available.	High capital costs. No O & M costs.	Retained
Treatment	Ex-Situ Chemical Treatment	Stabilization and/or Solidification (S/S)	The contaminated material is removed from its original location and added with appropriate treatment agents that stabilize and solidify the contaminated materials. The inert mixture is then either placed back at the original location, moved to another area of the Site or disposed of offsite.	Likely to be effective if appropriate S/S agent can be found. Bench-scale studies would have to be performed to determine the appropriate S/S agent.	Difficult to implement; greater difficulty if treated material has to be disposed off-site.	Medium to high capital costs and low to medium O&M costs.	Not retained
		Solvent Extraction	Solvent extraction processes use solvent sto treat contaminated solids similar to methods used by analytical laboratories to extract contaminants. They have to be performed under controlled temperature and pressure conditions.	Effective for PCBs but ineffective for metals.	Moderately difficult to implement and would require the services of specialized vendors.	Medium to high capital costs and no O&M costs.	Not retained.
		Chemical Dehalogenation	Use of chemical reagents and reduction processes to destroy or chemically alter the PCB congeners to a less toxic form.	Effective for PCBs but ineffective for metals.	Moderately difficult to implement and would require the services of specialized vendors.	Medium to high capital costs and no O&M costs.	Not retained.
	Ex-Situ Physical Treatment	Ex-Situ Thermal Treatment	Contaminated materials are removed from the surface or subsurface and treated thermally to destroy and/or volatilize the contaminants.	May or may not be effective for PCBs, would not be effective for metals.	Difficult to implement due to the logistics involved but can be performed by the appropriate vendor.	High capital costs, high O & M costs.	Not retained.
		Vitrification	This is a solidification process that uses heat of up to 2200 degrees Farenheit to melt and converts solid waste into glasslike crystalline products.	May or may not be effective for PCBs, would not be effective for metals.	Very difficult to implement and would involve large amount of energy requirements.	High capital costs, high O & M costs.	Not retained.

Table 6-1
Screening of Technologies
Feasibility Study
Shulman's Salvage Yard, Elmira, NY

General Response Action	Remedial Technology	Process Option	Description of Response Action	Effectiveness	Implementability	Relative Cost[a]	Retained?
Treatment	In-Situ Chemical Treatment	Stabilization and/or Solidification	This option is the similar in concept to ex-situ method described above but the mixing of stabilization reagents and solidifying agents are performed in-situ. Special tools for mixing may be required in order to accomplish in-situ mixing.	Likely to be effective if appropriate S/S agent can be found. Bench-scale studies would have to be performed to determine the appropriate S/S agent. Effectiveness also depends on the extent of mixing. This option must take into consideration the potential for zones.	Easier to implement than the ex-situ treatment since treatment depths are mostly shallow.	Medium to high capital costs and low O&M costs.	Retained
	In-Situ Physical Treatment	In-Situ Thermal Treatment	Contaminated materials treated in place thermally to destroy and/or volatilize the contaminants. The volatilized contaminants in the subsurface would be extracted through application of vacuum in the subsurface.	Unlikely to be effective for PCBs or metals.	Difficult to implement due to the logistics involved but can be performed by the appropriate vendor. It must also be noted that very few vendors are available to implement this technology.	High capital costs, high O & M costs.	Not retained.
Disposal	Off-Site Disposal	Off-Site Disposal of Hazardous Wastes	The contaminated soil, sediment and other wastes generated from the Site that are hazardous will be disposed of at an approved offsite facility such as a landfill.	Highly effective.	Medium degree of difficulty.	High capital costs and no O & M costs.	Retained
		Off-Site Disposal of Non-hazardous Wastes	Non-hazardous wastes from the Site will be disposed of at an approved offsite facility.	Highly effective.	Medium to high degree of difficulty.	Medium to high capital costs and no O & M costs.	Retained
	On-Site Disposal	On-Site Consolidation	Wastes with marginal exceedances are consolidated within the Site along with clean fill to meet PRGs.	This method is effective as long as acceptable risks can be demonstrated.	Easily implementable, helps avoid challenges associated with off-Site transportation.	Low capital and O & M costs,	Retained

Notes: (grey shading) denotes that this process option has been excluded from further evaluation in this FS.

Table 7-1
Summary of Volumes and Corresponding Remedial Actions
Shulman's Salvage Yard Feasibility Study
Elmira, New York

	Alternative 2 - Excavation and Off-Site Disposal		Alternative 3 - Excavation, Off-Site Disposal and On-Site Consolidation				Alternative 4 - In-Situ Stabilization and Solidification			
	On-Site Contamination	Off-Site Contamination	On-Site Contamination		Off-Site Contamination		On-Site Contamination		Off-Site Contamination	
	PCBs and Metals Impacted Soils		Soils Impacted by PCBs	Soils Impacted by Metals Only	Soils Impacted by PCBs	Soils Impacted by Metals Only	Soils Impacted by PCBs	Soils Impacted by Metals Only	Soils Impacted by PCBs	Soils Impacted by Metals Only
Off-Site Disposal Volume (CY)*	118,300	12,800	25,300		100	0	0	0	0	0
On-Site Consolidation Volume (CY)*	0	0	0	16,800	0	1,900	0	0	0	0
In-Situ Stabilization & Solidification Volume (CY)*	0	0	0	0	0	0	25,300	16,800	100	1,900
Institutional Controls Volume (CY)*	0	0	76,200		10,800		76,200		10,800	
Total Volume (CY) *	118,300	12,800	118,300		12,800		118,300		12,800	

Notes:
CY - Cubic Yards
Alternative 1 - No Action is not shown in the above table
Alternative 2 would address all soils that exceed unrestricted use soil cleanup objectives (SCOs).
Disposal, Consolidation and In-Situ Stabilization and Solidification actions under Alternatives 3 and 4 would address only soils that exceed commercial standards. These actions would be combined with institutional control measures to maintain commercial classification for the Site to address soils that are below the commercial standards but exceed unrestricted use SCOs.
* - All volumes are rounded to the nearest hundred CY

Table 7-2
Cost Estimate for Alternative 2 - Excavation and Off-Site Disposal
Shulman's Salvage Yard Feasibility Study
Elmira, New York

Item No.	Item Description	Extended Cost
CAPITAL COSTS		
1.	Pre-design Investigation	$ 54,200
2.	Remedial Design	$ 100,000
3.	General Conditions	$ 735,000
4.	Excavation	$ 656,000
5.	Transportation and Disposal	$ 16,240,000
6.	Backfilling	$ 3,059,000
	TOTAL CAPITAL COSTS	**$ 20,844,200**
	Contingency (15%)	**$ 3,126,700**
OPERATION AND MAINTENANCE COSTS (O & M)		
7.	Monitoring and Maintenance Costs	$ -
	TOTAL PRESENT WORTH COSTS FOR ALTERNATIVE 2	**$ 23,971,000**

Notes:

1.Above costs are feasibility study level (conceptual) costs, actual cost may vary from -30% to +50% of estimate.

2. Alternative 2 includes excavation and off-Site disposal of all contaminated soils that exceed unrestricted use soil cleanup objectives (SCOs)

3. For purposes of cost estimation, it is assumed that 5% of excavated soils would fail Toxic Substances Control Act (TSCA) disposal requirements, additional 5% of excavated soils would fail Resource Conservation and Recovery Act (RCRA) disposal requirements and additional 1% of excavated soils would fail both TSCA and RCRA disposal requirements.

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Table 7-3
Cost Estimate for Alternative 3 - Excavation, Off-Site Disposal and On-Site Consolidation
Shulman's Salvage Yard Feasibility Study
Elmira, New York

Item No.	Item Description	Extended Cost
CAPITAL COSTS		
1.	Pre-design Investigation	$ 66,200
2.	Remedial Design	$ 128,000
3.	General Conditions	$ 450,000
4.	Excavation	$ 319,000
5.	Transportation and Disposal	$ 3,239,000
6.	Backfilling and Consolidation	$ 850,000
	TOTAL CAPITAL COSTS	**$ 5,053,000**
	Contingency (20%)	**$ 1,264,000**
OPERATION AND MAINTENANCE COSTS (O & M)		
7.	Institutional Control and Monitoring Costs	**$ 73,000**
	TOTAL PRESENT WORTH COSTS FOR ALTERNATIVE 3	**$ 6,390,000**

Notes:

1.Above costs are feasibility study level (conceptual) costs, actual cost may vary from -30% to +50% of estimate.

2. Alternative 3 includes excavation and off-Site disposal of all contaminated soils that exceed commercial standards for PCBs and on-Site consolidation of soils in the remaining areas impacted with low level metals exceedances of commercial standards. These low-level impacted soils are consolidated along with clean fill within the PCB and metals impacted areas shown in Figure 7-2.

3. For purposes of cost estimation, it is assumed that 5% of PCB-impacted soils would fail Toxic Substances Control Act (TSCA) disposal requirements, additional 5% of PCB-impacted soils would fail Resource Conservation and Recovery Act (RCRA) disposal requirements and additional 1% of PCB-impacted soils would fail both TSCA and RCRA disposal requirements.

4. For areas that are below commercial standards but exceed the unrestricted use soil cleanup objectives (SCOs), institutional controls would be implemented to maintain the current Site classification.

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Table 7-4
Cost Estimate for Alternative 4 - In-Situ Stabilization and Solidification
Shulman's Salvage Yard Feasibility Study
Elmira, New York

Item No.	Item Description	Extended Cost
CAPITAL COSTS		
1.	Pre-design Investigation and Treatability Study	$ 115,200
2.	Remedial Design	$ 156,000
3.	General Conditions	$ 522,000
4.	In-Situ Stabilization and Solidification (S/S)	
	Material Costs for lime and portland cement mixing during S/S	$ 3,616,350
	Labor/Equipment Costs for lime and portland cement mixing during S/S	$ 642,600
	Other Costs for S/S	$ 798,050
	Total Costs for In-Situ S/S	$ 5,057,000
	TOTAL CAPITAL COSTS	**$ 5,850,200**
	Contingency (20%)	**$ 1,171,000**
OPERATION AND MAINTENANCE COSTS (O & M)		
5.	Institutional Control and Monitoring Costs	**$ 73,000**
	TOTAL PRESENT WORTH COSTS FOR ALTERNATIVE 3	**$ 7,095,000**

Notes:
1.Above costs are feasibility study level (conceptual) costs, actual cost may vary from -30% to +50% of estimate.
2. Alternative 4 includes in-situ stabilization and solidification (S/S) of contaminated soils exceeding commercial standards for PCBs and metals
3. For purposes of cost estimation, it is assumed that 5% by weight of lime and 20% by weight of portland cement would be added to contaminated soils for in-situ S/S; actual treatment agents would be determined thorugh bench-scale studies.
4. For areas that are below commercial standards but exceed the unrestricted use soil cleanup objectives (SCOs), institutional controls would be implemented to maintain the current Site classification.

Table 7-5 Comparative Analysis of Alternatives
Shulman's Salvage Yard Feasibility Study
Elmira New York

EVALUATION CRITERION	ALTERNATIVE 1 No Action	ALTERNATIVE 2 Excavation and Off-Site Disposal (Presumptive Remedy)	ALTERNATIVE 3 Excavation, Off-Site Disposal of PCB Impacts and On-Site Consolidation of Metals Impacts	ALTERNATIVE 4 In-Situ Stabilization and Solidification (S/S)
Overall Protection of Human Health and the Environment	No action taken to protect human health or environment from site contamination. Does not meet criteria.	High protectiveness since all impacted soils that exceed unrestricted use SCOs are removed from the Site and disposed off-Site to prevent exposures. Criteria Rating - High	High protectiveness, assuming that the groundwater impacts due to leachability of soils consolidated on-Site do not expose receptors to unacceptable levels. Some risks of exposures to soils that are below commercial standards but exceed unrestricted use SCOs. Criteria Rating - Medium to High if leachability is acceptable	Reasonably high protectiveness assuming that an appropriate S/S agent is determined. Some risks of exposures to soils that are below commercial standards but exceed unrestricted use SCOs. Criteria Rating - Medium to High
Compliance with New York State Standards, Criteria, and Guidance (SCGs)	No action taken to meet SCGs, does not meet criteria.	Complies with the most stringent SCGs through removal of all impacted soils from the Site. Criteria Rating - High.	Complies with SCGs for PCBs since PCB-impacted soils above commercial standards are excavated. Expected to comply with SCGs for metals impacted soils after mixing with clean backfill. Impacts to groundwater from the soils consolidated on-Site needs to be assessed via leachability studies. Criteria Rating - Medium to High, assuming no risks of impacts to groundwater.	Compliance with SCGs by reducing the leachability and mobility of the contaminants in the soils treated by S/S. May not comply with the SCGs in the traditional sense (i.e concentrations) but meets RAOs through specific performance metrics such as leachability, permeability and unconfined compressive strength (UCS). Criteria Rating - Medium to High, assuming an appropriate S/S agent could be determined through bench-scale studies.
Long-term Effectiveness and Permanence	No action taken to effectively address site contamination. Does not meet criteria.	Highly effective in the long-term as contaminants are removed permanently from the Site. Criteria Rating - High.	Highly effective in the long-term for PCBs; reasonably effective for metals, assuming there are no risks due to groundwater impacts because of the consolidated soils remaining on-Site. Criteria Rating - Medium to High, depending on leachability of soils consolidated on-Site.	Highly effective in the long-term for metals as there are proven S/S agents that can detoxify metals. Reasonably effective for PCBs, assuming a suitable S/S agent can be determined. Criteria Rating - Medium to High, assuming an appropriate S/S agent can be determined through bench-scale studies.
Reduction of Toxicity/ Mobility/Volume (T/M/V) Through Treatment	No action taken to reduce T/M/V through treatment. Does not meet criteria.	No reduction of T/M/V overall since the materials are simply moved from the Site to an off-site location (such as a landfill). However, the on-Site T/M/V is reduced. If the soils are deemed to be hazardous, then the disposal facility may treat the soils to reduce toxicity and volume. Mobility would be reduced once the disposal to off-site location is completed. Criteria Rating - Not Applicable.	No reduction of T/M/V overall since the materials are simply moved from the Site to an off-site location (such as a landfill) or consolidated on-Site. If the disposed PCB-impacted soils are deemed to be hazardous, then the disposal facility may treat the soils to reduce toxicity and volume. Mobility would be reduced for the soils that are disposed off-Site. Criteria Rating - Medium to High depending on the leachability of the soils consolidated on-Site.	S/S process reduces the mobility of contamination for both PCBs and metals by reducing the leachability and by encapsulating the materials. For metals, the toxicity and volume may also be reduced due to treatment agents but the toxicity due to PCBs remain s the same since PCBs do not generally react with treatment agents. Criteria Rating - Medium to High.
Short-term Effectiveness	No short-term impacts since no action is taken. Criteria Rating - High.	Short-term impacts would be significant as all impacted soils would be excavated and stockpiled prior to disposal. However, these impacts can be mitigated by following appropriate health and safety protocols to prevent short-term exposures. Criteria rating - Medium	Short-term impacts would be significant as all impacted soils would be excavated and stockpiled prior to disposal or consolidation. However, these impacts can be mitigated by following appropriate health and safety protocols to prevent short-term exposures. Criteria rating - Medium to High	Short-term impacts due to exposures to impacted soils would be much lower compared to alternatives that include excavation. However, the impact due to disruption of on-Site activities would be as significant as under alternatives involving excavation. Criteria rating - Medium to High

Table 7-5 Comparative Analysis of Alternatives
Shulman's Salvage Yard Feasibility Study
Elmira New York

EVALUATION CRITERION	ALTERNATIVE 1 No Action	ALTERNATIVE 2 Excavation and Off-Site Disposal (Presumptive Remedy)	ALTERNATIVE 3 Excavation, Off-Site Disposal of PCB Impacts and On-Site Consolidation of Metals Impacts	ALTERNATIVE 4 In-Situ Stabilization and Solidification (S/S)
Implementability	No action is implementable. Criteria Rating - High.	The remedial components under this alternative are easily implmentable. Criteria Rating - High	All the remedial components under this alternative are easily implementable. Criteria Rating - High.	The remedial components under this alternative are implementable. The ease of implementability depends on the nature of the soil at the Site and the ability to mix the soil with treatment agents. Specialized equipment and careful oversight is needed to ensure effective implementation. Criteria Rating - Medium to High.
Cost-Effectiveness	Total present worth cost is $0 Criteria Rating - High	Total present worth cost is about $23.97 million. Criteria Rating - Low	Total present worth cost is about $6.39 million. Criteria Rating - Medium to High	Total present worth cost is about $7.09 million Criteria Rating - Medium to High.
Community Acceptance	Not deemed as acceptable by the community. Criteria Rating - Low.	All the remedial components under this alternative are expected to be deemed acceptable by the community. Criteria Rating - High	All the remedial components under this alternative are expected to be deemed acceptable by the community. However, this is under the assumption that the impacted soils consolidated on-site do not pose unacceptable risks to receptors. Criteria Rating - High	All the remedial components under this alternative are expected to be deemed acceptable by the community. However, this is under the assumption that appropriate S/S agents could be determined based on bench-scale studies. Criteria Rating - High

Appendices

Appendix A

Detailed Volume Calculations

Appendix A - Detailed Volume Calculations
Shulman's Salvage Yard Feasibility Study
Elmira, New York

Volume Calculations - Commercial Standards

		PCBs		
	Surface Area (SF)	**Depth Interval**	**Vertical thickness (feet)**	**Volume (CY)**
On-Site	291300	0-1 ft bgs	1	10800
Off-Site	750	0-1 ft bgs	1	100
On-Site	130000	1-4 ft bgs	3	14500
Off-Site	0	1-4 ft bgs	3	0
On-Site	0	4-8 ft bgs	4	0
Off-Site	0	4-8 ft bgs	4	0
On-Site	0	8-12 ft bgs	4	0
Off-Site	0	8-12 ft bgs	4	0

	Metals			
Surface Area (SF)	**Depth Interval**	**Vertical thickness (feet)**	**Volume (CY)**	
0	0-1 ft bgs	1	0	
2750	0-1 ft bgs	1	200	
267000	1-4 ft bgs	3	15300	(Metals only, outside
15200	1-4 ft bgs	3	1700	of PCB areas)
4500	4-8 ft bgs	4	700	
0	4-8 ft bgs	4	0	
5400	8-12 ft bgs	4	800	
0	8-12 ft bgs	4	0	

Total - On-Site PCBs	25300	CY
Total - Off-Site PCBs	100	CY
Total - PCBs	**25400**	**CY**

Total - On-Site Metals	16800	CY
Total - Off-Site Metals	1900	CY
Total - Metals	**18700**	**CY**

Total soil volume exceeding commercial standards for PCBs and metals **44100 CY**

ft bgs - feet below ground surface
SF - square feet
CY - cubic yards

Appendix A - Detailed Volume Calculations
Shulman's Salvage Yard Feasibility Study
Elmira, New York

Volume Calculations - Unrestricted Use Standards

		PCBs and metals		
	Surface Area (SF)	**Depth Interval**	**Vertical thickness (feet)**	**Volume (CY)**
On-Site	415,000	0-1 ft bgs	1	15400
Off-Site	87,000	0-1 ft bgs	1	3300
On-Site	452,000	1-4 ft bgs	3	50300
Off-Site	85,000	1-4 ft bgs	3	9500
On-Site	146,300	4-8 ft bgs	4	21700
Off-Site	0	4-8 ft bgs	4	0
On-Site	104,100	8-16 ft bgs	8	30900
Off-Site	0	8-16 ft bgs	8	0

Total - On-Site	118300	CY
Total - Off-Site	12800	CY
Total	**131100**	**CY**

ft bgs - feet below ground surface
SF - square feet
CY - cubic yards

Appendix B

Detailed Cost Estimate for Alternative 2 – Excavation and Off-Site Disposal

CDM Smith	PROJECT:	Shulman	COMPUTED BY :	GR	CHECKED BY:	
	JOB NO.:	94421	DATE :	10/9/2014	DATE CHECKED:	
	CLIENT:	NYSDEC			PAGE NO. :	1

Description: Cost Estimate for Alternative 2 Excavation and Off-Site Disposal - Individual Cost Item Backup

Pre-Design Investigation (PDI)

To delineate the extent of contamination and to finalize the remediation areas and assess background concentrations. Assume ~15 soil boring locations sampled at three different depths over 5 days.

PDI Workplan	1	LS	$10,000		$10,000
Field oversight - Staff geologist	60	hr	$100		$6,000
Field supplies, equipment rental, per diem etc.	5	day	$250		$1,250
Driller labor and equipment (including geophysical)	5	day	$2,000		$10,000
PDI Summary Report	1	LS	$10,000		$10,000
Sample shipping	5	day	$200		$1,000
Laboratory Analytical	53	samples	$300		$15,900
(assume 3 samples per location + 3 duplicates + 5 blanks analyzed for PCBs and metals)					
TOTAL PRE-DESIGN INVESTIGATION COSTS:					**$54,200**

Remedial Design

To include the analysis of investigation results and existing data, preparation of the remedial design including draft, pre-final, and final design packages consisting of specifications, drawings, design analysis report, and construction cost estimate.

Prices are estimated based on CDM Smith's experience on similar project.

Meetings	8	hr	$245		$1,960
Remedial Design Report - Draft					
Engineer	200	hr	$100		$20,000
Project Manager	40	hr	$150		$6,000
Drafter	100	hr	$75		$7,500
Admin/miscellaneous	1	LS	$1,000		$1,000
Remedial Design Report - Final					
Engineer	80	hr	$100		$8,000
Project Manager	20	hr	$150		$3,000
Drafter	20	hr	$75		$1,500
Admin/miscellaneous	1	LS	$1,000		$1,000
Prepare bid specification packages, cost estimates, procurement etc.	1	LS	$50,000	=	$50,000
TOTAL PRE-DESIGN INVESTIGATION AND REMEDIAL DESIGN COSTS:					**$100,000**

CDM Smith	PROJECT: Shulman	COMPUTED BY: GR	CHECKED BY:
	JOB NO.: 94421	DATE: 10/9/2014	DATE CHECKED:
	CLIENT: NYSDEC		

Description: Cost Estimate for Alternative 2 Excavation and Off-Site Disposal - Individual Cost Item Backup

General Conditions

General conditions to include the project-dedicated site supervisory staff, development of work plans, site photographs/videos, project signs, insurance, mobilization/demobilization, and costs not covered elsewhere.

Estimate assumes that following the remedial design, the RA Contractor will mobilize to the site and complete the remedial action including the site preparation, excavation/removal, off-site transportation and disposal, backfill and compaction, final grading, and site restoration prior to project end.

Project Schedule

Assume the following project schedule:

Field Trailer Compound Establishment	1	week
Site Preparation (Decon areas, stockpile areas, clearing)	2	weeks
Remedial Excavation and T&D	24	weeks
Backfill and Compaction (lagging period)	4	weeks
Final Site Restoration and Demob	2	weeks
Total Construction Duration	33	weeks
Project Closeout	4	weeks
Total Project Duration	**37**	**weeks**

General Condition Costs

Engineering Support during Construction

Project Manager	$150	hr	148	$22,200
Project Engineer	$100	hr	296	$29,600
Total for engineering support	**$51,800**			

A) Site Supervisory Staff

Assume the following Site Supervisory Staff for duration of construction (see labor/equipment backup page for rates):

Site Superintendent	$120	per hour	
Construction Foreman	$120	per hour	
Environmental Technician (QC)	$85	per hour	
Pickup Truck #1	$13	per hour	
Pickup Truck #2	$13	per hour	
per diem for superintendent and foreman	$300	per day	
	$388.50	per hour	
	$15,540	per week	
Total Site Supervisory Staff for Construction Duration			**$513,000**

B) Survey, Permit, Workplan updates, Progress Reports etc.

Total Work Plan and Progress Report Preparation Cost:	**$100,000**

C) Mobilization/Demobilization Fees

Assume 10 large pieces of equipment to be used throughout remedial action.

Total Mobilization/Demobilization Cost (assumed allowance):	**$20,000**

D) Project Insurance

Per RS MEANS 01-31-13.30-0020 Builder's Risk Insurance, 0.24% of job cost. Allow $50,000 based on project size.

Estimated Project Insurance Cost:	**$50,000**

TOTAL GENERAL CONDITION COST: **$735,000**

PROJECT: Shulman	COMPUTED BY: GR	CHECKED BY:	
JOB NO.: 94421	DATE: 10/9/2014	DATE CHECKED:	
CLIENT: NYSDEC			

Description: Cost Estimate for Alternative 2 Excavation and Off-Site Disposal - Individual Cost Item Backup

Excavation of Contaminated Soil Materials

Total Excavation/Removal Volume (Table 7-1)

Soil Excavation Volume 131,100 CY

Soil Excavation Duration

Assume 140 CY/hour for excavation of soil based on RS Means Costworks 31.23.16.46.5540 , excavation of common earth in bulk using a 460 HP dozer with a daily output of 1,120 CY assuming average haul of 150'.

Total Excavation, segregation, treatment Period, workdays	118	DAYS
Total Excavation Period, work hours (8 hours per day)	944	HOURS
Total Excavation Period, work weeks	24	WEEKS
Total Excavation Period, months	6	MONTHS

*Assume treatment and backfill is concurrent with excavation (by separate crew), but lags behind by one month

Site clearing at the yard including railroad (allowance)				$90,000
Excavation costs per RS Means (incl. labor and equipment)	131,100	CY	$3.2	$419,600
Limited hauling within Site (25% internal haul)	32,775	CY	$2.9	$95,100
Soil erosion controls (allowance)	1	LS	$25,000	$25,000
Decontamination pad	1	LS	$10,000	$10,000
Post-excavation samples				
Sample shipping costs (assume 4 shipping events)	4	events	$500	$2,000
Samples analysis costs (assume 25% secondary samples)	55	samples	$250	$13,750
Total Excavation Labor and Equipment Costs				**$656,000**

CDM Smith	PROJECT: Shulman	COMPUTED BY : GR	CHECKED BY:	
	JOB NO.: 94421	DATE : 10/9/2014	DATE CHECKED:	
	CLIENT: NYSDEC			

Description: FS Cost Estimate for Alternative 2 Excavation and Off-Site Disposal - Individual Cost Item Backup

Transportation and Disposal (T & D)

Assumed density is 1.6 tons per bulk cubic yards (BCY) for soil.

Percentage of materials that are deemed hazardous with regards to TSCA only	5%	by weight
Percentage of materials that are deemed hazardous with regards to RCRA metals only	5%	by weight
Percentage of materials that are deemed hazardous with regards to TSCA and RCRA metals	1%	by weight

Soil Waste Category		In-place Quantity (BCY)	Quantity (tons)	Disposal Type
Hazardous Waste - TSCA only (assumed 5% of total)		6,560	10,500	Subtitle C Landfill
Hazardous Waste - TSCA and RCRA (assumed 1% of total)		1,320	2,200	Subtitle C Landfill
Hazardous Waste - RCRA only (assumed 5% of total)		6,560	10,500	Subtitle C Landfill
Non-Hazardous Waste - Soil (assumed remainder of total)		116,680	186,700	Subtitle D Landfill
Subtotal Waste Volume		**131,100**	**209,900**	

Waste Category		Quantity (tons)	T & D Unit Price (per ton)		Extended Costs
Hazardous Waste - TSCA only (assumed 5% of total)		10,500	$230		$2,415,000
Hazardous Waste - TSCA and RCRA (assumed 1% of total)		2,200	$800		$1,760,000
Hazardous Waste - RCRA only (assumed 5% of total)		10,500	$260		$2,730,000
Non-Hazardous Waste (assumed remainder of total)		186,700	$50		$9,335,000
TOTAL T&D Waste for Soil Disposal		**209,900**			**$16,240,000**

Total Transportation and Disposal Costs **$16,240,000**

CDM Smith	PROJECT: Shulman	COMPUTED BY: GR	CHECKED BY:
	JOB NO.: 94421	DATE: 10/9/2014	DATE CHECKED:
	CLIENT: NYSDEC		

Description: FS Cost Estimate for Alternative 2 Excavation and Off-Site Disposal - Individual Cost Item Backup

Backfill

Total Backfill Volume				131,100 CY
Backfill Duration				
Assume backfill runs concurrent to excavation, but lags behind by one month with a production rate of 250 CY/hour				
Total Backfill Period, workdays				66 DAYS
Total Backfill Period, work hours (8 hours per day)				524 HOURS
Total Backfill Period, work weeks				14 WEEKS
Total Backfill Period, months				4 MONTHS
Backfill Labor/Equipment Costs				
Backfill costs per RS Means	131,100	CY	$2.1	$275,400
Compaction Costs per RS Means	131,100	CY	$1.1	$137,700
Total Backfill Crew and Equipment Cost	**$413,100**			
Backfill Material Costs				
Common Fill Unit Cost		$15 per CY		
Common fill for remainder of excavation void.				
Total Backfill Volume:			131,100 CY	
Additional compaction volume to account for bulking between bank and loose cubic yards (LCY) for soil.				
Imported Clean Fill needed (with 85% Compaction)			154,300 CY	
Geotextile Marker Costs (incl. shipping)	$50,000			
Common Fill and Marker Material Cost:	**$2,365,000**			
Backfill Material Testing				
Requires one sample for every 5,000 cubic yards imported to the site, analyzed for full parameters including sieve analyses, moisture content, chemical compounds, and Ra-226:				
Assume $1500 per sample analysis fee				
# of Backfill Material Samples Required:			31 samples	
Backfill Testing Cost:	**$46,500**			
Soil Density Testing				
Assume $500 per visit by soil density testing technician, 2 visits per week, during backfill operations.				
# of Backfill Visits Required:			28 visits	
Soil Density Testing Cost:	**$14,000**			
Additional Railroad and Site Restoration Activities (allowance)	**$220,000**			
TOTAL BACKFILL COST: **$3,059,000**				

PROJECT: Shulman	COMPUTED BY : GR	CHECKED BY:	
JOB NO.: 94421	DATE : 10/9/2014	DATE CHECKED:	
CLIENT: NYSDEC		PAGE NO. : 1	

Description: Wage rates assumptions for the professional and craft labor and equipment rates for use in FS cost estimate.

Number of work hours per year: **2080** *52 weeks x 40 hours per week*

Professional Labor	Rate
Labor Category	
Project Manager	**$150**
Site Superintendent	**$120**
Construction Foreman	**$120**
Environmental Engineer	**$100**
Engineer	**$95**
Environmental Technician	**$85**
Surveyor	**$80**
Drafter	**$75**
Chemist	**$100**
N2 Operator (Water Treatment)	**$120**
Industrial Hygienist (SHSO)	**$100**
Security Guard	**$50**
Laborer (Semi-Skilled)	**$50**
Geologist	**$100**
Data Management	**$85**
Administrative Staff	**$65**

Appendix C

Detailed Cost Estimate for Alternative 3 – Excavation, Off-Site Disposal and On-Site Consolidation

CDM Smith	PROJECT: Shulman	COMPUTED BY : GR	CHECKED BY:		
	JOB NO.: 94421	DATE : 10/10/2014	DATE CHECKED:		
	CLIENT: NYSDEC		PAGE NO. : 1		

Description: Cost Estimate for Alternative 3 Excavation, Off-Site Disposal and On-Site Consolidation - Individual Cost Item Backup

Pre-Design Investigation (PDI)

1) To delineate the extent of contamination to finalize the remediation areas and 2) assess risks to groundwater due to on-Site consolidation.

Assume ~15 soil boring locations over 5 days, 5 samples for leachability study to assess groundwater risks.

PDI Workplan	1	LS	$10,000		$10,000
Field oversight - Staff geologist	40	hr	$100		$4,000
Field supplies, equipment rental, per diem etc.	5	day	$250		$1,250
Driller labor and equipment (including geophysical)	5	day	$2,000		$10,000
PDI Summary Report	1	LS	$10,000		$10,000
Sample shipping	5	day	$400		$2,000
Laboratory Analytical	53	samples	$300		$15,900
(assume 3 samples per location + 3 duplicates + 5 blanks analyzed for PCBs and metals)					
Leachate generation tests	4	samples	$600		$2,400
Leachate sample analysis (8 timeframes for each samples)	32	samples	$300		$9,600
Leachability test management and disposal of residuals	1	LS	$1,000		$1,000
TOTAL PRE-DESIGN INVESTIGATION COSTS:					**$66,200**

Remedial Design

To include the analysis of investigation results and existing data, preparation of the remedial design including draft, pre-final, and final design packages consisting of specifications, drawings, design analysis report, and construction cost estimate.

Prices are estimated based on CDM Smith's experience on similar project.

Meetings	20	hr	$245		$4,900
Remedial Design Report - Draft					
Engineer	320	hr	$100		$32,000
Project Manager	80	hr	$150		$12,000
Drafter	100	hr	$75		$7,500
Admin/miscellaneous	1	LS	$1,000		$1,000
Remedial Design Report - Final					
Engineer	120	hr	$100		$12,000
Project Manager	40	hr	$150		$6,000
Drafter	20	hr	$75		$1,500
Admin/miscellaneous	1	LS	$1,000		$1,000
Prepare bid specification packages, cost estimates, procurement etc.	1	LS	$50,000	=	$50,000
TOTAL PRE-DESIGN INVESTIGATION AND REMEDIAL DESIGN COSTS:					**$128,000**

PROJECT:	Shulman	COMPUTED BY :	GR	CHECKED BY:	
JOB NO.:	94421	DATE :	10/10/2014	DATE CHECKED:	
CLIENT:	NYSDEC				

Description: Cost Estimate for Alternative 3 Excavation, Off-Site Disposal and On-Site Consolidation - Individual Cost Item Backup

General Conditions

General conditions to include the project-dedicated site supervisory staff, development of work plans, site photographs/videos, project signs, insurance, mobilization/demobilization, and costs not covered elsewhere.

Estimate assumes that following the remedial design, the RA Contractor will mobilize to the site and complete the remedial action including the site preparation, excavation/removal, off-site transportation and disposal, backfill and compaction, final grading, and site restoration prior to project end.

Project Schedule

Assume the following project schedule:

Field Trailer Compound Establishment	1	week
Site Preparation (Decon areas, stockpile areas, clearing)	2	weeks
Remedial Excavation and T&D	8	weeks
Backfill and Compaction (lagging period)	4	weeks
Final Site Restoration and Demob	2	weeks
Total Construction Duration	17	weeks
Project Closeout	4	weeks
Total Project Duration	**21**	**weeks**

General Condition Costs

Engineering Support during Construction

Project Manager	$150	hr	84	$12,600
Project Engineer	$100	hr	168	$16,800

Total for engineering support **$29,400**

A) Site Supervisory Staff

Assume the following Site Supervisory Staff for duration of construction (see labor/equipment backup page for rates):

Site Superintendent	$120	per hour
Construction Foreman	$120	per hour
Environmental Technician (QC)	$85	per hour
Pickup Truck #1	$13	per hour
Pickup Truck #2	$13	per hour
per diem for superintendent and foreman	$300	per day
Total labor	$388.50	per hour
	$15,540	per week

Total Site Supervisory Staff for Construction Duration **$265,000**

B) Survey, Permit, Workplan updates, Progress Reports etc.

Total Work Plan Preparation Cost: **$120,000**

C) Mobilization/Demobilization Fees

Assume 10 large pieces of equipment to be used throughout remedial action.

Total Mobilization/Demobilization Cost (assumed allowance): **$20,000**

D) Project Insurance

Per MEANS 01-31-13.30-0020 Builder's Risk Insurance, 0.24% of job cost. Allow $15,000 based on project size.

Estimated Project Insurance Cost: **$15,000**

TOTAL GENERAL CONDITION COST: **$450,000**

CDM Smith	PROJECT: Shulman	COMPUTED BY : GR	CHECKED BY:
	JOB NO.: 94421	DATE : 10/10/2014	DATE CHECKED:
	CLIENT: NYSDEC		

Description: Cost Estimate for Alternative 3 Excavation, Off-Site Disposal and On-Site Consolidation - Individual Cost Item Backup

Excavation of Contaminated Soils exceeding Commercial Standards

Total Excavation/Removal Volume (Table 7-1)

Soil Excavation Volume - PCB Impacted Soils	25,400	CY
Soil Excavation Volume - Soils with Low Impacts of Metals Only	18,700	CY
Total Excavation Volume	44,100	CY
Excavation Area (to calculate number of post-excavation samples)	300,000	SF

Soil Excavation Duration

Assume 140 CY/hour for excavation of soil based on RS Means Costworks 31.23.16.46.5540 , excavation of common earth in bulk using a 460 HP dozer with a daily output of 1,120 CY assuming average haul of 150'.

Total Excavation, segregation, treatment Period, workdays	40	DAYS
Total Excavation Period, work hours (8 hours per day)	320	HOURS
Total Excavation Period, work weeks	8	WEEKS
Total Excavation Period, months	2	MONTHS

*Assume treatment and backfill is concurrent with excavation (by separate crew), but lags behind by one month

Site clearing at the yard including railroad (allowance)				$75,000
Excavation costs per RS Means (incl. labor and equipment)	44,100	CY	$3.2	$141,200
Limited hauling within Site (25% internal haul)	11,025	CY	$2.9	$32,000
Soil erosion controls (allowance)	1	LS	$25,000	$25,000
Decontamination pad	1	LS	$10,000	$10,000
Post-excavation samples				
Sample shipping costs (assume 4 shipping events)	8	events	$1,000	$8,000
Samples analysis costs (assume 25% secondary samples)	108	samples	$250	$27,000
Total Excavation Labor and Equipment Costs				**$319,000**

PROJECT:	Shulman	COMPUTED BY :	GR	CHECKED BY:	
JOB NO.:	94421	DATE :	10/10/2014	DATE CHECKED:	
CLIENT:	NYSDEC				

Description: Cost Estimate for Alternative 3 Excavation, Off-Site Disposal and On-Site Consolidation - Individual Cost Item Backup

Transportation and Disposal (T & D)

Assumed density is 1.6 tons per bulk cubic yard (BCY) for soil.

Percentage of materials that are deemed hazardous with regards to TSCA only	5%	by weight
Percentage of materials that are deemed hazardous with regards to RCRA metals only	5%	by weight
Percentage of materials that are deemed hazardous with regards to TSCA and RCRA metals	1%	by weight

Soil Waste Category		In-place Quantity (BCY)	Quantity (tons)	Disposal Type
Hazardous Waste - TSCA only (assumed 5% of total)		1,270	2,100	Subtitle C Landfill
Hazardous Waste - TSCA and RCRA (assumed 1% of total)		260	500	Subtitle C Landfill
Hazardous Waste - RCRA only (assumed 5% of total)		1,270	2,100	Subtitle C Landfill
Non-Hazardous Waste - Soil (assumed remainder of total)		22,610	36,200	Subtitle D Landfill
Subtotal Waste Volume		**25,400**	**40,900**	

Waste Category		Quantity (tons)	T & D Unit Price (per ton)		Extended Costs
Hazardous Waste - TSCA only (assumed 5% of total)		2,100	$230		$483,000
Hazardous Waste - TSCA and RCRA (assumed 1% of total)		500	$800		$400,000
Hazardous Waste - RCRA only (assumed 5% of total)		2,100	$260		$546,000
Non-Hazardous Waste (assumed remainder of total)		36,200	$50		$1,810,000
TOTAL T&D Waste for Soil Disposal		**40,900**			**$3,239,000**

Total Transportation and Disposal Costs **$3,239,000**

CDM Smith	PROJECT: Shulman	COMPUTED BY : GR	CHECKED BY:		
	JOB NO.: 94421	DATE : 10/10/2014	DATE CHECKED:		
	CLIENT: NYSDEC				

Description: Cost Estimate for Alternative 3 Excavation, Off-Site Disposal and On-Site Consolidation - Individual Cost Item Backup

Backfill

Clean Fill Volume (same as PCB-impacted volume)				25,400
Consolidation Volume from soils excavated from low-impact areas				18,700
Total Backfill Volume				44,100 CY
Backfill Duration				
Assume backfill runs concurrent to excavation, but lags behind by one month with a production rate of 250 CY/hour				
Total Backfill Period, workdays				22 DAYS
Total Backfill Period, work hours (8 hours per day)				176 HOURS
Total Backfill Period, work weeks				5 WEEKS
Total Backfill Period, months				2 MONTHS
Backfill Labor/Equipment Costs				
Backfill costs per RS Means	44,100	CY	$2.1	$92,700
Compaction Costs per RS Means	44,100	CY	$1.1	$46,400
Total Backfill Crew and Equipment Cost		**$139,100**		
Clean Fill Material Costs				
Common Fill Unit Cost		$15 per CY		
Total Clean Fill Volume:			25,400 CY	
Additional volume to account for bulking between bank and loose cubic yards (LCY) for soil.				
Imported Clean Fill needed (with 85% Compaction)			29,900 CY	
Geotextile fabric costs	33340 SY		$2.0	$66,680
Geotextile Marker Costs (incl. shipping)		$10,000		
Common Fill and Marker Material Cost:		**$526,000**		
Backfill Material Testing				
Requires one sample for every 5,000 cubic yards imported to the site, analyzed for full parameters including sieve analyses, moisture content, chemical compounds, and Ra-226:				
Assume $1500 per sample analysis fee				
# of Backfill Material Samples Required:			6 samples	
Backfill Testing Cost:		**$9,000**		
Soil Density Testing				
Assume $500 per visit by soil density testing technician, 2 visits per week, during backfill operations.				
# of Backfill Visits Required:			10 visits	
Soil Density Testing Cost:		**$5,000**		
Additional Railroad and Site Restoration Activities (allowance)		**$170,000**		
TOTAL BACKFILL COST:	**$850,000**			

CDM Smith	PROJECT: Shulman	COMPUTED BY : GR	CHECKED BY:		
	JOB NO.: 94421	DATE : 10/10/2014	DATE CHECKED:		
	CLIENT: NYSDEC				

Description: Cost Estimate for Alternative 3 Excavation, Off-Site Disposal and On-Site Consolidation - Individual Cost Item Backup

Institutional Controls and Groundwater Monitoring

Site Management Plan				
Engineer	150	hr	$100	$15,000
Project Manager	40	hr	$150	$6,000
Drafter	40	hr	$75	$3,000
Admin/miscellaneous	1	LS	$1,000	$1,000
Total cost for Site Management Plan				**$25,000**
Institutional Controls (including Environmental Easements)				
Administrative Costs to maintain current Zonal Classification of Site (allowance)				$5,000
Costs to establish and maintain environmental easement (allowance)				$10,000
Total cost for Institutional Control Measures				**$15,000**
Groundwater Monitoring				
Field sampling staff (2 persons)	30	hr	$170	$5,100
Field supplies, equipment rental, per diem etc.	3	day	$300	$900
Travel/per diem	3	day	$300	$900
Sample shipping	3	day	$100	$300
Laboratory Analytical	8	samples	$100	$800
(assume 6 sample locations + 1 duplicates + 1 blanks analyzed for metals)				
Annual groundwater monitoring cost				$8,000
Present value groundwater monitoring costs				**$32,900**
(assuming 7% discount rate for a 5-year period)				
TOTAL INSTITUTIONAL CONTROLS AND MONITORING COST:				**$73,000**

CDM Smith	PROJECT: Shulman	COMPUTED BY : GR	CHECKED BY:
	JOB NO.: 94421	DATE : 10/10/2014	DATE CHECKED:
	CLIENT: NYSDEC		PAGE NO. :

Description: Wage rates assumptions for the professional and craft labor and equipment rates for use in FS cost estimate.

Number of work hours per year: **2080** *52 weeks x 40 hours per week*

Professional Labor	Rate
Labor Category	
Project Manager	**$150**
Site Superintendent	**$120**
Construction Foreman	**$120**
Environmental Engineer	**$100**
Engineer	**$95**
Environmental Technician	**$85**
Surveyor	**$80**
Drafter	**$75**
Chemist	**$100**
N2 Operator (Water Treatment)	**$120**
Industrial Hygienist (SHSO)	**$100**
Security Guard	**$50**
Laborer (Semi-Skilled)	**$50**
Geologist	**$100**
Data Management	**$85**
Administrative Staff	**$65**

Present Worth Calculations

P = Present Worth	
A = Annual amount	
i = interest rate	7%
n = number of years	5

$$P = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

The multiplier for (P/A) =	**4.1**

Appendix D

Detailed Cost Estimate for Alternative 4 –

In-Situ Stabilization and Solidification

CDM Smith	PROJECT: Shulman	COMPUTED BY : GR	CHECKED BY:
	JOB NO.: 94421	DATE : 10/10/2014	DATE CHECKED:
	CLIENT: NYSDEC		PAGE NO. : 1

Description: Cost Estimate for Alternative 4 In-Situ Stabilization and Solidification - Individual Cost Item Backup

Pre-Design Investigation (PDI) and Treatability Study

1) To delineate the extent of contamination to finalize the remediation areas and 2) assess risks to groundwater due to in-situ stabilization.
Assume ~15 soil boring locations over 5 days, 5 samples for leachability study to assess groundwater risks.

PDI Workplan	1	LS	$10,000		$10,000
Field oversight - Staff geologist	60	hr	$100		$6,000
Field supplies, equipment rental, per diem etc.	5	day	$250		$1,250
Driller labor and equipment (including geophysical)	5	day	$2,000		$10,000
PDI Summary Report	1	LS	$10,000		$10,000
Sample shipping	5	day	$400		$2,000
Laboratory Analytical	53	samples	$300		$15,900
(assume 3 samples per location + 3 duplicates + 5 blanks analyzed for PCBs and metals)					
Leachate generation tests	3	samples	$600		$1,800
Leachate sample analysis (8 timeframes for each samples)	24	samples	$300		$7,200
Leachability test management and disposal of residuals	1	LS	$1,000		$1,000
Treatability Study to determine treatment agent	1	LS	$50,000		$50,000
TOTAL PRE-DESIGN INVESTIGATION AND TREATABILITY STUDY COSTS:					**$115,200**

Remedial Design

To include the analysis of investigation results and existing data, preparation of the remedial design including draft, pre-final, and final design packages consisting of specifications, drawings, design analysis report, and construction cost estimate.
Prices are estimated based on CDM Smith's experience on similar project.

Meetings	40	hr	$245		$9,800
Remedial Design Report - Draft					
Engineer	480	hr	$100		$48,000
Project Manager	120	hr	$150		$18,000
Drafter	100	hr	$75		$7,500
Admin/miscellaneous	1	LS	$1,500		$1,500
Remedial Design Report - Final					
Engineer	120	hr	$100		$12,000
Project Manager	40	hr	$150		$6,000
Drafter	20	hr	$75		$1,500
Admin/miscellaneous	1	LS	$1,000		$1,000
Prepare bid specification packages, cost estimates, procurement etc.	1	LS	$50,000	=	$50,000
TOTAL PRE-DESIGN INVESTIGATION AND REMEDIAL DESIGN COSTS:					**$156,000**

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Description: Cost Estimate for Alternative 4 In-Situ Stabilization and Solidification - Individual Cost Item Backup

General Conditions

General conditions to include the project-dedicated site supervisory staff, development of work plans, site photographs/videos, project signs, insurance, mobilization/demobilization, and costs not covered elsewhere.

Estimate assumes that following the remedial design, the RA Contractor will mobilize to the site and complete the remedial action including the site preparation, in-situ S/S, final grading, and site restoration prior to project end.

Project Schedule

Assume the following project schedule:

Field Trailer Compound Establishment	1	week
Site Preparation (Decon areas, stockpile areas, clearing)	2	weeks
In-Situ Stabilization and Solidification implementation	13	weeks
Final Site Restoration and Demob	2	weeks
Total Construction Duration	18	weeks
Project Closeout	4	weeks
Total Project Duration	**22**	**weeks**

General Condition Costs

Engineering Support during Construction

Project Manager	$150	hr	176	$26,400
Project Engineer	$100	hr	352	$35,200
Total for engineering support	**$61,600**			

A) Site Supervisory Staff

Assume the following Site Supervisory Staff for duration of construction (see labor/equipment backup page for rates):

Site Superintendent	$120	per hour
Construction Foreman	$120	per hour
Environmental Technician (QC)	$85	per hour
Pickup Truck #1	$13	per hour
Pickup Truck #2	$13	per hour
per diem for superintendent and foreman	$300	per day
Total labor	$388.50	per hour
	$15,540	per week

Total Site Supervisory Staff for Construction Duration **$280,000**

B) Survey, Permit, Workplan updates, Progress Reports etc.

Total Work Plan Preparation Cost: **$150,000**

C) Mobilization/Demobilization Fees

Assume 10 large pieces of equipment to be used throughout remedial action.

Total Mobilization/Demobilization Cost (assumed allowance): **$20,000**

D) Project Insurance

Per MEANS 01-31-13.30-0020 Builder's Risk Insurance, 0.24% of job cost. Allow $10,000 based on project size.

Estimated Project Insurance Cost: **$10,000**

TOTAL GENERAL CONDITION COST: $522,000

CDM Smith	PROJECT:	Shulman	COMPUTED BY :	GR	CHECKED BY:	
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Description: Cost Estimate for Alternative 4 In-Situ Stabilization and Solidification - Individual Cost Item Backup

In-Situ Stabilization and Solidification (S/S)

Total Stabilization/Solidification Area (Figure 7-3)

Soil In-Situ S/S Surface Area (0-4 ft depth)	300,000 SF			
Soil In-Situ S/S Surface Area (>4 ft depth)	5,400 SF			
Total In-Situ S/S Volume (from Table 7-1)	44,100 CY			
	70,560 tons			

In-Situ Stabilization Solidification (S/S) Duration

Assume 70 feet x 70 feet grid completed per work day i.e. 4900 SF of surface area mixed with S/S agents over the entire depth of treatment.

Total in-Situ S/S treatment period, workdays	63 DAYS
Total in-Situ S/S treatment period, work hours (8 hours per day)	504 HOURS
Total treatment period, work weeks	13 WEEKS
Total treatment period, months	3 MONTHS

Site clearing at the yard including railroad (allowance)				$75,000
Erosion control measures (allowance)	1	LS	$25,000	$25,000
Decontamination/Cleaning pad	1	LS	$10,000	$10,000
Lime mass requirement (assume 5% of contaminated soil mass)		3530 tons		
Lime material costs (includes shipping)		ton	$300	$1,059,000
Portland cement mass requirement (assume 20% of contaminated soil mass)		14120 tons		
Portland cement material costs (including shipping)		ton	$180	$2,541,600
Water for in-situ mixing	63	day	$250	$15,750
In-situ mixing tool and equipment rental costs	$925	hours	504	$466,200
In-situ mixing labor costs	$350	hours	504	$176,400
(in-situ mixing labor and equipment rates based on RS Means 31.32.13.19.2100)				
Total treatment implementation costs (incl. labor and equipment)				$4,368,950
Post-treatment samples				
Sample shipping costs (assume 4 shipping events)	4	events	$1,000	$4,000
Samples analysis costs	60	samples	$500	$30,000
Installation of 1-ft top soil cover (per RS Means 31.05.13.10.0800)	11111	CY	$40.90	$454,500
Grading of top soil cover (per RS Means 31.22.16.10.0012)	33333	SY	$0.88	$29,400
Additional Railroad and Site Restoration Activities (allowance)				$170,000
Total In-Situ Stabilization and Solidification Costs				**$5,057,000**

CDM Smith

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Description: Cost Estimate for Alternative 4 In-Situ Stabilization and Solidification - Individual Cost Item Backup

Institutional Controls and Groundwater Monitoring

Site Management Plan				
Engineer	150	hr	$100	$15,000
Project Manager	40	hr	$150	$6,000
Drafter	40	hr	$75	$3,000
Admin/miscellaneous	1	LS	$1,000	$1,000
Total cost for Site Management Plan				**$25,000**
Institutional Controls (including Environmental Easements)				
Administrative Costs to maintain current Zonal Classification of Site (allowance)				$5,000
Costs to establish and maintain environmental easement (allowance)				$10,000
Total cost for Institutional Control Measures				**$15,000**
Groundwater Monitoring				
Field sampling staff (2 persons)	30	hr	$170	$5,100
Field supplies, equipment rental, per diem etc.	3	day	$300	$900
Travel/per diem	3	day	$300	$900
Sample shipping	3	day	$100	$300
Laboratory Analytical	8	samples	$100	$800
(assume 6 sample locations + 1 duplicates + 1 blanks analyzed for metals)				
Annual groundwater monitoring cost				$8,000
Present value groundwater monitoring costs				**$32,900**
(assuming 7% discount rate for a 5-year period)				
TOTAL INSTITUTIONAL CONTROLS AND MONITORING COST:				**$73,000**

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Description: Wage rates assumptions for the professional and craft labor and equipment rates for use in FS cost estimate.

Number of work hours per year: **2080** *52 weeks x 40 hours per week*

Professional Labor	**Rate**
Labor Category	
Project Manager	**$150**
Site Superintendent	**$120**
Construction Foreman	**$120**
Environmental Engineer	**$100**
Engineer	**$95**
Environmental Technician	**$85**
Surveyor	**$80**
Drafter	**$75**
Chemist	**$100**
N2 Operator (Water Treatment)	**$120**
Industrial Hygienist (SHSO)	**$100**
Security Guard	**$50**
Laborer (Semi-Skilled)	**$50**
Geologist	**$100**
Data Management	**$85**
Administrative Staff	**$65**

Present Worth Calculations

P = Present Worth	
A = Annual amount	
i = interest rate	7%
n = number of years	5

$$P = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

The multiplier for (P/A) = **4.1**