PRE-DESIGN INVESTIGATION AND ALTERNATIVES ANALYSIS REPORT
AREAS OF CONCERN
EMERSON POWER TRANSMISSION
ITHACA, NEW YORK
SITE NO. 755010
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Contents

Contents

Contents

Contents

Contents

Figures

Tables

Contents

1 Introduction

On behalf of Emerson and its subsidiary, Emerson Power Transmission Corp. (EPT), WSP Engineering of New York, P.C., has prepared this Pre-Design Investigation and Alternatives Analysis Report for the EPT site in Ithaca, New York. This report was prepared in accordance with an Administrative Order on Consent (Index #A7-0125-87-09) entered into by the New York State Department of Environmental Conservation (NYSDEC) and EPT on July 13, 1988. This report presents the results of the pre-design investigations that were required to further define the extent of soil and/or groundwater impacts in the four areas of concern (AOCs) identified in the Supplemental Remedial Program/Alternatives Analysis (SRP/AA) Report dated June 30, 2008 and the Revised SRP/AA (Final) Report dated September 23, 2008, for the EPT site. The report also presents an alternative analysis for the four AOCs. The AOCs consist of the following:

- AOC 1 – Former Department 507 Degreaser – Methylene chloride and vinyl chloride were detected in soil at concentrations above the NYSDEC Restricted Use Soil Cleanup Objectives (SCOs) for protection of groundwater in one sample. Cis-1,2-dichloroethene (DCE), trans-1,2-DCE, and vinyl chloride were detected in groundwater above the ambient water quality standards.
- AOC 4 – Former Open Reservoir (Stone) – A light petroleum product was encountered.
- AOC 15 – Former 500-Gallon Gasoline Aboveground Tank – A light petroleum product was encountered.
- AOC 24 – Fire Water Reservoir – A light petroleum product was encountered.

Part II of the Revised SRP/AA Report presented an alternative analysis addressing each of these four AOCs. Based on comments received from the NYSDEC in a July 14, 2008, letter to Emerson, this report includes an evaluation of remedial alternatives utilizing the criteria set forth in Sections 1.8(f) and 4.1(e) of 6 New York Code of Rules and Regulations Part 375 and the NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation, dated December 25, 2002. The identification and screening and detailed evaluation of potentially feasible technologies was previously presented in the Revised SRP/AA. The detailed evaluation of potentially feasible technologies presented in this report uses the criteria set forth in Part 375 and DER-10 and provides a rationale for the proposed remedial alternative in each AOC. Although a remedial strategy has been recommended, further pre-design treatability testing is required for some of the selected remedial technologies.

A summary of the previous AOC investigation findings and remedial action objectives (RAOs) were presented in the Revised SRP/AA. The RAOs for AOCs 1, 4, 15, and 24 at the site include:

- Reduce, control, or eliminate the concentrations of COCs present within soil and groundwater onsite in AOC 1 above their respective standards.
- Reduce or eliminate the potential for ingestion/direct contact with COC affected soils at AOC 1.
- Reduce or eliminate the presence of light non-aqueous phase liquid (LNAPL, i.e., free product) identified in AOCs 4, 15, and 24 to the extent possible.

Section 2.0 includes a description and history of the EPT facility, followed by a discussion of the site geology and hydrogeology. Section 3.0 presents the results of the pre-design investigation activities conducted to further define the extent of soil and/or groundwater impacts at each of the four AOCs. Section 4.0 identifies the standards, criteria and guidance (SCGs) that will govern the development and selection of remedial alternatives. Section 5.0 presents a detailed description and screening of remedial alternatives, and Section 6.0 presents a comparative analysis of alternatives and identifies the recommended remedial alternative for each AOC.

2 Site Background

2.1 SITE LOCATION

The EPT facility is located at 620 South Aurora Street in Ithaca, New York (Figure 1). The site consists of three main buildings along the northeast and southwest portions of South Hill (Figure 1). The facility buildings are located at an elevation of approximately 600 feet above mean sea level. The majority of the floor space is in the main plant building, which extends approximately 1,600 feet near the northeastern portion of the 110-acre site. The main building is flanked by a number of smaller buildings to the southwest and a series of access roads and parking lots to that terrace the hillside above the plant to the east (Figure 2). Further uphill and to the east are South Aurora Street and the campus of Ithaca College. Undeveloped woodland borders the site to the southwest along the steep embankments of the hill. West Spencer Street, which runs parallel to the EPT property, marks the western edge of the wooded area and the base of South Hill. Beyond Spencer Street to the west and in areas along the steep northern approach to South Hill and the EPT property are residential areas. Those neighborhoods are bordered by Six Mile Creek, which flows north along the base of South Hill and eventually empties into Cayuga Lake approximately 2 miles northwest of the site. Figure 2 shows the facility layout and the surrounding areas.

The original building at the EPT site was built in 1906 by Morse Industrial Corporation, which manufactured steel roller chain for the automobile industry. From approximately 1928 to 1983, Borg-Warner Corporation owned the property and manufactured automotive components and power transmission equipment using similar processes, but not necessarily the same materials, as those currently conducted by EPT. A more detailed description of the site history and construction dates of the various buildings at the site is detailed in the report entitled Onsite Assessment of the Former Borg Warner – Morse Chain Facility (ESC 2005). Up until the late 1970s, Borg-Warner Corporation used trichloroethene (TCE), a widely-used solvent at the time for degreasing metal parts. In 1983, Morse Industrial Corporation was purchased from Borg-Warner Corporation by Emerson and became known as Emerson Power Transmission. EPT manufactures industrial roller chain, bearings, and clutching for the power transmission industry. Investigations conducted by Emerson in 1987 identified onsite groundwater contamination, originating from a fire-water reservoir located on the western portion of the property. Emerson promptly reported these findings to the NYSDEC. The remediation of this contamination was the subject of the July 1987 Consent Order (Index # A7-0125-87-09) referenced above.

2.2 SITE GEOLOGY AND HYDROGEOLOGY

The EPT site is located on the northern edge of the Appalachian Plateau Physiographic Province, which is characterized in central New York by deeply dissected hilly uplands and glacially gouged stream valleys. The EPT site lies on the limits of one of the dissected hills and overlooks the Cayuga Lake basin, which is formed in a former stream valley eroded and enlarged by the advance of glaciers. Underlying the site is a thin, discontinuous veneer of glacial till and man-made fill. The soil is classified as the “A-zone” in the site conceptual model and hydrogeologic framework presented in the Revised SRP/AA Report. It is typically a silty or clayey gravel and ranges in depth from 2.5 to 33 feet thick, though most of the EPT site and the western slope of South Hill is covered by less than 15 feet of soil. Soil depths generally increase with decreasing elevation and eventually merge with glacio-lacustrine silt and clay that lines the bottom of the valley floor below South Hill.

Beneath the overburden lies bedrock of the Ithaca Siltstone, a member of the Genesee Formation. The bedrock is typically well-cemented with generally non-fossiliferous beds ranging in thickness from 0.1 inch to 2.5 feet in thickness. Previous interpretations of the site bedrock, based on core logs recovered from boreholes drilling during investigation activities, differentiated the rock into three zones based on the frequency of bedding plane fractures and joints: an upper “stress relief zone” (B-zone), a middle “transitional zone” (C-zone), and a lower “lithologically controlled zone” (D-zone). The uppermost B-zone is characterized as very highly to highly fractured weathered bedrock. Onsite the B-zone extends to a maximum depth of approximately 22 feet below ground surface (bgs) and has an average thickness of approximately 8 to 10 feet on the western portion of the site where the current remediation system is located.

The transitional zone (C-zone) extends from the base of the B-zone to a maximum depth of approximately 55 feet bgs at the EPT site. The lower lithologically controlled zone (D-zone) extends from the bottom of the C-zone to a minimum depth of 145 feet bgs. According to geologic logs, bedding plan fractures are reportedly confined to intervals that are widely spaced, and their occurrence is controlled by lithology. A discussion of joint measurements and structural framework is provided in the Revised SRP/AA Report.

Groundwater flow direction within the overburden and underlying B-zone generally mimics surface topography, which slopes to the northwest. Groundwater flow direction within the siltstone bedrock (C and D zones) is significantly affected by vertical and horizontal distribution of vertical joint sets and horizontal bedding plane fractures within the upper sections of bedrock.

Groundwater near the fire water reservoir area is present within the overburden and bedrock. Overburden groundwater is perched and is restricted to limited areas of the site where the discontinuous soil cover is thickest. In areas where the soil cover is thin (i.e., steep slopes along Turner Place), the overburden or upper portion of fractured bedrock is not saturated. Based on measurements collected during groundwater sampling, the overburden groundwater in the remediation area is in hydraulic communication with the underlying bedrock of the B-zone, and the two units act as a single hydraulic zone. In addition, the results of aquifer testing conducted within the remediation area demonstrates that because of the highly fractured and jointed nature of the B-zone, the unit responds as porous media. In the less fractured and jointed deeper sections of bedrock, the system responds as a fracture flow network with both primary and secondary porosity.

Based on the results of pre-design investigations completed in 2008, the horizontal and vertical distribution of site related volatile organic compounds (VOCs) in groundwater have been defined. In addition, the extent of LNAPL petroleum product has also been defined, as detailed in Section 3.

3 Area of Concern Investigations

Based on the results of the investigations completed in August and September 2007, four AOCs (1, 4, 15, and 24) were identified by the NYSDEC as requiring remedial action to address VOCs in groundwater and soil (AOC 1) and a light petroleum product encountered in AOCs 4, 15, and 24. In order to further define the extent of impacts within the four AOCs and to determine the most appropriate remedial alternative for each, pre-design investigations were completed in June 2008 (Figure 3 and 4). The following sections describe the initial investigation conducted in these four AOCs and the scope of the pre-design investigations. This is followed by a discussion of the pre-design investigation results.

3.1 PRE-DESIGN INVESTIGATION SCOPE

3.1.1 AOC 1 – Former Department 507 Degreaser

Certain site-related VOCs were detected above state criteria in soil and groundwater collected from previously advanced soil boring SB-1d located on the northern limit of the former Department 507 degreaser. To delineate the horizontal extent of VOCs in groundwater and soil in AOC 1, two direct push soil borings (SB-1e and SB-1f) were installed outside the building due to access issues near soil boring SB-1d, which was located inside the building (Figure 3). The boring locations were discussed in the field with NYSDEC and it was agreed that the proximity of soil boring SB-1f to soil boring SB-24b and the proximity of soil boring SB-15c to the soil borings in AOC 1 would be sufficient to characterize the nature and extent of groundwater and soil impacts within AOC 1. The soil borings were advanced to 12.5 feet bgs and 12.6 feet bgs, respectively, corresponding to auger refusal at bedrock. Due to several utility conflicts, soil boring SB-1f was relocated approximately 50 feet northeast of its original proposed location. At the location of previous boring SB-1d, a B-zone well was initially proposed. However, the well could not be drilled within this area of the building due to the low ceiling height.

In accordance with the approved SRI work plan, continuous split-spoon soil samples were collected from each boring. Based on the field screening results and visual observations, two soil samples from each boring were submitted to the laboratory for analysis. As requested by the NYSDEC, one soil sample was collected from the unsaturated zone just above the water table and a second sample was collected from the interval at which petroleum product was observed. Both samples were analyzed for VOCs using U.S. Environmental Protection Agency (EPA) Method 8260. The sample that exhibited evidence of petroleum product was fingerprinted for hydrocarbons using laboratory method 31013.

Upon completion of the soil borings, a 2-inch temporary piezometer was installed in SB-1e and SB-1f. Water samples were collected from each location and submitted for laboratory analysis of VOCs using EPA Method 8260.

3.1.2 AOC 4 – Former Open Reservoir (Stone)

Two soil borings were previously installed to the top of bedrock in the vicinity of the former open stone reservoir in Building 6A (Figure 18). A petroleum product was observed between 8 and 10 feet bgs in soil boring SB-4b (2007). As per the SRI work plan, a 4-inch product recovery well was installed at the location of former soil boring SB-4b to 9.8 feet bgs (top of bedrock). Continuous split spoon soil samples were collected during drilling. Based on the field screening results, one unsaturated soil sample was collected from 6 to 7 feet bgs and submitted for laboratory analysis of total VOCs. Petroleum product was encountered at approximately 8 feet bgs and one saturated soil sample was collected from 8 to 9.8 feet bgs and submitted for laboratory analysis of VOCs using EPA Method 8260 and hydrocarbon fingerprinting using laboratory method 31013.

To further delineate the petroleum product identified in soil boring SB-4b, three additional soil borings (SB-4c, SB-4d, and SB-4e) were installed in this area (Figure 4). Bedrock refusal was encountered at depths of 1, 2, and 4 feet bgs, respectively and each boring was dry. Soil samples were collected immediately above bedrock from each boring and analyzed for VOCs using EPA Method 8260. Because no product was encountered in soil borings SB-4c, SB-4d, and SB-4e, these borings were abandoned and no additional recovery wells were installed.

3.1.3 AOC 15 – Former 500-Gallon Gasoline Aboveground Tank

A former 500-gallon gasoline aboveground storage tank (AST) was located northwest of Building 4. During the supplemental RI, one soil boring (SB-15) was installed to the top of bedrock (approximately 25 feet bgs) in the center of the area where the tank had been located. Petroleum staining and petroleum product were noted between 20 and 26 feet bgs during installation of the boring. Although no STARS VOCs were detected in the soil sample collected between 20 and 24 feet bgs, further characterization and delineation of the petroleum product was appropriate to determine the extent of product along the retaining wall in this area (Figure 3).

In June 2008, one soil boring was installed at the previous soil boring location SB-15, and continuous soil samples were collected. Based on the field screening results, one soil sample from the unsaturated (vadose) zone was collected from 12 to 14 feet bgs and submitted for laboratory analysis of VOCs. Petroleum product was encountered at approximately 20 feet bgs. One product-saturated soil sample was collected from 25 to 25.4 feet and submitted for laboratory analysis of VOCs using EPA Method 8260 and hydrocarbon fingerprinting using laboratory method 31013. Upon completion of the boring, a 4-inch recovery well was installed to 25 feet bgs and the boring was renamed RW-15.

In accordance with the SRI work plan, soil boring SB-15b was installed 30 feet southwest of SB-15 along the retaining wall to a depth of 19.8 feet bgs where auger refusal was encountered in bedrock. Continuous soil samples were collected. As per the request of the NYSDEC, one soil sample was collected from the unsaturated zone at 16 to 18 feet bgs at the top of bedrock and submitted for laboratory analysis of VOCs using EPA Method 8260. No product was encountered at this location; therefore, boring SB-15b was considered to represent the southwestern most extent of petroleum product related to AOC 15.

Soil boring SB-15a was installed 25 feet northeast of soil boring SB-15. Continuous soil samples were collected before encountering bedrock at a depth of 22.4 feet bgs. Based on field screening methods, one soil sample from the unsaturated zone was collected from 10 to 12 feet bgs and submitted for laboratory analysis of VOCs. Product was encountered at a depth of 20 feet bgs. One saturated-zone soil sample was collected from 22 to 22.4 feet bgs and submitted for laboratory analysis of VOCs using EPA Method 8260 and hydrocarbon fingerprinting using laboratory method 31013 for characterization purposes. Because product was encountered at this location, a 4-inch diameter product recovery well was installed and the boring was renamed RW-15a.

An additional boring (SB-15c) was installed immediately adjacent to the retaining wall to delineate the extent of petroleum product encountered in soil boring SB-15a. Soil boring SB-15c was installed 40 feet northeast of soil boring SB-15a (Figure 3). Continuous split spoon samples were collected from the ground surface to the top of bedrock at 14 feet bgs. As discussed with NYSDEC, one unsaturated-zone soil sample was collected from the top of bedrock (12 to 14 feet bgs) and submitted for laboratory analysis of VOCs using EPA Method 8260. No product was encountered at this location; therefore, boring SB-15c was considered to represent the eastern-most extent of petroleum product related to AOC 15.

3.1.4 AOC 24 – Fire Water Reservoir

In August 2007, two 2-inch-diameter groundwater monitoring wells (MW-07B and MW-08B) were installed adjacent to the fire water reservoir (Figure 3) to further evaluate groundwater quality within the upper portion of the fractured bedrock (B-zone). Monitoring well MW-07B was installed south of the fire water reservoir and well MW-08B was installed to the east. The wells were screened in the uppermost fractured bedrock from 10 to 20 feet bgs (1 foot below the bottom of the reservoir). During rock coring activities for these wells, an oily sheen was observed on the cores and drilling fluids. Following installation, a light LNAPL petroleum product was encountered in well MW-08B.

To define the extent of LNAPL petroleum product in shallow fractured bedrock near MW-08B, two soil borings (one northeast and one southwest) were installed approximately 25 to 30 feet from well MW-08B to an interval within the upper section of fractured bedrock (within the B-zone).

Soil boring SB-24b was installed in the uppermost fractured bedrock from 9 to 14 feet bgs. Continuous soil samples were collected and logged to the termination depth. Based on field screening results, one unsaturated-zone soil sample was collected from boring SB-24b from 8 to 10 feet bgs and submitted for laboratory analysis of VOCs using EPA Method 8260. Because petroleum product was encountered, one saturated-zone soil sample was collected from soil boring SB-24b from 12 to 12.4 feet bgs and submitted for laboratory analysis of VOCs using EPA Method 8260 and hydrocarbon fingerprinting using laboratory method 31013 for characterization purposes. Auger refusal was encountered at 12.4 feet bgs at the bedrock interface. As per the SRI work plan, boring SB-24b (renamed RW-24b) was reamed to 14.1 feet and a 4-inch product recovery well was installed with 5 feet of PVC slotted screen.

Soil boring SB-24a was installed to 14.5 feet bgs. No groundwater or product was encountered at SB-24a, therefore, a well was not installed at this location. Continuous soil samples were collected and logged to the termination depth. Based on field screening results, one unsaturated-zone soil sample was collected from boring MW-24a from 10 to 10.1 feet bgs and submitted for laboratory analysis of VOCs using EPA Method 8260. Boring SB-24a encountered refusal in bedrock at 10.1 feet bgs. Drilling with a roller bit was attempted past 10.1 feet bgs, but no product was encountered at soil boring SB-24a and the soil boring was subsequently abandoned.

3.2 RESULTS

3.2.1 AOC 1 – Former Department 507 Degreaser

In AOC 1, two soil borings were installed to the top of bedrock (SB-1e and SB-1f) to delineate the VOCs formerly detected in groundwater from boring SB-1d located inside the building (Figure 3). The groundwater sample collected from boring SB-1e contained 2.2 micrograms per liter of vinyl chloride, which is slightly above the NYSDEC Ambient Water Quality Standards and Guidance Values of 2 micrograms per liter (Table 1). The groundwater sample collected from boring SB-1f (approximately 50 feet northeast of SB-1e) did not contain site related VOCs above NYSDEC standards. The pre-design investigation results show that the extent of affected groundwater in AOC 1 is restricted to an isolated area that includes locations SB-1d and SB-2e. The area of affected groundwater within the A-zone is defined; however, the degree to which the B-zone is affected in AOC 1 has not been fully characterized. Two additional monitoring wells are proposed to fill this data gap. Figure 5 show the distribution of site related VOCs in groundwater within AOC 1.

Soil samples collected from borings SB-1e and SB-1f did not contain site related VOCs above the NYSDEC Subpart 375-6 - Protection of Groundwater criteria (Table 2). VOCs in soil within AOC-1 are restricted to an area immediately around SB-1d. Figure 6 show the distribution of soil related VOCs in soil within AOC 1.

During sampling activities, a petroleum odor and oily sheen were noted on the soils between 10 to 12 feet bgs in SB-1e and 12 to 12.6 feet bgs in SB-1f. Fingerprinting analysis identified the petroleum product as motor oil, and the hydrocarbon concentrations were 2,800 milligrams per kilogram (mg/kg) in SB-1e and 680 mg/kg in SB-1F (Table 2). The LNAPL motor oil petroleum sheen is delineated to the south, west, and north, as shown in Figure 7.

3.2.2 AOC-4 – Former Open Reservoir (Stone)

In AOC 4 four soil borings were installed to further delineate oily product previously encountered at approximately 8-10 feet bgs in former boring SB-4b (August 2007). A saturated-zone soil sample was collected between 8-8.9 feet from soil boring SB-4B (later renamed MW-4B) which was installed at the same location in June 2008 (Figure 8), and the sample was analyzed for petroleum fingerprinting. The sample contained 2,100 mg/kg of petroleum hydrocarbons in the fuel oil No. 2 range and 7,600 mg/kg of petroleum hydrocarbons in the motor oil range (Table 2). Petroleum product was not encountered in the remaining soil borings. No VOCs were detected above the comparative criteria in any of the soil samples collected from the four borings installed in this AOC. The extent of LNAPL in AOC-4 is shown in Figure 8.

3.2.3 AOC-15 – Former 500-gallon Aboveground Gasoline Tank

In August 2007 one soil boring (SB-15) was installed to the top of bedrock (approximately 25 feet bgs) in AOC-15 in the center of the area where the former AST was located. During drilling, petroleum was encountered between 20 and 26 feet bgs. Further delineation and characterization of this area was completed in June 2008. During the pre-design investigation work completed in June 2008, petroleum was also encountered at approximately 20 feet bgs in borings SB-15 (June 2008) and SB-15a. Soil samples were collected for hydrocarbon fingerprinting in boring SB-15 from 24–25.4 feet bgs and in SB-15a from 22 to 22.4 feet bgs. The fingerprinting analysis identified the petroleum product as motor oil. Concentrations of petroleum hydrocarbons ranged from 1,300 mg/kg to 13,000 mg/kg (Table 2). No staining or product was identified in borings SB-15b or SB-15c. The extent of LNAPL petroleum product for AOC-15 is depicted in Figure 7. Because petroleum product was encountered in soil borings SB-15 and SB-15a, recovery wells were installed at these locations and subsequently renamed RW-15 and RW-15a, respectively.

The soil sample collected from 22 to 22.4 feet bgs in boring SB-15a contained vinyl chloride at 21 micrograms per kilogram (µg/kg), which is slightly above the NYSDEC Restricted SCO for the protection of groundwater (20 µg/kg). No other site related VOCs were detected above NYSDEC criteria.

3.2.4 AOC-24 – Fire Water Reservoir

In AOC 24, borings SB-24a and SB-24B were installed to bedrock to further delineate the light petroleum encountered in well MW-08B (August 2007). Product staining was only encountered in boring SB-24B, which was converted to a recovery well and renamed RW-24b (Figure 7). In boring SB-24b, which contained a petroleum product, the unsaturated-zone soil sample collected at 8 to 10 feet bgs did not contain any VOCs above NYSDEC comparative criteria. The saturated-zone soil sample collected between 12 to 12.4 feet bgs contained 59 µg/kg of acetone which is slightly above the NYSDEC Restricted SCO for the protection of groundwater (50 µg/kg; Table 2). In addition, hydrocarbon fingerprinting identified the oily product encountered in this boring (SB-24b) as motor oil with a concentration of 1,600 mg/kg. As stated above, a recovery well was installed in this boring. No product or groundwater was encountered in boring SB-24a and the soil sample collected from the unsaturated zone at approximately 10 feet bgs did not contain any VOCs above the comparative criteria. The extent of light petroleum product related to AOC 24 has been defined as shown in Figure 7.

4 Identification of Standards, Criteria, and Guidance

This report was prepared in general conformance with the provisions of Part 375 Section 1.8(f) and DER-10 Section 4.1(e). Applicable provisions of these regulations require that remedial actions comply with SCGs. The potential SCGs that have been identified for the four AOCs at the site are presented in this section.

4.1 DEFINITION OF SCGS

“Standards and criteria” are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal and state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances.

“Guidelines” are non-promulgated criteria and guidelines that are not legal requirements; however, remedial programs should be designed with consideration given to guidelines that, based on professional judgment, are determined to be applicable to the site.

NYSDEC has also identified certain guidance as “to-be-considered” (TBC) material. TBC materials are non-promulgated advisories or guidance issued by federal or state governments that are not legally binding and do not have the status of potential SCGs.

4.2 TYPES OF SCGS

The NYSDEC has provided guidance on the application of the SCGs concept in the remedial investigation/feasibility study process. SCGs are to be progressively identified and applied on a site-specific basis as the remedial action selection proceeds. The potential SCGs considered for the potential remedial alternatives in the Revised SRP/AA and this report were categorized into the following NYSDEC-recommended classifications:

- Chemical-Specific SCGs –are health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values for the chemicals of interest. These values establish the acceptable amount of concentration of a chemical that may be found in or discharged to the ambient environment.
- Location-Specific SCGs – are restrictions placed on the concentration of hazardous substances or the conduct of activity solely because they occur in specific locations.
- Action-Specific SCGs – are technology- or activity-based requirements or limitations on actions taken with respect to hazardous waste management and site cleanup.

4.3 IDENTIFIED SCGS AND TBCS

The identification of federal and state SCGs and TBCs for the evaluation of remedial alternatives for the four AOCs at the site was a progressive, multi-step process. The SCGs and TBCs identified as applicable are presented below.

4.3.1 Chemical-Specific SCGs

The potential chemical-specific SCGs for the four AOCs are summarized in Table 3. Chemical-specific SCGs that apply to the impacted soils in AOC 1 are the NYSDEC Subpart 375-6 Restricted Use SCOs for Protection of Groundwater. Groundwater cleanup standards based on the New York Division of

Water TOGS 1.1.1, Table 1, Ambient Water Quality Standards and Guidance Values, which includes the groundwater standards found in 6 NYCRR Part 703.5 are applicable chemical-specific standards.

The NYSDEC DER-10 guidance is applicable to the petroleum LNAPL (product) identified during the installation of soil borings or monitoring wells during the SRI and pre-design investigation activities. In accordance with the DER-10 guidance, petroleum product identified at AOCs 4, 15, and 24 shall be treated or removed when practicable, or contained when treatment or removal or not practicable.

4.3.2 Location-Specific SCGs

Examples of potential location-specific SCGs include flood plain and wetland regulations, restrictions promulgated under the National Historic Preservation Act, Endangered Species Act, and other federal acts. Each AOC is located on the facility property and either inside or just outside building structures. Many of these are not considered SCGs for these AOCs. Location-specific SCGs also include local building permit conditions for facilities constructed at each AOC. This may be considered a potential location-specific SCG depending upon the remedial alternative.

4.3.3 Action-Specific SCGs

The potential action-specific SCGs for the AOCs are summarized in Table 4. The action-specific SCGs outlined in this report include those common to all of the remedial alternatives discussed in the detailed evaluation of remedial technologies.

5 Detailed Evaluation of Remedial Alternatives

5.1 GENERAL

This section presents information relevant to the selection of a remedial alternative(s) for AOCs 1, 4, 15, and 24 at the site. Potentially feasible technologies were identified in Section 13.0 of the Revised SRP/AA Report. Potentially feasible technologies are further screened in this report to determine the appropriateness and suitability for achieving the RAOs at each AOC. The remedial technologies developed are described in detail and analyzed with respect to the criteria set forth in Sections 1.8(f) and 4.1(e) of Part 375 and DER-10, respectively. These criteria encompass statutory requirements and include other gauges of the overall feasibility and acceptability of remedial alternatives.

The detailed evaluation of remedial alternatives presented in this section consists of an assessment of each of the remedial alternatives against the following evaluation criteria:

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

The results of the detailed evaluation of remedial alternatives will be used to aid in the recommendation of the appropriate alternative(s) for implementation at each of the AOCs. The remedial alternatives evaluated for each AOC are presented below.

AOC 1

<u>Groundwater</u>

- Alternative 1 – No Action
- Alternative 2 - Monitored Natural Attenuation (MNA)
- Alternative 3 – *In Situ* Bioremediation
- Alternative 4 – *In Situ* Chemical Oxidation (ISCO)

<u>Soil</u>

- Alternative 1 – No Action
- Alternative 2 - Capping/Institutional Controls

AOCs 4, 15, and 24

<u>Groundwater</u>

- Alternative 1 – No Action
- Alternative 2 – *In Situ* Chemical Oxidation
- Alternative 3 – Free Product Removal and Offsite Treatment/Disposal

5.2 DESCRIPTION OF EVALUATION CRITERIA

This section presents a description of the evaluation criteria used in the detailed analysis of the remedial alternatives.

5.2.1 Overall Protection of Human Health and the Environment

This evaluation criterion assesses whether the alternative is protective of human health and the environment and relies on the assessments conducted for other evaluation criteria, including long-term and short-term effectiveness, and compliance with SCGs.

5.2.2 Compliance with SCGs

This evaluation criterion evaluates the remedial alternative's ability to comply with SCGs. The following items are considered during the evaluation of the remedial alternative:

- Compliance with chemical-specific SCGs
- Compliance with location-specific SCGs
- Compliance with action-specific SCGs

This evaluation also addresses whether or not the remedial alternative complies with other appropriate federal and state criteria, advisories, and guidance (TBCs).

5.2.3 Long-Term Effectiveness and Permanence

The evaluation of each remedial alternative relative to its long-term effectiveness and permanence is made considering the risks that may remain following completion of the remedial alternative. The following factors will be assessed in the evaluation of the alternative's long-term effectiveness and permanence:

- Environmental impacts from untreated waste or treatment residuals at the completion of the remedial alternative
- The adequacy and reliability of controls (if any) that will be used to manage treatment residuals or remaining untreated waste
- The alternative's ability to meet RAOs established for the AOCs at the site

5.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

This evaluation criterion addresses the degree to which remedial actions will permanently and significantly reduce the toxicity, mobility, or volume of the constituents present in media at each AOC through treatment. The evaluation focuses on the following factors:

- The treatment process and the amount of materials to be treated
- The treatment process's anticipated ability to reduce the toxicity, mobility, or volume
- The nature and quantity of treatment residuals that will remain after treatment
- The relative amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled
- The degree to which the treatment is irreversible

5.2.5 Short-Term Effectiveness

The short-term effectiveness of the remedial action is evaluated relative to its effect on human health and the environment during implementation of the alternative. The evaluation of each alternative with respect to its short-term effectiveness will consider the following:

- Short-term impacts to which the community may be exposed during implementation of the alternative
- Potential impacts to workers during implementation of the remedial actions, and the effectiveness and reliability of protective measures
- Potential environmental impacts of the remedial action and the effectiveness of mitigative measures to be used during implementation
- Amount of time until protection is achieved

5.2.6 Implementability

This evaluation criterion addresses the technical and administrative feasibility of implementing the remedial alternative, including the availability of the various services and materials required for implementation. The following factors are considered during the implementation evaluation:

- ***Technical Feasibility*** – This factor refers to the relative ease of implementing or completing the remedial alternative based on site-specific constraints. In addition, the remedial alternative's constructability and operational reliability are considered, as well as the ability to monitor the effectiveness of the remedial alternative.
- ***Administrative Feasibility*** – This factor refers the feasibility of acquiring, and the time required to obtain, any necessary approvals and permits.

5.2.7 Cost

This criterion refers to the total cost to implement the remedial alternative. The total cost of each alternative represents the sum of the direct capital costs (materials, equipment, and labor), indirect capital costs (engineering, licenses or permits, and the contingency allowances), and operation and maintenance (O&M) costs. O&M costs may include operating labor, energy, chemicals, and sampling and analysis. These costs, which are developed to allow the comparison of the remedial alternatives, are estimated with expected accuracies of -30 to +50 percent, in accordance with EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA.* A 20 percent contingency factor is included to cover unforeseen cost incurred during implementation. Present worth costs are calculated for alternatives expected to last more than 2 years. In accordance with EPA guidance, a 7 percent discount rate (before taxes and after inflation) is used to determine the present worth factor.

5.3 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR GROUNDWATER – AOC 1

This section presents the detailed analysis of each remedial alternative for groundwater in AOC 1 identified in Section 5.1 using the criteria listed in Section 5.2. It should be noted that petroleum product identified in soil borings SB-1e and SB-1f will be addressed as part of AOC 24 due to its proximity.

5.3.1 Alternative 1 – No Action

5.3.1.1 Technical Description

The no-action alternative serves as a baseline for comparison of the overall effectiveness of the other remedial alternatives. The no-action alternative would not involve the implementation of any remedial activities to address the COCs present in groundwater at AOC 1. The AOC would be allowed to remain in its current condition and no effort would be made to change the current site conditions.

5.3.1.2 Overall Protection of Human Health and the Environment

The no-action alternative does not reduce, control, or eliminate the COCs present in groundwater in excess of standards or provide data to measure future protection of human health and the environment.

5.3.1.3 Compliance with SCGs

The chemical-specific SCGs identified for this alternative are presented in Table 3. Chemical-specific SCGs that may apply to groundwater in AOC 1 include the New York State Groundwater Quality Standards, which identify acceptable chemical constituent concentrations in groundwater. The no-action alternative would not achieve the groundwater SCGs.

This alternative does not involve the implementation of any remedial activities; therefore, the action-specific and location-specific SCGs are not applicable.

5.3.1.4 Long-Term Effectiveness and Permanence

Under the no-action alternative, the COCs present in groundwater would not be addressed. As a result, this alternative would not meet the RAOs identified for this AOC.

5.3.1.5 Reduction of Toxicity, Mobility, and Volume through Treatment

Under the no-action alternative, the impacted groundwater in AOC 1 would not be treated, recycled, or destroyed through active treatment; therefore, the toxicity, mobility, and volume of the COCs present in the impacted groundwater would not be reduced through treatment.

5.3.1.6 Short-Term Effectiveness

The no-action alternative would not involve any short-term environmental impacts or risks to the community or workers.

5.3.1.7 Implementability

There are no technical or administrative issues associated with implementing the no-action alternative.

5.3.1.8 Cost

There are no costs associated with the no-action alternative.

5.3.2 <u>Alternative 2 – Monitored Natural Attenuation</u>

5.3.2.1 Technical Description

MNA would involve establishing a groundwater monitoring network and sampling program to evaluate natural attenuation of constituents in the groundwater. Natural attenuation involves intrinsic processes as stated in the EPA definition of MNA: "the biodegradation, dispersion, dilution, sorption, volatilization, and/or chemical and biochemical stabilization of contaminants to effectively reduce contaminant toxicity, mobility, or volume to levels that are protective of human health and the environment" (EPA 1997). With proper subsurface conditions (i.e., for chlorinated VOCs [CVOCs], those conducive to reductive dechlorination) and low concentrations of VOCs, natural attenuation processes can reduce VOC concentrations (both CVOCs and petroleum-related VOCs) and meet the RAOs.

Under this alternative, a groundwater monitoring network would be established in Area 1 and periodic sampling would be conducted to assess natural attenuation of VOCs in the groundwater and chemical indicators[1] of natural attenuation. Initially, monitoring events would be conducted more frequently to gather data on MNA parameters and to establish a long-term monitoring plan. The results of the groundwater monitoring events would be presented in a report and would serve to determine long-term frequency of future monitoring events and to predict the time until the groundwater RAOs were achieved

[1] Chemical indicators for natural attenuation include: dissolved oxygen, redox potential, nitrate/nitrite, sulfate/sulfide, ferrous/ferric iron, methane, chloride and pH. (Wiedemeier, T.Hl; et. al., "Overview of the Technical Protocol for Natural Attenuation of Chlorinated Aliphatic Hydrocarbons in Groundwater Under Development for the US Air Force Center for Environmental Excellence.")

for this area. In the event that the sampling results indicated that natural attenuation was not occurring as anticipated, recommendations would be presented for implementing another remedial alternative.

The important attributes of subsurface conditions for the promotion of MNA are the availability of a source of organic carbon and anaerobic conditions. The presence of degradation products of TCE in groundwater at AOC 1, including cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride, indicate that existing subsurface conditions may be suitable for MNA. A monitoring program would be used to confirm whether the subsurface conditions are conducive to CVOC degradation via reductive dechlorination.

MNA also can be used as a supplemental remedy to other treatment technologies.

5.3.2.2 Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment if the natural attenuation mechanisms are proven effective and groundwater RAOs are achieved. There would be no contact with groundwater with the exception of monitoring events. It may be necessary to consider institutional controls, such as deed restrictions, in addition to MNA.

5.3.2.3 Compliance with SCGs

Chemical-specific SCGs that may apply to groundwater at AOC 1 include the New York State Groundwater Quality Standards, which identify acceptable chemical constituent concentrations in groundwater. Depending on the effectiveness of the natural attenuation mechanisms in the groundwater, this alternative could potentially meet the requirements of this SCG over time. The actual time to achieve this SCG would be determined by predictive modeling performed during remedial design.

This alternative does not involve the implementation of any remedial activities other than sampling and monitoring activities, therefore, the action-specific and location-specific SCGs are not applicable.

5.3.2.4 Long-Term Effectiveness and Permanence

Under this alternative, the COCs present in groundwater at AOC 1 would be addressed by natural attenuation mechanisms. If MNA is demonstrated through groundwater sampling, this alternative would meet the RAO of reducing concentrations of COCs in the groundwater.

The long-term effectiveness of the MNA alternative is dependent on the mechanisms available to degrade the COCs in groundwater in AOC 1. Field data need to be obtained in order to assess whether natural attenuation would be effectively achieve the SCGs in the long term However, the presence of TCE degradation products, including cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride, indicate that existing subsurface conditions are likely suitable for MNA.

5.3.2.5 Reduction of Toxicity, Mobility, and Volume through Treatment

Under this alternative, the toxicity and volume of impacted groundwater could potentially be reduced via naturally attenuating mechanisms. This alternative would not reduce the mobility of groundwater; however, natural attenuation would reduce the toxicity and volume of COCs in the groundwater.

5.3.2.6 Short-Term Effectiveness

MNA would not involve any short-term environmental impacts or risks to the community or workers.

5.3.2.7 Implementability

MNA is easily implemented. Equipment and personnel qualified to conduct groundwater monitoring activities are readily available as are analytical laboratories to perform the chemical analyses of the groundwater samples.

5.3.2.8 Cost

The estimated capital cost associated with this alternative is $162,000. The estimated annual O&M for this alternative (rounded) is $54,000. This cost includes collecting groundwater samples from newly installed monitoring wells within AOC 1, as well as upgradient of this area and analyzing the samples quarterly for COCs and annually for MNA parameters. The present worth cost has been calculated assuming that annual groundwater monitoring activities are continued for a period of 10 years. The estimated present worth cost of this alternative is $541,000. A detailed breakdown of the estimated costs associated with this alternative is presented in Table 5.

5.3.3 Alternative 3 – *In Situ* Bioremediation

5.3.3.1 Technical Description

Enhanced *in situ* bioremediation involves supplying an electron donor to the subsurface to provide a substrate for naturally occurring or augmented microorganisms. Naturally-occurring bacteria are known to degrade chlorinated compounds in the subsurface and can be enhanced by adding nutrients and substrates (such as whey, vegetable oil, sodium lactate, molasses, glycerol, or hydrogen release compounds) and sometimes by introducing certain microbial cultures to the subsurface. The important attributes of subsurface conditions for the promotion of reductive dechlorination are the availability of a source of organic carbon and reducing conditions. The presence of degradation products of TCE in groundwater at AOC 1, including cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride, indicate that existing subsurface conditions would support *in situ* bioremediation.

Electron donors can be introduced through temporary injection points or permanent injection points. Given the subsurface conditions in AOC 1, low or no pressure application driven by diffusion and gravity would be most appropriate. This would allow the material to “flood” the thin overburden horizon and upper portion of the fractured bedrock affected by COCs in groundwater. As part of the selected alternative for AOC 1, two shallow B-zone groundwater monitoring wells will be installed outside and downgradient of the former degreaser area near soil boring SB-1b. Groundwater samples will be collected to determine the extent, if any, of affected shallow B-zone groundwater beyond the general vicinity of SB-1d where site-related VOCs were previously detected above groundwater standards in the A-zone.

5.3.3.2 Overall Protection of Human Health and the Environment

The implementation of *in situ* bioremediation to treat impacted groundwater at AOC 1 likely would meet the RAO of reducing the current concentrations of COCs. This alternative would reduce the toxicity, mobility, and volume of COCs by promoting and increasing the anaerobic biodegradation of COCs present in groundwater at AOC 1.

5.3.3.3 Compliance with SCGs

Chemical-specific SCGs that may apply to groundwater in AOC 1 include the New York State Groundwater Quality Standards, which identify acceptable chemical constituent concentrations in groundwater. Chemical-specific SCGs that potentially apply to this alternative are presented in Table 3. This alternative would likely achieve the chemical specific SCGs.

Action-specific SCGs for this alternative are associated with health and safety requirements and transportation and disposal requirements (e.g., soil cuttings, purge water). Workers and worker activities during implementation of this alternative must comply with the Occupational Safety and Health Administration (OSHA) requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting, as identified in 20 CFR 1910, 20 CFR 1926 and 29 CFR 1904. In addition, Resource Conservation and Recovery Act (RCRA) requirements for preparedness and prevention, contingency plans, and emergency procedures may be applicable to this alternative. Compliance with these SCGs would be achieved by following a NYSDEC-approved remedial work plan and a site-specific health and safety plan (HASP).

The RCRA and U.S. Department of Transportation (USDOT) requirements for the packaging, labeling, transportation, and disposal of hazardous or regulated materials may be applicable to this alternative. Compliance with these SCGs would be achieved by utilizing a licensed hazardous waste transporter and a properly permitted disposal facility.

No location-specific SCGs were identified.

5.3.3.4 Long-Term Effectiveness and Permanence

A groundwater monitoring program would be implemented during the operational period as well as for a period of time after completion of the bioremediation injection events to monitor its effectiveness with respect to achieving the RAOs. The long-term effectiveness is dependent on maintaining anaerobic aquifer conditions that are conducive to reductive dechlorination. Addition of substrates to enhance microbial growth can be effective in the subsurface for many months and can promote or enhance anaerobic conditions for a significant period of time after application. Bench testing and/or field pilot testing would provide a basis for selected the appropriate substrate and associated application levels to the subsurface to further enhance biodegradation, and to assess whether or not the native bacterial population can achieve the remedial goals without additional bioaugmentation. Furthermore, characterization of the existing microbial populations at the Site may be required to assess whether the indigenous microbial populations present at the site are sufficient to facilitate degradation of the site COCs in groundwater. The location of permanent injection points could be properly determined based on the results of the pre-design investigation activities summarized in Section 3. Based on the available information, this alternative would likely be effective in achieving the SCGs and also provide permanence.

5.3.3.5 Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative will reduce the toxicity, mobility, and volume of COCs present in groundwater in AOC 1.

5.3.3.6 Short-Term Effectiveness

Implementation of this alternative would not involve any short-term environmental impacts or risks to the community. Workers involved in implementing the remedy would be protected by the use of personal protective equipment (PPE) or engineering controls, as specified in a site-specific HASP that would be developed during the remedial design. Air monitoring would be performed during implementation of this alternative to confirm the volatilized organic vapors are within acceptable levels, as specified in the site-specific HASP, thus minimizing any potential impacts to workers.

5.3.3.7 Implementability

Enhanced biodegradation is technically and administratively feasible to implement at the site. Pilot testing would be completed to determine the appropriate type and concentration of substrate to promote biodegradation. Biostimulants and substrates are commercially available and could be introduced to the subsurface through temporary or permanent injection points. The injection points can easily be installed in AOC 1. Prior to implementation of this alternative, pilot testing would be completed to determine the appropriate type and concentration of substrate to promote biodegradation. This alternative would require long-term monitoring of VOCs and natural attenuation parameters to evaluate the rate and extent of natural degradation.

5.3.3.8 Cost

The capital costs associated with this alternative include pre-design testing, site preparation, injection and monitoring well installation, and introduction of substrates. The estimated total capital cost for this alternative is $391,000 and is based on the assumption that pre-design testing indicates only substrate, not biostimulation, is necessary to effectively promote biodegradation. The estimated annual O&M cost for this alternative (rounded) is $48,000. This cost includes collecting groundwater samples from newly installed monitoring wells within AOC 1, as well as upgradient of this area and analyzing these groundwater samples quarterly for COCs and biological parameters. The present worth cost has been calculated assuming that annual groundwater monitoring activities are continued for a period of 10 years. The estimated present worth cost of this alternative is $728,000. A detailed breakdown of the estimated costs associated with this alternative is presented in Table 6.

5.3.4 Alternative 4 – *In Situ* Chemical Oxidation

5.3.4.1 Technical Description

ISCO involves the delivery of oxidants to the subsurface to chemically oxidize the VOCs in groundwater in AOC 1 to innocuous compounds (e.g., carbon dioxide and chloride). This alternative would also address VOCs in unsaturated-zone overburden soils. Proven oxidants used to treat VOCs include hydrogen peroxide, iron-catalyzed hydrogen peroxide or Fenton's reagent, modified Fenton's, potassium permanganate, and sodium persulfate. Based on the VOCs and concentrations identified in AOC 1, permanganate-based oxidants would not be applicable because they do not treat methylene chloride (detected in a soil sample collected from a soil boring installed in AOC 1). Laboratory and pilot testing would be conducted to identify and select an appropriate oxidant, application procedure, and optimize the rate of application.

Applying oxidant to this area could be achieved by installing permanent diffusive application points, screened across the entire area of interest, or screened above the fractured bedrock. Oxidant would be added to the application points and allowed to diffuse through soil and bedrock, potentially following similar pathways that historical releases of COCs have taken. Pre-design investigation activities were completed as previously described to determine the extent of COC impacts in the groundwater at AOC 1. As part of the selected alternative for AOC 1, these prior investigations would be augmented with two additional shallow B-zone groundwater monitoring wells installed outside and downgradient of the former degreaser area near soil boring SB-1b. Groundwater samples will be collected to determine the extent, if any, of affected shallow B-zone groundwater beyond the general vicinity of SB-1d where site-related VOCs were previously detected above groundwater standards in the A-zone.

5.3.4.2 Overall Protection of Human Health and the Environment

The implementation of ISCO to treat impacted groundwater at AOC 1 would meet the RAO of reducing the concentrations of VOCs. In addition, by targeting the soils impacted by COCs as well as groundwater, this alternative would also mitigate future impacts to groundwater.

5.3.4.3 Compliance with SCGs

Chemical-specific SCGs that may apply to groundwater at AOC 1 include the New York State Groundwater Quality Standards, which identify acceptable chemical constituent concentrations in groundwater. Chemical-specific SCGs that potentially apply to this alternative are presented in Table 3. This alternative could meet the requirements of this SCG.

Action-specific SCGs that may pertain to this option are associated with the storage and handling of oxidizing chemicals onsite. The federal and state rules and regulations associated with handling and storage of hazardous materials would need to be followed, and appropriate local, state, and federal permits obtained as required.

Process residuals generated during the implementation of the option (e.g., spent chemical oxidants removed from the extraction wells [if any]) would be characterized to determine the appropriate off-site disposal requirements. If any of the materials are characterized as a hazardous waste, then the RCRA, UTS/LDR, and USDOT requirements for the packaging, labeling, transportation, and disposal of hazardous or regulated materials may be applicable. Compliance with these requirements would be achieved by utilizing a licensed waste transporter and properly permitted disposal facilities. Action-specific SCGs that potentially apply to this alternative are presented in Table 4.

No location-specific SCGs were identified.

5.3.4.4 Long-Term Effectiveness and Permanence

With proper oxidant selection and application, VOCs can be effectively oxidized into non-toxic compounds and achieve the RAOs for groundwater in AOC 1. Thus, this alternative would provide for long-term effectiveness and permanence.

5.3.4.5 Reduction of Toxicity, Mobility, and Volume through Treatment

Successful implementation of this alternative would chemically oxidize the VOCs into innocuous constituents and thereby reduce the toxicity, mobility, and volume in groundwater at AOC.

5.3.4.6 Short-Term Effectiveness

Implementation of this alternative would not involve any short-term environmental impacts or risks to the community. Workers involved in implementing the remedy would be protected by the use of PPE or engineering controls, as specified in a site-specific HASP that would be developed during the remedial design. Air monitoring would be performed during implementation of this alternative to confirm the volatilized organic vapors are within acceptable levels, as specified in the site-specific HASP, thus minimizing any potential impacts to workers.

In addition the transportation and handling of chemical oxidants would be mitigated by adhering to the site-specific HASP and compliance with applicable local, state and federal chemical transportation, storage, and handling rules and regulations.

5.3.4.7 Implementability

This approach can readily be implemented as it would only require the installation of application points and a long-term monitoring program, which are easily established.

5.3.4.8 Cost

The capital costs associated with this alternative include site preparation, injection and monitoring well installation, pre-design testing, and introduction of an oxidant. The estimated total capital cost for this alternative is $490,000 and is based on the successful completion of pre-design testing. The estimated annual O&M for this alternative (rounded) is $48,000. This cost includes collecting groundwater samples from newly installed monitoring wells within AOC 1, as well as upgradient of this area and analyzing these groundwater samples semi-annually for COCs and other ISCO-related parameters. The present worth cost has been calculated assuming that annual groundwater monitoring activities are continued for a period of 5 years. The estimated present worth cost of this alternative is $687,000. A detailed breakdown of the estimated costs associated with this alternative is presented in Table 7.

5.4 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR SOIL – AOC 1

This section presents the detailed analysis of the remedial alternative for soil in AOC 1 identified in Section 5.1 against the criteria described in Section 5.2.

5.4.1 <u>Alternative 1 – No Action</u>

5.4.1.1 Technical Description

The no-action alternative serves as a baseline for comparison of the overall effectiveness of the other remedial alternatives. The no-action alternative does not involve the implementation of any remedial activities to address the COCs present in soil at AOC 1. The AOC would be allowed to remain in it current condition and no effort would be made to change the current site conditions.

5.4.1.2 Overall Protection of Human Health and the Environment

The no-action alternative does not address the impacted soil at AOC 1; therefore, the no-action alternative does not meet the RAOs for this AOC.

5.4.1.3 Compliance with SCGs

The chemical-specific SCGs identified for this alternative are presented in Table 3. Chemical-specific SCGs that may apply to soil at AOC 1 include the NYSDEC Subpart 375-6 Restricted Use SCO for Protection of Groundwater. This alternative would not meet this SCG.

This alternative does not involve the implementation of any remedial activities; therefore the action-specific and location-specific SCGs are not applicable.

5.4.1.4 Long-Term Effectiveness and Permanence

Under the no-action alternative, the COCs present in soil would not be addressed. As a result, this alternative would not meet the RAOs identified for this AOC.

5.4.1.5 Reduction of Toxicity, Mobility, and Volume through Treatment

Under the no-action alternative, the impacted soil at AOC 1, the toxicity, mobility, and volume of the COCs present in the impacted soil would not be reduced through treatment.

5.4.1.6 Short-Term Effectiveness

This alternative poses no short-term environmental impacts or risks to the community or workers.

5.4.1.7 Implementability

The no-action alternative is technically feasible and could be implemented at this AOC. This alternative would not require any permits to implement.

5.4.1.8 Cost

There are no costs associated with the no-action alternative.

5.4.2 Alternative 2 – Capping/Institutional Control

5.4.2.1 Technical Description

Capping of impacted soil at AOC 1 would involve maintaining a low-permeability cap across the area inside the building to prevent potential contact and exposure. The existing concrete slab inside the building is approximately 3 inches thick and is underlain by approximately 3 inches of base gravel material. Under this alternative, the existing concrete slab would be maintained and inspected at some frequency to ensure it remains intact. In addition, institutional controls, in the form of a deed restriction would be prepared and recorded to prevent disturbance of the concrete cap and a site management plan (SMP) would be developed and implemented. The institutional controls and site management plan would serve to:

- identify the use restrictions in AOC 1
- identify the operation and maintenance measures required for AOC 1
- identify actions that would need to be conducted in the event the area had to be accessed
- identify a groundwater monitoring program, including installing monitoring wells and sampling them on a regular basis

As part of the SMP an Institutional Control/Engineering Control (IC/EC) certification, prepared and submitted by a professional engineer or environmental professional would be prepared to document that the institutional and engineering controls have been put in place. The document would require periodic review to certify that site conditions are unchanged from the previous certification and that nothing has occurred that would impair the ability of the implemented control to protect public human health and the environment. The property owner would be required to submit an updated IC/EC as necessary.

5.4.2.2 Overall Protection of Human Health and the Environment

Maintaining a low-permeability cap across AOC 1 area would effectively isolate the impacted soils and eliminate the potential for human exposure however it would not comply with SCGs.

5.4.2.3 Compliance with SCGs

The chemical-specific SCGs identified for this alternative are presented in Table 3. This alternative would not comply with the chemical-specific SCGs (i.e., NYSDEC Subpart 375-6 Restricted Use SCO for Protection of Groundwater).

The action-specific SCGs identified for this alternative are presented in Table 4. Action-specific SCGs that apply to this alternative include health and safety requirements associated with the excavation and grading of the impacted surface soil, if present. Workers and worker activities that occur during implementation of this alternative must comply with OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting as identified in 20 CFR 1910, 20 CFR 1926 and 29 CFR 1904. NYS regulations pertaining to identifying, listing, and managing hazardous wastes may be applicable if it is determined through sampling and laboratory analysis, that there are constituents at hazardous concentrations in the asphalt, concrete and gravel materials that are removed. Compliance with action-specific SCGs would be accomplished by following a NYSDEC-approved remedial action work plan and site-specific HASP.

No location-specific SCGs were identified.

5.4.2.4 Long-Term Effectiveness and Permanence

In the long-term, capping would effectively mitigate the potential for exposure to affected soils by providing a physical barrier. Future subsurface excavation activities would require personal protection equipment in accordance with site-specific health and safety plans because disruption of soil could pose a physical risk. The cap would be maintained using readily available materials, repair and replacement of areas of the cap, if necessary, would easily be accomplished. However, it would not meet the RAOs for AOC-1.

5.4.2.5 Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative would not reduce the toxicity or volume of COCs but the cap would minimize the potential for VOCs in soil to be mobilized and migrate to the groundwater by minimizing or eliminating surface water infiltration.

5.4.2.6 Short-Term Effectiveness

Implementation of this alternative would not involve any short-term environmental impacts or risks to the community. Workers involved in implementing the remedy would be protected by the use of PPE or engineering controls, as specified in a site-specific HASP that would be developed during the remedial design. Air monitoring would be performed during implementation of this alternative to confirm the volatilized organic vapors are within acceptable levels, as specified in the site-specific HASP, thus minimizing any potential impacts to workers

5.4.2.7 Implementability

The capping alternative is technically and administratively feasible and easily implemented. The area inside the building is accessible for repair or modifications to the existing concrete and construction in the area is implementable.

5.4.2.8 Cost

The estimated capital cost for this alternative is $53,000. The capital cost includes modifying and/or repairing the existing concrete floor inside the building at this AOC. The estimated annual O&M for this alternative (rounded) is $6,000. This cost includes maintenance and repair of the cap, as necessary. The present worth cost has been calculated assuming that the cap will be maintained for a period of 30 years. The estimated present worth cost of this alternative is $127,000. A detailed breakdown of the estimated costs associated with this alternative is presented in Table 8.

5.5 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR GROUNDWATER – AOCS 4, 15, AND 24

This section presents a detailed analysis of the remedial alternatives for petroleum product present in groundwater at AOCs 4, 15, and 24 identified in Section 5.1 against the criteria described in Section 5.2. Due to the proximity of soil borings SB-1e and SB-1f, the petroleum product identified in these borings will be address as part of AOC 24.

5.5.1 Alternative 1 – No Action

5.5.1.1 Technical Description

The no-action alternative serves as a baseline for comparison of the overall effectiveness of the other remedial alternatives. Under this alternative the petroleum product in groundwater at AOCs 4, 15, and 24 would be allowed to remain in their current condition.

5.5.1.2 Overall Protection of Human Health and the Environment

The no-action alternative does meet the RAOs established for AOCs 4, 15, and 24.

5.5.1.3 Compliance with SCGs

The chemical-specific SCGs identified for this alternative are presented in Table 3. Chemical-specific SCGs that may apply to groundwater at AOCs 4, 15, and 24 include the NYSDEC DER-10 guidance applicable to the LNAPL (product). The no-action alternative does not comply with the DER-10 guidance which indicates that free product shall be treated or removed when practicable, or contained when treatment or removal is not practicable.

The action-specific and location-specific SCGs are not applicable for this alternative.

5.5.1.4 Long-Term Effectiveness and Permanence

The no-action alternative would not meet the RAOs identified for the AOCs.

5.5.1.5 Reduction of Toxicity, Mobility, and Volume through Treatment

Under the no-action alternative, petroleum product in groundwater at AOCs 4, 15, and 24 would be allowed to remain; therefore, there would be no reduction of toxicity, mobility, and volume through treatment.

5.5.1.6 Short-Term Effectiveness

Implementation of this alternative would not involve any short-term environmental impacts or risks to the community.

5.5.1.7 Implementability

The no-action alternative is technically and administratively feasible to implement; not permits would be required.

5.5.1.8 Cost

The no-action alternative does not involve any costs.

5.5.2 Alternative 2 – *In Situ* Chemical Oxidation

5.5.2.1 Technical Description

As previously described, ISCO involves the delivery of oxidants to the subsurface to oxidize constituents of concern to innocuous compounds such as carbon dioxide and chloride. Proven oxidants used to address thin layers of residual free product include hydrogen peroxide, iron-catalyzed hydrogen peroxide or Fenton's reagent, Modified Fenton's, potassium permanganate, and sodium persulfate. For this alternative permanent monitoring wells would be installed in AOCs 4, 15, and 24. An oxidant would be injected into wells where product is present on one or more occasions. Laboratory and pilot testing would be conducted to identify and select an appropriate oxidant, application procedure, and optimize the rate of application. This technology would only be appropriate for small amounts or thin layers of free product observed in monitoring wells. If significant thickness of free product is observed in monitoring wells, ISCO could be used to oxidize residual free product remaining in wells after the implementation of a more appropriate removal technology as discussed in Alternative 3.

The pre-design investigation activities discussed in Section 3 delineated the free product in AOCs 4, 15, and 24.

5.5.2.2 Overall Protection of Human Health and the Environment

Implementation of ISCO potentially may achieve the groundwater RAOs; however, it can also be utilized as a polishing technology coupled with the free product removal described in the next section. For this site, ISCO is considered more appropriate as a polishing technology and thus is further evaluated in conjunction with one of the other alternatives for AOCs 4, 15, and 24.

5.5.2.3 Compliance with SCGs

Implementing ISCO to treat petroleum product in groundwater at AOCs 4, 15, and 24 may achieve the chemical-specific SCG for this alternative.

The action-specific SCGs identified for this alternative are presented in Table 4. Action-specific SCGs that apply to this alternative include health and safety requirements associated with the excavation and grading of the impacted surface soil, if present. Workers and worker activities that occur during implementation of this alternative must comply with OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting as identified in 20 CFR 1910, 20 CFR 1926 and 29 CFR 1904. Compliance with action-specific SCGs would be accomplished by following a NYSDEC-approved remedial action work plan and site-specific HASP.

No location-specific SCGs were identified.

5.5.2.4 Long-Term Effectiveness and Permanence

Long-term effectiveness of ISCO is directly related to successful application throughout the impacted area. With proper oxidant selection and distribution, it is possible to treat thin layers of free product and achieve the RAOs for groundwater. There is uncertainty about the amount of product present in AOCs 4, 14, and 24 thus it is uncertain whether ISCO alone would be effective in the long-term and permanent.

5.5.2.5 Short-Term Effectiveness

Implementation of this alternative would not involve any short-term environmental impacts or risks to the community. Access to the treatment area would be limited to workers involved in the implementation and they would be protected by the use of PPE or engineering controls, as specified in a site-specific HASP that would be developed during the remedial design, thus minimizing any potential impacts to workers.

The risks associated with transportation and handling of chemical oxidants would be mitigated by adhering to the site-specific HASP and compliance with applicable local, state and federal chemical transportation, storage, and handling rules and regulations.

5.5.2.6 Implementability

This alternative is technically and administratively feasible. All materials are readily available. Laboratory and pilot testing could be completed in a short time frame.

5.5.2.7 Cost

The estimated capital cost for this alternative is $218,000. The capital costs associated with this alternative include installation of groundwater monitoring wells, purchase and application of oxidant (two injection events), and monitoring. The estimated annual O&M for this alternative (rounded) is $108,000 for groundwater monitoring. The present worth cost has been calculated assuming this alternative will be implemented for a period of 5 years. The estimated present worth cost of this alternative is $593,000. A detailed breakdown of the estimated costs associated with this alternative is presented in Table 9.

5.5.3 Alternative 3 – Free Product Removal and Offsite Treatment/Disposal

5.5.3.1 Technical Description

This alternative involves the physical removal and disposal of the LNAPL product on the groundwater in AOCs 4, 15, and 24. Methods for removing the product include using vacuum extraction directly into trucks specifically designed for this purpose, manual bailing, product-only recovery pumps, and/or absorbent socks. The product would be containerized and disposed of at an appropriately permitted facility. Product can be removed directly from wells or a collection sump that is installed in the area. Product recovery wells have been installed within each of these AOCs, as described in Section 3.

Product-only recovery pumps are not effective at removing thin layers of product. Depending on the thickness of the accumulated product in wells or sumps, methods of removal can be evaluated for suitability. One approach would be initially vacuuming or bailing out the floating layer of free product, and then installing absorbent socks to capture product that re-enters. If absorbent socks become NAPL saturated quickly because of large amounts of free product, relying only on vacuuming or bailing may be the most effective method. Certain removal methods such as vacuuming using a vacuum truck may not be implementable at AOC 4 due to it’s location of this area inside the facility building. Any approach will require monitoring the wells for free product using a product-level delineation meter to determine if product re-enters the monitoring wells or sumps.

5.5.3.2 Overall Protection of Human Health and the Environment

Implementation of free product removal and disposal at AOCs 4, 15, and 24 would meet the RAO of reducing the amount of product present in groundwater. In addition, this alternative would also minimize migration and reduce the volume of free product in the subsurface.

5.5.3.3 Compliance with SCGs

The chemical-specific SCG for this alternative would be met such that free product would be removed.

The action-specific SCGs identified for this alternative are presented in Table 4. Workers and worker activities that occur during implementation of this alternative must comply with OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting as identified in 20 CFR 1910, 20 CFR 1926 and 29 CFR 1904. Compliance with action-specific SCGs would be accomplished by following a NYSDEC-approved remedial action work plan and site-specific HASP.

No location-specific SCGs were identified.

5.5.3.4 Long-Term Effectiveness and Permanence

Product removal has been demonstrated to be an effective and permanent remedial technology. This alternative can meet the RAOs established for AOCs 4, 15, and 24. Under this alternative, the volume of free product in groundwater would be reduced through physical removal from groundwater.

5.5.3.5 Short-Term Effectiveness

Implementation of this alternative would not involve any short-term environmental impacts or risks to the community. Access to the AOCs would be limited to workers involved in the implementing the work and they would be protected by the use of PPE or engineering controls, as specified in a site-specific HASP that would be developed during the remedial design.

Handling and management of product removed from the subsurface would be freeing accordance with the site-specific HASP and applicable local, state and federal chemical transportation, storage, and handling rules and regulations, thus minimizing any potential impacts to workers.

Under this alternative, a limited amount of investigation derived waste would be generated; however, with proper management it would pose no risk to the community.

5.5.3.6 Implementability

Free product removal is technically and administratively feasible in AOCs 4, 15, and 24. Equipment is readily available and can be mobilized to the site in a short time-frame. In addition, a monitoring program is easily implemented.

5.5.3.7 Cost

The estimated capital cost for this alternative is $143,000. The capital costs associated with this alternative include installation either of extraction wells or collection sumps, removal equipment, and waste disposal costs. The estimated annual O&M for this alternative (rounded) is $108,000. This cost includes groundwater monitoring and periodic removal events, as necessary. The present worth cost has been calculated assuming that the product removal activities will be maintained for a period of 5 years. The estimated present worth cost of this alternative is $586,000. A detailed breakdown of the estimated costs associated with this alternative is presented in Table 10.

6 Comparative Analysis of Alternatives

6.1 GENERAL

This section presents a comparative analysis of each remedial alternative using the evaluation criteria presented in Section 5. The advantage and disadvantage of the alternatives relative to each other and with respect to the evaluation criteria are identified and the results used as a basis for recommending a remedial alternative for addressing the impacted media in each AOC.

Presented below is a comparative analysis of groundwater remedial alternatives for AOC 1, followed by a comparative analysis of soil remedial alternative for AOC 1, and finally a comparative analysis of groundwater remedial alternatives for petroleum product in AOCs 4, 15, and 24. The results of this comparative analysis will be used as the basis for recommending a remedial alternative to address each AOC.

6.2 COMPARATIVE ANALYSIS OF GROUNDWATER REMEDIAL ALTERNATIVES FOR AOC 1

The following section provides a comparative analysis of groundwater remedial alternatives for AOC 1 based on the evaluation criteria.

6.2.1 Overall Protection of Human Health and the Environment

All of the remedial alternatives for COCs in groundwater in AOC 1, with the exception of the no-action alternative, are protective of human health and the environment. Each alternative can achieve the RAOs, if properly designed for the site conditions. However, the MNA alternative (Alternative 2), *in situ* bioremediation alternative (Alternative 3), and *in situ* chemical oxidation alternative (Alternative 4) would provide better protection of the environment by providing greater reduction in the total mass of COCs.

6.2.2 Compliance with SCGs

All of the remedial alternatives for groundwater in AOC 1, with the exception of the no-action alternative, have the potential of meeting the SCGs. MNA (Alternative 2) depends on the presence and effectiveness of natural attenuation mechanisms, which would are necessary for meeting chemical-specific SCGs with this alternative. Alternatives 3 and 4 require proper design following pilot testing to ensure the alternatives can effectively achieve chemical-specific SCGs.

6.2.3 Long-Term Effectiveness and Permanence

The no-action alternative would not meet the RAOs established for the site. The remaining alternatives would meet the RAOs. However, Alternatives 3 and 4 would provide the greater long-term effectiveness since they would remove the COCs in groundwater. In addition, Alternatives 3 and 4 would result in improved groundwater quality in a much shorter period of time than Alternative 2 by actively treating the source. Alternative 2 would be effective in the long-term in combination with Alternative 3 or 4. Alternative 4 may require multiple applications of oxidant to successfully meet the RAOs. All alternatives would require long-term monitoring of groundwater quality.

6.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

The no-action alternative would not reduce the toxicity, mobility, or volume of COCs present in groundwater. Alternative 2 would not reduce the mobility of groundwater and reduction in toxicity and volume of COCs in groundwater would be controlled by the rate of natural attenuation processes. Alternatives 3 and 4 would reduce the toxicity, mobility, and volume of COCs because both involve an active treatment. However, only Alternative 4 would permanently eliminate COCs in groundwater.

6.2.5 Short-Term Effectiveness

There would be no short-term impacts associated with implementation of the no-action alternative. Alternatives 2, 3, and 4 and would not pose any short-term environmental impacts or risks to the community. For each, potential impacts to workers during implementation of the remedial actions would be addressed through the use of PPE or engineering controls, as specified in a site-specific HASP that would be developed during the remedial design.

Handling and management of risk relative to exposure to materials and wastes associated with each remedial alternative would be addressed in the site-specific HASP and applicable local, state and federal chemical transportation, storage, and handling rules and regulations, thus minimizing any potential impacts to workers.

6.2.6 Implementability

All of the remedial alternatives are technically and administratively feasible to implement. Materials and equipment associated with each are readily available. Alternatives 3 and 4 require pilot testing to determine the suitability of the subsurface matrix for these technologies which can readily be implemented in a short time frame. The effectiveness of each alternative would be monitored through a monitoring program which is readily implemented.

6.2.7 Estimated Cost

The no-action alternative has no associated cost. The estimated cost for Alternative 2 is $541,000; Alternative 3 is $728,000, and Alternative 4 is $687,000. A detailed breakdown of cost estimates is presented in Tables 5 through 7.

6.3 COMPARATIVE ANALYSIS OF SOIL REMEDIAL ALTERNATIVES FOR AOC 1

The following section provides a comparative analysis of soil remedial alternatives for AOC 1 based on the evaluation criteria.

6.3.1 Overall Protection of Human Health and the Environment

The no-action alternative would not be protective of human health and the environment. Alternative 2, which consists of a cap, would prevent potential human contact with impacted soil. In addition, institutional controls in the form of a deed restriction would be prepared and recorded to prevent disturbance of the concrete cap, and an SMP would be developed and implemented. These actions would provide for future protection of human health and the environment.

6.3.2 Compliance with SCGs

The no-action alternative would not meet the SCGs for soil in AOC 1. Alternative 2 would not meet the chemical-specific SCG of removing the source area in soil. Action-specific SCGs would be met during implementation of Alternative 2 by establishing site-specific HASP and developing institutional controls, in the form of a deed restriction to prevent disturbance of the concrete cap and an SMP.

There are no applicable location-specific SCGs.

6.3.3 Long-Term Effectiveness and Permanence

The no-action alternative would not meet the RAOs established for the site. Alternative 2 would mitigate the potential for contact with impacted soil in the long-term by providing a physical barrier. A maintenance plan would be developed to ensure the integrity of the cap is maintained in the future. In addition, institutional controls, in the form of a deed restriction would be prepared and recorded to prevent disturbance of the concrete cap and an SMP would be developed and implemented. These actions would provide for long-term protection of human health and the environment.

6.3.4 Reduction of Toxicity, Mobility, and Volume through Treatment

The no-action alternative would not reduce the toxicity, mobility, or volume of COCs present in soil. Alternative 2 would not reduce the toxicity and volume of COCs in soil but mobility would be minimized by the cap.

6.3.5 Short-Term Effectiveness

The no-action alternative poses no risk to the community or workers. Similarly, Alternative 2 (cap) poses no risk to the community and potential risks to workers during implementation of the remedy would be minimized through strict adherence to requirements of the site-specific HASP.

6.3.6 Implementability

Both alternatives (No Action and Cap) are technically and administratively easy to implement. However, the effectiveness of the no-action alternative would not be monitored compared to Alternative 2 which would involve a implementing an operation and maintenance plan.

6.3.7 Estimated Cost

The no-action alternative has no associated cost. The estimated cost for Alternative 2 is $127,000. A detailed breakdown of cost estimates for these alternatives is presented in Table 8.

6.4 COMPARATIVE ANALYSIS OF GROUNDWATER REMEDIAL ALTERNATIVES FOR FREE PRODUCT IN AOCS 4, 15, AND 24

The following section provides a comparative analysis of remedial alternative for free product in groundwater for AOCs 4, 15, and 24 based on the seven evaluation criteria.

6.4.1 Overall Protection of Human Health and the Environment

All of the remedial alternatives evaluated for free product in groundwater in AOC 4, 15, and 24, with the exception of the no-action alternative, have the potential to be protective of human health and the environment. Alternative 2 may not achieve the groundwater RAOs as a stand-alone technology; however, it could be used as a polishing technology coupled with the free product removal technology. Alternative 3 would meet the RAO of reducing the amount of product present in groundwater and would minimize migration by removing the source from groundwater.

6.4.2 Compliance with SCGs

All of the remedial alternatives for groundwater in AOCs 4, 15, and 24, with the exception of the no-action alternative, have the potential of meeting the SCGs. Action-specific SCGs can be met for Alternatives 2 and 3 with implementation of engineering controls and a site-specific HASP. Chemical-specific SCGs for Alternative 2 would be met because free product would be destroyed through oxidation and for Alternative 3 would be met through free product removal.

6.4.3 Long-Term Effectiveness and Permanence

The no-action alternative would not meet the RAOs established for the site. The remaining alternatives would meet the RAOs. Alternative 2 (ISCO) would oxidize the petroleum and provide for permanence. Alternative 3 would remove the petroleum product and thus provide for permanence. Under Alternatives 2 and 3, monitoring would be performed to evaluate the effectiveness of the remedy and determine when and if follow-up actions are necessary.

6.4.4 Reduction of Toxicity, Mobility, and Volume through Treatment

The no-action alternative would not reduce the toxicity, mobility, or volume of COCs present in groundwater. Implementation of ISCO (Alternative 2) would reduce the toxicity, mobility, and volume of free product in impacted groundwater at AOCs 4, 15, and 24 by destroying or transforming the product. Alternative 3 would reduce the volume of free product through physical removal and also minimizes the mobility of the product in groundwater. The results of the pre-design investigation indicate that product is only present in discrete locations, so migration of a product plume may not be an issue.

6.4.5 Short-Term Effectiveness

The no-action alternative poses no risk to the community or workers. Similarly, Alternatives 2 (ISCO) and 3 (Product Removal) pose no risk to the community and potential risks to workers during implementation of the remedy would be minimized through strict adherence to requirements of the site-specific HASP. Potential risks associated with management of materials used in this alternative and any wastes also would be addressed in the site-specific HASP as well as comply with applicable local, state and federal transportation, storage, and handling rules and regulations.

6.4.6 Implementability

All of the remedial alternatives are technically and administratively feasible to implement. Materials and equipment are readily available and can be readily mobilized to the site. ISCO would require pre-design work and testing to select the proper oxidant that is compatible with the soil and bedrock matrix (if determined to be impacted) of the AOCs. Alternatives 2 and 3 require a monitoring program, which is easily implemented.

6.4.7 Estimated Cost

The no-action alternative has no associated cost. The estimated cost for implementing Alternative 2 is $593,000. The estimated cost for implementing Alternative 3 is $586,000. A detailed breakdown of cost estimates for these alternatives can be found in Tables 9 and 10.

6.5 RECOMMENDED ALTERNATIVES

The following sections describe the recommended alternative for each AOC.

6.5.1 AOC 1 – Groundwater

The recommended remedial alternative to address the dissolved VOCs in groundwater in AOC1 is ISCO followed by MNA (Alternatives 4 and 2). ISCO involves the application a chemical oxidant to transform the VOCs to innocuous compounds. Chemical oxidants have a limited life-span in the aquifer and their effectiveness is limited to dissolved VOCs. Approximately half of the COC mass is sorbed to saturated soils and will slowly desorb from site soils. Following the ISCO remedy, MNA is recommended to address the remaining VOCs. Naturally-occurring conditions that support reductive dechlorination of COCs can be maintained for long periods and effectively treat COCs as they desorb from the soil. ISCO generally leads to an increase in dissolved organic carbon which can be used by native microbes to reductively dechlorinate site-related COCs.

Pilot testing will be completed to identify full-scale design criteria. ISCO pilot testing will involve collecting site soil and groundwater and performing a series of bench-scale tests to identify the oxidant demand, and the potential to mobilize metals in oxidizing conditions. It is anticipated that base-activated persulfate will be tested because it has the capability of oxidizing all the VOCs present and is less likely to inhibit bioremediation as compared to other oxidants such as permanganate.

As part of the recommended alternative, two shallow B-zone groundwater monitoring wells will be installed outside and downgradient of the former degreaser area in AOC 1 near soil boring SB-1e. Groundwater samples will be collected to determine the extent, if any, of affected shallow B-zone groundwater beyond the general vicinity of SB-1d where site-related VOCs were previously detected above groundwater standards in the A-zone. The area of affected groundwater within the A-zone is defined; however, the degree to which the B-zone is affected in AOC 1 has not been fully characterized.

Two proposed wells will be installed to fill this data gap. The selected remedial approach for groundwater in AOC 1 may be modified or changed depending on the results of groundwater samples collected from the proposed new B-zone monitoring wells.

The estimated cost for Alternative 2 is $541,000 and Alternative 4 is $687,000. A detailed breakdown of cost estimates is presented in Tables 5 through 7.

6.5.2 AOC 1 - Soil

The recommended alternative for addressing soil in AOC 1 is capping and institutional controls (Alternative 2). Capping and institutional controls will achieve the RAO of preventing exposure to affected soil and limiting future contact. Also, the SMP will outline the procedures necessary for maintaining a containment cap and control potential exposure in the event of future actions in this AOC.

The estimated capital cost for this alternative is $53,000.

6.5.3 AOCs 4, 15, and 24

The recommended alternative for addressing free product in AOCs 4, 15, and 24 is removal (Alternative 3). This technology will achieve the RAO for these AOCs without altering subsurface conditions and is also cost effective. Further evaluation will be conducted to determine the product thickness at each AOC and the appropriate removal technology (wells or collection sumps). The estimated cost for implementing Alternative 3 is $586,000.

The recommended removal techniques would be manual bailing or vacuuming out free product, and possibly installing absorbent socks to capture any free product between removal events. If there is a significant thickness of product, a product-only pump or vacuum truck is recommended. If there is a limited thickness of product, just greater than a sheen, manual bailing is the recommended removal method. After the initial product removal event, absorbent socks will be placed in the product collection points to capture any product re-entering the wells between the initial removal event and scheduled monitoring events. Depending on the results of the first monitoring event, if the layer of product approaches a sheen, evaluating an oxidant to polish off the sheen could be recommended. Applying an oxidant to the sheen will require some pre-design work to ensure proper oxidant selection and determine its effectiveness in destroying the product. After product has been successfully eliminated, monitoring events will continue for a scheduled time to ensure there is no movement of product into the monitoring points.

Acronyms

µg/kg	micrograms per kilogram
AOC	area of concern
AST	aboveground storage tank
bgs	below ground surface
COC	constituents of concern
CVOC	chlorinated volatile organic compound
DCE	dichloroethene
EPA	U.S. Environmental Protection Agency
EPT	Emerson Power Transmission
HASP	Health and Safety Plan
IC/EC	Institutional Control/Engineering Control
ISCO	*in situ* chemical oxidation
LNAPL	light non-aqueous phase liquid
mg/kg	milligrams per kilogram
MNA	monitored natural attenuation
NYSDEC	New York State Department of Environmental Conservation
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
RAOs	remedial action objectives
RCRA	Resource Conservation and Recovery Act
SCGs	standards, criteria, and guidance
SCO	Soil Cleanup Objectives
SMP	Site Management Plan
SRP/AA	Supplemental Remedial Program/Alternatives Analysis
TBC	to-be-considered
TCE	trichloroethene
USDOT	U.S. Department of Transportation
VOC	volatile organic compounds

Figures

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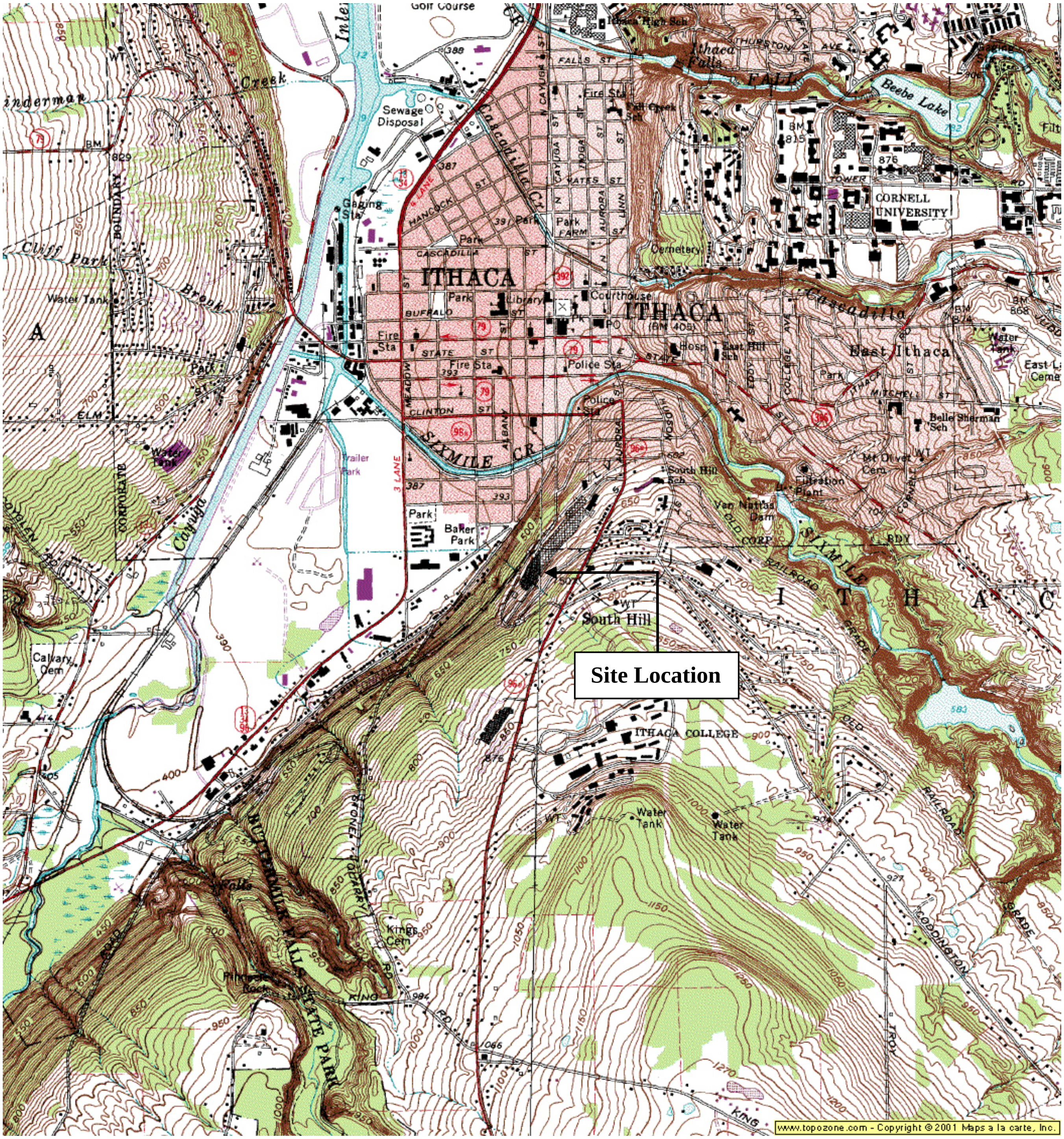
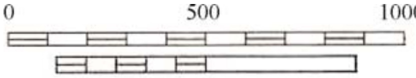


Reference
7.5 Minute Series Topographic Quadrangle
Ithaca East, New York
Photorevised 1976 Scale 1:25,000 Metric

N

Quadrangle Location

Scale in Meters



Scale in Feet

WSP ENGINEERING OF NEW YORK, P.C.

11190 Sunrise Valley Drive,
Suite 300
Reston, VA 20191
(703) 709-6500

Figure 1
Site Location
Emerson Power Transmission
Ithaca, New York

Drawn By: EGC

Checked:

Approved:

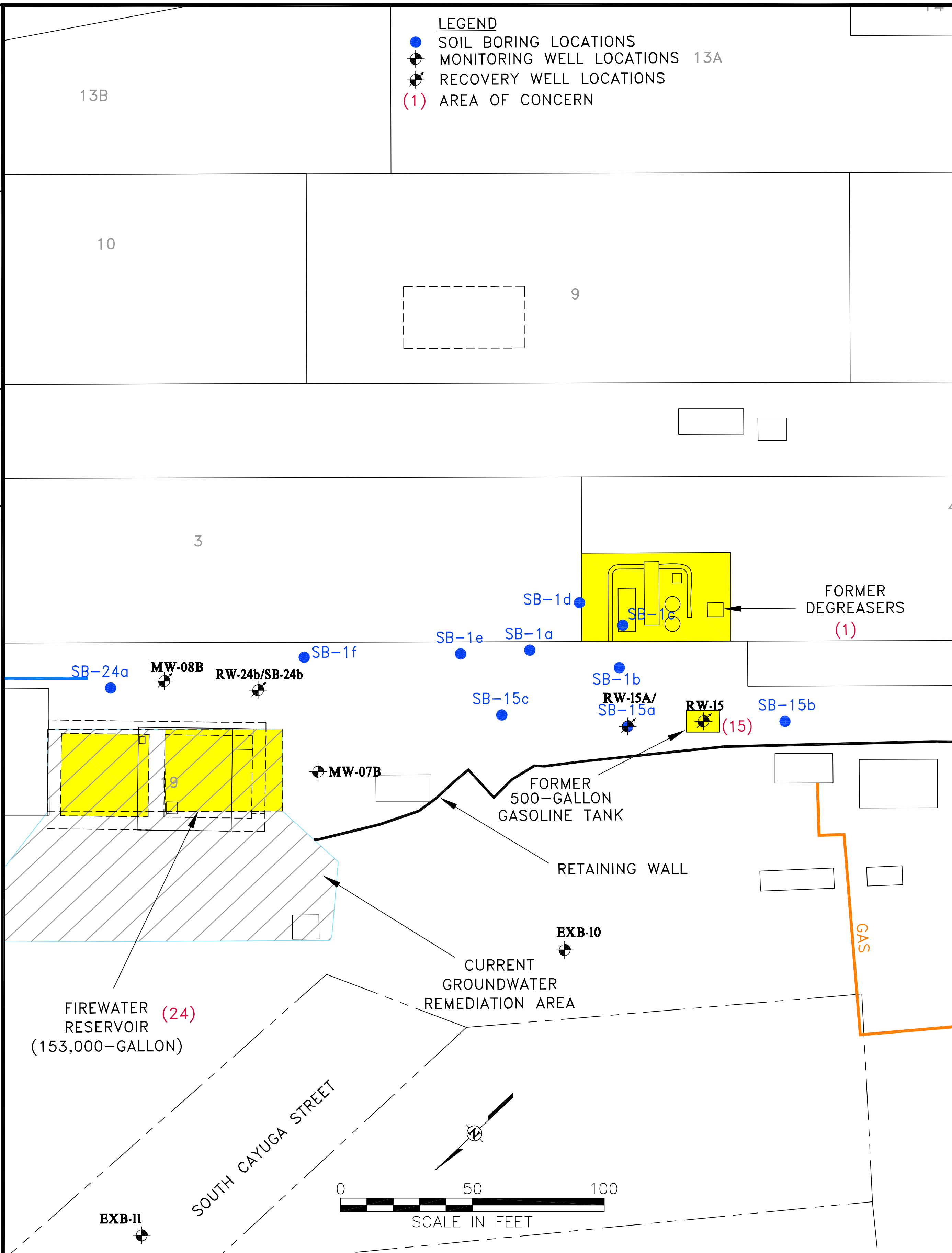
DWG Name: 127491326

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK
PREPARED FOR
EMERSON POWER TRANSMISSION

FIGURE 2

SITE LAYOUT

WSP
ENGINEERING OF
NEW YORK, P.C.
11190 SUNRISE VALLEY DRIVE SUITE 300
RESTON, VIRGINIA 20191 (703) 709-6500



DWG Name: 127491373

Checked:

Approved:

Drawn By: EGC

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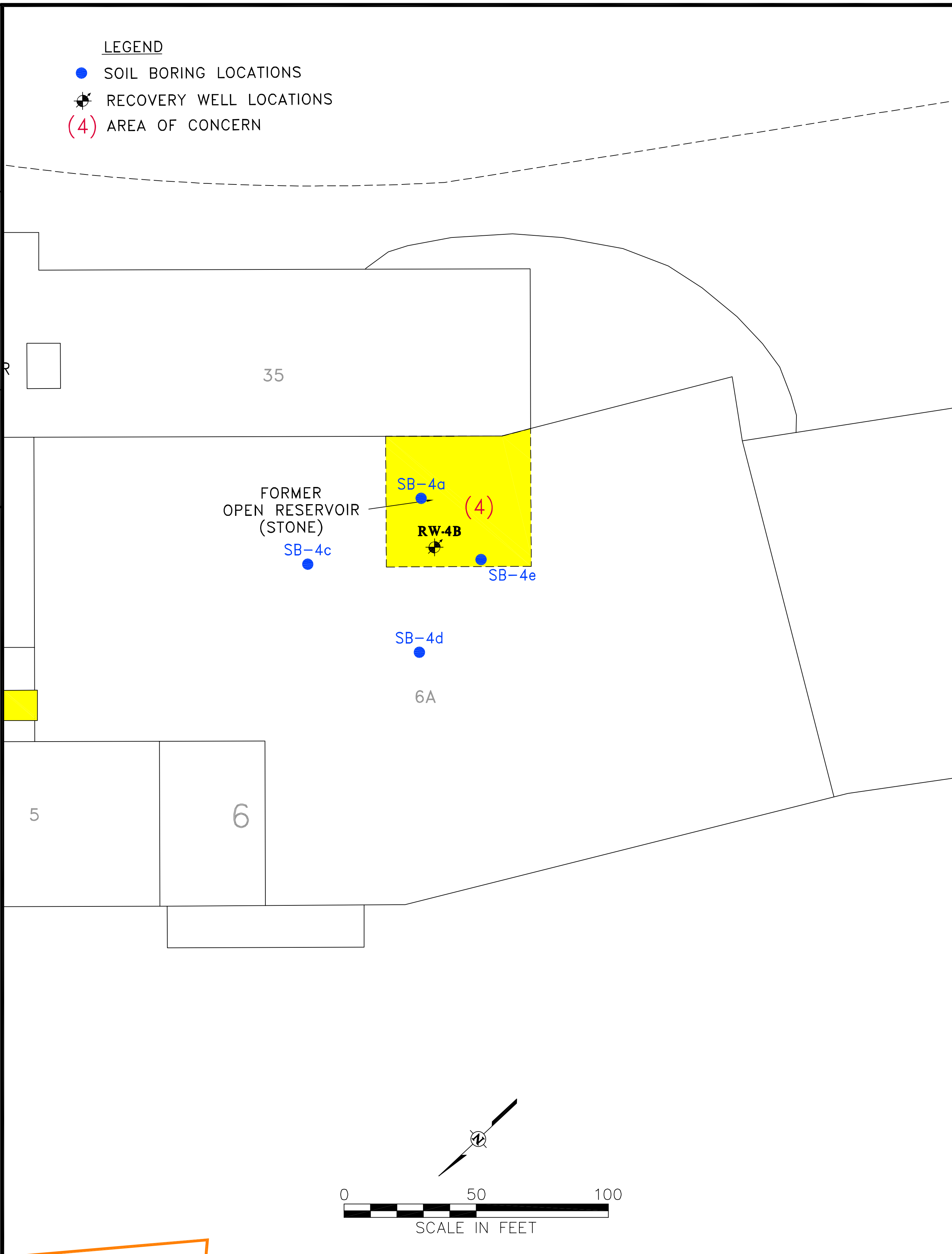
FIGURE 3

SOIL BORING LOCATIONS FOR AOCS 1, 15 AND 24

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK

PREPARED FOR
EMERSON POWER TRANSMISSION



DWG Name: 127491373

Checked:

Approved:

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FIGURE 4

SOIL BORING LOCATIONS
FOR AOC 4

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK

PREPARED FOR
EMERSON POWER TRANSMISSION

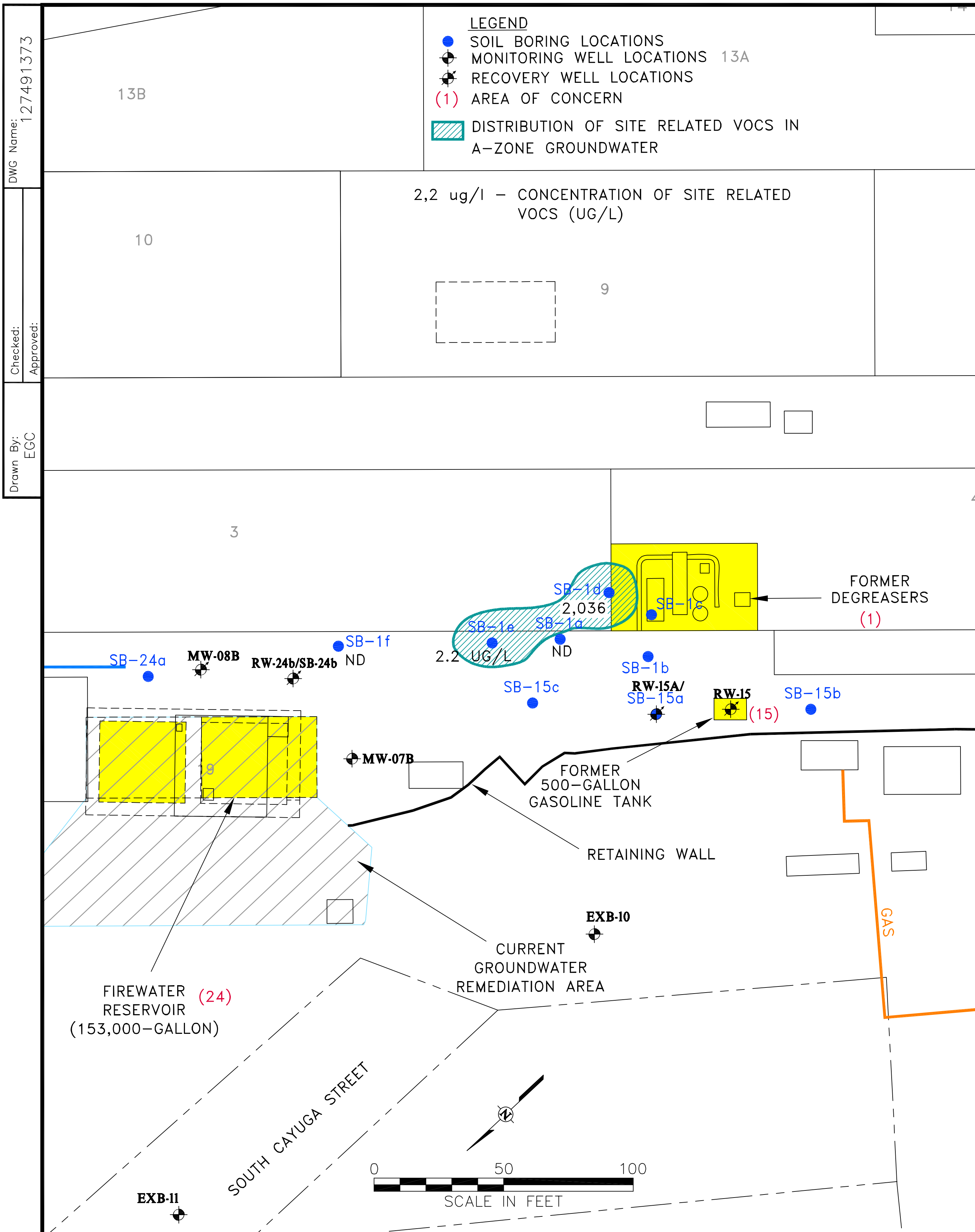

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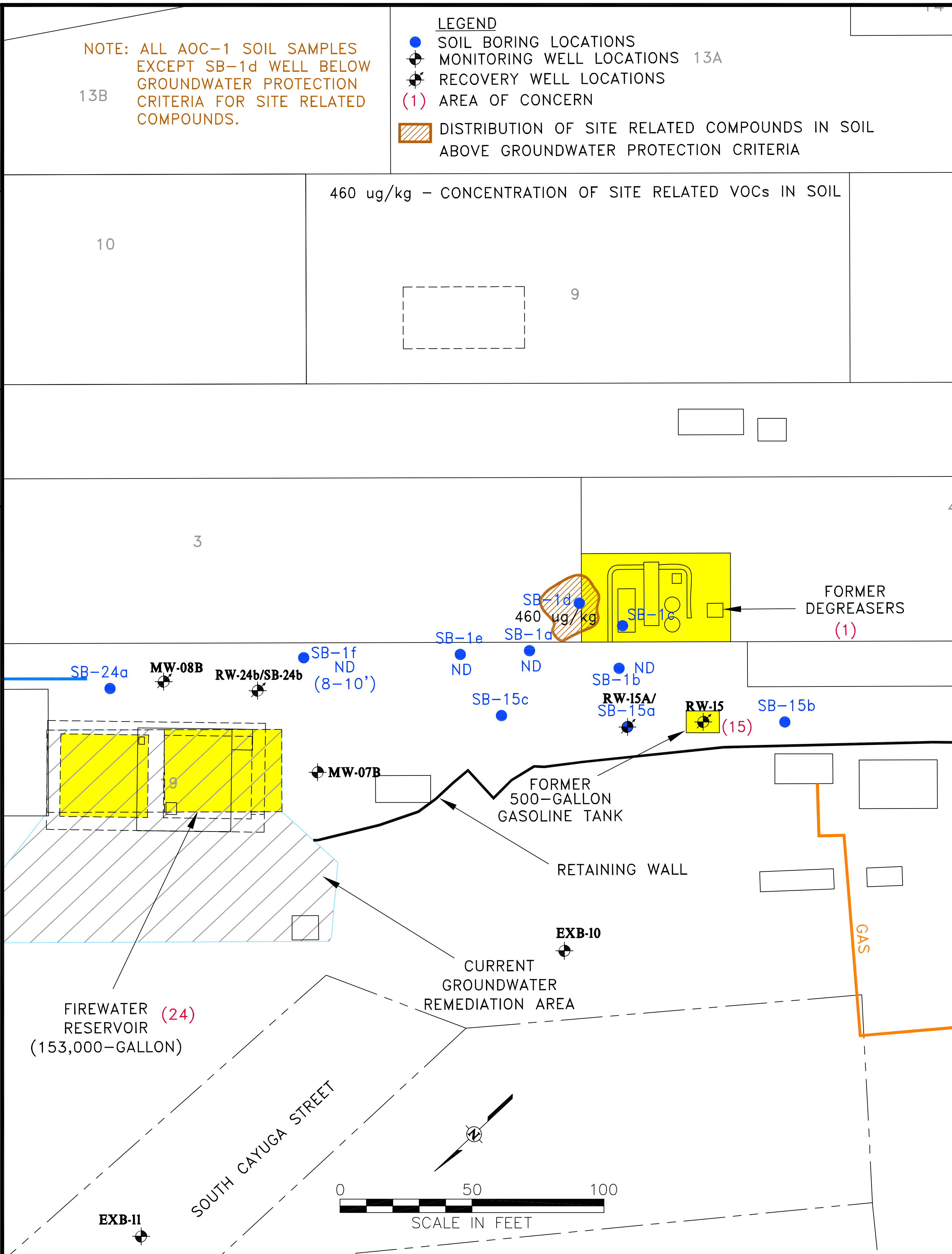
FIGURE 5

AOC-1 DISTRIBUTION OF SITE RELATED VOCS IN A-ZONE GROUNDWATER

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK

PREPARED FOR
EMERSON POWER TRANSMISSION



DWG Name: 127491373

Checked:

Approved:

Drawn By: EGC

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FIGURE 6

DISTRIBUTION OF COMPOUNDS IN SOIL AT AOC 1

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK

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EMERSON POWER TRANSMISSION

DWG Name: 127491373
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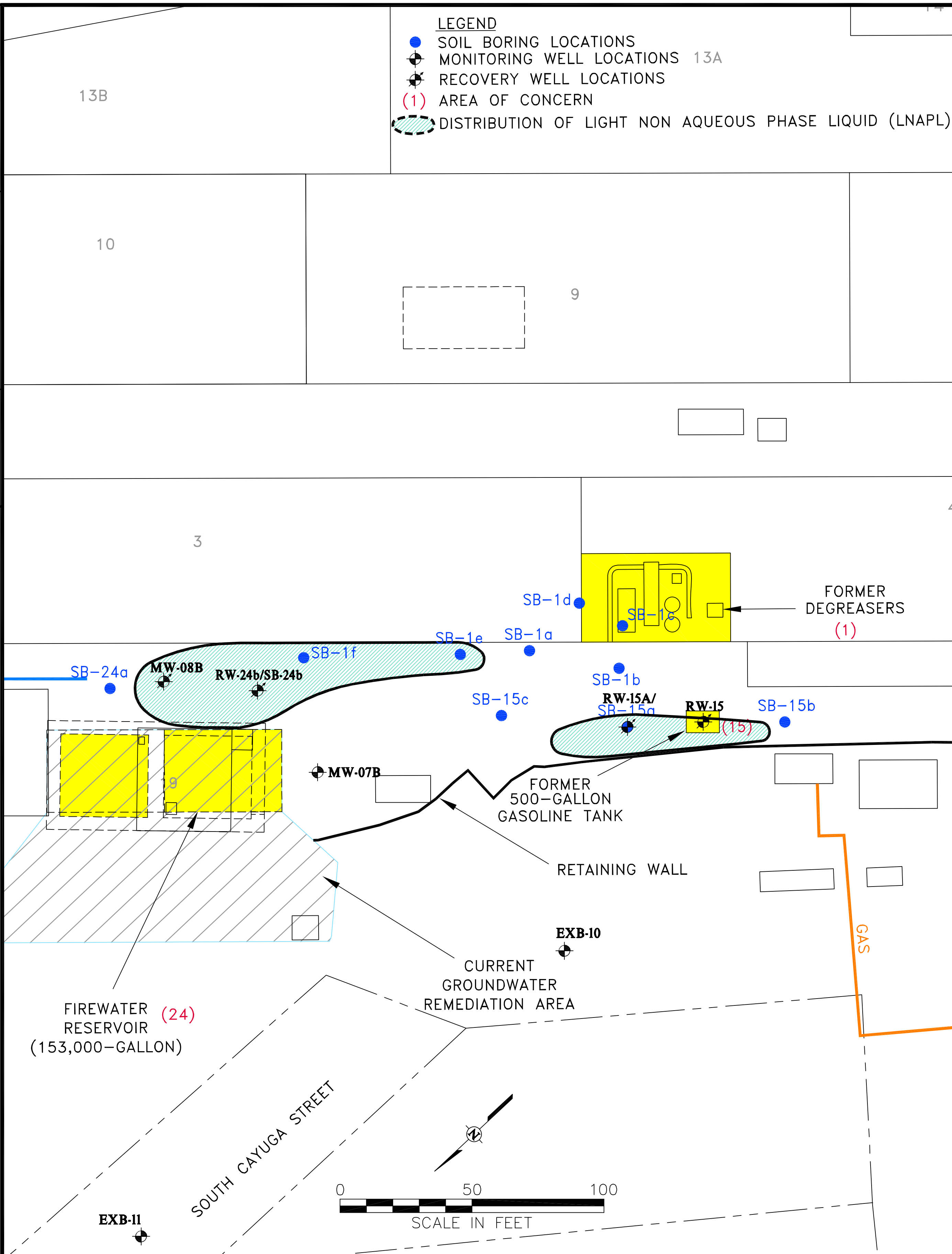

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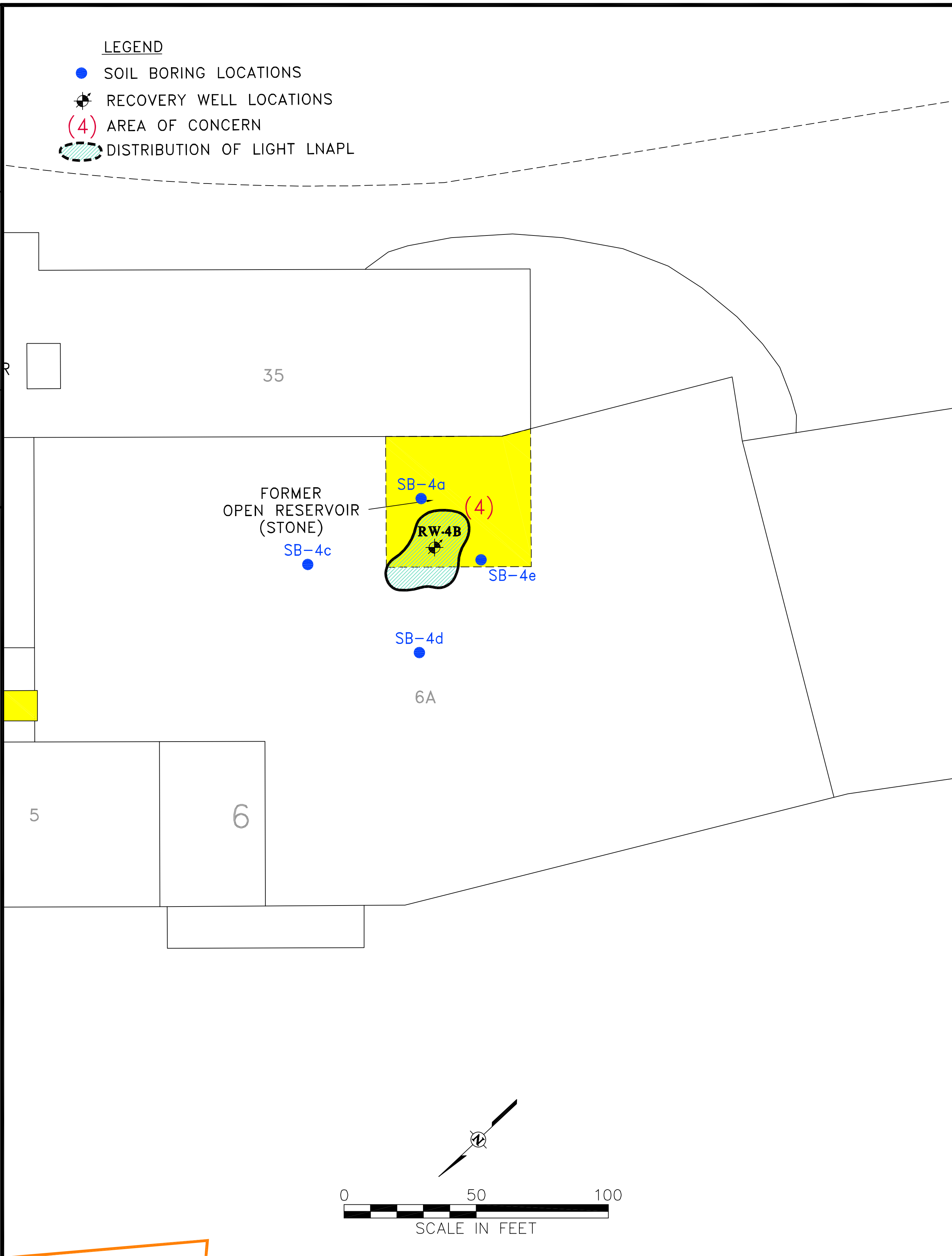
FIGURE 7

DISTRIBUTION OF LNAPL
FOR AOCS 15 AND 24

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK

PREPARED FOR
EMERSON POWER TRANSMISSION



DWG Name: 127491373

Checked:

Approved:

Drawn By: EGC

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FIGURE 8

DISTRIBUTION OF LNAPL AND RECOVERY WELL LOCATIONS – (AOC 4)

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK

PREPARED FOR
EMERSON POWER TRANSMISSION

Tables

Table 1

Soil Sample Results for AOCs 1, 4, 15, and 24
Pre-Design Investigations
August 2007 and June 2008 (a)
Emerson Power Transmission Facility
Ithaca, New York

			AOC 1							
Sample ID:	**NYSDEC Subpart 375-6 - Industrial**	**NYSDEC Subpart 375-6 - Protection of Groundwater**	**SB-1a**	**SB-1b**	**SB-1c**	**SB-1d**	**SB-1e**	**SB-1e** (b)	**SB-1F**	**SB-1F** (b)
Sample Type:										
Sampling Date:			**08/21/07**	**08/21/07**	**08/21/07**	**08/21/07**	**06/03/08**	**06/03/08**	**06/03/08**	**06/03/08**
Depth (feet):			**8-10**	**12-13.3**	**8-9**	**11-12**	**8-10**	**10-12**	**8-10**	**12-12.6**
VOCs (µg/Kg)										
Acetone	1,000,000	50	30 U	25 U	11 J	710 U	**120**	**77**	**92**	**140**
Carbon disulfide	NT	NT	2 J	1 J	2 J	150	5.6 U	5.2 U	5.5 U	5.7 U
cis-1,2-Dichloroethylene	1,000,000	250	6 U	2 J	5 U	130 J	5.6 U	12 U	5.5 U	11
Isopropyl Benzene	NT	NT	6 U	5 U	5 U	140 U	5.6 U	5.2 U	5.5 U	5.7 U
Methyl Acetate	NT	NT	6 U	5 U	5 U	210	5.6 U	12 U	5.5 U	5.7 U
Methylene chloride	1,000,000	50	27	23	11	**170**	11 U	12 U	9.3 U	8 U
Tetrachloroethene	300,000	1,300	1 J	2 J	2 J	140 U	5.6 U	12 U	5.5 U	5.7 U
Toluene	1,000,000	700	6 U	5 U	5 U	140 U	5.6 U	7.1	180	7.7
Trichloroethene	400,000	470	12	28	6	73 J	5.6 U	5.2 U	5.5 U	9.2
Vinyl chloride	27,000	20	12 U	10 U	10 U	**290**	11 U	10 U	11 U	11 U
Hydrocarbons (mg/kg)										
Fuel oil no. 2	NT	NT	NA	NA	NA	NA	NA	120 U	NA	12 U
Other-1	NT	NT	NA	NA	NA	NA	NA	120 U	NA	12 U
TPH (Motor Oil Range)	NT	NT	NA	NA	NA	NA	NA	2,800	NA	680

a/ NA - not analyzed J - estimated value
NT - no standard U - not detected
b/ A petroleum odor and oily sheen were noted on the soils during installation of the boring
c/ SB-4B was re-named MW-4B following well installation
SB-15 was re-named MW-15 following well installation
SB-15a was re-named MW-15a following well installation
SB-24b was re-named MW-24b following well installation
d/ Only product samples (product saturated soils) were collected and analyzed from these borings.
e/ Boring name on chain of custody was MW-24a; however, no monitoring well was installed in this boring.
Note: **Bold** values exceed a New York State Subpart 375-6 criteria

Table 1

Soil Sample Results for AOCs 1, 4, 15, and 24
Pre-Design Investigations
August 2007 and June 2008 (a)
Emerson Power Transmission Facility
Ithaca, New York

			AOC 4						
Sample ID:	**NYSDEC Subpart 375-6 - Industrial**	**NYSDEC Subpart 375-6 - Protection of Groundwater**	**SB-4a**	**SB-4b**	**SB-4B** (c,d)	**SB-4c**	**SB-4c**	**SB-4d**	**SB-4e**
Sample Type:							**DUP**		
Sampling Date:			**08/29/07**	**08/29/07**	**06/11/08**	**06/12/08**	**06/12/08**	**06/12/08**	**06/12/08**
Depth (feet):			**0.5-1**	**7-8**	**8-9.8**	**0.5-1**	**0.5-1**	**0.5-1.8**	**3-3.9**
VOCs (µg/Kg)									
Acetone	1,000,000	50	12 J	26 U	50	39	28	25 U	26 U
Carbon disulfide	NT	NT	25 U	26 U	5.7 U	5.6 U	5.7 U	5 U	5.2 U
cis-1,2-Dichloroethylene	1,000,000	250	5 U	5 U	5.7 U	5.6 U	5.7 U	5 U	5.2 U
Isopropyl Benzene	NT	NT	5 U	5 U	5.7 U	5.6 U	5.7 U	5 U	5.2 U
Methyl Acetate	NT	NT	5 U	5 U	5.7 U	5.6 U	5.7 U	5 U	5.2 U
Methylene chloride	1,000,000	50	39	18	6.2	5.6 U	5.7 U	9.7	6.7
Tetrachloroethene	300,000	1,300	1 J	5 U	5.7 U	5.6 U	5.7 U	5 U	5.2 U
Toluene	1,000,000	700	5 U	5 U	5.7 U	5.6 U	5.7 U	5 U	5.2 U
Trichloroethene	400,000	470	5 U	5 U	5.7 U	5.6 U	5.7 U	5 U	5.2 U
Vinyl chloride	27,000	20	10 U	10 U	11 U	11 U	11 U	10 U	10 U
Hydrocarbons (mg/kg)									
Fuel oil no. 2	NT	NT	NA	NA	2,100	NA	NA	NA	NA
Other-1	NT	NT	NA	NA	600 U	NA	NA	NA	NA
TPH (Motor Oil Range)	NT	NT	NA	NA	7,600	NA	NA	NA	NA

a/ NA - not analyzed J - estimated value
NT - no standard U - not detected
b/ A petroleum odor and oily sheen were noted on the soils during insta
c/ SB-4B was re-named MW-4B following well installation
SB-15 was re-named MW-15 following well installation
SB-15a was re-named MW-15a following well installation
SB-24b was re-named MW-24b following well installation
d/ Only product samples (product saturated soils) were collected and ar
e/ Boring name on chain of custody was MW-24a; however, no monitori
Note: **Bold** values exceed a New York State Subpart 375-6 criteria

Table 1

Soil Sample Results for AOCs 1, 4, 15, and 24
Pre-Design Investigations
August 2007 and June 2008 (a)
Emerson Power Transmission Facility
Ithaca, New York

			AOC 15					
Sample ID:	**NYSDEC Subpart 375-6 - Industrial**	**NYSDEC Subpart 375-6 - Protection of Groundwater**	**SB-15**	**SB-15** (c,d)	**SB-15a**	**SB-15a** (c,d)	**SB-15b**	**SB-15c**
Sample Type:								
Sampling Date:			**06/05/08**	**06/05/08**	**06/03/08**	**06/04/08**	**06/04/08**	**06/09/08**
Depth (feet):			**12-14**	**24-25.4**	**10-12**	**22-22.4**	**16-18**	**12-14**
VOCs (µg/Kg)								
Acetone	1,000,000	50	**310**	**54**	**52**	**79**	**74**	41
Carbon disulfide	NT	NT	5.7 U	5.4 U	5.8 U	10 U	5.8 U	5.6 U
cis-1,2-Dichloroethylene	1,000,000	250	5.7 U	5.4 U	5.8 U	42	5.8 U	5.6 U
Isopropyl Benzene	NT	NT	5.7 U	5.4 U	5.8 U	38	5.8 U	5.6 U
Methyl Acetate	NT	NT	5.7 U	5.4 U	5.8 U	10 U	5.8 U	5.6 U
Methylene chloride	1,000,000	50	22	7	8.8 U	10 U	9.2 U	6.6
Tetrachloroethene	300,000	1,300	5.7 U	5.4 U	5.8 U	10 U	5.8 U	5.6 U
Toluene	1,000,000	700	5.7 U	5.4 U	5.8 U	7.5 U	5.8 U	5.6 U
Trichloroethene	400,000	470	7	5.4 U	8.2	13	5.8 U	5.6 U
Vinyl chloride	27,000	20	11 U	11 U	12 U	**21**	12 U	11 U
Hydrocarbons (mg/kg)								
Fuel oil no. 2	NT	NT	NA	580 U	NA	590 U	NA	NA
Other-1	NT	NT	NA	1,300	NA	590 U	NA	NA
TPH (Motor Oil Range)	NT	NT	NA	5,700	NA	13,000	NA	NA

a/ NA - not analyzed J - estimated value
NT - no standard U - not detected
b/ A petroleum odor and oily sheen were noted on the soils during insta
c/ SB-4B was re-named MW-4B following well installation
SB-15 was re-named MW-15 following well installation
SB-15a was re-named MW-15a following well installation
SB-24b was re-named MW-24b following well installation
d/ Only product samples (product saturated soils) were collected and ar
e/ Boring name on chain of custody was MW-24a; however, no monitori
Note: **Bold** values exceed a New York State Subpart 375-6 criteria

Table 1

Soil Sample Results for AOCs 1, 4, 15, and 24
Pre-Design Investigations
August 2007 and June 2008 (a)
Emerson Power Transmission Facility
Ithaca, New York

			AOC 24		
Sample ID:	**NYSDEC Subpart 375-6 - Industrial**	**NYSDEC Subpart 375-6 - Protection of Groundwater**	**SB-24a** (e)	**MW-24B**	**MW-24B** (c,d)
Sample Type:					
Sampling Date:			**06/10/08**	**06/05/08**	**6/5/2008**
Depth (feet):			**10-10.1**	**8-10**	**12-12.4**
VOCs (µg/Kg)					
Acetone	1,000,000	50	50	27 U	**59**
Carbon disulfide	NT	NT	5.3 U	5.3 U	5.3 U
cis-1,2-Dichloroethylene	1,000,000	250	5.4 U	5.3 U	5.3 U
Isopropyl Benzene	NT	NT	5.4 U	5.3 U	5.3 U
Methyl Acetate	NT	NT	5.3 U	5.3 U	5.3 U
Methylene chloride	1,000,000	50	8.2	8.1	5.8
Tetrachloroethene	300,000	1,300	5.3 U	5.3 U	5.3 U
Toluene	1,000,000	700	5.4 U	5.3 U	5.3 U
Trichloroethene	400,000	470	24	35	42
Vinyl chloride	27,000	20	11 U	11 U	11 U
Hydrocarbons (mg/kg)					
Fuel oil no. 2	NT	NT	NA	NA	U
Other-1	NT	NT	NA	NA	U
TPH (Motor Oil Range)	NT	NT	NA	NA	1,600

a/ NA - not analyzed J - estimated value
NT - no standard U - not detected
b/ A petroleum odor and oily sheen were noted on the soils during insta
c/ SB-4B was re-named MW-4B following well installation
SB-15 was re-named MW-15 following well installation
SB-15a was re-named MW-15a following well installation
SB-24b was re-named MW-24b following well installation
d/ Only product samples (product saturated soils) were collected and ar
e/ Boring name on chain of custody was MW-24a; however, no monitori
Note: **Bold** values exceed a New York State Subpart 375-6 criteria

Table 2

Water Sample Results
Pre-Design Investigations
Emerson Power Transmission Site
Ithaca, New York

Sample ID:	**TOGS 1.1.1, Table 1, Ambient Water Quality Standards and Guidance Values (a)**	**SB-1A**	**SB-1D**	**SB-1E**	**SB-1F**
Sampling Date:		**8/21/2007**	**8/21/2007**	**6/3/2008**	**6/4/2008**
Site-Related VOCs (μg/L)					
trans-1,2-Dichloroethene	5	1 U	**15**	1 U	4 U
cis-1,2-Dichloroethylene	5	1 U	**1,800** D (b)	1 U	4 U
Trichloroethene	5	1 U	**31**	1 U	4 U
Vinyl chloride	2	1 U	**190** D	**2.2**	4 U
Other VOCs (ug/L)					
Acetone	50	16	7	14	**72** J (b)
Carbon disulfide	NT	1.3	1.2	1 U	4 U
Chloroethane	5	**7.1**	1 U	**8.3**	4 UJ
1,1-dichloroethane	5	1.7	2.1	**6.3**	4 UJ
1,1-Dichloroethene	5	1 U (b)	3.3	**1** U	4 U
Methylcyclohexane	NT	1 U	1.6	1 Y	1 U
Toluene	5	1 U	1 U	1 U	**85**

a/ New York State Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1, Table 1: New York State Ambient Water Quality Standards and Guidance Values (June 1998)

b/ U - not detected
J - estimated result
D - result is from secondary dilution
VOCs - volatile organic compounds

Table 3

Chemical-Specific SCGs
Emerson Power Transmission Site
Ithaca, New York

Regulation	Citation	Potential Status	Summary of Requirements	Considerations in the Remedial Process/Action for Attainment
Groundwater Quality Standards	6 NYCRR Part 703.5	Applicable	Establishes quality standards for groundwater.	These criteria are applicable in evaluating groundwater quality.
NYSDEC Ambient Water Quality Standards and Guidance Values	Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1	Applicable	Provides a compilation of ambient water quality standards and guidance values for toxic and non-conventional pollutants for use in the NYSDEC programs.	These standards are applicable in evaluating groundwater quality.
NYSDEC's Brownfield and Superfund Regulation	6 NYCRR Subpart 375-6.8: Remedial Program Soil Cleanup Objectives for Protection of Groundwater (December 2006)	Applicable	Provides a basis and a procedure to determine soil cleanup levels specific to site use.	These guidance values are applicable in evaluating soil quality.

Table 4

Action-Specific SCGs
Emerson Power Transmission Site
Ithaca, New York

Regulation	Citation	Potential Status	Summary of Requirements	Considerations in the Remedial Process/Action for Attainment
1. SCGs Potentially Common to All Alternatives				
OSHA - General Industry Standards	20 CFR Part 1910	Applicable	These regulations specify the 8-hour time-weighted average concentration for worker exposure to various organic compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR 1910.120.	Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
OSHA - Safety and Health Standards	29 CFR Part 1926	Applicable	These regulations specify the type of safety equipment and procedures to be followed during site remediation.	Appropriate safety equipment will be on site and appropriate procedures will be followed during remedial activities.
OSHA - Recordkeeping, Reporting, and Related Regulations	29 CFR Part 1904	Applicable	These regulations outline recordkeeping and reporting requirements for an employer under OSHA.	These regulations apply to the company(s) contracted to install, operate, and maintain remedial actions at hazardous waste sites.
RCRA - Preparedness and Prevention	40 CFR Parts 264.30 - 264.31	Relevant & Appropriate	These regulations outline requirements for safety equipment and spill control.	Safety and communication equipment will be installed at the site as necessary. Local authorities will be familiarized with the site.
RCRA - Contingency Plan and Emergency Procedures	40 CFR Parts 264.50 - 264.56	Relevant & Appropriate	Provides requirements for outlining emergency procedures to be used following explosions, fires, etc.	Plans will be developed and implemented during remedial design. Copies of the plan will be kept on site.
2. SCGs Applicable to Monitored Natural Attenuation for Groundwater and Soil in AOC 1				
Notice in Deed	40 CFR Parts 264/265 116-119(b)(1)	Applicable	Established provisions for a deed notation for constituents in soil and groundwater in AOC 1 to prevent land disturbance by future owners.	The regulations are potentially applicable because closed areas may be similar to closed RCRA units.

Table 4

Action-Specific SCGs
Emerson Power Transmission Site
Ithaca, New York

Regulation	Citation	Potential Status	Summary of Requirements	Considerations in the Remedial Process/Action for Attainment
3. SCGs Applicable to Free Product Removal/Offsite Disposal for AOCs 4, 15, and 24				
Identification and Listing of Hazardous Wastes	6 NYCRR Part 371	Applicable	Establishes procedures for identifying solid wastes that are subject to regulation as hazardous wastes.	Materials excavated/removed from the site will be handled in accordance with RCRA and New York State hazardous waste regulations, if appropriate.
RCRA - Regulated Levels for Toxic Characteristics Leaching Procedure (TCLP) Constituents	40 CFR Part 261	Applicable	These regulations specify the TCLP constituent levels for identification of hazardous wastes that exhibit the characteristics of toxicity.	Removed soil may be sampled and analyzed for TCLP constituents prior to disposal to determine if the materials are hazardous based on the characteristic of toxicity.
Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities	6 NYCRR Part 372	Applicable	Provides guidelines relating to the use of the manifest system and its recordkeeping requirements. It applies to generators, transporters, and facilities in New York State.	This regulation will be applicable to any company(s) contracted to do treatment work at the site or to transport hazardous material from the site.
Standards Applicable to Transporters of Applicable Hazardous Waste - RCRA Section 3003	40 CFR Parts 262 and 263 40 CFR Parts 170-179	Applicable	Establishes the responsibility of off-site transporters of hazardous waste in the handling, transportation, and management of the waste. Requires manifesting, recordkeeping, and immediate action in the event of a discharge.	These requirements will be applicable to any company(s) contracted to transport hazardous material from the site.
DOT Rules for Transportation of Hazardous Materials	49 CFR Parts 107, 171.1 - 172.558	Applicable	Outlines procedures for the packaging, labeling, manifesting, and transporting of hazardous waste.	Any company contracted to transport hazardous material from the site will be required to follow regulations.
New York Regulations for Transportation of Hazardous Waste	6 NYCRR Part 373.3 a-d	Applicable	Outlines procedures for the packaging, labeling, manifesting, and transporting of hazardous waste.	These requirements will be applicable to any company(s) contracted to transport hazardous material from the site.
Waste Transporter Permits	6 NYCRR Part 364	Applicable	Governs the collection, transport, and delivery of regulated waste within New York State.	Properly permitted haulers will be used if any waste materials are transported off-site.

Table 4

Action-Specific SCGs
Emerson Power Transmission Site
Ithaca, New York

Regulation	Citation	Potential Status	Summary of Requirements	Considerations in the Remedial Process/Action for Attainment
New York Regulations for Hazardous Waste Management Facilities	6 NYCRR Parts 373-1.1 - 373-.1.8	Applicable	Provides requirements and procedures for obtaining a permit to operate a hazardous waste Treatment, Storage, and Disposal facility (TSDF). Also lists contents and conditions of permits.	Any off-site facility accepting waste from the site must be properly permitted.
USEPA - Administered Permit Program: The Hazardous Waste Permit Program	RCRA Section 3005 40 CFR 270.124	Applicable	Covers to basic permitting, application, monitoring, and reporting requirements for off-site hazardous waste management facilities.	Any off-site facility accepting waste from the site must be properly permitted. Implementation of the site remedy will include consideration of these requirements.
Land Disposal Restrictions	40 CFR Part 368	Applicable	Restricts land disposal of hazardous wastes that exceeded specific criteria. Establishes Universal Treatment Standards (UTS) to which hazardous waste must be treated prior to land disposal.	This regulation may apply to the soil generated during remedy implementation.
New York Hazardous Waste Management System - General	6 NYCRR Part 370	Relevant & Appropriate	Provides definitions of terms and general instructions for the Part 370 series of hazardous waste management.	Hazardous waste is to be managed according to this regulation.
RCRA - General Standards	40 CFR Part 264.111	Relevant & Appropriate	General performance standards requiring minimization of need for further maintenance and control; minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products. Also requires decontamination or disposal of contaminated equipment, structures, and soils.	Proper design considerations will be implemented to minimize the need for future maintenance. Decontamination actions and facilities will be included.

Table 5

Cost Estimate for AOC 1 Groundwater Alternative 2 - Monitored Natural Attenuation

Emerson Power Transmission
Ithaca, New York

Item No.	Description	Estimated Quantity	Units	Unit Price (Material and Labor)	Estimated Amount
Monitored Natural Attenuation Capital Costs					
1	Mobilization/Demobilization	1	LS	$5,000	$5,000
2	Permitting	1	LS	$5,000	$5,000
3	New Monitoring Wells	3	EA	$10,000	$30,000
4	Miscellaneous Waste Disposal	1	LS	$8,000	$8,000
5	Groundwater Monitoring	2	EA	$20,000	$40,000
6	Reporting	1	LS	$15,000	$15,000
7	Site Restoration	1	LS	$5,000	$5,000
				SUBTOTAL CAPITAL COST	**$108,000**
				ADMINISTRATIVE AND ENGINEERING (30%)	**$32,400**
				CONTINGENCY (20%)	**$21,600**
				TOTAL ESTIMATED CAPITAL COST	**$162,000**
				ROUNDED TO	**$162,000**
Monitored Natural Attenuation Annual Operation and Maintenance (O&M) Costs					
8	Groundwater Monitoring & Reporting	2	EA	$20,000	$40,000
9	Waste Disposal	1	LS	$5,000	$5,000
				SUBTOTAL O&M COST	**$45,000**
				CONTINGENCY (20%)	**$9,000**
				ANNUAL O&M COST	**$54,000**
				10-YEAR PRESENT WORTH OF ANNUAL O&M AT 7% DISCOUNT RATE	**$379,273**
				TOTAL PRESENT WORTH OF ALTERNATIVE (ROUNDED)	**$541,000**

Assumptions:

1. Mobilization/Demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to install new groundwater monitoring wells and collect field groundwater data.
2. Permitting cost estimate includes any permits, licensing fees, or approval that must be obtained to proceed with monitoring well installation at the site.
3. New monitoring well cost estimate includes the labor, materials, and equipment necessary to install three new permanent monitoring wells.
4. Miscellaneous waste disposal cost estimate is based on disposal of PPE, disposable equipment, soil cuttings, and purge water generated during monitoring well installation and groundwater monitoring events at a facility permitted to accept the waste.
5. Groundwater monitoring cost estimate includes labor and materials necessary to collect groundwater samples and the laboratory analysis for COCs and MNA parameters (ethane, ethene, methane, alkalinity, carbon dioxide, chloride, soluble organic carbon, dissolved oxygen, ferrous iron, nitrate, nitrite, sulfide, sulfate; and field parameters including temperature, conductivity, pH, and oxidation reduction po degradation.
6. Reporting cost estimate includes any local, state, or federal regulatory requirements for reporting on the success of preliminary MNA inv strategies if MNA is not indicated by sampling results.
7. Site restoration cost estimate includes all labor and materials necessary to restore site to pre-existing conditions following monitoring well installation.
8. Groundwater monitoring cost estimate based on all labor and materials necessary to collect groundwater samples and the laboratory analysis necessary for select MNA parameters (as listed above under item #5) and to monitor COCs in groundwater semi-annua
9. Waste disposal cost estimate is based on disposal of PPE and disposable equipment generated during groundwater monitoring events at a facility permitted to accept the waste.
10. Present worth cost is based on total capital (direct and indirect) expenditure (taken the first year) and annual (operation and maintenance) costs taken over a 10-year time frame at a discount rate of 7 percent.
11. Cost estimates based on 2008 dollars.
12. Cost estimates based on WSP's past experience and vendor estimates.

Table 6

Cost Estimate for AOC 1 Groundwater Alternative 3 - *In-Situ* Bioremediation

Emerson Power Transmission
Ithaca, New York

Item No.	Description	Estimated Quantity	Units	Unit Price (Material and Labor)	Estimated Amount
***In-Situ* Bioremediation Pilot Test and Pre-Design**					
1	Mobilization/Demobilization	1	LS	$15,000	$15,000
2	Permitting	1	LS	$5,000	$5,000
3	Direct Push Injection	1	LS	$25,000	$25,000
4	Pre-Design Testing	1	LS	$10,000	$10,000
				SUBTOTAL CAPITAL COST	**$55,000**
				ADMINISTRATIVE AND ENGINEERING (30%)	**$16,500**
				CONTINGENCY (20%)	**$11,000**
				TOTAL ESTIMATED DESIGN COST	**$82,500**
				ROUNDED TO	**$83,000**
***In-Situ* Bioremediation Capital Costs**					
5	Mobilization/Demobilization	1	LS	$15,000	$15,000
6	Permitting	1	LS	$5,000	$5,000
7	Permanent Injection Point Installation	6	EA	$5,000	$30,000
8	Direct Push Injection	1	EA	$50,000	$50,000
9	Substrate	4	EA	$5,000	$20,000
10	Site Restoration	1	LS	$10,000	$10,000
11	Period Injection Events	3	EA	$25,000	$75,000
				SUBTOTAL CAPITAL COST	**$205,000**
				ADMINISTRATIVE AND ENGINEERING (30%)	**$61,500**
				CONTINGENCY (20%)	**$41,000**
				TOTAL ESTIMATED CAPITAL COST	**$307,500**
				ROUNDED TO	**$308,000**
***In-Situ* Bioremediation Annual Operation and Maintenance (O&M) Costs**					
12	Groundwater Monitoring & Reporting	2	EA	$15,000	$30,000
13	Waste Disposal	1	LS	$10,000	$10,000
				SUBTOTAL O&M COST	**$40,000**
				CONTINGENCY (20%)	**$8,000**
				ANNUAL O&M COST	**$48,000**
				10-YEAR PRESENT WORTH OF ANNUAL O&M AT 7% DISCOUNT RATE	**$337,132**
				TOTAL PRESENT WORTH OF ALTERNATIVE (ROUNDED)	**$728,000**

Assumptions:

1. Mobilization/Demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to conduct a pilot test to determine suitability of *in-situ* bioremediation.
2. Permitting cost estimate includes any permits, licenscing fees, or approval that must be obtained to proceed with the pilot test.
3. Direct push injection cost estimate includes the labor, materials, and equipment necessary to inject substrate for pilot test into no more than 4 direct push injection locations.
4. Pre-design testing cost estimate includes analysis necessary to determine the suitability of the subsurface and biological cultures for *in-situ* bioremediation.
5. Mobilization/Demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to conduct i*n-situ* bioremediation.
6. Permitting cost estimate includes any permits, licenscing fees, or approval that must be obtained to install permament injection points inside the building at AOC 1 and direct push injection points outside the building.
7. Permanent injection point cost estimate includes all labor, materials, and equipment necessary to install 6 permanent injection points inside Building 3. This cost does not include substrate.
8. Direct push injection point cost estimate includes all labor, materials, and equipment necessary to install 27 direct push injections outside of the building at AOC 1. This cost does not include substrate.
9. Substrate cost estimate is an assumed cost for substrate necessary for enhanced natural attenuation via substrate augmentation. The cannot be determined until pilot testing.
10. Site restoration cost estimate includes all labor and materials necessary to restore site to pre-existing conditions following the injections.
11. Periodic injection event cost estimate includes all labor, materials, and equipment necessary to return for polishing events, if required, following sampling results. This cost includes substrate.
12. Groundwater monitoring cost estimate includes labor and materials necessary to collect groundwater samples and the laboratory analysis for VOCs to monitor biodegradation of COCs in groundwater semi-annually.
13. Waste disposal cost estimate is based on disposal of PPE and disposable equipment generated during groundwater monitoring events at a facility permitted to accept the waste.
14. Present worth cost is based on total capital (direct and indirect) expenditure (taken the first year) and annual (operation and maintenance) costs taken over a 10-year time frame at a discount rate of 7 percent.
15. Cost estimates based on 2008 dollars.
16. Cost estimates based on WSP's past experience and vendor estimates.

Table 7

Cost Estimate for AOC 1 Groundwater Alternative 4 - *In-Situ* Chemical Oxidation

Emerson Power Transmission
Ithaca, New York

Item No.	Description	Estimated Quantity	Units	Unit Price (Material and Labor)	Estimated Amount
***In-Situ* Chemical Oxidation Pilot Test and Pre-Design**					
1	Mobilization/Demobilization	1	LS	$15,000	$15,000
2	Permitting	1	LS	$5,000	$5,000
3	Direct Push Injection	1	LS	$25,000	$25,000
4	Pre-Design Testing	1	LS	$10,000	$10,000
				SUBTOTAL CAPITAL COST	**$55,000**
				ADMINISTRATIVE AND ENGINEERING (30%)	**$16,500**
				CONTINGENCY (20%)	**$11,000**
				TOTAL ESTIMATED DESIGN COST	**$82,500**
				ROUNDED TO	**$83,000**
***In-Situ* Chemical Oxidation Capital Costs**					
5	Mobilization/Demobilization	1	LS	$15,000	$15,000
6	Permitting	1	LS	$5,000	$5,000
7	Permanent Injection Point Installation	6	EA	$5,000	$30,000
8	Direct Push Injection	1	LS	$50,000	$50,000
9	Oxidant	2,850	LB	$4	$11,400
10	Site Restoration	1	LS	$10,000	$10,000
11	Periodic Injection Events	3	EA	$50,000	$150,000
				SUBTOTAL CAPITAL COST	**$271,400**
				ADMINISTRATIVE AND ENGINEERING (30%)	**$81,420**
				CONTINGENCY (20%)	**$54,280**
				TOTAL ESTIMATED CAPITAL COST	**$407,100**
				ROUNDED TO	**$407,000**
***In-Situ* Chemical Oxidation Annual Operation and Maintenance (O&M) Costs**					
12	Groundwater Monitoring & Reporting	2	EA	$15,000	$30,000
13	Waste Disposal	1	LS	$10,000	$10,000
				SUBTOTAL O&M COST	**$40,000**
				CONTINGENCY (20%)	**$8,000**
				ANNUAL O&M COST	**$48,000**
				5-YEAR PRESENT WORTH OF ANNUAL O&M AT 7% DISCOUNT RATE	**$196,809**
				TOTAL PRESENT WORTH OF ALTERNATIVE (ROUNDED)	**$687,000**

Assumptions

1. Mobilization/Demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to conduct a pilot test to determine suitability of *in-situ* chemical oxidation.
2. Permitting cost estimate includes any permits, licensing fees, or approval that must be obtained to proceed with the pilot test.
3. Direct push injection cost estimate includes the labor, materials, and equipment necessary to inject an oxidant for pilot test with no more than 4 direct push injection locations.
4. Pre-design testing cost estimate includes analysis necessary to characterize the subsurface matrix and select an appropriate oxidant.
5. Mobilization/Demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to conduct full scale ISCO alternative.
6. Permitting cost estimate includes any permits, licenscing fees, or approval that must be obtained to install permament injection points inside the building at AOC 1 and direct push injection points outside the building.
7. Permanent injection point installation cost estimate includes all labor, materials, and equipment necessary to install 6 permanent injection points inside Building 3. This cost does not include oxidant.
8. Direct push injection point cost estimate includes all labor, materials, and equipment necessary to install 27 direct push injections outside of the building at AOC 1. This cost does not include oxidant.
9. Oxidant cost estimate is an assumed amount of oxidant for the first event. The dosage and type of oxidant will be determined during pilot testing. Cost estimate assumes 2 grams of oxidant per kilogram of saturated soil over 2,600 square feet a
10. Site restoration cost estimate includes all labor and materials necessary to restore site to pre-existing conditions following the injections.
11. Periodic injection event cost estimate includes all labor, materials, and equipment necessary to return for polishing events, if required, following sampling results. This cost includes oxidant.
12. Groundwater monitoring cost estimate includes labor and materials necessary to collect groundwater samples and the laboratory analysis for VOCs to monitor COCs in groundwater semi-annually.
13. Waste disposal cost estimate is based on disposal of PPE and disposable equipment generated during groundwater monitoring events at a facility permitted to accept the waste.
14. Present worth cost is based on total capital (direct and indirect) expenditure (taken the first year) and annual (operation and maintenance) costs taken over a 5-year time frame at a discount rate of 7 percent.
15. Cost estimates based on 2008 dollars.
16. Cost estimates based on WSP's past experience and vendor estimates.

Table 8

Cost Estimate for AOC 1 Soil Alternative 2 - Cap and Institutional Controls

Emerson Power Transmission
Ithaca, New York

Item No.	Description	Estimated Quantity	Units	Unit Price (Material and Labor)	Estimated Amount
Concrete Cap Capital Costs					
1	Mobilization/Demobilization	1	LS	$15,000	$15,000
2	Indoor Concrete Floor Modifications	1	LS	$20,000	$20,000
				SUBTOTAL CAPITAL COST	**$35,000**
				ADMINISTRATIVE AND ENGINEERING (30%)	**$10,500**
				CONTINGENCY (20%)	**$7,000**
				TOTAL ESTIMATED CAPITAL COST	**$52,500**
				ROUNDED TO	**$53,000**
Concrete Cap Annual O&M					
3	Cap Maintenance	1	LS	$5,000	$5,000
				SUBTOTAL O&M COST	**$5,000**
				CONTINGENCY (20%)	**$1,000**
				TOTAL ESTIMATED CAPITAL COST	**$6,000**
				30-YEAR PRESENT WORTH OF INSTITUTIONAL CONTROLS AT 7% DISCOUNT RATE	**$74,454**
				TOTAL PRESENT WORTH OF ALTERNATIVE (ROUNDED)	**$127,000**

Assumptions:

1. Mobilization/Demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to remove existing asphalt and gravel and install an asphalt concrete cap over AOC 1.
2. Indoor concrete floor modifications cost estimate includes all labor, equipment, and materials necessary to repair and modifiy the existing concrete floor inside in the area of the former degreaser to maintain a concrete cap.
3. Annual cap maintenance cost estimate includes all labor, equipment, and materials necessary to maintain the bituminous asphalt concrete cap.
4. Present worth cost is based on total capital (direct and indirect) expenditure (taken the first year) and annual (operation and maintenance) costs taken over a 30-year time frame at a discount rate of 7 percent.
5. Cost estimates based on 2008 dollars.
6. Cost estimates based on WSP's past experience and vendor estimates.

Table 9

Cost Estimate for AOCs 4, 15, and 24 Groundwater Alternative 2 - *In-Situ* Chemical Oxidation for Free Product

Emerson Power Transmission
Ithaca, New York

Item No.	Description	Estimated Quantity	Units	Unit Price (Material and Labor)	Estimated Amount
***In-Situ* Chemical Oxidation Pilot Test and Pre-Design**					
1	Mobilization/Demobilization	1	LS	$15,000	$15,000
2	Permitting	1	LS	$5,000	$5,000
3	Direct Push Injection	1	LS	$15,000	$15,000
4	Pre-Design Testing	1	LS	$10,000	$10,000
				SUBTOTAL CAPITAL COST	**$45,000**
				ADMINISTRATIVE AND ENGINEERING (30%)	**$13,500**
				CONTINGENCY (20%)	**$9,000**
				TOTAL ESTIMATED DESIGN COST	**$67,500**
				ROUNDED TO	**$68,000**
***In-Situ* Chemical Oxidation Capital Costs**					
5	Mobilization/Demobilization	1	LS	$15,000	$15,000
6	Permitting	1	LS	$5,000	$5,000
7	Oxidant Injection	2	EA	$35,000	$70,000
8	Site Restoration	1	LS	$10,000	$10,000
				SUBTOTAL CAPITAL COST	**$100,000**
				ADMINISTRATIVE AND ENGINEERING (30%)	**$30,000**
				CONTINGENCY (20%)	**$20,000**
				TOTAL ESTIMATED CAPITAL COST	**$150,000**
				ROUNDED TO	**$150,000**
***In-Situ* Chemical Oxidation Annual Operation and Maintenance (O&M) Costs**					
9	Groundwater Monitoring	1	LS	$30,000	$30,000
10	Waste Disposal	1	LS	$30,000	$30,000
11	Oxidant Injection Event	1	LS	$30,000	$30,000
				SUBTOTAL O&M COST	**$90,000**
				CONTINGENCY (20%)	**$18,000**
				ANNUAL O&M COST	**$108,000**
				5-YEAR PRESENT WORTH OF ANNUAL O&M AT 7% DISCOUNT RATE	**$442,821**
				TOTAL PRESENT WORTH OF ALTERNATIVE (ROUNDED)	**$593,000**

<u>Assumptions:</u>

1. Mobilization/Demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to conduct a pilot test to determine suitability of *in-situ* chemical oxidation.
2. Permitting cost estimate includes any permits, licenscing fees, or approval that must be obtained to proceed with the pilot test.
3. Direct push injection cost estimate includes the labor, materials, and equipment necessary to conduct subsurface analysis for pilot test with no more than 4 direct push injection locations.
4. Pre-design testing cost estimate includes analysis necessary to characterize the subsurface matrix and select an appropriate oxidant.
5. Mobilization/Demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to conduct full scale ISCO alternative.
6. Permitting cost estimate includes any permits, licenscing fees, or approval that must be obtained to conduct ISCO of free product in AOCs 4, 15, and 24.
7. Oxidant injection cost estimate includes all labor, materials, and equipment necessary to add oxidant to no more than 4 monitoring wells in AOCs 4, 15, and 24 for two events during the first year.
8. Site restoration cost estimate includes all labor and materials necessary to restore site to pre-existing conditions following the injections.
9. Groundwater monitoring cost estimate includes labor and materials necessary to collect groundwater samples and the laboratory analysis to monitor levels of free product in groundwater four times annually over a 5 year period.
10. Waste disposal cost estimate is based on disposal of PPE and disposable equipment generated during groundwater monitoring events at a facility permitted to accept the waste.
11. Injection event cost estimate includes one additional oxidation event per year over a 5 year period.
12. Present worth cost is based on total capital (direct and indirect) expenditure (taken the first year) and annual (operation and maintenance) costs taken over a 5-year time frame at a discount rate of 7 percent.
13. Cost estimates based on 2008 dollars.
14. Cost estimates based on WSP's past experience and vendor estimates.

Table 10

Cost Estimate for AOCs 4, 15, and 24 Groundwater Alternative 3 - Free Product Removal and Offsite Treatment/Disposal

Emerson Power Transmission
Ithaca, New York

Item No.	Description	Estimated Quantity	Units	Unit Price (Material and Labor)	Estimated Amount
Free Product Removal Capital Costs					
1	Mobilization/Demobilization	1	LS	$15,000	$15,000
2	Permitting	1	LS	$5,000	$5,000
3	Product Removal Events	1	LS	$50,000	$50,000
4	New Extraction Wells	2	EA	$5,000	$10,000
5	Waste Disposal	1	LS	$15,000	$15,000
				SUBTOTAL CAPITAL COST	**$95,000**
				ADMINISTRATIVE AND ENGINEERING (30%)	**$28,500**
				CONTINGENCY (20%)	**$19,000**
				TOTAL ESTIMATED CAPITAL COST	**$142,500**
				ROUNDED TO	**$143,000**
Free Product Removal Annual Operation and Maintenance (O&M) Costs					
6	Product Removal Events	4	EA	$10,000	$40,000
7	Groundwater Monitoring	4	EA	$10,000	$40,000
8	Waste Disposal	1	LS	$10,000	$10,000
				SUBTOTAL O&M COST	**$90,000**
				CONTINGENCY (20%)	**$18,000**
				ANNUAL O&M COST	**$108,000**
				5-YEAR PRESENT WORTH OF ANNUAL O&M AT 7% DISCOUNT RATE	**$442,821**
				TOTAL PRESENT WORTH OF ALTERNATIVE (ROUNDED)	**$586,000**

Assumptions:

1. Mobilization/Demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to physically remove free product from extraction monitoring wells or collection sumps in AOCs 4, 15, and 24.
2. Permitting cost estimate includes any permits, licensing fees, or approval that must be obtained to proceed free product removal and disposal.
3. Product removal event cost estimate includes all labor, equipment, and materials necessary to periodically remove product from extraction wells or collections sumps via a vacuum truck, manual bailing, product-only pump, or absorbant sock (method to be determined after thickness of product determined in field). Costs will vary depending upon which technology is utilized. A higher end cost was used for the purpose of alternative evaluation.
4. New extraction well installtion cost estimate includes all labor, equipment, and materials necessary to install a new extraction well in one soil boring where free product was detected.
5. Waste disposal cost estimate is based on disposal of PPE, disposable equipment, and removed free product at a facility permitted to accept waste.
6. Product removal event cost estimate includes all labor, equipment, and materials necessary to remove product from extraction wells or collection sumps via the selected removal method if free product re-enters wells following the initial removal event. A higher end cost was used for the purpose of alternative evaluation.
7. Groundwater monitoring cost estimate includes labor and materials necessary to collect groundwater samples and the laboratory analysis to monitor levels of free product in groundwater four times annually over a 5-year time frame.
8. Waste disposal cost estimate is based on disposal of PPE and disposable equipment generated during groundwater monitoring events at a facility permitted to accept the waste.
9. Present worth cost is based on total capital (direct and indirect) expenditure (taken the first year) and annual (operation and maintenance) costs taken over a 5-year time frame at a discount rate of 7 percent.
10. Cost estimates based on 2008 dollars.
11. Cost estimates based on WSP's past experience and vendor estimates.