SOUTH HILL SANITARY SEWER NETWORK
ALTERNATIVES ANALYSIS REPORT
EMERSON POWER TRANSMISSION
ITHACA, NEW YORK
SITE NO. 755010

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1 Introduction

On behalf of Emerson and its subsidiary, Emerson Power Transmission Corp. (EPT), WSP Engineering of New York, P.C., has prepared this Alternatives Analysis (AA) Report for the South Hill sanitary sewer network north of the EPT site in Ithaca, New York (Figure 1). 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, 1987, and the NYSDEC Record of Decision Amendment dated June 2009. The report presents the results of the supplemental investigation completed to further evaluate the vapor migration pathways associated with the South Hill sanitary sewer network, which were identified as Area of Concern (AOC) 21 in the Supplemental Remedial Investigation Report, dated April 4, 2008. Also, this AA report provides an analysis of potentially appropriate remedial alternatives for addressing the soil vapor migration pathways along the sanitary sewer network.

1.1 PURPOSE AND OBJECTIVES OF THE ALTERNATIVES ANALYSIS

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, screening, and detailed evaluation of potentially feasible technologies are provided. 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.

As detailed in the Revised Supplemental Remedial Program/Alternatives Analysis (SRP/AA) Report dated September 23, 2008, three pathways were identified for the potential migration of vapors associated with historical releases of volatile organic compounds (VOCs) from the sanitary sewer lines servicing the EPT facility (along Turner Place and South Cayuga Street). The potential vapor migration pathways include the following:

- along the sanitary sewer lines
- along the residential sanitary sewer laterals
- within the vertical and horizontal planes of porosity (fractured bedrock) surrounding the sewer lines

This report presents the results of soil vapor samples collected along the identified migration pathways and provides an evaluation of remedial alternatives to address vapor migration along the sewer lines and along residential sewer laterals. The AA report was developed with the receptor-based objective of achieving acceptable indoor air quality in residential properties and protecting utility workers that may be exposed to soil vapor during intrusive subsurface work or access to the sanitary sewers. The remedial action objectives (RAOs) outlined in Section 4 further discusses the receptors considered in evaluating the proposed alternatives.

1.2 REPORT ORGANIZATION

This report is organized into eight sections. Section 1 describes the project, identifies the purpose of this report, and presents the report organization. Section 2 includes a description and history of the EPT facility, followed by a discussion of the site geology, hydrogeology, and an updated conceptual site model (CSM) for soil vapor migration along the sanitary sewers on Turner Place, East Spencer Street, and South Cayuga Street. Section 3 details the scope of work that was completed to evaluate the migration pathways followed by a discussion of the sampling results. Section 4 identifies the RAOs and Section 5 identifies the standards, criteria, and guidance (SCGs) that will govern the development and selection of remedial alternatives. Section 6 identifies and presents a preliminary screening of potentially feasible technologies. Section 7 presents a detailed description and screening of remedial alternatives, and Section 8 presents a comparative analysis of alternatives and identifies the recommended remedial alternative for addressing soil vapor migration along the South Hill sanitary sewer and lateral network.

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 2). 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 for those which 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. 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 revealed 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 line 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. Along Turner Place, the top of fractured bedrock is found at depths of 2 feet to 7 feet bgs and the thickness of the B-zone is approximately 10 feet. Along East Spencer Street, the top of bedrock is found at approximately 7 feet bgs and the thickness of the B-zone is approximately 5 feet. Whereas just north of East Spencer Street, alluvial deposits are found to depths of between 9 and 11 feet below ground surface.

Onsite, 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. Offsite, the fractures below the B-zone are confined to intervals that are widely spaced and the frequency of fracturing is controlled by lithology. A detailed discussion of joint measurements and overall structural framework is provided in the Revised SRP/AA Report.

Groundwater flow within the overburden and underlying B-zone generally mimics surface topography, which slopes to the northwest. Groundwater flow within the siltstone bedrock (C and D zones) is significantly affected by the vertical and horizontal distribution of vertical joint sets and horizontal bedding plane fractures within the upper sections of bedrock. 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. Along the middle section of Turner Place, groundwater is found below the B-zone at depths between 15 and 21 feet bgs. In addition, to the north of East Spencer Street, alluvial deposits are encountered near the ground surface to 9 to 11 feet bgs and where water-bearing bedding plane fractures and joints within the bedrock appear to discharge into the overburden (unconsolidated) material.

2.3 SOUTH HILL SANITARY SEWER NETWORK - CONCEPTUAL SITE MODEL

This updated CSM for the South Hill sanitary sewer network is based on all available soil vapor and sub-slab soil gas data collected within the South Hill area and is designed to show the relationship between historical releases of VOCs (solvents) from the sanitary sewer lines on Turner Place, East Spencer Street, and South Cayuga Street and the associated transport pathways.

As detailed in previous reports, two parallel sewer lines extend from the EPT site to the north down Turner Place where they join at a manhole near the intersection of Columbia Street and then continue along Turner Place before making a 90 degree turn west to continue along East Spencer Street (Figure 3). A third sewer line extends from the western portion of the EPT property north along South Cayuga Street. According to City utility drawings, the majority of the sanitary sewer lines along both Turner Place and South Cayuga Street (South Hill sanitary sewer network) are trenched directly into the upper section of fractured bedrock and invert elevations range from approximately 5 to 7 feet bgs. In areas where the lines were installed less than 3 feet bgs, flowable fill (concrete) was used to increase the load capacity of the sewer lines.

The sewer lines along Turner Place, East Spencer Street and South Cayuga Street have been identified as historical sources of releases of VOCs to the subsurface. Based on a review of historical information, solvent discharges to the municipal sewers likely occurred over a number of years during Borg Warner's ownership and ceased in the late 1970's. Releases from these sewers can be conceptualized as leaking through cracks and joints of an aging system that migrated and flowed along the surrounding bedding material, where present, or directly into the fractured bedrock (Figure 4). The latter would be the case for most of the Turner Place, East Spencer Street, and South Cayuga Street sewer lines as they are reportedly constructed directly within unsaturated highly fractured bedrock. Subsequently, VOC-containing wastewater which seeped into the fractured bedrock continued to migrate into the deeper sediment filled fractures (joints and bedding planes) in bedrock or was held by capillary forces within the pore spaces. VOCs in the sediment filled fractures subsequently volatilize into the gaseous phase and are transported by diffusion both vertically and laterally (based on a pressure differential) through the fractures and along the sewers, eventually reaching the basement of some homes within the South Hill area. Figure 4 depicts a conceptualization of historical releases from the sewers. Figure 5 depicts the conceptualized migration pathways on a cross-section of the sewer lines along Turner Place, through the fractured and jointed bedrock, which also extends beneath nearby homes both along Turner Place and East Spencer Street.

VOC vapor migration within identified bedrock features is evident particularly along East Spencer Street where vapors have migrated through vertical bedrock features identified during geophysical testing, into the subsurface beneath some homes as indicated by sub-slab vapor sample results. The results of sub-slab vapor testing for four homes in this area indicated the need for mandatory mitigation based on the soil vapor/indoor air matrix presented in the New York State Department of Health's (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York, dated October 2006. In addition, some of the highest levels of TCE in soil gas were detected in samples collected directly above the sanitary sewer line that extends along East Spencer Street. As discussed below in Section 3.0, soil vapor sample SV-67 was collected approximately 1.5 to 2 feet above the sewer line extending west down East Spencer Street. TCE was detected at a concentration of 5,260 micrograms per cubic meter ($\mu g/m^3$) and tetrachloroethene (PCE) was detected at a concentration of 389 $\mu g/m^3$.

In summary, the results of soil vapor sampling show that VOC-containing vapors are present over the sewer lines and sewer laterals and the identified fractures in the bedrock. The VOC-containing vapors along the sewer lines and sewer laterals are likely attributable to volatilization of VOCs present in fractures and in-filled voids within the underlying bedrock. Two potential fracture trends were identified between Turner Place and East Spencer Street, extending southwest to northeast between both roads (at depth). Vapor samples collected directly over these and other fractures in the South Hill neighborhood contained VOC concentrations comparable to those detected in samples collected from beneath the basement slab in certain homes.

In addition, results of soil vapor sampling conducted along the sewer on South Aurora Street show that solvent releases have occurred from the sewer line originating at the former NCR facility. This sewer line extends across the southeast portion of the EPT property, then north along South Aurora Street, west along Columbia Street, and connects to the sewer on Turner Place. Municipal sewer lines originating from the Therm facility connect to the South Aurora/Columbia Street sewer line, which in turn, also connects to the Turner Place sewer.

3 Supplemental Investigation for Sanitary Sewers

The sanitary sewers that serve the EPT facility and continue down Turner Place, East Spencer Street, and South Cayuga Street are potential pathways for the migration of VOC vapors. In 2008, additional investigations were conducted along the sewer lines to determine if affected soil vapors are migrating along three potential vapor migration pathways (1) the sanitary sewer lines, (2) the residential sanitary sewer laterals, and/or (3) within the vertical and horizontal planes of porosity (fractured bedrock) surrounding/beneath the sewer lines. The scope of the investigation and results are discussed below.

3.1 SCOPE OF WORK

A total of 15 additional soil vapor samples were collected at the locations designated SV-53 through SV-67 on Figure 6. These locations were selected based on previous soil vapor sample results collected as part of the 2007 Supplemental Remedial Investigation. Sample locations SV-53, 54, 56, 57, 60, 62, 65, and 67 were installed directly over the sewer lines along Turner Place, South Cayuga Street, and East Spencer Street. These locations were selected to evaluate the potential presence of site-related VOCs in soil gas along the sewer lines Soil vapor points SV-56 and SV-57 were installed immediately adjacent to manhole 4 (MH-4) where the highest soil gas concentrations have been previously measured. MH-4 is also the convergence point of the three sewer lines originating from the EPT, NCR and Therm facilities. Sample locations SV-55, 58, 61, and 64 were installed directly over the sewer laterals of selected mitigated homes to evaluate the potential for migration of soil vapor along the sewer laterals. These sewer laterals were chosen based on TCE results for sub-slab soil gas samples collected beneath the homes on that specific property before installation of a vapor mitigation system. In addition, sample locations SV-59, 63, and 66 were installed over bedrock features to evaluate the migration of vapors through fractures in the bedrock. These locations were selected based on previous surface and subsurface geophysical studies conducted in the area.

To install the temporary soil gas sampling devices directly above the sewer lines, direct-push rods equipped with a 1.25-inch outer diameter (OD) drive point were advanced to approximately 2 feet above the top of the sewer line. The City of Ithaca Water and Sewer Division was on location to record the depths of the sewer lines. The top of the sewer lines located in the intersection of Turner Place and Hillview Place were measured to be present at a depth of 4 feet bgs. The top of the sewer lines located in the intersection of Turner Place and Columbia Street were also measured to be present at a depth of 4 feet bgs. The top of the sewer line extending along the east side of Turner Place located in the intersection of Turner Place and Pleasant Street was measured to be present at a depth of 8 feet bgs. The top of the sewer line extending along the west side of Turner Place located in the intersection of Turner Place and Pleasant Street occurred at a depth of 4 feet bgs. The top of the sewer line located on East Spencer Street occurred at a depth of 8.5 feet bgs. Once the drive point was in place, a 6-inch-long stainless steel screen was attached to 0.25-inch inner diameter (ID) Teflon® or Teflon®-lined tubing and lowered to the bottom of the open borehole. Nine inches of quartz sand were placed in the bottom of the borehole around the screen and tubing to create a 9-inch-thick sample interval. The remainder of the borehole was sealed with a bentonite slurry. The base of the wire mesh screen was then threaded into the top of the drive point by rotating the tubing and screen. The probe rods were then removed from the hole leaving the drive point, screen, and tubing in place. For sample locations installed over bedrock (SV-59, 63, and 66), depth to bedrock was encountered at 2 feet bgs at location SV-59 and at 7 feet bgs at locations SV-63 and 66.

Before soil vapor samples were collected, a pre-sample purge was conducted to remove dilution air from the tubing and probe assembly. The flow rate of the purging did not exceed 0.2 liters per minute (L/min). To collect the soil vapor sample, an Entech flow regulator was connected directly to the sample tubing, using Teflon® tubing. The flow regulator was attached to an evacuated 1-liter Entech canister to initiate sample collection. The flow regulator was pre-set by the laboratory to collect the soil vapor sample over a 1-hour period at a flow rate that would not exceed 0.2 L/min. After 1 hour, the flow regulator was disconnected from the canister to complete the sample collection. The sample name, location, time and date of sample collection, regulator and canister number, and the analytical method were recorded on the chain-of-custody form and in the field log book. Following collection of the soil vapor samples, the tubing was removed from the ground and the borehole was capped with blacktop or concrete to match the surrounding surface.

Site conditions were documented during the soil vapor sampling activities in accordance with Section 2.7.1 of the NYSDOH guidance.

3.1.1 Sample Analysis

All samples were shipped, or transported by courier, under strict chain of custody to Centek Laboratories, a NYSDOH Environmental Laboratory Approval Program-approved laboratory. The samples were analyzed for the complete list of VOCs specified in U.S. Environmental Protection Agency (EPA) Method TO-15. Analytical results for all VOCs detected by EPA Method TO-15 were reported to the NYSDEC. The minimum detection limits using EPA Method TO-15 for all samples was 0.25 $\mu g/m^3$ for TCE and vinyl chloride and the lowest achievable laboratory detection limit (approximately 1.0 $\mu g/m^3$) for all other VOCs.

3.1.2 Quality Assurance/Quality Control

Each Entech canister used for the sampling activities was certified-clean by the laboratory. A duplicate soil vapor sample was collected from soil vapor point SV-66 using a “T” connect device. In addition, a laboratory-prepared trip blank accompanied the sample canister for one of the vapor samples from the laboratory to the field and from the field to the laboratory. The trip blank was used to evaluate the potential for sample cross-contamination during shipment or during sample collection.

In accordance with the NYSDOH Soil Vapor Intrusion Guidance, the reliability and representativeness of the sampling data and associated quality assurance/quality control (QA/QC) information was verified by a WSP QA/QC Chemist (qualified person) to ensure the following:

- the data package is complete
- holding times are met
- the QC data fall within the required limits and specifications
- the data have been generated using established and agreed upon analytical protocols
- the raw data confirm the results provided in data summary tables and QC verification forms
- correct data qualifiers have been used
- the data deliverables comply with the most recent NYSDEC Analytical Services Protocol B (2005)

3.2 SUPPLEMENTAL SOIL VAPOR SAMPLING RESULTS

The supplemental soil vapor sample results are presented on Figure 6 and summarized in Table 1. The laboratory data package is included in Appendix A. For comparative purposes the results of all soil vapor samples collected to date by Emerson are depicted on Figure 7 and included in summary Table 2. The following discussions of results focus on the two primary compounds of concern (TCE and PCE). In addition, the fact that sample points were collected mainly along street right of ways, the findings are presented by street name below.

3.2.1 Turner Place

The soil vapor samples collected above the two sewer lines extending along Turner Place from the EPT facility down to Columbia Street (Figure 6) contained TCE concentrations ranging from 264 $\mu g/m^3$ (SV-53) to 1,840 $\mu g/m^3$ (SV-54). PCE concentrations ranged from 596 $\mu g/m^3$ at location SV-53 to 2,460 $\mu g/m^3$ at location SV-54. The samples were collected approximately 1.5 to 2 feet vertically above each line. Soil vapor point SV-55 was collected above a sewer along the eastern side of Turner Place and contained TCE at a concentration of 64.5 $\mu g/m^3$ and PCE at a concentration of 303 $\mu g/m^3$.

The soil vapor results for samples collected above the Turner Place sewer lines at the intersection of Columbia Street (Figure 6) contained TCE concentrations ranging from 1,280 $\mu g/m^3$ (SV-57) to1,900 $\mu g/m^3$ (SV-56). PCE concentrations ranged from 2,680 $\mu g/m^3$ to 5,140 $\mu g/m^3$. The locations of these samples are downgradient of where the NCR sewer line connects with the sanitary sewer line on Turner Place. The NCR sewer line extends in a northerly direction across the eastern portion of the EPT property then continues along South Aurora Street to Columbia Street where it extends west one block to Turner Place (Figure 6). Soil vapor sample SV-58 was collected above a sewer lateral along the western side of Turner Place and contained TCE at a concentration of 146 $\mu g/m^3$ and PCE at a concentration of 1,160 $\mu g/m^3$. Soil vapor point SV-59 was collected from the top of the highly fractured bedrock (over a bedrock feature) near a sewer lateral downgradient of manhole 4 on Turner Place. TCE was detected at a concentration of 5.08 $\mu g/m^3$ and PCE was detected at a concentration of 10.2 $\mu g/m^3$.

The soil vapor samples collected above the Turner Place sewer lines at the intersection of Pleasant Street (Figure 6) contained TCE concentrations ranging from 33.3 $\mu g/m^3$ (SV-62) to 742 $\mu g/m^3$ (SV-60). PCE was detected at both soil vapor points SV-60 and SV-62 at a concentration of 28.3 $\mu g/m^3$. Soil vapor point SV-61 was collected above a sewer lateral that is connected to the sewer line extending along the west side of Turner Place. TCE was detected at a concentration of 1,680 $\mu g/m^3$ and PCE was detected at a concentration of 110 $\mu g/m^3$. Soil vapor point SV-63 was collected from the top of the highly fractured bedrock (over a bedrock feature) near a sewer lateral at the intersection of East Spencer Street and Turner Place. TCE was detected at a concentration of 846 $\mu g/m^3$ and PCE was detected at a concentration of 29.6 $\mu g/m^3$.

3.2.2 East Spencer Street

The soil vapor sample SV-67 was collected approximately 1.5 to 2 feet above the sewer line extending west down East Spencer Street. TCE was detected at a concentration of 5,260 $\mu g/m^3$ and PCE was detected at a concentration of 389 $\mu g/m^3$.

3.2.3 South Cayuga Street

The soil vapor sample collected above the South Cayuga Street sewer lines at the intersection of South Hill Terrace (SV-65) contained TCE and PCE at concentrations of 597 $\mu g/m^3$ and 4,470 $\mu g/m^3$, respectively. Soil vapor point SV-64 was collected above a sewer lateral along the eastern side of South Cayuga Street and contained TCE at a concentration of 20.2 $\mu g/m^3$ and PCE at a concentration of 43.4 $\mu g/m^3$. Soil vapor point SV-66 was collected from the top of the highly fractured bedrock (over a bedrock feature) near a sewer lateral along the upper portion of South Hill Terrace. TCE was detected at a concentration of 49.7 $\mu g/m^3$ and PCE was detected at a concentration of 1,580 $\mu g/m^3$.

3.2.4 Soil Vapor Summary

The results of the supplemental soil vapor sampling indicate that vapor containing VOCs are present along each of the identified vapor migration pathways (1) the trench/bedding material of the Turner Place, East Spencer Street, and South Cayuga Street sanitary sewers, (2) the trench/bedding material along the residential sanitary sewer laterals, and (3) within the highly fractured bedrock surrounding and beneath the sewer lines. The highest concentration of TCE in vapor migrating along the sewer was found on East

Spencer Street. The highest soil vapor data collected along the sewer lines correlates with the highest sub-slab sample results for homes within this same area along East Spencer Street.

In addition, previous results of soil vapor sampling show that solvent releases have occurred from the sewer line originating at the former NCR facility. This sewer connects to the sanitary sewer network on Turner Place and continues south to East Spencer Street. Also, municipal sewer lines originating from the Therm facility connect to the Turner Place sanitary sewer network which, as stated above, continues to East Spencer Street.

4 Remedial Action Objectives

4.1 GENERAL

RAOs are medium-specific goals for protecting human health and the environment. Definition of the RAOs under a full feasibility study requires identification and assessment of constituents of concern (COCs), affected media, potential migration pathways, exposure routes, and potential receptors. Because these RAOs are specific to the identified AOC, and human health risks and habitat-based assessments were not completed for the site, the RAOs were developed by considering standards, criteria, and guidelines identified as potentially applicable to the site and by considering the most probable exposure pathways.

This section briefly summarizes the information used as the basis for development of the RAOs, identifies the RAOs applicable to the AOC, and describes the impacted areas at the AOC based on the RAOs.

4.2 RAOS

RAOs were determined by following NYSDEC and NYSDOH guidance for soil, vapor intrusion and indoor air quality. As discussed, the sanitary sewers and laterals are a potential migration pathway for soil vapor affected by COCs. Inhalation has been identified as a potential exposure pathway for affected soil vapor that has migrated from releases from the sewers. Exposure to indoor air impacted by COCs in residential properties is the primary exposure route and residents of properties with impacted indoor air are the primary receptors. There is also the potential for inhalation or dermal exposure to COCs when intrusive work is conducted. This may include subsurface utility work along the sanitary sewer lines, entering manholes, or excavation of road surfaces along this section of the sanitary sewer network.

Results of investigations indicate there is the potential for migration of vapor along the sanitary sewers and laterals. In addition, unconsolidated soils or materials along a section of sewer line on East Spencer Street may contain COCs. Based on this information, the RAOs for the AOC are as follows:

- Reduce, control, or eliminate the inhalation pathway in residential properties affected by COCs.
- Reduce or control utility worker exposure to COCs.
- Reduce, control, or eliminate the concentrations of COCs present in unconsolidated soils or materials along a designated length of sewer piping from the intersection of Turner Place and East Spencer Street at manhole MH-9, down East Spencer Street approximately 300 feet (see Figure 3).

The RAOs identified for soil vapor migration along the sanitary sewer lines that were previously investigated and the soil vapor data along East Spencer Street are used as the basis for identifying the impacted areas. In Sections 6 and 7, the RAOs are used as a basis for identifying remedial technologies and developing remedial alternatives to address vapor migration and COC mass removal.

5 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 sanitary sewers are presented in this section.

5.1 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.

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

NYSDEC has also identified certain guidance as "to-be-considered" (TBC) materials. 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.

5.2 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 – 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 – restrictions placed on the concentration of hazardous substances or the conduct of activity solely because they occur in specific locations.
- Action-Specific SCGs – technology- or activity-based requirements or limitations on actions taken with respect to hazardous waste management and site cleanup.

5.3 IDENTIFIED SCGS AND TBCS

The identification of federal and state SCGs and TBCs for the evaluation of remedial alternatives for the sanitary sewers was a progressive, multi-step process. The SCGs and TBCs identified as applicable are presented below and summarized in Tables 3, 4, and 5.

5.3.1 Chemical-Specific SCGs

New York State does not have chemical-specific SCGs for concentrations of COCs in soil vapor that could apply to vapor migration along the sewers. When considering vapor intrusion into residential properties as a result of migrating soil vapors, the NYSDOH has established decision-based matrices and air guideline values in its Soil Vapor Intrusion Guidance (NYSDOH 2006) that apply to specific chemicals

(Table 3). These matrices are used to determine if taking reasonable measures to reduce exposure, further monitoring, or mitigation are required based on the action level of 5.0 $\mu g/m^3$ for TCE and 100 $\mu g/m^3$ for PCE in indoor air, as well as taking into account sub-slab soil vapor concentrations. These matrices are applicable when considering the RAO of reducing the inhalation pathway in residential properties.

The chemical-specific SCGs that may apply to the impacted soils that may be surrounding the sewer lines are the NYSDEC Subpart 375-6 Restricted Use Soil Cleanup Objectives (SCOs) for Protection of Groundwater.

5.3.2 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. None of these location-specific SCGs are applicable to any of the remedial alternatives. Location-specific SCGs also include local building permit conditions for facilities constructed or work performed at the sewer lines (Table 4). This may be considered a potential location-specific SCG depending upon the remedial alternative. In addition, protection of surface water may be applicable as part of the remedial alternative.

5.3.3 Action-Specific SCGs

The potential action-specific SCGs for the sanitary sewers are summarized in Table 5. The action-specific SCGs outlined in this report include those common to all of the remedial alternatives discussed in the detailed evaluation of remedial alternatives.

6 Identification and Screening of Potentially Feasible Technologies

The following sections describe remedial technologies that were selected based on RAOs established for the sanitary sewers. This section describes the evaluation matrix presented in Table 6, which screens potentially feasible remedial technologies for addressing soil vapor migration and COC mass removal or reduction along the sanitary sewers. The remedial technologies that were selected as being potentially feasible following a qualitative analysis of technical benefits, limitations, and cost considerations, are included in a more detailed analysis in Section 7 and Table 7.

6.1 DESCRIPTION OF IDENTIFIED TECHNOLOGIES FOR THE SANITARY SEWER NETWORK

6.1.1 No Action

The no-action alternative would not involve the implementation of any remedial activities to address soil vapor migration or mass removal along the sanitary sewer network. No effort would be made to change any of the current conditions in the AOC. The no-action alternative has no technical benefits or limitations because it does not address any treatment technology and therefore would not achieve the RAOs. There are no costs associated with implementing this alternative. However, because the no-action alternative does not address the RAOs, it was not considered a potentially feasible technology. The no-action alternative will be retained for additional screening to provide a comparative baseline for all other potentially feasible technologies.

6.1.2 East Spencer Sewer Line Focused Excavation and Venting

This alternative would involve excavating and removing the existing sewer line and unconsolidated material (if present) in the immediate vicinity of the sewer (e.g., bedding material, overburden) along an approximate 300 foot length of sewer piping extending from the intersection of Turner Place and East Spencer Street at manhole MH-9, down East Spencer Street (see Figure 3). This designated length of sewer piping is where the highest concentration of TCE was detected in soil vapor, where the highest TCE concentration was detected in sub slab soil vapor samples, and where the highest TCE concentrations were detected in vapor samples collected above two key fracture features that are present between Turner Place and East Spencer Street. The soil vapor data and conceptual site model presented in Sections 2.3 and 3.0 provide the basis for targeting this section of sewer pipe.

During excavation and replacement, the main sewer line and laterals would be re-routed to manage sewer discharge from residential properties. The replacement sanitary sewer piping would require air and water tight joints to prevent vapor intrusion and migration inside the pipe from the surrounding formation upon completing the excavation activities. In addition, the pipe bedding would need to be comprised of highly permeable material to facilitate venting of vapors along the newly installed sewer trench. Slotted or perforated piping would be installed in this trench to enhance soil vapor venting. Soil vapor that reenters the excavated trench would be vented using one or two discharge points (e.g., standpipes) connected to the trench piping. These discharge points/standpipes would contain devices (e.g., wind turbine or barometric actuated systems) to enhance ventilation to the atmosphere. Similar to the discharge associated with the vapor mitigation systems in the neighborhood; vented vapors are not anticipated to have any measurable impact to ambient air.

It would be necessary to reconnect all residential sanitary sewer laterals to the newly constructed sanitary sewer line. In addition, this alternative may involve the replacement of manholes and their subsequent subsurface structures.

City utility drawings indicate that the South Hill sanitary sewer piping was installed from 5 to 7 feet bgs within the fractured bedrock. Piping that was installed to depths less than 3 feet were encased in flowable fill. The sewer replacement work may be completed by the City of Ithaca Department of Public Works. Handling of COC affected materials would be conducted by a properly certified and trained contractor in accordance with applicable rules and regulations.

This alternative would be implemented in combination with the continued operation of sub-slab depressurization systems at the residential properties in the designated mitigation study area to achieve the RAO of reducing indoor air concentrations of COCs.

This alternative would result in a moderate infrastructure and road construction project in a residential neighborhood with moderate capital costs. Excavation and replacement of a sanitary sewer line with a venting system is a potentially feasible alternative and will be retained for further analysis.

6.1.3 Soil Vapor Extraction Along Sewer Lines

Soil vapor extraction (SVE) is a common treatment technology used to remove VOCs from unsaturated soil. SVE works by removing soil vapor from the subsurface through adequately spaced extraction wells or horizontal piping screened only in the vadose (unsaturated) zone. The vacuum side of a blower is connected to the extraction wells or piping to induce a flow of vapors by generating a subsurface vacuum. As soil vapors move through the subsurface, VOCs adsorbed to the soil or contained in soil moisture partition into the vapor phase to maintain equilibrium. The extracted vapors are then conveyed to the surface for discharge and/or treatment. Vapor treatment methods include GAC, thermal destruction, or oxidation. The other alternative to applying SVE to the AOC would be to apply a vacuum directly to the sewer lines to gather soil vapors migrating around and along the sewer piping. The successful operation of an SVE system on the sanitary sewer lines would require multiple SVE blowers and associated treatment equipment to address the vapor issues at each sewer line.

This alternative requires additional pre-design work to ensure proper implementation. It would be necessary to review detailed engineering drawings of the sewer lines for construction specifications, including invert elevations, construction materials, and any pipe bedding material. If adequate drawings cannot be obtained, an investigation would be necessary to identify the construction components of the sewer lines. City utility drawings indicate that the South Hill sanitary sewer piping was installed from 5 to 7 feet bgs within the fractured bedrock. Piping that was installed to depths less than 3 feet were encased in flowable fill. Confirmation of construction specifications and depths would be required before any activity could proceed. In addition, high permeability bedding material around other utility corridors could cause short-circuiting and loss of vacuum. Construction specifications of these additional utility lines must also be identified.

Before this system can be implemented, SVE pilot tests would need to be completed to assess the appropriateness of full-scale implementation of this alternative. Additional soil vapor samples are needed to eliminate data gaps that exist along portions of the suspected pathways. There is likely to be short circuiting and loss of vacuum through storm drains, manholes, and perforations in the sanitary sewer piping.

This alternative is also complicated by the placement of treatment equipment in the neighborhood and associated noise from this equipment if it cannot be placed on the facility property. Placement of treatment equipment at the facility may be difficult to achieve due to the overall length and associated headloss of conveying captured air/vapor to the facility property. This would entail multiple large vacuum blowers and larger diameter piping to convey the air/vapor to the facility property, which may not be feasible.

This alternative would be implemented in combination with the continued operation of sub-slab depressurization systems at the residential properties in the designated mitigation study area to achieve the RAO of reducing indoor air concentrations of COCs. This alternative will be retained for further analysis.

6.1.4 Soil Vapor Extraction Along Laterals Connected to Sewer Lines

SVE along sewer laterals applies the same SVE technology as described above, but targets the laterals from the main sanitary sewer line to residential properties. This would be implemented by applying a vacuum around each of the laterals and installing all necessary SVE equipment as a means of preventing the migration of vapor to residential properties by way of the lateral pathways.

This alternative would also require pre-design work to ensure its proper implementation. As with applying SVE to the main sewer line, it would be necessary to review engineering drawings for existing sewer lines and conduct an investigation if appropriate information is not available. It would be necessary to confirm depths of installation of existing sewer lines and laterals.

Before this system could be implemented, SVE pilot tests would need to be completed to assess the appropriateness of full-scale implementation of this alternative. Additional soil vapor samples are needed to eliminate data gaps that exist along portions of the suspected pathways.

This alternative would be implemented in combination with the continued operation of sub-slab depressurization systems at the residential properties in the designated mitigation study area to achieve the RAO of reducing indoor air concentrations of COCs.

This alternative is technically impracticable to implement because it would require installing multiple vacuum blowers which would need to be housed in secure structures constructed on homeowner properties. Also, it would be impractical to provide electrical service to each vacuum blower via separate meters that would need to be installed at these locations. For these reasons, this alternative will not be retained for further analysis.

6.1.5 Blanket Mitigation of Homes

The blanket mitigation alternative would consist of installing sub-slab depressurization systems at identified residential properties across the designated mitigation study area without additional pre-mitigation air sampling (Figure 8). This alternative would address residential properties on a precautionary level to ensure they are protected from vapor intrusion of COCs.

The installation of a sub-slab depressurization system consists of a pre-design visit to survey the property and conduct sub-slab communication testing (if a concrete slab is present). Communication testing is completed by drilling a hole through the existing concrete slab and applying a vacuum to determine if the slab is capable of maintaining a negative pressure under vacuum. If the integrity of the slab is suitable for applying a vacuum, the system consists of drilling a 4-inch diameter vacuum point in the slab and routing polyvinyl chloride (PVC) piping to an externally-mounted fan. A manometer is installed on the piping to measure the vacuum established beneath the slab.

Properties without a concrete slab or with a deteriorated concrete slab are mitigated by first installing a layer of drain board over the dirt or gravel floor and pouring a concrete slab. A vacuum point is installed as previously described. Crawl spaces are addressed by installing an EPDM liner and applying a sub-membrane vacuum point.

Post-mitigation communication testing of the system is conducted by measuring vacuum across the slab after the system is installed. Vacuum manometer readings are also recorded to ensure proper system operation. Additionally, post-mitigation air sampling may be conducted to ensure the system successfully achieves acceptable post-mitigation indoor air requirements. The mitigation systems require annual inspection to ensure continued functionality of the system. The inspections include, at a minimum, inspecting the fan, manometer, slab, and membranes for any damage.

This alternative does not achieve all RAOs required for the AOC. However, sub-slab depressurization as a method of controlling vapor intrusion into residential properties is a proven technology that has been implemented at the site. This alternative will be retained for further analysis.

6.1.6 Air Sampling and Mitigation of Homes

This alternative would involve the continuing sampling of designated residential properties within the area of interest (Figure 8) to evaluate indoor air quality and subslab soil vapor levels. Homes not previously mitigated would undergo testing at a frequency to be determined. Sub-slab depressurization systems would be installed in homes where VOC concentrations were detected above criteria. This alternative will also require continued indoor air sampling of any property not receiving a mitigation system to ensure conditions do not change and later mandate mitigation. The sub-slab depressurization systems would be installed as previously described.

This alternative does not achieve all RAOs required for the AOC. However, sub-slab depressurization as a method of controlling vapor intrusion into residential properties is a proven technology that has been implemented at the site. This alternative will be retained for further analysis.

6.1.7 *In-Situ* Granular Activated Carbon

This alternative would entail the use of granular activated carbon (GAC) filled collars or dams (barriers) along the sewer lines at regular intervals as a method of removing VOCs from soil vapor that potentially migrate along certain portions of the sewer bedding. The COCs are readily absorbed by GAC, however, GAC filled collars or dams would not be effective as stand alone remedies because accumulated vapors may not migrate and be captured. For successful application, it would be necessary to convey vapors potentially migrating along certain portions of the sewer bedding through the *in-situ* GAC barriers by drawing vapors using a vacuum blower. The placement of vacuum equipment on the EPT site and in the neighborhood is not technically feasible.

This alternative would require the continued operation of sub-slab depressurization systems in residential properties in the area to achieve the RAOs. Because of the complexities and uncertainties associated with this alternative, it will not be retained for further analysis.

6.1.8 *In-Situ* Chemical Oxidation

In-situ chemical oxidation (ISCO) involves introducing a strong oxidant into a subsurface aquifer, typically via an injection well. There are many types of commercially-available oxidants used to address chlorinated solvents, including hydrogen peroxide, potassium permanganate, and sodium persulfate. Oxidants address contaminants by mineralizing the contaminant on contact, producing carbon dioxide, water, dissolved hydrogen, or other innocuous compounds. Potassium permanganate also produces manganese dioxide and can increase manganese levels in groundwater. For chlorinated compounds with double bonds, such as TCE, chemical oxidation breaks the double bonds at the beginning of the process. Thus, the formation of potentially toxic byproducts does not occur. Unreacted oxidants naturally decompose in groundwater, and there are no long-term adverse effects to the groundwater.

With successful delivery and uniform distribution, the process results in a nearly instantaneous reduction in VOCs in the treated area. This technology is well-suited for addressing groundwater contamination “hot spots” in a relatively short time because of the ability to target an area. This treatment technology eliminates the need for ex-situ treatment of groundwater, which reduces technical complexity and associated costs. It requires very little or no maintenance when compared with mechanically based technologies.

However, ISCO would not be an appropriate technology to treat soil vapors migrating along the sanitary sewer lines and fractured bedrock because this technology is not suitable for treating soil vapors and delivery of ISCO into this system would be technically impracticable. The ISCO process occurs in the aqueous phase and thus is not appropriate for the treatment of VOCs in soil vapor. Therefore, this alternative will not be retained for further analysis.

6.1.9 Vapor Dam

A vapor dam is an impermeable structure that would be installed in the subsurface to inhibit the flow of soil vapors. Vapor dams can be placed in utility corridors to prevent the flow of soil vapors through higher permeability bedding material surrounding the pipe. This technology would be implemented by installing a vapor dam along the sanitary sewer lines and/or laterals to prevent the migration of vapors along this utility corridor. These dams can be designed with or without a venting system to remove accumulated vapors. This technology without a venting system would not be effective at meeting the RAOs because any accumulated vapors would remain in the subsurface and have the potential for migrating around the vapor dam and along adjacent utility corridors (e.g., electrical, water, natural gas), bedrock fractures, or overburden material. Vapor dams with a venting system could not be practically implemented to due the redundancy of vent point locations that would need to be installed across the neighborhood and the similar implementation issues identified for the vapor extraction technologies. Furthermore, this technology could not be effectively implemented in areas where the sewer pipe is encased in flowable fill on top of bedrock. Therefore, this alternative will not be retained for further analysis.

7 Detailed Evaluation of Remedial Alternatives

7.1 GENERAL

This section presents information relevant to the selection of a remedial alternative(s) for the South Hill sanitary sewer network. Potentially feasible alternatives are further screened in this report to determine the appropriateness and suitability for achieving the RAOs for the sanitary sewer network. The remedial alternatives 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 to address the RAOs established for the vapor migration occurring along the sanitary sewer network. The remedial alternatives evaluated for the AOC are presented below:

- Alternative 1 – No Action
- Alternative 2 – East Spencer Sewer Line Focused Excavation and Venting
- Alternative 3 – Soil Vapor Extraction along Sewer Lines
- Alternative 4 – Blanket Mitigation of Homes
- Alternative 5 – Air Sampling and Mitigation of Homes

7.2 DESCRIPTION OF EVALUATION CRITERIA

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

7.2.1 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.

7.2.2 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).

7.2.3 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 AOC.

7.2.4 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 the AOC through treatment. The evaluation focuses on the following factors:

- the treatment process and the amount of materials to be treated
- the treatment process' 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

7.2.5 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

7.2.6 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 to the feasibility of acquiring, and the time required to obtain, any necessary approvals and permits.

7.2.7 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.

7.3 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR VAPOR MIGRATION

This section presents the detailed analysis of each remedial alternative for reducing the migration of vapors associated with the sanitary sewers in conjunction with the RAOs proposed for the sanitary sewer network as identified in Section 4.2 using the criteria listed in Section 7.2.

7.3.1 Alternative 1 – No Action

7.3.1.1 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 vapor potentially traveling through or present in the AOC. The AOC would be allowed to remain in its current condition and no effort would be made to change its current conditions.

7.3.1.2 Overall Protection of Human Health and the Environment

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

7.3.1.3 Compliance with SCGs

The chemical-specific SCGs identified for this alternative are presented in Table 3. Chemical-specific SCGs that may apply to vapor in the AOC include the NYSDOH Soil Vapor Intrusion (VI) Guidance, which identifies acceptable chemical constituent concentrations in indoor air. The chemical-specific SCGs that may apply to the impacted soils or unconsolidated materials that may be surrounding the sewer lines are the NYSDEC Subpart 375-6 Restricted Use SCOs for Protection of Groundwater.

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

7.3.1.4 Long-Term Effectiveness and Permanence

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

7.3.1.5 Reduction of Toxicity, Mobility, and Volume through Treatment

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

7.3.1.6 Short-Term Effectiveness

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

7.3.1.7 Implementability

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

7.3.1.8 Cost

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

7.3.2 Alternative 2 – East Spencer Sewer Line Focused Excavation and Venting

7.3.2.1 Technical Description

Sewer line excavation would involve the removal of the sanitary sewer line and unconsolidated material (e.g., pipe bedding, overburden) in the immediate vicinity of the sewer line extending a distance of approximately 300 feet from the intersection of Turner Place and East Spencer to manhole MH-9 on East Spencer Street (see Figure 3). This designated length of sewer piping is where the highest concentration of TCE was detected in soil vapor, where the highest TCE concentration was detected in sub slab soil vapor samples, and where the highest TCE concentrations were detected in vapor samples collected above two key fracture features that are present between Turner Place and East Spencer Street. The soil vapor data and conceptual site model presented in Sections 2.3 and 3.0 provide the basis for targeting this section of sewer pipe. The purpose of the targeted excavation is to remove any identified COC affected bedding material that may be present along this section of sewer line that may be contributing to COCs in soil vapor. Excavated bedding material would be managed and disposed off-site at an approved facility in accordance with local, state, and federal regulations.

The replacement of the sanitary sewer piping would require the use of air and water tight joints to prevent vapor intrusion and migration inside the pipe from the surrounding formation upon completing the excavation activities. In addition, the pipe bedding would also need to be composed of highly permeable material to facilitate venting of vapors along the newly installed sewer trench. Slotted or perforated piping would be installed in this trench to enhance soil vapor venting. Soil vapor that reenters the excavated trench would be vented using a single or series of discharge points (e.g., standpipes) connected to the trench piping. These discharge points/standpipes would contain devices (wind turbine or barometric actuated systems) to enhance ventilation to the atmosphere. Field testing may be required to determine the most appropriate venting system.

It would be necessary to reconnect all residential sanitary sewer laterals to the newly constructed sanitary sewer line. In addition, this alternative may involve the replacement of manholes and their subsequent subsurface structures.

The removal and replacement of this sanitary sewer line may be performed by/with the City of Ithaca Department of Public Works. Handling of any COC affected material would be performed by a properly trained contractor in accordance with applicable rules and regulations.

This alternative would be implemented in combination with the continued operation of sub-slab depressurization systems at the residential properties in the designated mitigation study area to achieve the RAO of reducing indoor air concentrations of COCs.

7.3.2.2 Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment if the sewer line excavation, as well as the continued operation of the vapor mitigation systems, achieves the RAOs.

7.3.2.3 Compliance with SCGs

Chemical-specific SCGs that may apply to this alternative include the NYSDOH VI guidance, which identify acceptable chemical constituent concentrations in indoor air due to soil vapor intrusion. With the proper implementation of the vapor mitigation systems, this alternative could potentially meet the requirements of the SCG in a short amount of time after installation. The chemical-specific SCGs that may apply to the impacted soils that may be surrounding the sewer lines are the NYSDEC Subpart 375-6 Restricted Use SCOs for Protection of Groundwater.

Location-specific SCGs that may apply to this alternative include City of Ithaca and New York State Department of Transportation (NYSDOT) requirements pertaining to the removal and replacement of sanitary sewer lines, as well as road work and reconstruction. The installation of mitigation systems in conjunction with this alternative will also require City of Ithaca permitting.

Action-specific SCGs are common to all of the remedial alternatives and include Occupational Safety and Health Administration (OSHA) regulations, waste handling regulations, and federal environmental regulations.

7.3.2.4 Long-Term Effectiveness and Permanence

This alternative could be effective in the long-term because COCs present in bedding materials around the sewer pipe would be removed and vapors remaining in the shallow unsaturated bedrock and in fractured bedrock would be addressed as vapors in the subsurface continue to migrate along the newly installed sewer line with a venting system.

The long-term effectiveness of this alternative includes the continued operation of sub-slab depressurization systems at the residential properties in the area to achieve the RAO of reducing indoor air concentrations of COCs.

7.3.2.5 Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative would reduce the mobility of COCs present within the replaced sewer trench via venting and would remove COC affected materials surrounding the sewer pipe. However, this alternative does not actively treat or address COCs in unsaturated fractured bedrock.

7.3.2.6 Short-Term Effectiveness

This alternative would eliminate the migration of vapors within and along the designated sewer line excavation in the short term. Continuous monitoring of ambient air would be performed to ensure workers are not exposed to elevated vapor concentrations. Construction activities would have an impact to the community because of road closures (East Spencer Street is a one-way road and would need to be closed until the work was completed requiring a management plan for the public to access residential properties), irritant noise from construction equipment, and general disruption of the neighborhood. Dust must be monitored and controlled, and erosion measures would be necessary because of the significant potential for runoff due to the slope of hills in the neighborhood.

The construction would be similar to that of general road construction work conducted by the City of Ithaca on a regular basis. The sewer line may run along public right-of-ways, and expedited implementation would include community involvement and meeting local requirements.

7.3.2.7 Implementability

The excavation and replacement of the sanitary sewer along the designated section of East Spencer Street could be accomplished using conventional construction equipment. Approvals would be necessary from the City of Ithaca to replace the sewer and a traffic management program would be necessary.

7.3.2.8 Cost

The capital cost associated with this alternative is $596,000 (Table 8). The capital costs include the removal and replacement of the sewer line along East Spencer Street as depicted on Figure 3. O&M costs include annual O&M for the vapor mitigation systems. The total present worth cost for this alternative is $982,000.

7.3.3 Alternative 3 – Soil Vapor Extraction on Sewer Lines

7.3.3.1 Technical Description

Alternative 3 involves the installation of an SVE system on the sanitary sewer lines with the goal of removing any accumulated vapors located within the bedding material surrounding the sanitary sewer piping. This alternative also may include the installation of a vacuum on the inside of the sanitary sewer piping itself. The vapor removed by the extraction system would be treated using conventional treatment methods (e.g., vapor phase activated carbon) prior to discharge into ambient air. The successful operation of an SVE system on the sanitary sewer lines would require multiple SVE blowers and associated treatment equipment to address the vapor issues at each sewer line.

This alternative would also require pre-design work to ensure its proper implementation. As with Alternative 2, it would be necessary to review engineering drawings for existing sanitary sewer lines and conduct an investigation if appropriate information is not available. It would be necessary to confirm the depths of existing sanitary sewer lines.

Before this system could be implemented, SVE pilot tests would need to be completed to assess the appropriateness of full-scale implementation of this alternative. In addition, additional soil vapor samples are needed to eliminate data gaps that exist along portions of the suspected pathways.

This alternative is also complicated by the placement of treatment equipment in the neighborhood and associated noise from this equipment if it cannot be placed on the facility property. Placement of treatment equipment at the facility may be difficult to achieve due to the overall length and associated headloss of conveying captured air/vapor to the facility property. This would entail multiple large vacuum blowers and larger diameter piping to convey the air/vapor to the facility property, which may not be feasible. In addition, due to the severe slope of the hillside throughout the area, it would be difficult to install piping back to the facility property.

As with Alternative 2, this alternative would be implemented in combination with the continued operation of sub-slab depressurization systems at the residential properties in the designated mitigation study area to achieve the RAO of reducing indoor air concentrations of COCs.

7.3.3.2 Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment if the installation of the SVE system, as well as the continued operation of the vapor mitigation systems, achieves the RAOs.

7.3.3.3 Compliance with SCGs

Chemical-specific SCGs that may apply to vapor migration within the AOC include the NYSDOH VI guidance, which identifies acceptable chemical constituent concentrations in indoor air due to soil vapor intrusion. The chemical-specific SCGs that may apply to the impacted soils that may be surrounding the sewer lines are the NYSDEC Subpart 375-6 Restricted Use SCOs for Protection of Groundwater. With the proper implementation of the in-home vapor mitigation system, this alternative could potentially meet the requirements of the indoor air SCG in a short amount of time after installation. The SCOs may be more difficult to achieve with this alternative.

Location-specific SCGs that may apply to this alternative include City of Ithaca and NYSDOT requirements pertaining to modification of the sanitary sewer system with the addition of SVE equipment, road work, and reconstruction. The installation of mitigation systems in conjunction with this alternative would also require City of Ithaca permitting.

Action-specific SCGs are common to all of the remedial alternatives and include OSHA regulations, waste handling regulations, and federal environmental regulations.

7.3.3.4 Long-Term Effectiveness and Permanence

Under this alternative, the COCs present in vapor would be addressed by an extraction system. The long term effectiveness of this alternative is uncertain because it depends on the bedding material and the construction of the existing sewer lines. Installation of the SVE system on the sewer lines includes utilizing the existing sewer line construction and drawing a vacuum along the sewer lines. There is a possibility that short circuiting of air flow would inhibit the effectiveness of the SVE system. As a stand-alone technology, SVE on the sewer lines would not meet all the established RAOs. Enacting restrictions for utility workers would be recommended in conjunction with SVE to ensure safety if the SVE system was not effective at mitigating continued vapor migration.

The long-term effectiveness of this alternative includes the continued and proper operation of sub-slab depressurization systems at the residential properties in the designated mitigation study area to achieve the RAO of reducing indoor air concentrations of COCs.

7.3.3.5 Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative would reduce the mobility and volume of COCs present in the sewer system if it can be successfully implemented.

7.3.3.6 Short-Term Effectiveness

This alternative could immediately remove soil vapors upon start up and thus could be effective in the short term. However, if short circuiting occurred, this alternative would not be effective in the short term.

This alternative has many of the same short-term impacts as Alternative 2. Measures would be taken to ensure exposure remains below acceptable levels. Implementing SVE would involve extensive construction and related concerns, including noise, community disruption, road closures, dust, and runoff. This alternative would likely be more difficult to expedite because it would involve applying an active treatment technology to the sewer lines, which may be met by community and local permitting concerns. Treatment equipment installed for this alternative would be disruptive in both the short and long-term because of size and noise.

7.3.3.7 Implementability

The installation of an SVE system on the sewer lines could be accomplished using conventional construction methods. However, it may not be feasible to implement this alternative because there is no readily available property in the South Hill neighborhood to locate equipment associated with an SVE system. It is not feasible to place treatment equipment on the EPT property and run conveyance piping to the facility due to the overall length of the required piping resulting in significant frictional head loss. Very large treatment equipment (i.e., vacuum blower(s)) and large-diameter conveyance piping would be required to overcome the frictional head loss associated with elevation and distance.

The construction of each sanitary sewer line would also have an effect on the implementability of the system. The possibility of inadequate void space around the piping or large gaps in the piping construction may cause short-circuiting of the air flow, which would have an overall reduction in the application of the vacuum. In addition, surface water drainage that runs through the void space and bedding material of the sewer piping may prevent the SVE system from having an adequate and consistent vacuum and would create an additional discharge (aqueous phase) from the treatment system to be handled.

7.3.3.8 Cost

The capital cost associated with this alternative is $2,214,000 (Table 9). The capital costs include the design as well as the installation of the SVE system. O&M costs include annual O&M for the vapor mitigation systems. O&M costs have also been included to operate the SVE system for a period of five years. The total present worth cost for this alternative is $3,062,000.

7.3.4 Alternative 4 – Blanket Mitigation

7.3.4.1 Technical Description

The blanket mitigation alternative would consist of installing sub-slab depressurization systems at identified residential properties across the designated mitigation study area without additional pre-mitigation air sampling (Figure 8). This alternative would address residential properties on a precautionary level to ensure they are protected from vapor intrusion of COCs.

The installation of a sub-slab depressurization system consists of a pre-design visit to survey the property and conduct sub-slab communication testing (if a concrete slab is present). Communication testing is completed by drilling a hole through the existing concrete slab and applying a vacuum to determine if the slab is capable of maintaining a negative pressure under vacuum. If the integrity of slab is suitable for applying a vacuum, the system consists of drilling a 4-inch diameter vacuum point in the slab and routing PVC piping to an externally-mounted fan. A manometer is installed on the piping to measure the vacuum established beneath the slab.

Properties without a concrete slab or with a deteriorated concrete slab are mitigated by first installing a layer of drain board over the dirt or gravel floor and pouring a concrete slab. A vacuum point is installed as previously described. Crawl spaces are addressed by installing an EPDM liner and applying a sub-membrane vacuum point.

Post-mitigation communication testing of the system is conducted by measuring vacuum across the slab after the system is installed. Vacuum manometer readings are also recorded to ensure proper system operation. Additionally, post-mitigation air sampling may be conducted to ensure the system successfully achieves acceptable post-mitigation indoor air requirements. The mitigation systems require annual inspection to ensure continued functionality of the system. The inspections include, at a minimum, inspecting the fan, manometer, slab, and membranes for any damage.

7.3.4.2 Overall Protection of Human Health and the Environment

This alternative would achieve the overall protection of human health and the environment by mitigating vapor intrusion into residential properties by the installation of a vapor mitigation system. This alternative would not achieve the RAO of reducing, controlling, or eliminating the concentrations of COCs present in unconsolidated soils or materials along the sanitary sewers.

7.3.4.3 Compliance with SCGs

Chemical-specific SCGs that may apply to vapor migration into homes include the NYSDOH VI guidance, which identifies acceptable chemical constituent concentrations in indoor air due to soil vapor intrusion. The chemical-specific SCGs that may apply to the impacted soils that may be surrounding the sewer lines are the NYSDEC Subpart 375-6 Restricted Use SCOs for Protection of Groundwater. With the proper implementation of the in-home vapor mitigation system, this alternative could potentially meet the requirements of the indoor air SCG in a short amount of time after installation. The SCOs would not be met with this alternative.

Location-specific SCGs that may apply to this alternative include City of Ithaca Building Department permits to install the vapor mitigation systems as alterations to residential properties.

Action-specific SCGs are common to all of the remedial alternatives and include OSHA regulations, waste handling regulations, and federal environmental regulations.

7.3.4.4 Long-Term Effectiveness and Permanence

The effectiveness of this method at addressing vapor intrusion into residential properties will continue in the long-term with the continued operation of the installed mitigation systems. The alternative would prevent vapor intrusion of COCs into the residence and would achieve the RAO of reducing concentrations of COCs in indoor air. It would be necessary to gain access to residential properties by obtaining signed access agreements from property owners. If access was not granted, the property would not be mitigated and the RAOs would not be achieved.

This alternative does not address the source or pathways of vapor migration. Migration of vapors along the sanitary sewers and laterals would not be addressed with this alternative.

7.3.4.5 Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative would reduce the mobility and volume of COCs present in indoor air in residential properties. However, this alternative does not address the source or pathways of vapor migration, nor does it address the reduction in the mobility, toxicity, or volume within the sanitary sewer system.

7.3.4.6 Short-Term Effectiveness

This alternative is an effective means of addressing the vapor intrusion into residential properties with the continued operation of the installed systems. The COCs would be addressed by preventing vapor intrusion into residential properties. However, this alternative does not address vapors migrating along sanitary sewer lines and laterals or within fractures in the bedrock in the mitigation study area. This alternative also does not address any COC affected soils/material that may be located along the sewer lines.

Installing sub-slab depressurization systems involves low risk to workers because exposure to elevated concentrations of COCs in the sub-slab or indoor air is limited. Indoor air concentrations are not typically high enough to pose a significant threat to human health in the short-term. Measures would be taken to monitor air and protect workers.

Installation of mitigation systems in residential properties may be disruptive to homeowners and residents in the short-term. Efforts must be taken to work at convenient, daytime hours and minimize noise and personal disruption as much as possible. Gaining access to residential properties may increase the time necessary to install a mitigation system. In addition, the construction process itself may be slowed because of access limitations and City of Ithaca involvement in the residential construction permitting process. However, sub-slab depressurization systems are effective immediately upon installation and would begin preventing vapor intrusion as soon as they become operational.

7.3.4.7 Implementability

Sub-slab depressurization systems can be implemented and have already been demonstrated to be effective in achieving acceptable indoor air concentrations. Installation of the systems is achieved through conventional means.

One limitation to implementability may be obtaining access to residential properties. Proceeding with construction of a sub-slab depressurization system would require a signed access agreement from the property owners. If a homeowner selects not to grant access to a property, the property may continue to be at risk of vapor intrusion.

7.3.4.8 Cost

The capital cost associated with this alternative is $1,827,000 (Table 10). The capital cost includes the installation of vapor mitigation systems in every home within the designated mitigation study area and the post-mitigation air sampling costs following vapor mitigation system implementation to ensure acceptable indoor air concentrations are achieved. O&M costs include maintaining the operation of these systems (e.g., annual inspections, electricity usage). The present worth cost for this alternative is $2,688,000.

7.3.5 <u>Alternative 5 – Air Sampling and Mitigation</u>

7.3.5.1 Technical Description

Alternative 5 involves continuing sampling of designated residential properties within the area of interest (Figure 8) to evaluate indoor air quality and subslab soil vapor levels. Homes not previously mitigated would undergo testing at a frequency to be determined. Sub-slab depressurization systems would be installed in homes where VOC concentrations were detected above criteria. The NYSDOH Matrix for indoor air sampling would dictate whether mandatory mitigation is required. This alternative will also require continued indoor air sampling of any property not receiving a mitigation system after the first round of sampling to ensure conditions do not change and mandate mitigation. The continued air sampling would occur at a frequency to be determined.

The sub-slab depressurization systems would be installed and monitored as described in Alternative 4.

7.3.5.2 Overall Protection of Human Health and the Environment

This alternative would achieve the overall protection of human health and the environment by mitigating vapor intrusion into residential properties by the installation of a vapor mitigation system. This alternative would not achieve the RAO of reducing, controlling, or eliminating the concentrations of COCs present in unconsolidated soils or materials along the sanitary sewers.

7.3.5.3 Compliance with SCGs

Chemical-specific SCGs that may apply to vapor migration at the AOC include the NYSDOH VI guidance, which identifies acceptable chemical constituent concentrations in indoor air due to soil vapor intrusion. The chemical-specific SCGs that may apply to the impacted soils that may be surrounding the sewer lines are the NYSDEC Subpart 375-6 Restricted Use SCOs for Protection of Groundwater. With the proper implementation of the in-home vapor mitigation system, this alternative could potentially meet the requirements of the indoor air SCG in a short amount of time after installation. The SCOs would not be met with this alternative.

Location-specific SCGs that may apply to this alternative include City of Ithaca Building Department permits to install the vapor mitigation systems as alterations to residential properties.

Action-specific SCGs are common to all of the remedial alternatives and include OSHA regulations, waste handling regulations, and federal environmental regulations.

7.3.5.4 Long-Term Effectiveness and Permanence

The effectiveness of this method at addressing the vapor intrusion into residential properties will continue in the long-term with the continued operation of the installed mitigation systems. The alternative would prevent vapor intrusion of COCs into the residence and would meet the RAO of reducing concentrations of COCs in indoor air. It would be necessary to gain access to residential properties with signed access agreements from property owners. If access was not granted, the property would not be mitigated and the RAOs would not be achieved.

This alternative does not address the source or pathways of vapor migration. Migration of vapors along the sanitary sewers and laterals would not be addressed with this alternative.

7.3.5.5 Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative will reduce the mobility and volume of COCs present in indoor air in residential properties. However, this alternative does not address the source or pathways of vapor migration, nor does it address the reduction in the mobility, toxicity, or volume within the sewer system.

7.3.5.6 Short-Term Effectiveness

This alternative is an effective means of addressing the vapor intrusion into residential properties with the continued operation of the installed systems. The COCs in the AOC would be addressed by preventing vapor intrusion into residential properties. However, this alternative does not address vapors migrating along sanitary sewer lines and laterals in the mitigation study area. This alternative also does not address any COC affected soils/material that may be located along the sewer lines.

As with Alternative 4, installing sub-slab depressurization systems involves low risk to workers because exposure to elevated concentrations of COCs in the sub-slab or indoor air is limited. Indoor air concentrations are not typically high enough to pose a significant threat to human health in the short-term. Measures would be taken to monitor air and protect workers.

Installation of mitigation systems in residential properties may be disruptive to homeowners and residents in the short-term. Efforts must be taken to work at convenient, daytime hours and minimize noise and personal disruption as much as possible. Gaining access to residential properties may increase the time necessary to install a mitigation system. In addition, the construction process itself may be slowed because of access limitations and City of Ithaca involvement in the residential construction permitting process. However, sub-slab depressurization systems are effective immediately upon installation and would begin preventing vapor intrusion as soon as they are turned on.

The short-term effectiveness is also limited by the air sampling process because NYSDOH recommends air sampling only during the heating season (from November 15 to March 31). If a property cannot be sampled during a particular heating season for any reason, it would be a significant amount of time before sampling could proceed. This limitation would inhibit the mitigation system installation process.

7.3.5.7 Implementability

Indoor air sampling is easily implemented and the mitigation systems can be designed and installed based on these results.

Sub-slab depressurization systems could be implemented and have already been demonstrated to be effective in achieving acceptable indoor air concentrations. Installation of the systems is achieved through conventional means.

One limitation to implementability may be obtaining access to residential properties. Proceeding with construction of a sub-slab depressurization system would require a signed access agreement from the homeowner. If a homeowner elects not to grant access to a property, the property may continue to be at risk of vapor intrusion.

7.3.5.8 Cost

The capital cost associated with this alternative is $828,000 (Table 11). The capital costs include initial air sampling, construction of vapor mitigation systems, and post-mitigation air sampling of homes within the designated mitigation study area shown on Figure 8. O&M costs include maintaining the operation of these systems (e.g., annual inspections, electricity usage). Annual air sampling costs are considered on an annual basis for all properties not mitigated after the first round of air sampling. The present worth cost for this alternative is $1,706,000.

8 Comparative Analysis of Alternatives

8.1 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 are used as a basis for recommending a remedial alternative for addressing the impacted media in the AOC.

Presented below is a comparative analysis of remedial alternatives for the AOC. The results of this comparative analysis will be used as the basis for recommending a remedial alternative to address the AOC.

8.2 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

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

8.2.1 Overall Protection of Human Health and the Environment

All of the remedial alternatives, with the exception of Alternative 1 (no-action), have the potential to be protective of human health and the environment. Alternative 2 involves removal of bedding material around the sewer line that may contain COCs and also addresses vapors containing COCs which may migrate into the trench of the sewer line from the surrounding fractured bedrock. Alternative 3 involves the active removal of vapors and may be protective of human health and the environment, assuming this alternative could be implemented. Also, Alternatives 2, 3, 4, and 5 rely on continued operation of vapor mitigation systems that have been installed in homes to achieve the RAO of reducing, eliminating, or preventing the inhalation pathway for COCs. Alternatives 4 and 5 are protective of human health and the environment because they both address the primary exposure pathway, which is vapor intrusion into residential properties but do not meet the mass removal RAO. However, Alternatives 4 and 5 are effective in achieving the receptor-based goals of this analysis.

8.2.2 Compliance with SCGs

Only Alternative 2 has the potential of meeting all the SCGs. All of the alternatives rely on continued operation of vapor mitigation systems that have been installed in homes in order to ensure compliance with chemical-specific SCGs related to indoor air quality. Alternative 2 may also meet the chemical-specific SCG of soil SCOs that may be applicable. Location-specific SCGs primarily involve City of Ithaca requirements for construction and access to each home. With consideration of local code, all location-specific SCGs could be achieved. Action-specific SCGs could be met for Alternatives 2 through 5 with implementation of engineering controls and a site-specific Health and Safety Plan (HASP).

8.2.3 Long-Term Effectiveness and Permanence

The no-action alternative would not meet the RAOs established for the AOC. The remaining alternatives have the potential to meet the vapor related RAOs. Alternative 2 would be effective in the long-term and provide a permanent solution because bedding material containing COCs would be removed from the designated section of sewer line and vapors that emanate from surrounding fractured bedrock along and around the replaced sewer line would be addressed by a venting system. Alternative 3 potentially could be effective in the long-term; however, this alternative is not technically feasible to construct in the South Hill neighborhood. Alternatives 2 and 3 would also be implemented in conjunction with long-term operation of sub-slab depressurization systems that have been installed in homes in the South Hill neighborhood to meet the RAO of reducing, controlling, or eliminating the inhalation pathway.

Alternatives 4 and 5 would be effective in the long-term as they address vapor intrusion into homes, and the systems could be operated and maintained indefinitely. However, Alternatives 4 and 5 do not address the source or pathways of vapor migration and are receptor-based alternatives related to inhalation of COCs in indoor air.

8.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

The no-action alternative would not reduce the toxicity, mobility, or volume of COCs present in the AOC. Alternative 2 would reduce the mass of COCs that may be identified around the designated sewer line section and also reduce the volume and mobility of the COCs in vapor. Any vapors that accumulate in the new sewer trench over time would be removed via a venting system. Alternative 3 would reduce the mobility and volume of COCs within the AOC because this alternative involves implementation of an active treatment technology. However, because of complexities in implementing an SVE system, this alternative may not be successful. Alternatives 4 and 5 would serve as a preventive measure by eliminating the migration pathway directly into residential properties, thus reducing the toxicity, mobility, and volume of COCs entering residential properties through intrusion pathways.

8.2.5 Short-Term Effectiveness

There would be no short-term impacts associated with implementation of the no-action alternative. Alternative 2 would have a much greater effectiveness immediately after installation. Alternative 3 would be effective in the short-term; however it would be affected by the shortcomings of implementation and the difficulty in maintaining an effective vacuum. Alternative 4 would be effective once the mitigation systems are installed and operational, which may be limited by the permitting process, access to properties, and installer limitations. Alternative 5 would have less short-term effectiveness because indoor air sampling would delay the installation process, particularly if sampling must wait until the following heating season. Both Alternatives 4 and 5 immediately begin to reduce COCs with the start-up of a vapor mitigation system, which typically does not take long to construct and implement.

Alternatives 2 and 3 would have similar short-term impacts to the environment because of the extensiveness of construction and associated risks. These alternatives would significantly impact the local community because of their invasive nature. Alternatives 4 and 5 would have lesser short-term impacts because construction is less intrusive and extensive.

8.2.6 Implementability

The no-action alternative does not require the implementation of any technology. All of the other alternatives have implementation complexities. The implementation of Alternative 2 would require conventional construction, may involve the City of Ithaca for installation, and would require approval by local government jurisdictions. Alternative 3 would require large vacuum blowers to operate the SVE systems, and finding a location for the treatment equipment would be difficult. Locating treatment equipment at the EPT facility may not be feasible because of significant frictional head loss in the piping traversing an extensive distance and elevation changes. Large-diameter piping would be required to attempt to compensate for these losses and installation of this size piping would be difficult due to shallow bedrock. The alternative to housing the SVE treatment equipment on EPT property is to construct the systems on private property within the South Hill neighborhood. This is not a practical alternative because of significant noise concerns and general community disruption. In addition, implementation of SVE in the shallow overburden would create significant vacuum losses that may prevent the system from operating successfully. Short circuiting of vacuum air flow is likely through pipe bedding material, surrounding utility corridors, and poorly sealed locations along roadways.

Alternatives 4 and 5 are more easily implemented because installation of vapor mitigation systems has already been demonstrated as an effective technology for preventing intrusion of vapors into residential properties and disruption to the community is significantly less. Mitigation systems have been installed throughout the neighborhood and are understood by the community, which would reduce possible delays in the installation process. The systems are installed by well known conventional construction methods with readily available materials.

8.2.7 Estimated Cost

The no-action alternative has no associated cost. The estimated present worth cost for Alternative 2 is $982,000; Alternative 3 is $3,062,000, Alternative 4 is $2,688,000, and Alternative 5 is $1,706,000. A detailed breakdown of cost estimates is presented in Tables 8 through 11.

8.3 RECOMMENDED ALTERNATIVES

The recommended remedial alternative to address the South Hill sanitary sewer network and associated soil vapor intrusion issues is Alternative 2 which includes excavation of the sewer line and unconsolidated material surrounding the sewer along a section of sewer piping from the intersection of Turner Place and East Spencer Street at manhole MH-9, down East Spencer Street approximately 300 feet, replacement of the sewer line, placement of select backfill and ventilation piping, and a venting system. This alternative also includes continued operation of sub-slab depressurization systems in residential properties in the area. This alternative directly addresses the issue of soil vapor intrusion into residential properties and achieves the RAO of reducing, controlling, or eliminating the inhalation pathway. In addition, this alternative also achieves the RAO of reducing the mass of COCs in the sanitary sewer network by targeting the section of sewer piping that may contain COC mass based on soil vapor data. Alternative 3 is not practical to implement due to the lack of available property for treatment equipment, disruption to the South Hill neighborhood, and shortcomings of applying this technology at the site. Alternatives 4 and 5 address residential properties where vapor intrusion is of the greatest concern, but do not address the source area or migration pathways. Therefore, these alternatives are not recommended as stand-alone remedial approaches.

References

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Acronyms

$\mu g/m^3$	microgram per cubic meter
AA	Alternatives Analysis
AOC	area of concern
bgs	below ground surface
COC	constituents of concern
CSM	conceptual site model
EPA	U.S. Environmental Protection Agency
EPT	Emerson Power Transmission
GAC	granular activated carbon
HASP	Health and Safety Plan
ID	inner diameter
ISCO	*in-situ* chemical oxidation
L/min	liters per minute
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
O&M	operation and maintenance
OD	outer diameter
OSHA	Occupational Safety and Health Administration
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RAOs	remedial action objectives
SCGs	standards, criteria, and guidance
SCOs	Soil Cleanup Objectives
SRP/AA	Supplemental Remedial Program/Alternatives Analysis
SVE	soil vapor extraction
TBC	to be considered
TCE	trichloroethene
VI	vapor intrusion
VOC	volatile organic compounds

Figures

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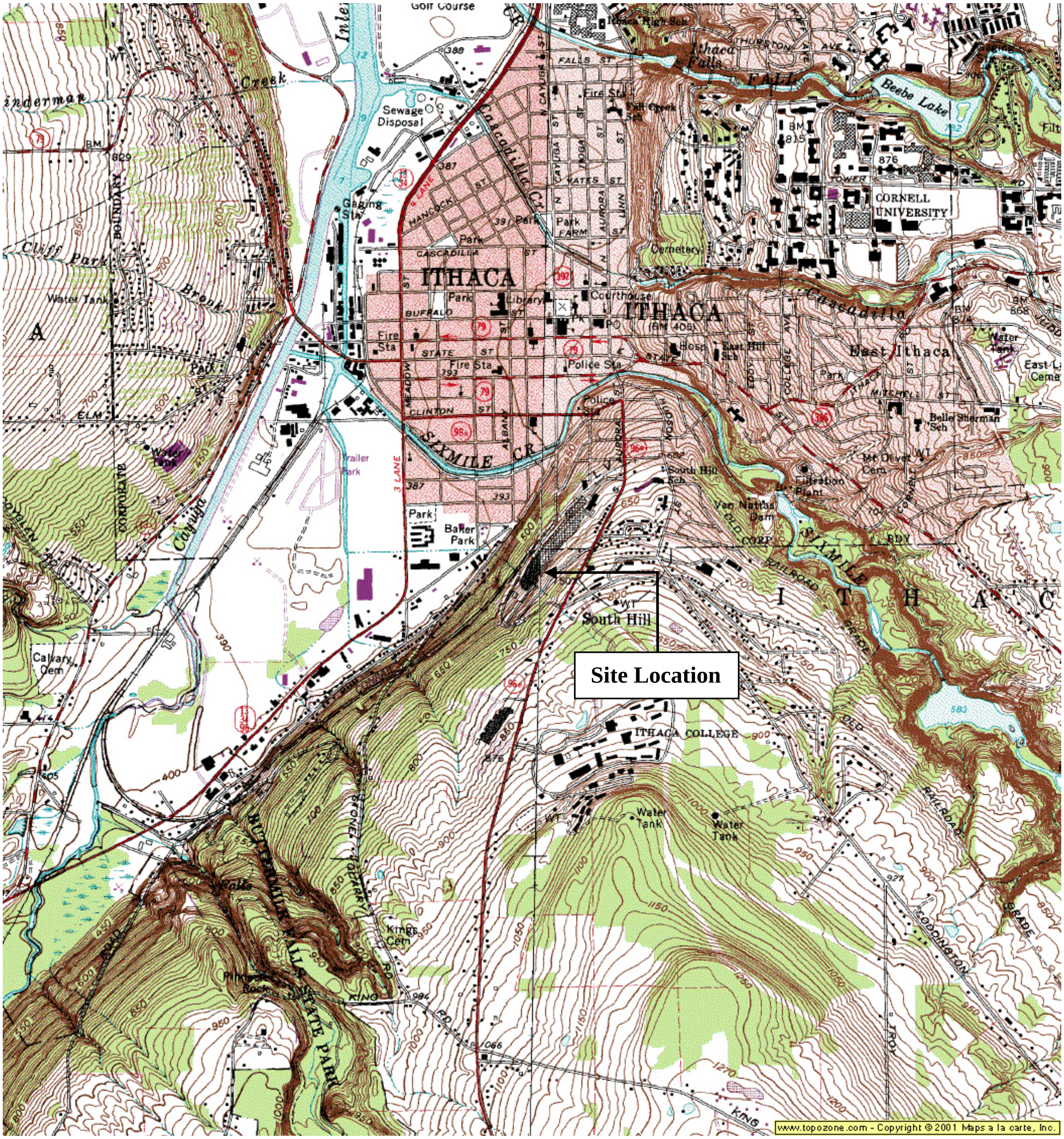

Reference
7.5 Minute Series Topographic Quadrangle
Ithaca East, New York
Photorevised 1976 Scale 1:25,000 Metric

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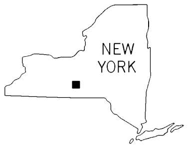

Quadrangle Location

Scale in Meters
0 500 1000
0 1000 2000
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: SPH
Approved: LKB
DWG Name: 127491326

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK
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FIGURE 2
SITE LAYOUT

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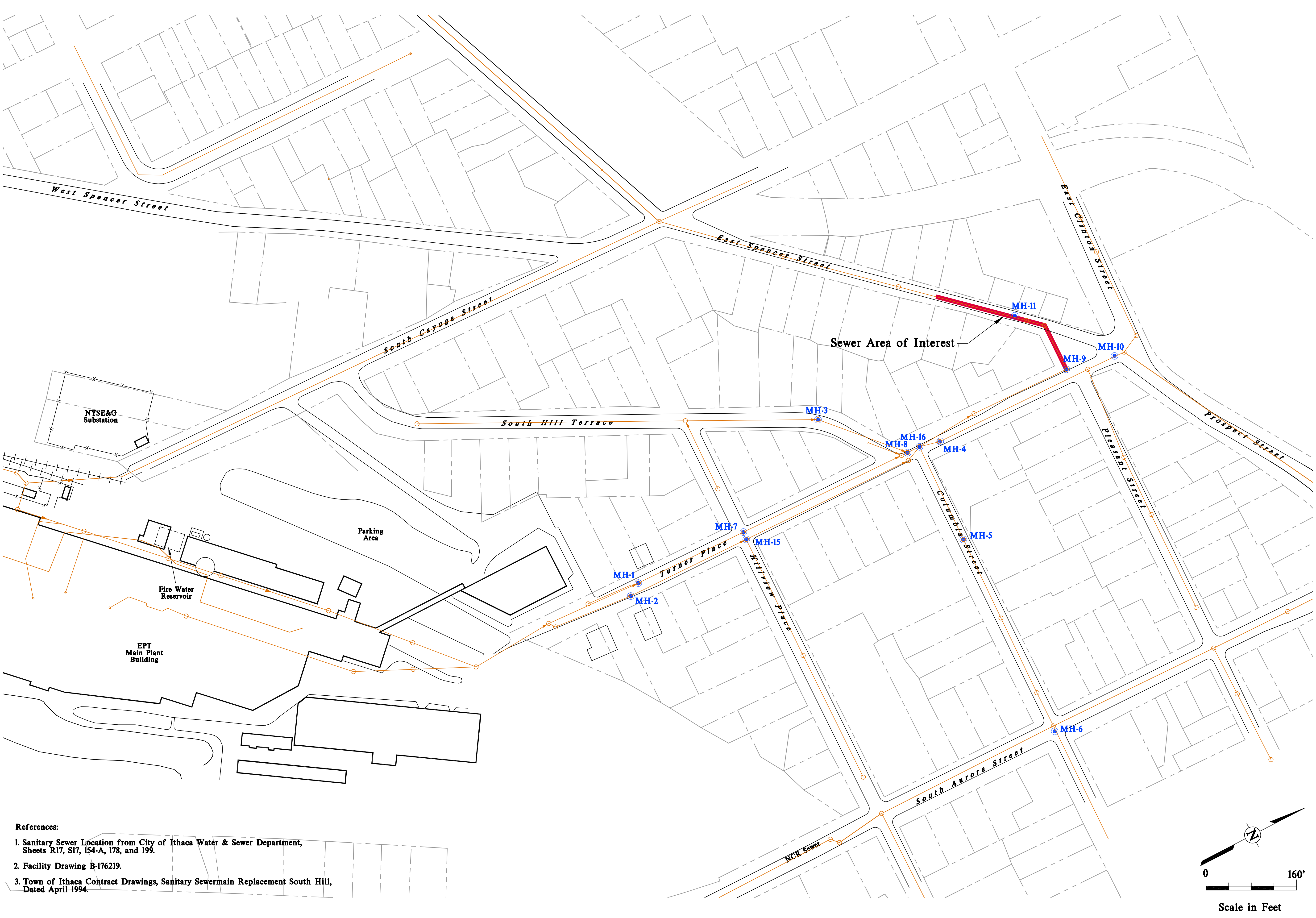

References:

1. Sanitary Sewer Location from City of Ithaca Water & Sewer Department, Sheets R17, S17, 154-A, 178, and 199.
2. Facility Drawing B-176219.
3. Town of Ithaca Contract Drawings, Sanitary Sewermain Replacement South Hill, Dated April 1994.

Drawn By: EGC
Checked: LKB
Approved: TMM
DWG Name: 127491390

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Figure 3

SOUTH HILL SANITARY SEWER NETWORK

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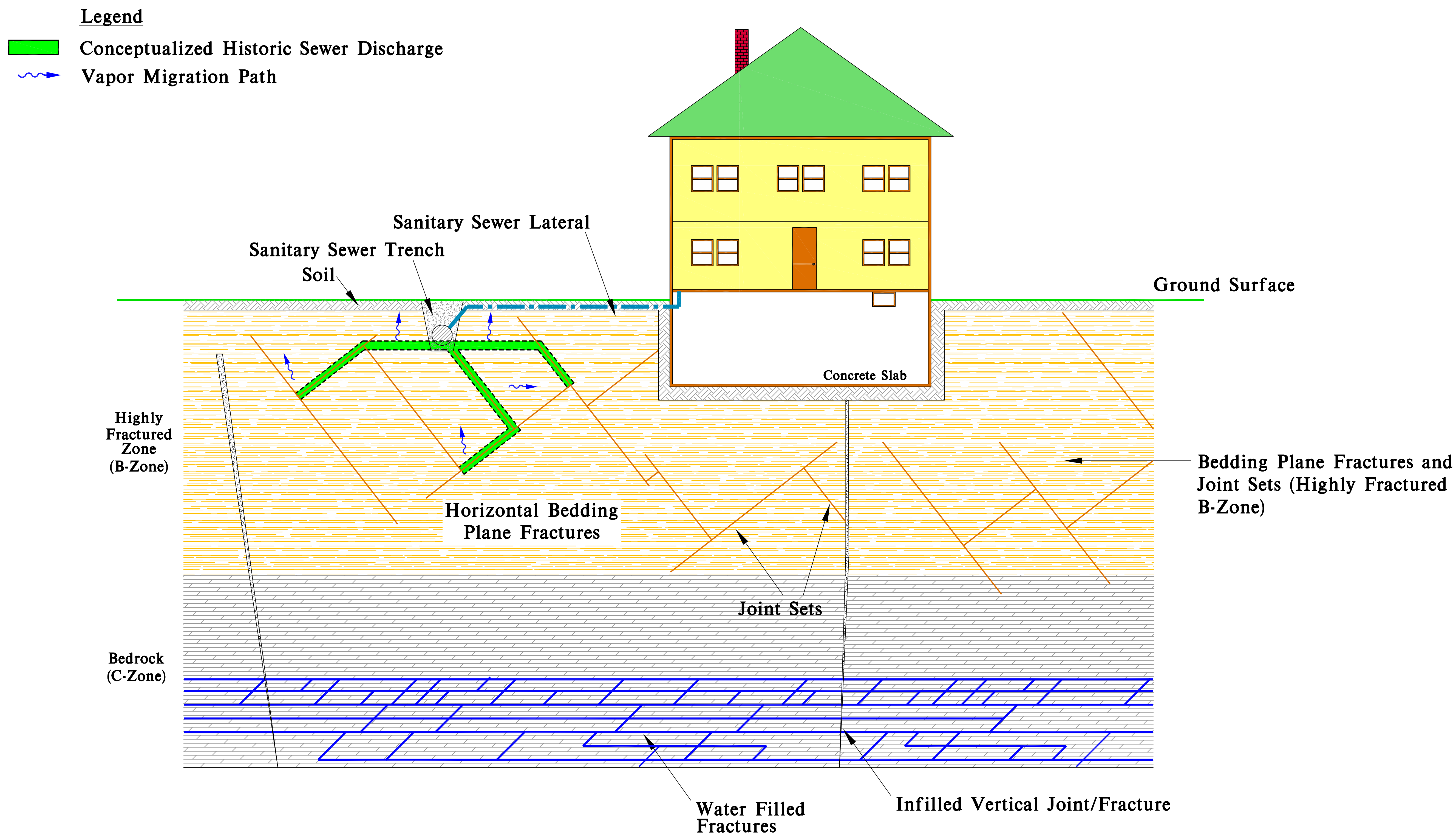

Drawn By: EGC
Checked: LKB
Approved: TMM
DWG Name: 08007428

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Figure 4

SOIL VAPOR MIGRATION PATHWAYS
CONCEPTUAL SITE MODEL

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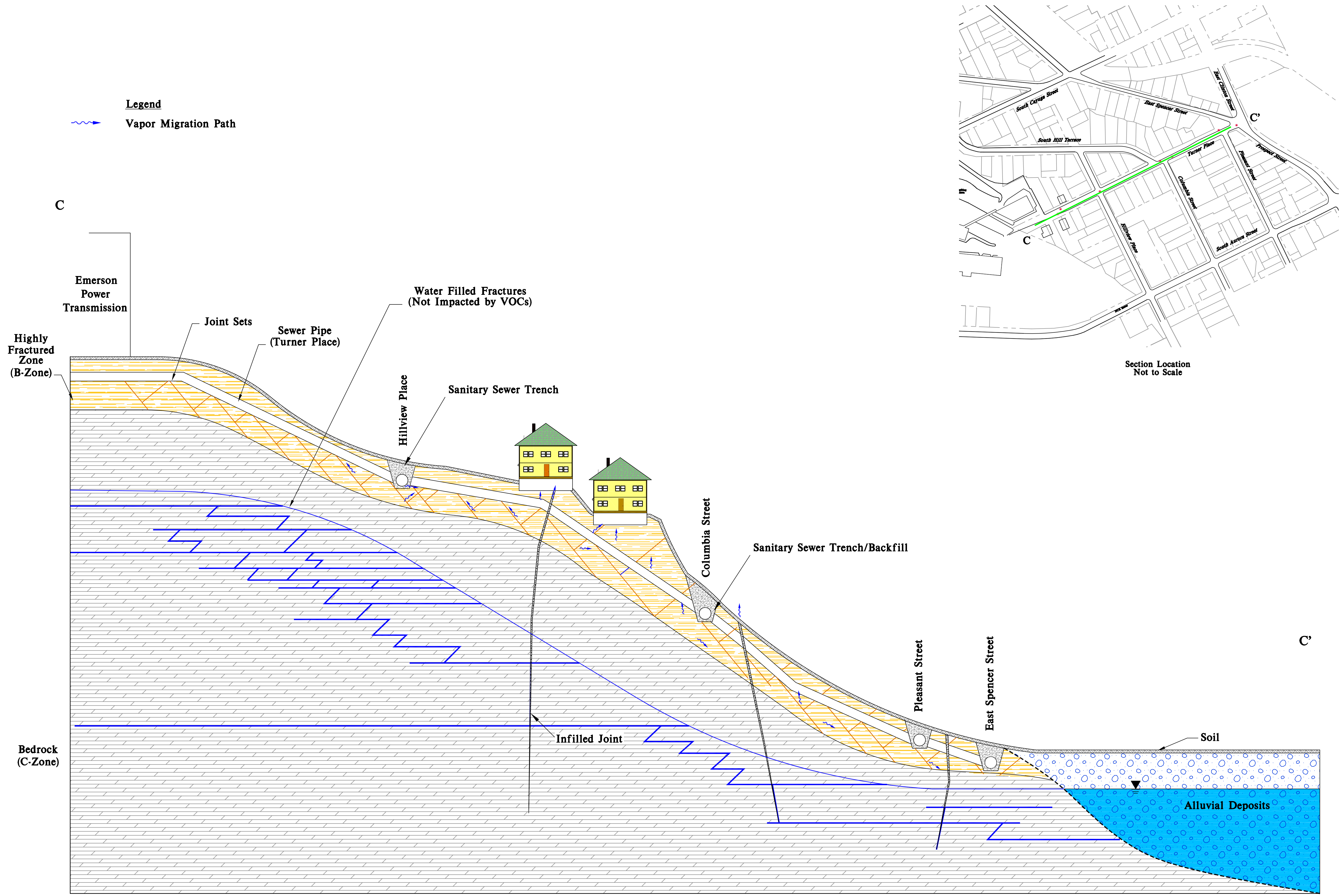

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DWG Name: 08007428

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Figure 5

CONCEPTUAL MODEL VAPOR
MIGRATION ALONG TURNER PLACE

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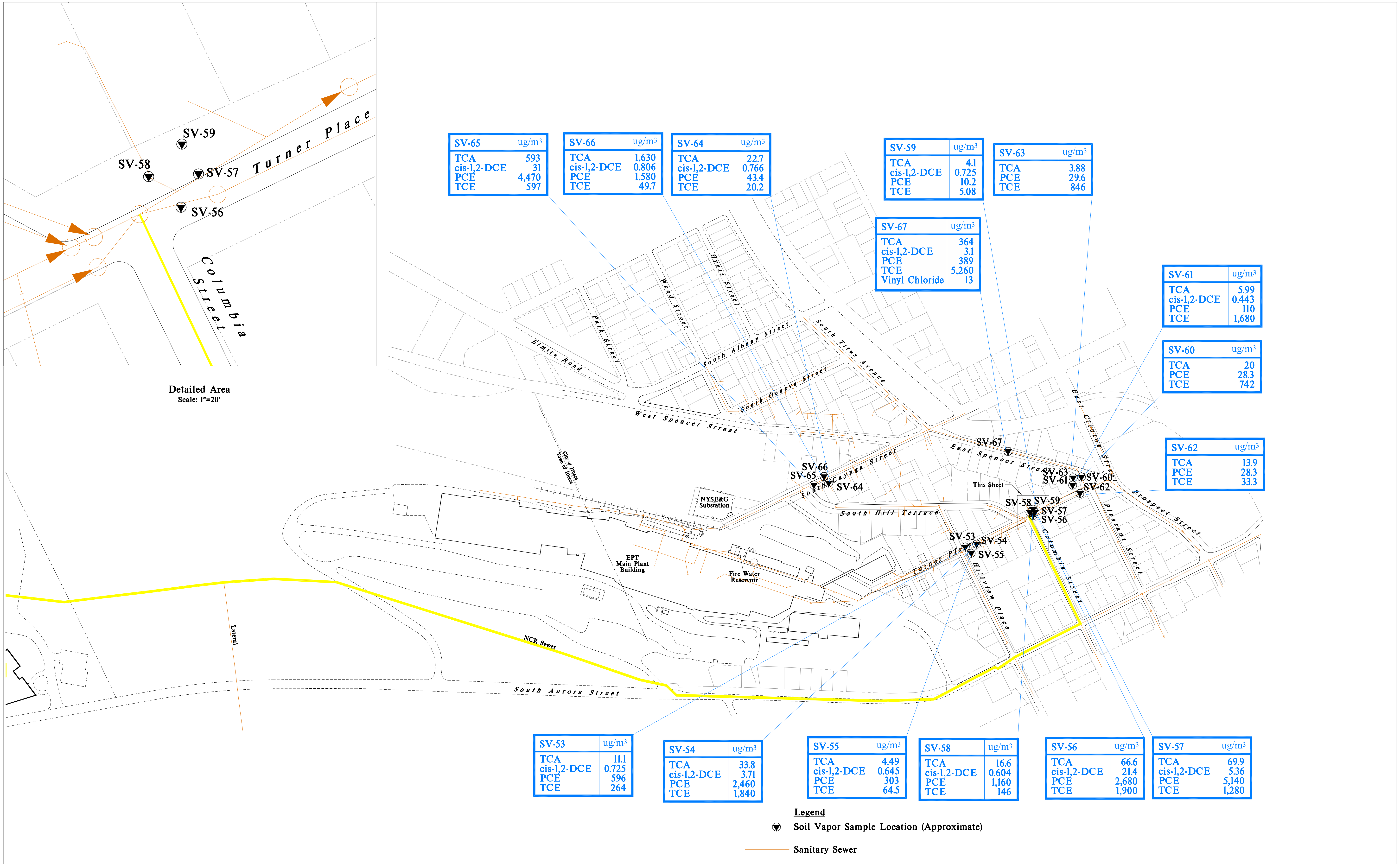


References:

1. Sanitary Sewer Location from City of Ithaca Water & Sewer Department, Sheets R17, S17, 154-A, 178, and 199.
2. Facility Drawing B-176219.
3. Town of Ithaca Contract Drawings, Sanitary Sewermain Replacement South Hill, Dated April 1994.

REVISIONS

REV	DESCRIPTION

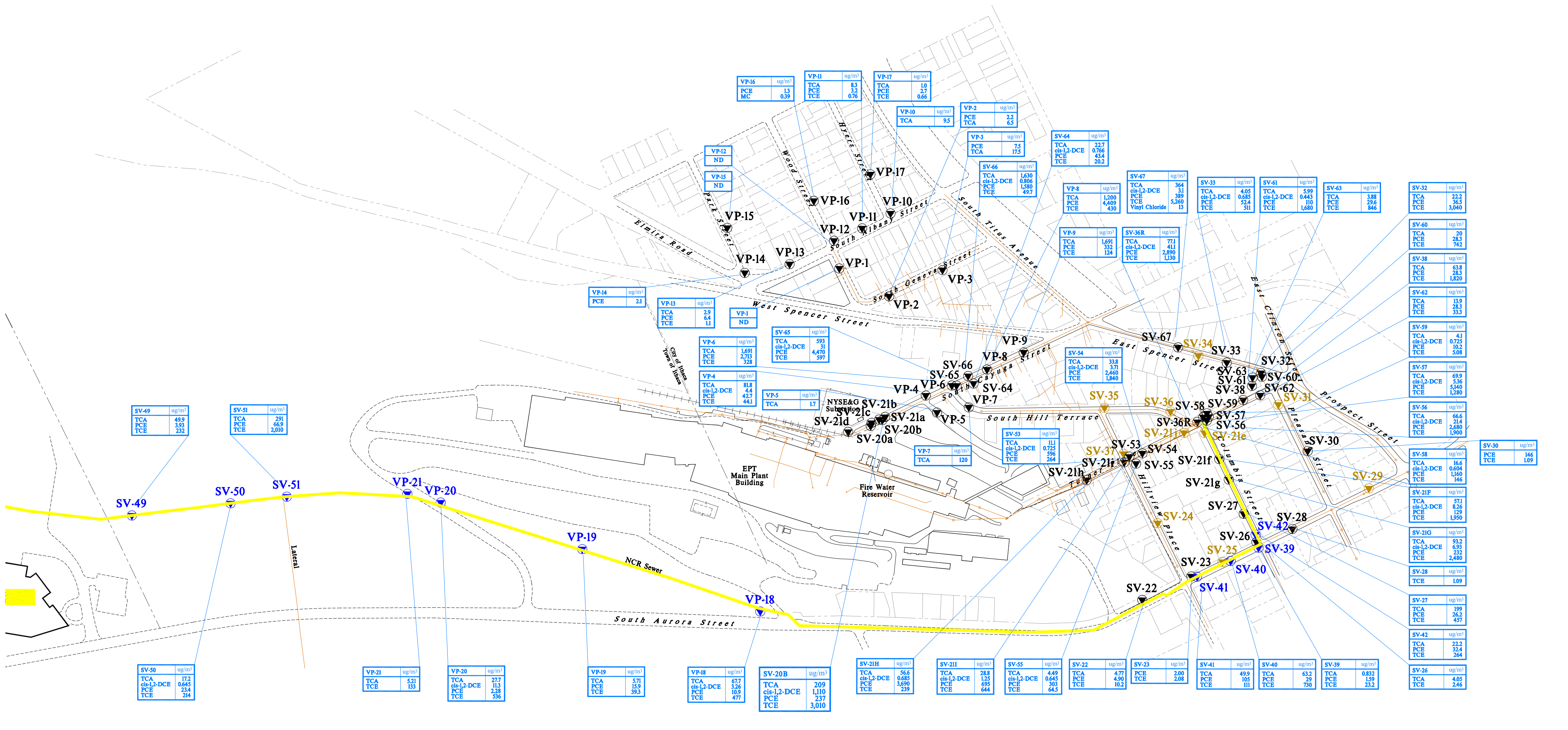
DRAWN BY JME
CHECKED LKB
APPROVED

SOIL VAPOR POINT SAMPLE RESULTS
JULY 2008
EMERSON POWER TRANSMISSION
ITHACA, NEW YORK
PREPARED FOR
EMERSON

WSP Consulting Engineers, P.C.
11190 Sunrise Valley Drive Suite 300
Reston, Virginia 20191
(703) 709-6500

FIGURE 6

Drawing Number
08007438



Legend

- Soil Vapor Sample Location (Approximate)
- Sanitary Sewer
- Soil Vapor Sample Location Installed Near Former NCR Sewer Line as Part of Supplemental RI
- Soil Vapor Sample Location Not Completed Due to Shallow Bedrock Refusal or Utility Conflict

References:

1. Sanitary Sewer Location from City of Ithaca Water & Sewer Department, Sheets R17, S17, 154-A, 178, and 199.
2. Facility Drawing B-176219.
3. Town of Ithaca Contract Drawings, Sanitary Sewermain Replacement South Hill, Dated April 1994.

REVISIONS

REV	DESCRIPTION

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APPROVED	

SOIL VAPOR POINT SAMPLE RESULTS 2004 TO 2008

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FIGURE 7

Drawing Number 08007438

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Figure 8

MONITORING AND MITIGATION AREA

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Tables

Table 1

Soil Vapor Sample Results
July 2008
Emerson Power Transmission
Ithaca, New York

Sample ID:	**SV-53**	**SV-54**	**SV-55**	**SV-56**	**SV-57**	**SV-58**	**SV-59**	**SV-60**	**SV-61**	**SV-62**	**SV-63**	**SV-64**	**SV-65**	**SV-66**	**SV-66**	**SV-67**
Sample Type:															**DUP**	
Sampling Date:	**7/29/2008**	**7/29/2008**	**7/29/2008**	**7/29/2008**	**7/29/2008**	**7/29/2008**	**7/29/2008**	**7/30/2008**	**7/30/2008**	**7/30/2008**	**7/30/2008**	**7/30/2008**	**7/30/2008**	**7/30/2008**	**7/30/2008**	**7/30/2008**
Site-Related VOCs (μg/m^3)																
1,1,1-Trichloroethane	11.1 C	33.8	4.49 S	66.6 S	69.9 SI	16.6 CI	4.1 I	20 C	5.99	13.9	3.88	22.7 I	593 SI	1,630 I	1,290 I	364 CI
cis-1,2-Dichloroethylene	0.725	3.71	0.645 S	21.4 S	5.36 S	0.604	0.725	0.604 U	0.443 J	0.604 U	0.604 U	0.766	31 SI	0.806	0.806	3.14 SI
Methylene chloride	0.53 U	2.19	1.24 S	0.53 U	0.53 U	1.69	0.53 U	0.812	0.918	0.812	0.777	0.671	0.53 U	1.09	1.06	0.53 U
Tetrachloroethene	596	2,460	303 S	2,680 SI	5,140 SI	1,160 I	10.2 I	28.3 I	110 I	28.3	29.6 I	43.4 I	4,470 SI	1,580 I	1,210 I	389 SI
trans-1,2-Dichloroethene	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	6.13 C
Trichloroethene	264	1,840	64.5 S	1,900 S	1,280 SI	146 I	5.08 I	742	1,680	33.3	846	20.2 I	597 SI	49.7 I	55.2 I	5,260 SI
Vinyl chloride	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	13 SI
Other VOCs (μg/m^3)																
Acetone	114	43	21.5 S	293 JC	410 S	46.6	131	17.9	32.4	9.42	33.6	23.4	211 SI	43.2	46.4	36.7 SI
Benzene	24	25	1.04 S	25 S	37 SI	19.5 I	29.5 I	3.93 I	3.44	1.14	3.12	1.1 I	62.7 SI	22.7 I	25 I	8.12 SI
2-Butanone	12.3	1.25 U	1.77 S	24.3 S	17.4 S	7.49 J	10	1.8	5.34	1.89	3.21	3.06	0.899 U	6.59 J	7.49 J	5.31 S
Carbon disulfide	34.2 C	37.7 C	0.601 C	3.67 C	5.86 C	3.26 C	13 C	9.81 C	1.14 C	1.36 C	1.96 C	0.506 C	33.2 C	12.3 C	13.3 C	8.55 C
Carbon tetrachloride	0.256 U	0.256 U	0.256 U	0.256 U	0.256 U	0.256 U	0.256 U	0.767	0.256 U	0.256 U	2.24	0.256 U	0.256 U	0.256 U	0.256 U	28.8 SI
Chloroethane	0.805	0.402 U	0.402 S	0.402 U	0.402 U	0.402 U	0.402 U	0.402 U	0.402 U	0.402 U	0.402 U	0.402 U	1.82 SI	0.322 J	0.295 J	0.402 U
Chloroform	274	298 C	16.9 S	381 S	472 S	58.1	24.8	22.8	73.5	66	8.74	230	1,050 SI	155	155	482 J
Cyclohexane	50.4 C	67.2 C	0.77 S	61.6 S	196 S	22	46.5	1.92	0.525 U	0.525 U	2.62	1.08	0.525 U	40.6 C	43 C	16.8 S
1,4-Dichlorobenzene	0.917 U	0.917 U	2.38 S	0.917 U	0.917 U	1.35	0.917 U	0.917 U	0.917 U	0.917 U	1.59	0.917 U	0.917 U	2.69	3.48	0.917 U
Dichlorodifluoromethane	4.57	2.31	1.71 S	1.56 S	1.46 S	1.61	1.66	1.91	1.96	0.754 U	1.91	1.51	1.26 S	1.96	1.86	1.66 S
Ethylbenzene	3.53	2.3	0.662 U	79.4 SI	46.8 SI	11 I	5.3 I	0.75 I	1.02 I	0.53 J	1.32 I	0.485 JI	40.6 SI	5.08 I	5.38 I	13.2 SI
4-ethyltoluene	4.1	3.1	1.2 S	47 SI	50 SI	4.7 I	6.85 I	0.6 J	1.05 I	0.75	0.849 I	0.55 JI	13.5 SI	3.9 I	4.8 I	86.9 SI
Freon 113	1.64 C	1.64	1.17 UC	1.17 UC	2.57 S	1.17 UC	1.17 UC	1.17 UC	1.17 UC	1.01 JC	1.17 UC	1.17 UC	1.17 UC	1.17 UC	1.17 UC	1.17 UC
n-Heptane	140	69.1	1.54 S	220 S	275 SI	78.3	619	4.08	4.42	1.5	6.96	2 I	9,310 SI	183 I	185 I	22.1 SI
n-Hexane	139	78.8	1.29 S	298 S	319 J	57.3	300	3.04	6.59	1.76	7.59	2.01	20,700 SI	165	158	60.5 SI
Isopropanol	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	3.27	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U
Methyl isobutylketone (MIBK)	130	62	1.33 S	162 SI	208 SI	67 I	618 I	3.21 I	3.62 I	1.37	6.04 I	1.62 I	9,110 SI	168 I	170 I	16.2 SI
Toluene	27.2	19.5	1.53 S	41.8 SI	74.3 SI	39.5 I	0.575 U	5.71 I	2.83 I	1.57	14.6 I	2.22 I	0.575 U	34.5 I	36.8 I	13.8 SI
Trichlorofluoromethane	1.71	1.26	0.8 J	1.03 S	0.742 J	0.971	1.03	0.971	1.2	2.28	0.971	0.742 J	0.857 S	1.66	1.66	0.971 S
1,2,4-trimethylbenzene	11.5	9.64	3.2 S	76.4 SI	73.9 SI	10.5 I	15 I	2.35 I	2.8 I	3.15	2.1 I	2 I	25.5 SI	18 I	14.5 I	296 SI
1,3,5-trimethylbenzene	7.5	6.35	2.6 S	38 SI	41.5 SI	7.7 I	10 I	2.05 I	2.4 I	2.15	2.05 I	1.8 I	9.09 SI	8.39 I	8.84 I	66.5 SI
2,2,4-trimethylpentane	5.6	2.99	0.712 U	2.9 S	6.46 S	3.56	10.9	0.712 U	0.712 U	0.712 U	0.712 U	0.712 U	96.4 S	4.23	1.42	2.85 S
o-Xylene	4.81	3.09	0.662 U	207 SI	76.4 SI	6.93 I	8.39 I	1.5 I	1.19 I	1.02	1.59 I	0.839 I	15 SI	5.25 I	5.69 I	25.2 SI
m&p Xylenes	9.27	8.74	1.46 S	505 SI	230 SI	23.4 I	20.7 I	3.4 I	3.22 I	1.99	5.56 I	2.65 I	33.5 SI	16.3 I	16.8 I	43.3 SI

a/ U - not detected
J - estimated concenration
C - analyte exceeds calibration criteria; quantitation estimated
S - analyte estimated due to elevated surrogate standard recovery.
I - associated internal standard criteria not met, estimated result.
DUP - duplicate sample

Table 2

All Soil Vapor Sample Results
Emerson Power Transmission Site
Ithaca, New York

Sample ID:	VP-1	VP-2	VP-3	VP-4	VP-5	VP-6	VP-7	VP-8	VP-9	VP-10	VP-11	VP-12	VP-13	VP-14	VP-15	VP-16	VP-17	VP-18
Sample Type:																		
Sampling Date:	07/28/05	06/17/04	06/17/04	06/17/04	06/17/04	06/17/04	06/17/04	06/01/04	06/17/04	07/28/05	07/28/05	07/28/05	07/28/05	07/28/05	07/28/05	07/28/05	07/28/05	11/18/05
Site Related VOCs (µg/m3)																		
1,1,1-Trichloroethane	11.5 U	6.5	17.5	81.8	1.7 U	1,691	120	1,200	1,691	9.5	8.3	0.83 U	2.9	0.83 U	0.83 U	0.83 U	1	67.7 C
1,2-Dichloroethane	8.3 U	1.2 U	2.4 U	12 U	1.3 U	38 U	56 U	38 U	13 U	0.62 U	0.62 U	0.62 U	0.62 U	0.62 U	0.62 U	0.62 U	0.62 U	0.617 U
cis-1,2-Dichloroethylene	8.3 U	1.2 U	2.4 U	4.4	1.3 U	38 U	56 U	38 U	13 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	3.26 C
Methylene chloride	18.8 U	2.6 U	5.2 U	2.7 U	2.8 U	83 U	125 U	83 U	28 U	0.53 U	0.53 U	0.53 U	0.53 U	0.53 U	0.53 U	0.39	0.53 U	6.96
Tetrachloroethene	14.2 U	2.2	7.5	42.7	2.2 U	2,713	95 U	4,409	332	1 U	3.2	1 U	6.4	2.1	1 U	1.3	2.7	10.9
trans-1,2-Dichloroethene	8.3 U	1.2 U	2.4 U	1.2 U	1.3 U	38 U	56 U	38 U	13 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.604 U
Trichloroethene	11.3 U	1.6 U	3.2 U	44.1	1.7	328	75 U	430	124	0.82 U	0.76	0.82 U	1.1	0.82 U	0.82 U	0.82 U	0.66	477
Vinyl chloride	5.4 U	0.8 U	1.5 U	0.8 U	0.8 U	25 U	36 U	25 U	8 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U
Non Site Related VOCs (µg/m3)																		
Acetone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Butanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cyclohexane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-ethyltoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Freon 113	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isopropanol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl isobutylketone (MIBK)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyltert-butylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Heptane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Hexane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-trimethylbenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3,5-trimethylbenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,2,4-trimethylpentane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
o-Xylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
m&p Xylenes	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 2

All Soil Vapor Sample Results
Emerson Power Transmission Site
Ithaca, New York

Sample ID:	**VP-19**	**VP-20**	**VP-21**	**SV-20B**	**SV-21F**	**SV-21F**	**SV-21G**	**SV-21H**	**SV-21I**	**SV-22**	**SV-23**	**SV-26**	**SV-27**	**SV-28**	**SV-30**	**SV-32**	**SV-33**	**SV-36R**
Sample Type:						**DUP**												
Sampling Date:	**11/18/05**	**11/18/05**	**11/18/05**	**08/22/07**	**08/22/07**	**08/22/07**	**08/22/07**	**08/23/07**	**08/23/07**	**08/28/07**	**08/29/07**	**08/28/07**	**08/22/07**	**08/29/07**	**08/29/07**	**08/22/07**	**08/23/07**	**08/30/07**
Site Related VOCs (µg/m3)																		
1,1,1-Trichloroethane	5.71 C	27.7 C	5.21 I	209	57.1	65.4	93.2	56.6	28.8	4.77 I	0.721 UJ	4.05 I	199	0.777 UJ	0.832 U	22.2	4.05	77.1
1,2-Dichloroethane	0.617 U	0.617 U	0.617 U	0.411 UJ	0.617 U	0.617 U	0.617 U	0.617 UI	0.617 UI	0.617 U	0.617 U	0.617 U	0.617 UI	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U
cis-1,2-Dichloroethylene	0.604 C	11.3 C	0.604 C	1,110	8.26	7.82	6.93	0.685	1.25	0.604 U	0.604 U	0.604 U	0.604 UI	0.604 U	0.604 U	0.604 U	0.685	41.1
Methylene chloride	3.81	6.67	6 I	1.09	0.777	0.706	0.565	1.45	3.39	0.424 U	0.671	0.53 U	0.53 UI	2.9 I	0.918 I	0.53	0.53	0.636
Tetrachloroethene	15.9	2.28 I	1.03 U	237	129	160	232	3,690	695	4.9 I	2	1.03 U	26.2	0.758 UJ	146 I	36.5	52.4	2,890
trans-1,2-Dichloroethene	0.604	2.22	0.604 U	6.85	0.604 U	0.604 U	0.604 U	0.604 UI	0.604 UI	0.604 UC	0.604 U	0.604 U	0.604 UI	0.604 U	0.604 U	0.604 U	0.604 U	0.604 U
Trichloroethene	39.3	536	133 I	3,010	1,950	2,420	2,480	239	644	10.2 I	2.08	2.46 I	457	1.09 I	1.09 I	3,040	511	1,130
Vinyl chloride	0.39 U	0.39 U	0.39 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 UI	0.104 UI	0.104 U	0.104 U	0.104 U	0.104 UI	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U
Non Site Related VOCs (µg/m3)																		
Acetone	NA	NA	NA	42.7	28	32.4	36.2	52.2	108	145 I	37.2	0.724 U	0.724 UI	122 I	47.3 I	28.7	69.5	96.6
Benzene	NA	NA	NA	5.2	2.63	2.44	2.11	6.33	61.7	1.36	8.44	0.487 U	53.3	7.53 I	2.6 I	1.56	1.53	32.8
Bromodichloromethane	NA	NA	NA	32 C	1.84 C	1.98	1.02 UC	15.5 C	13.9 C	1.02 U	1.02 U	1.02 U	23.2 C	1.02 U	2.04 I	1.02 UC	2.32 C	1.43
2-Butanone	NA	NA	NA	5.22	0.899 U	0.899 U	0.899 U	5.43	21	0.899 U	0.899 U	0.899 U	0.899 U	0.899 U	0.899 U	0.899 U	2.22	25.2
Carbon disulfide	NA	NA	NA	9.5	2.63	2.56	3.1	5.82	24.1	23.4 I	16.1	50 I	90.5	13.4 I	2.75 I	44.9	2.25	6.24
Carbon tetrachloride	NA	NA	NA	2.62 C	1.15 C	1.15	1.47 C	2.3 C	2.75 C	0.256 U	0.256 U	0.256 U	0.256 JC	0.256 U	0.256 U	2.37 C	3.07 C	7.42
Chloroethane	NA	NA	NA	0.402 U	0.402 U	0.402 U	0.402 U	0.402 UI	0.402 UI	0.402 U	0.402 U	0.402 U	0.402 UI	0.402 U	0.402 U	0.402 U	0.402 U	0.402 U
Chloroform	NA	NA	NA	326	59.6	66	210	509	433	5.91 I	42.2	7.1 I	167	14.7 I	46.1 I	6.45	44.7	286
Chloromethane	NA	NA	NA	0.315 U	0.315 U	0.315 U	0.315 U	0.315 UI	0.315 UI	0.63 I	0.945	0.315 U	0.315 UI	1.15 I	0.315 U	0.315 U	0.315 U	0.315 U
Cyclohexane	NA	NA	NA	23.8	7.35	8.05	0.525 U	5.88	44.1	1.5 I	5.14	0.525 U	171	5.11 I	0.84 I	42	1.64	3.29
1,4-Dichlorobenzene	NA	NA	NA	0.917 U	0.917 U	0.795 U	0.795 U	0.917	0.795	0.917 U	0.917 U	0.917 U	0.795 UI	0.917 U	0.917 U	0.917 U	0.856 U	0.917 U
Dichlorodifluoromethane	NA	NA	NA	2.61	0.754 U	2.71	3.02	4.52	0.754	2.06 I	2.16	1.96 I	2.36	2.21 I	2.16 I	2.71	2.66	6.79
1,1-Dichloroethane	NA	NA	NA	0.617 U	0.617 U	0.617 U	0.617 U	0.617 UI	0.617 UI	0.617 UC	0.617 U	0.617 UC	0.617 UI	0.617 UC	0.617 UC	0.617 U	0.617 U	2.26
1,1-Dichloroethene	NA	NA	NA	0.645	0.605 U	0.605 U	0.605 U	0.605 UI	0.605 UI	0.605 U	0.605 U	0.605 U	0.605 UI	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U
Ethylbenzene	NA	NA	NA	34.4	4.37	4.28	1.9	12.4 UI	84.7 UI	15.4 I	43.7	15 I	2620	30.4 I	50.5 I	1.46	1.32	14.1
4-ethyltoluene	NA	NA	NA	61.5	2.9	2.8	1.05	3.5	25	9.99 I	21.5	5.15 I	54	13.2 I	52.4 I	0.7 U	0.6 U	4.9
Freon 113	NA	NA	NA	1.48	2.18	2.18	3.58	5.14	3.82	1.17 U	1.17 U	0.857 UJ	9.43	1.17 U	1.17 U	1.32	2.49	7.09
2-Hexanone	NA	NA	NA	1.25 U	1.25 U	1.25 U	1.25 U	1.25 UI	1.25 UI	1.25 U	1.25 U	1.25 U	1.25 UI	1.25 U	1.25 U	1.25 U	1.25 U	2.54
Isopropanol	NA	NA	NA	8	0.375 U	0.375 U	0.375 U	0.375 UI	0.375 UI	0.375 U	0.375 U	0.375 U	0.375 UI	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U
Methyl isobutylketone (MIBK)	NA	NA	NA	1.25 U	1.25 U	1.25 U	1.25 U	1.25	1.25	1.25	1.25 U	1.25	1.25	0.874	1.25	1.25 U	1.25 U	1.08 U
Methyltert-butylether	NA	NA	NA	0.55 U	0.55 U	0.55 U	0.55 U	0.55 UI	5.31	2.75 C	2.68	0.55 UC	3.85	2.93 C	24.6 C	0.55 U	0.55 U	0.55 U
n-Heptane	NA	NA	NA	52.9	8.33	8.33	7.37	7.54	95	0.833 I	19.6	2,030 I	270	48.7 I	1.29 I	236	2.46	23.3
n-Hexane	NA	NA	NA	22.9	35.1	37.6	14.3	10.7	83.8	0.537 U	41.6	1,180 I	397	15.8 I	3.4 I	193	2.54	25.4
Styrene	NA	NA	NA	3.55	0.649 U	0.649 U	0.649 U	0.649 UI	0.649 UI	0.649 U	0.649 U	0.649 U	0.649 UI	0.649 U	0.649 U	0.649 U	0.649 U	0.649 U
Toluene	NA	NA	NA	34.9	82.4	88.9	13.4	59.8	583	30.6 I	81.2	34.5 I	486	113 I	70.5 I	6.4	18.4	78.1
Trichlorofluoromethane	NA	NA	NA	1.66	1.66	1.6	1.88	2.23	2.11	1.77 I	1.6	1.54 I	1.88	2.4 I	1.43 I	1.66	1.6	2.11
1,2,4-trimethylbenzene	NA	NA	NA	1,700	16	18.5	5.6	15	90.9	44 I	95.9	31.5 I	145	62.4 I	172 I	3.95	2.85	30.5
1,3,5-trimethylbenzene	NA	NA	NA	248	5.85	6.05	3.4	5.8	28	11.5 I	28.5	13.5 I	84.9	18 I	41.6 I	2.65	2.2	7
2,2,4-trimethylpentane	NA	NA	NA	15.7	0.522 U	0.712 U	0.712 U	1.23	7.31	0.855 I	2.33	0.712 U	21.8	5.27 I	1.28 I	0.712 U	0.712 U	9.02
o-Xylene	NA	NA	NA	136	5.91	6.18	3.4	15	95.3	17.7 I	48.1	12.4 I	1,910	36.4 I	65.3 I	2.3	1.5	13.2
m&p Xylenes	NA	NA	NA	159	17.7	22.1	14.2	51.2	352	61.3 I	124	34 I	9,580	113 I	210 I	6.36	6.18	30.9

Table 2

All Soil Vapor Sample Results
Emerson Power Transmission Site
Ithaca, New York

Sample ID:	**SV-38**	**SV-39**	**SV-39R**	**SV-40**	**SV-41**	**SV-42**	**SV-49**	**SV-50**	**SV-51**	**SV-53**	**SV-54**	**SV-55**	**SV-56**	**SV-57**	**SV-58**	**SV-59**	**SV-60**
Sample Type:			**DUP**														
Sampling Date:	**08/29/07**	**10/26/07**	**10/26/07**	**10/26/07**	**10/26/07**	**10/26/07**	**07/18/07**	**07/18/07**	**07/18/07**	**07/29/08**	**07/29/08**	**07/29/08**	**07/29/08**	**07/29/08**	**07/29/08**	**07/29/08**	**07/30/08**
Site Related VOCs (µg/m3)																	
1,1,1-Trichloroethane	63.8 I	0.832	0.777 UJ	63.2 I	49.9	22.2	49.9	17.2	291	11.1 C	33.8	4.49 S	66.6 S	69.9 SI	16.6 CI	4.1 I	20 C
1,2-Dichloroethane	0.617 U	1.17 U	1.17 U	1.17 U	1.17 U	1.17 U	0.617	0.535	0.617	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U
cis-1,2-Dichloroethylene	0.604 I	4.39	3.67	0.766	1.73	0.927	0.604 C	0.645 C	0.604 C	0.725	3.71	0.645 S	21.4 S	5.36 S	0.604	0.725	0.604 U
Methylene chloride	8.83 I	1.73	1.41	14.1	0.53 U	0.53 U	0.530	0.494	0.530	0.53 U	2.19	1.24 S	0.53 U	0.53 U	1.69	0.53 U	0.812
Tetrachloroethene	28.3 I	1.59 I	1.59 I	29 I	105 I	32.4 I	3.93	23.4	66.9	596	2,460	303 S	2,680 SI	5,140 SI	1,160 I	10.2 I	28.3 I
trans-1,2-Dichloroethene	0.604 U	0.604 U	0.604 U	0.604 U	0.604 U	0.604 U	0.604 U	0.604 U	0.604 U	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC
Trichloroethene	1,820 I	23.2	20.5	730 I	111	264	232	214	2,010	264	1,840	64.5 S	1,900 S	1,280 SI	146 I	5.08 I	742
Vinyl chloride	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U
Non Site Related VOCs (µg/m3)																	
Acetone	265	43.7	42	54.1	63.7	115	18.1	27.5	23.4	114	43	21.5 S	293 JC	410 S	46.6	131	17.9
Benzene	1.01	3.47	3.57	5.55 I	12	12.7	0.877	1.01	0.942	24	25	1.04 S	25 S	37 SI	19.5 I	29.5 I	3.93 I
Bromodichloromethane	4.02	1.98	1.77	12.4 I	2.66	3.54	4.56	1.57	5.93	4.29	1.02 U	1.02	22.5	12.3	5.86	1.02 U	2.79
2-Butanone	1.56	8.69	8.39	19.8	24.6	19.8	1.26	0.899 U	0.899 U	12.3	1.25 U	1.77 S	24.3 S	17.4 S	7.49 J	10	1.8
Carbon disulfide	29.4	3.67	3.51	28.5	3.89	5.76	0.348 UJ	14.6	13.3	34.2 C	37.7 C	0.601 C	3.67 C	5.86 C	3.26 C	13 C	9.81 C
Carbon tetrachloride	3.9	0.256 U	0.256 U	1.79	1.85	0.256 U	0.32	0.256	5.44	0.256 U	0.256 U	0.256 U	0.256 U	0.256 U	0.256 U	0.256 U	0.767
Chloroethane	0.402 U	0.402 U	0.402 U	0.402 U	0.402 U	0.402 U	0.402 U	0.402 U	0.402 U	0.805	0.402 U	0.402 S	0.402 U	0.402 U	0.402 U	0.402 U	0.402 U
Chloroform	969	10.2	9.78	476	884	167	34.7	50.1	866	274	298 C	16.9 S	381 S	472 S	58.1	24.8	22.8
Chloromethane	0.315 U	0.315 U	0.315 U	1.24	0.315 U	0.315 U	0.315 U	0.315 J	0.315 U	0.315 U	0.315 U	0.315 U	0.315 U	0.315 U	0.315 U	0.315 U	0.315 U
Cyclohexane	0.525 U	4.83	4.72	14 I	62.3	23.8	0.525 U	0.525 U	6.3	50.4 C	67.2 C	0.77 S	61.6 S	196 S	22	46.5	1.92
1,4-Dichlorobenzene	0.917 U	3.82	3.62	3.12	4.32	3.72	0.917 U	0.917 U	0.917 U	0.917 U	0.917 U	2.38 S	0.917 U	0.917 U	1.35	0.917 U	0.917 U
Dichlorodifluoromethane	4.32	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U	2.46	2.82	5.18	4.57	2.31	1.71 S	1.56 S	1.46 S	1.61	1.66	1.91
1,1-Dichloroethane	0.494 U	0.411 UJ	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U	0.535 UJ	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U
1,1-Dichloroethene	0.645	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U
Ethylbenzene	0.75	5.3 I	4.55 I	17.2 I	6.8 I	4.72 I	1.19	1.99	1.68	3.53	2.3	0.662 U	79.4 SI	46.8 SI	11 I	5.3 I	0.75 I
4-ethyltoluene	0.55 U	1.3 I	1.3 I	5.8 I	3.9 I	3.05 I	0.999	2	0.8	4.1	3.1	1.2 S	47 SI	50 SI	4.7 I	6.85 I	0.6 J
Freon 113	0.857 U	0.857 UJ	0.779 UJ	1.48	1.56	1.32	14.3	75.6	5.45	1.64 C	1.64	1.17 UC	1.17 UC	2.57 S	1.17 UC	1.17 UC	1.17 UC
2-Hexanone	1.25 U	1.25 U	1.25 U	1.25 U	1.25 U	1.25 U	1.25 U	4.33	0.833 UJ	1.25 U	1.25 U	1.25 U	1.25 U	1.25 U	1.25 U	1.25 U	1.25 U
Isopropanol	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	3.27
Methyl isobutylketone (MIBK)	1.25 U						1.25 U	1.21 UJ	1.25 U	130	62	1.33 S	162 SI	208 SI	67 I	618 I	3.21 I
Methyltert-butylether	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U	0.550 U	0.550 U	0.550 U	0.550 U	0.550 U	0.550 U	0.550 U	0.550 U
n-Heptane	0.625 U	5.58	5.21	14.2 I	46.7	21.2	1.5	8.37	21.7	140	69.1	1.54 S	220 S	275 SI	78.3	619	4.08
n-Hexane	0.537 U	3.3	2.97	24.7	96.7	30.8	1.61	3.04	40.5	139	78.8	1.29 S	298 S	319 J	57.3	300	3.04
Styrene	0.649 U	4.5 I	3.77 I	0.649 U	1.43 I	0.649 U	0.649 U	0.649 U	0.52 UJ	0.649 U	0.649 U	0.649 U	0.649 U	0.649 U	0.649 U	0.649 U	0.649 U
Toluene	4.94	8.5 I	8.08 I	14.9 I	67.4 I	26 I	6.7	6.51	7.89	27.2	19.5	1.53 S	41.8 SI	74.3 SI	39.5 I	0.575 U	5.71 I
Trichlorofluoromethane	3.2	1.48	1.48	1.43	1.66	1.31	1.71	2.23	1.88	1.71	1.26	0.8 J	1.03 S	0.742 J	0.971	1.03	0.971
1,2,4-trimethylbenzene	2.1	5.25 I	6.2 I	32.5 I	14.5 I	9.99 I	4.15	7.49	5.2	11.5	9.64	3.2 S	76.4 SI	73.9 SI	10.5 I	15 I	2.35 I
1,3,5-trimethylbenzene	0.75 U	1.3 I	2.7 I	10.1 I	9.19 I	5.9 I	0.75 U	3.2	0.75 U	7.5	6.35	2.6 S	38 SI	41.5 SI	7.7 I	10 I	2.05 I
2,2,4-trimethylpentane	0.712 U	0.855	0.855	0.712	1.38	1.04	0.712 U	0.712 U	0.712 U	5.6	2.99	0.712 U	2.9 S	6.46 S	3.56	10.9	0.712 U
o-Xylene	0.75	4.19 I	3.44 I	26.9 I	10 I	5.61 I	1.54	2.82	1.81	4.81	3.09	0.662 U	207 SI	76.4 SI	6.93 I	8.39 I	1.5 I
m&p Xylenes	3.18	13.7 I	11.4 I	75.9 I	29.6 I	17.2 I	5.43	7.46	5.34	9.27	8.74	1.46 S	505 SI	230 SI	23.4 I	20.7 I	3.4 I

Table 2

All Soil Vapor Sample Results
Emerson Power Transmission Site
Ithaca, New York

Sample ID:	**SV-61**	**SV-62**	**SV-63**	**SV-64**	**SV-65**	**SV-66**	**SV-66**	**SV-67**
Sample Type:							**DUP** (a)	
Sampling Date:	**07/30/08**	**07/30/08**	**07/30/08**	**07/30/08**	**07/30/08**	**07/30/08**	**07/30/08**	**07/30/08**
Site Related VOCs (µg/m3)								
1,1,1-Trichloroethane	5.99	13.9	3.88	22.7 I	593 SI	1,630 I	1,290 I	364 CI
1,2-Dichloroethane	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U
cis-1,2-Dichloroethylene	0.443 J	0.604 U	0.604 U	0.766	31 SI	0.806	0.806	3.14 SI
Methylene chloride	0.918	0.812	0.777	0.671	0.53 U	1.09	1.06	0.53 U
Tetrachloroethene	110 I	28.3	29.6 I	43.4 I	4,470 SI	1,580 I	1,210 I	389 SI
trans-1,2-Dichloroethene	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	0.604 UC	6.13 C
Trichloroethene	1,680	33.3	846	20.2 I	597 SI	49.7 I	55.2 I	5,260 SI
Vinyl chloride	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	0.104 U	13 SI
Non Site Related VOCs (µg/m3)								
Acetone	32.4	9.42	33.6	23.4	211 SI	43.2	46.4	36.7 SI
Benzene	3.44	1.14	3.12	1.1 I	62.7 SI	22.7 I	25 I	8.12 SI
Bromodichloromethane	3.20	1.02 U	0.681 U	10.3	1.02 U	2.11	2.25	11.7
2-Butanone	5.34	1.89	3.21	3.06	0.899 U	6.59 J	7.49 J	5.31 S
Carbon disulfide	1.14 C	1.36 C	1.96 C	0.506 C	33.2 C	12.3 C	13.3 C	8.55 C
Carbon tetrachloride	0.256 U	0.256 U	2.24	0.256 U	0.256 U	0.256 U	0.256 U	28.8 SI
Chloroethane	0.402 U	0.402 U	0.402 U	0.402 U	1.82 SI	0.322 J	0.295 J	0.402 U
Chloroform	73.5	66	8.74	230	1,050 SI	155	155	482 J
Chloromethane	0.315 U	0.315 U	0.315 U	0.315 U	0.315 U	0.315 U	0.315 U	0.315 U
Cyclohexane	0.525 U	0.525 U	2.62	1.08	0.525 U	40.6 C	43 C	16.8 S
1,4-Dichlorobenzene	0.917 U	0.917 U	1.59	0.917 U	0.917 U	2.69	3.48	0.917 U
Dichlorodifluoromethane	1.96	0.754 U	1.91	1.51	1.26 S	1.96	1.86	1.66 S
1,1-Dichloroethane	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U	0.617 U
1,1-Dichloroethene	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U	0.605 U
Ethylbenzene	1.02 I	0.53 J	1.32 I	0.485 JI	40.6 SI	5.08 I	5.38 I	13.2 SI
4-ethyltoluene	1.05 I	0.75	0.849 I	0.55 JI	13.5 SI	3.9 I	4.8 I	86.9 SI
Freon 113	1.17 UC	1.01 JC	1.17 UC	1.17 UC	1.17 UC	1.17 UC	1.17 UC	1.17 UC
2-Hexanone	1.25 U	1.25 U	1.25 U	1.25 U	1.25 U	1.25 U	1.25 U	1.25 U
Isopropanol	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U	0.375 U
Methyl isobutylketone (MIBK)	3.62 I	1.37	6.04 I	1.62 I	9,110 SI	168 I	170 I	16.2 SI
Methyltert-butylether	0.550 U	0.550 U	0.550 U	0.550 U	0.550 U	0.550 U	0.550 U	0.550 U
n-Heptane	4.42	1.5	6.96	2 I	9,310 SI	183 I	185 I	22.1 SI
n-Hexane	6.59	1.76	7.59	2.01	20,700 SI	165	158	60.5 SI
Styrene	0.649 U	0.649 U	0.649 U	0.649 U	0.649 U	0.649 U	0.649 U	0.649 U
Toluene	2.83 I	1.57	14.6 I	2.22 I	0.575 U	34.5 I	36.8 I	13.8 SI
Trichlorofluoromethane	1.2	2.28	0.971	0.742 J	0.857 S	1.66	1.66	0.971 S
1,2,4-trimethylbenzene	2.8 I	3.15	2.1 I	2 I	25.5 SI	18 I	14.5 I	296 SI
1,3,5-trimethylbenzene	2.4 I	2.15	2.05 I	1.8 I	9.09 SI	8.39 I	8.84 I	66.5 SI
2,2,4-trimethylpentane	0.712 U	0.712 U	0.712 U	0.712 U	96.4 S	4.23	1.42	2.85 S
o-Xylene	1.19 I	1.02	1.59 I	0.839 I	15 SI	5.25 I	5.69 I	25.2 SI
m&p Xylenes	3.22 I	1.99	5.56 I	2.65 I	33.5 SI	16.3 I	16.8 I	43.3 SI

(a) U - not detected; NA - not analyzed; S - analyte estimated due to elevated surrogate standard recovery;
J - estimated concenration; I - associated internal standard criteria not met, estimated result;
C - analyte exceeds calibration criteria; quantitation estimated; DUP - duplicate sample.

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
NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York	New York State Department of Health Center for Environmental Health Bureau of Environmental Exposure Investigation October 2006	Applicable	Provides guidance for evaluating soil vapor intrusion at a site	This guidance document is to be considered when evaluating a site with soil vapor intrusion.
NYSDEC Subpart 375-6 Restricted Use SCOs for Protection of Groundwater	6 NYCRR Part 375-3	To be considered	Provides a basis and procedure to determine soil cleanup levles, as appropriate, for sites when cleanup to pre-desposal conditions is not possible or feasible.	These values are to be considered in evaluating soil quality.

Table 4

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

Regulation	Citation	Potential Status	Summary of Requirements	Considerations in the Remedial Process/Action for Attainment
Discharge of Dredge or Fill Material into Waters of the United States	40 CFR Part 230	To be considered	Requirements for discharge of fill material or dredge material into waters of the United States.	Activities resulting in the excavation of soil near Six Mile Creek may require a permit from the United States Army Corps of Engineers.
CWA - Discharge to Waters of the United States	Section 404	To be considered	Types of discharges regulated under the CWA include: discharge to surface water or ocean, indirect discharge to a POTW, and discharge of dredged or fill material into waters of the United States (including wetlands).	May be applicable for remediation alternatives addressing sanitary sewers that discharge to the local POTW.
Protection of Waters Program	6 NYCRR Part 608	To be considered	Protection of waters permit program regulates: 1) any disturbance of the bed or banks of a protected stream or water course; 2) construction and maintenance of dams; and 3) excavation or fill in waters of the state.	Remedial actions involving significant trenching or excavating near Six Mile Creek may require a permit issued by the NYSDEC.
City of Ithaca Building Department	Chapter 146 of the City of Ithaca Municipal Code	Applicable	Building permits are required for construction and alterations of buildings.	Remedial actions involving installation of buildings to house treatment equipment or installation of mitigation systems would require permitting by the City of Ithaca.
City of Ithaca	City of Ithaca Municipal Code	Applicable	Local regulations and requirements pertaining to construction work occurring in the public right of way.	Any sewer or road construction may require City of Ithaca permitting.

Table 5

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
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 or 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.

Table 5

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
CWA - Discharge to Waters of the U.S.	40 CFR Part 122, 125, 403, 230, and 402 CWA Section 404	To be considered	Establishes site-specific pollutant limitations and performance standards which are designed to protect surface water quality. Types of discharges regulated under CWA include: discharge to surface water or ocean, indirect discharge to a POTW, and discharge of dredged or fill material into U.S. waters.	May be relevant and appropriate for remediation alternatives because of close proximity to Six Mile Creek.
Land Disposal Facility Notice in Deed	40 CFR Parts 264/265 116-119(b)(1)	Applicable	Established provisions for a deed notation for closed hazardous waste disposal units to prevent land disturbance by future owners.	The regulations are potentially applicable because closed areas may be similar to closed RCRA units.
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.	Excavated soil/sediment 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.

Table 5

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
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.
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 the 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.

Table 5

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
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.	Excavated soils that display the characteristics of hazardous waste or that are decharacterized after generation must be treated to 90% constituent concentration reduction capped at 10 times the UTS.
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.
CAA-NAAQS	40 CFR Part 60	Relevant & Appropriate	Establishes ambient air quality standards for protection of public health.	Remedial operations will be performed in a manner that minimizes the production of air contamination and particulate matter.

Table 6

Identification and Qualitative Evaluation Matrix for Potential Remediation Technologies for the Sanitary Sewers
Emerson Power Transmission Site
Ithaca, New York

Remediation Technology	Qualitative Evaluation of Technical Benefits, Technical Limitations, and Cost			Relative Cost Range	Recommendation & Rationale
	Technical Benefits	**Technical Limitations**	**Cost Considerations**		
No Action	• None; the constituents in the sewers would not be addressed by any treatment technology • Does not achieve RAOs for the AOC	• None	• The no-action alternative does not require the implementation of any treatment technology	None	**Not Feasible**: RAOs would not be achieved
East Spencer Sewer Line Focused Excavation and Venting	• Removal of potential source material along sewer line • May prevent vapor intrusion and migration along the sewer trench from the surrounding formation by venting after potential source removal • Venting system requires very little or no maintenance compared to other mechanically based technologies	• Only soil vapor that migrates into the newly installed sewer trench would be addressed with venting system. Radius of venting influence may be minimal • Requires continued operation of sub-slab depressurization systems in residential properties to achieve all RAOs	• Moderate to high capital cost • May include periodic O&M costs associated with maintaining air- and water-tight joints in the sewer, and possible disruption during road construction events, etc.	Moderate to High	**Feasible**: Focused excavation, replacement of sewer lines and venting system is technically feasible and may achieve RAOs in the long-term.
Soil Vapor Extraction Along Sewer Lines	• Involves the installation of a soil vapor extraction (SVE) system on the sanitary sewer lines with the goal of removing any accumulated vapors located within the bedding material surrounding the sanitary sewer piping • Can achieve vapor containment by preventing migration of soil vapors along the sewer line	• May not be functional due to vacuum loss and short-circuiting through preferential pathways (other utility corridor, bedding materials, etc.) • Requires placement of treatment equipment at facility or in neighborhood on or adjacent to private property which is not feasible • Requires continued operation of sub-slab depressurization systems in residential properties to achieve all RAOs	• Capital and annual O&M costs can be high if large-scale vapor treatment equipment is required • Capital cost may increase if piping or equipment must be staged far from the sewer lines (i.e. larger blowers and large diameter piping) • High annual operating costs and O&M costs • Requires a significant amount of pre-design work and pilot testing to assess the appropriateness of full-scale implementation of this alternative	High	**Potentially Feasible:** SVE can reduce migration of soil vapors and may achieve RAOs if determined to be implementable based on pre-design investigation.
Soil Vapor Extraction Along Laterals Connected to Sewer Lines	• Involves the installation of an SVE system on the sanitary sewer line laterals with the goal of removing any accumulated vapors located within the bedding material surrounding the sanitary sewer laterals • Would prevent the migration of vapor to residential properties by way of the lateral pathways	• Does not address migration and mass of COCs along the sewer lines • Would require intrusive subsurface work on every residential property with sanitary sewer lateral connection • Would require access to private land to install treatment equipment. Treatment equipment would be housed in secured buildings throughout neighborhood with electrical service that is not feasible to install at each building. • Requires continued operation of sub-slab depressurization systems in residential properties to achieve all RAOs	• Capital and annual O&M costs can be high if large-scale vapor treatment equipment is required • Capital cost may increase if piping or equipment must be staged far from the sewer lines (i.e. larger blowers and large diameter piping) • High annual operating costs and O&M costs • Requires a significant amount of pre-design work and pilot testing to assess the appropriateness of full-scale implementation of this alternative	High	**Not Feasible:** SVE on the sewer laterals is not feasible because of the potential requirement for multiple systems and the place treatment equipment on private property is not feasible.
Blanket Mitigation of Homes	• Proven technology for eliminating vapor intrusion pathway into residential properties • Would address all residential properties in the community, regardless of indoor air concentrations of VOCs • Would effectively reduce or eliminate concentrations of VOCs in indoor air in both the short and long term	• Does not address the source or pathways of vapor migration • Effectiveness is limited to homeowner participation • Would not achieve the RAO of reducing utility worker exposure or mass removal; would require access restrictions or a notification system to prevent utility worker exposure	• Moderate to high cost to implement depending on number of homeowners that participate and complexity of installations • Moderate analytical costs associated with post-installation air sampling • Low O&M costs that include minimal electricity required for fan operation, annual inspections, and any necessary repairs	Moderate to High	**Potentially Feasible:** Blanket mitigation is implementable and would achieve all RAOs with the exception of mass removal

Table 6

Identification and Qualitative Evaluation Matrix for Potential Remediation Technologies for the Sanitary Sewers
Emerson Power Transmission Site
Ithaca, New York

Remediation Technology	Qualitative Evaluation of Technical Benefits, Technical Limitations, and Cost			Relative Cost Range	Recommendation & Rationale
	Technical Benefits	Technical Limitations	Cost Considerations		
Air Sampling and Mitigation of Homes	• Proven technology for eliminating vapor intrusion pathway into residential properties • Would only address residential properties that require mitigation based on the results of continued indoor air sampling • Would effectively reduce or eliminate concentrations of VOCs in indoor air in both the short and long term	• Does not address the source or pathways of vapor migration • Effectiveness is limited to homeowner participation • Would not achieve the RAO of mass removal	• Moderate cost to implement depending on number of properties that require mitigation and the complexity of installations • Moderate analytical costs associated with pre-mitigation and post-mitigation air sampling • Low O&M costs that includes minimal electricity required for fan operation, annual inspections, and any necessary repairs	Moderate	**Potentially Feasible:** Air sampling and mitigation is implementable and would achieve all RAOs with the exception of mass removal
In-Situ Granular Activated Carbon	• Granular activated carbon (GAC) is suitable for the removal of VOCs in the vapor phase • GAC is a conventional and demonstrated technology • Conventional installation methods	• Difficult to direct affected soil vapors through a GAC barrier or dam without drawing vapors through the barrier • Soil vapors may migrate through other utility corridors or fractures and bypass GAC • Requires continued operation of sub-slab depressurization systems in residential properties	• May require numerous large, subsurface GAC units or expansive GAC barriers that will require extensive excavation • Moderate to high O&M costs because of the operation of a vacuum source to facilitate pass through of vapors and removal of spent GAC may be intrusive and extensive	Moderate to High	**Not Feasible:** GAC is not appropriate as an *in-situ* technology because it is not feasible to direct soil vapors through GAC units placed in the subsurface. RAOs would not be met with this technology
In-Situ Chemical Oxidation	• *In-situ* chemical oxidation (ISCO) can effectively reduce the concentration of VOCs if the correct oxidant is selected and applied under suitable subsurface conditions	• ISCO is not a technology suitable for addressing the vapor phase; primarily effective as a groundwater treatment technology • Does not achieve either RAO because ISCO would not effectively reduce subsurface soil vapor concentrations	• The cost of applying ISCO is typically moderate to high; however, this technology is not suitable for treating soil vapor	Moderate to High	**Not Feasible:** ISCO is not an appropriate technology for addressing COCs in soil vapor
Vapor Dam	• Vapor dams would be installed around sanitary sewer lines and/or laterals and transect the bedding material, which would involve much less complicated or extensive construction techniques • If placed correctly, a vapor dam could stop the movement of soil vapors along the sanitary or lateral sewer lines	• Soil vapor migration in the subsurface is not predictable and it is unknown if soil vapors will migrate around the vapor dam through other fractures and channels in the subsurface • Technology would not address mass removal unless a venting system was constructed with the vapor dams • Requires continued operation of sub-slab depressurization systems in residential properties	• Moderate cost to install vapor dams, depending on the number installed • Low to no O&M costs if the vapor dams were suitable for long-term subsurface installation	Moderate	**Not Feasible:** Vapor dams are not a feasible technology because soil vapors would continue to migrate around the vapor dams and through surrounding fractures in bedrock and would not be removed. Vapor dams with a venting system would have similar implementation issues as the SVE alternatives

Table 7

Evaluation Matrix for Potentially Feasible Remediation Technologies for the Sanitary Sewers
Emerson Power Transmission Site
Ithaca, New York

Potentially Feasible Technology	Site-Specific Technical Feasibility				Recommendation for Selection
	Long-term Effectiveness	Short-Term Effectiveness	Implementability	Estimated Time Frame	
East Spencer Sewer Line Focused Excavation and Venting	• Effective in the long-term because COCs present in materials around the sewer pipe would be removed and vapors remaining in the shallow unsaturated bedrock and in fractured bedrock would be addressed as they reenter the newly installed trench via venting • Achieves all RAOs with the continued operation of sub-slab depressurization systems in residential properties	• Would remove COC mass and eliminate migration of vapors in and along the section of sanitary sewer line excavated and replaced • Could potentially expose workers and the community to soil vapors during construction • Construction activities would have impacts to the community because of road closures, irritant noise from construction equipment, and general disruption of the neighborhood • Would require erosion measures because of significant slope of roadways in the area • Would take a moderate amount of time to construct because of the complexity of the sanitary sewer network along East Spencer Street	• Would require conventional construction measures • Would cause moderate inconvenience to residents of the area • Requires permission from the City of Ithaca to close streets in the neighborhood during construction. • Requires assistance and involvement from the City of Ithaca and possibly other agencies (e.g., NYSDOT) because it is a municipal sewer system and public roadway. City of Ithaca may perform sewer replacement simplifying implementation	1 year (with mitigation systems operating up to 15 years)	**Recommended:** This alternative is effective, implementable, and will meet the established RAOs
Soil Vapor Extraction Along Sewer Lines	• Long term effectiveness is unclear because it depends on the bedding material and the construction of the existing sewer lines • Short-circuiting may inhibit the effectiveness of an SVE system • The system would need to be operable for as long as the shallow bedrock formation yields vapors • Does not achieve all RAOs as a stand-alone technology; requires continued installation and operation of sub-slab depressurization systems in residential properties	• If effectively implemented, SVE would immediately remove soil vapors upon start up • Could potentially expose workers and the community to soil vapors during construction • Construction activities would have significant impacts to the community because of road closures, irritant noise from construction equipment, and general disruption of the neighborhood • Would require erosion measures because of significant slope of roadways in the area • Treatment equipment installed would be disruptive in both the short and long-term because of its size and noise	• Would require unconventional construction measures • May not be practical to install in the neighborhood because of the high level of noise associated with the blowers and other treatment equipment • Large-scale SVE system may require the equipment to be located on private property, which is not readily available. • Would require very large treatment equipment (i.e., vacuum blower(s)) and large-diameter conveyance piping if equipment is staged at the facility • Void space around the piping or large gaps in the piping construction may cause short-circuiting of the air flow • Surface water drainage that runs through the void space and bedding material of the sewer piping may prevent the SVE system from having an adequate and consistent vacuum and would create an additional discharge (aqueous phase) from the treatment system to be handled	Up to 5 years (with mitigation systems operating up to 15 years)	**Not Recommended:** Pending pre-design investigation results; may not be appropriate to apply SVE along all sewer lines, and may only be partially effective at addressing areas with highest concentrations of COCs. Not practical to install treatment equipment in the neighborhood

Table 7

Evaluation Matrix for Potentially Feasible Remediation Technologies for the Sanitary Sewers
Emerson Power Transmission Site
Ithaca, New York

Potentially Feasible Technology	Site-Specific Technical Feasibility				Recommendation for Selection
	Long-term Effectiveness	Short-Term Effectiveness	Implementability	Estimated Time Frame	
Blanket Mitigation of Homes	• The effectiveness of this alternative will continue indefinitely with continued operation and proper maintenance of the sub-slab depressurization system • Requires access to residential properties; without homeowner cooperation, this alternative cannot achieve the RAOs • Does not address the source or pathways of vapor migration or the source of COCs that may be present along the sewer lines • Does not achieve all RAOs as a stand-alone technology; would require provisions for utility workers accessing sanitary sewer lines	• Effective immediately upon installation and start-up of the sub-slab depressurization system • Installation of this alternative involves low risk to workers because exposure to elevated concentrations of COCs in the sub-slab or indoor air is limited; indoor air concentrations are not typically high enough to pose a significant threat to human health in the short-term • Disruptive to homeowners and residents in the short-term during installation of the system • Delayed access to properties by homeowners will lengthen the time for installation and operation of a system • City of Ithaca building permit requirements can slow the installation process	• Sub-slab depressurization systems can be implemented and have already been demonstrated to be effective in achieving acceptable indoor air concentrations • Installation of the systems is achieved through conventional means • Obtaining access to properties may inhibit installation process if homeowners select not to sign access agreements	Mitigation systems operating up to 15 years	**Potentially Recommended**: Effective and proven technology for achieving RAO of reducing indoor air concentrations of COCs; does not address RAO of utility worker exposure without specific access provisions. Does not address COC mass along sewer lines or vapor migration source or pathways.
Air Sampling and Mitigation of Homes	• The effectiveness of this alternative will continue indefinitely with continued operation and proper maintenance of the sub-slab depressurization system • Requires access to residential properties for sampling and installation; without homeowner cooperation, this alternative cannot achieve the RAOs • Homes that have indoor air concentrations of COCs exceeding standards would immediately be address • Does not address the source or pathways of vapor migration • Does not achieve all RAOs as a stand-alone technology; would require provisions for utility workers accessing sanitary sewer lines	• Effective immediately upon installation and start-up of the sub-slab depressurization system • Indoor air sampling poses no risk to homeowners or tenants • NYSDOH recommends air sampling only during the heating season (from November 15 to March 31). If a property cannot be sampled during a particular heating season for any reason, it would be a significant amount of time before sampling could proceed. • Installation of the systems involves low risk to workers because exposure to elevated concentrations of COCs in the sub-slab or indoor air is limited; indoor air concentrations are not typically high enough to pose a significant threat to human health in the short-term • Disruptive to homeowners and residents in the short-term during installation of the system • Delayed access to properties by homeowners will lengthen the time for installation and operation of a system • City of Ithaca building permit requirements can slow the installation process	• An indoor air sampling plan can be easily implemented • Sub-slab depressurization systems can be implemented and have already been demonstrated to be effective in achieving acceptable indoor air concentrations • Installation of the systems is achieved through conventional means • Obtaining access to properties may inhibit installation process if homeowners select not to sign access agreements	Mitigation systems operating up to 15 years	**Potentially Recommended**: Effective and proven technology for achieving RAO of reducing indoor air concentrations of COCs. Does not address COC mass along sewer lines or vapor migration source or pathways.

Table 8

Cost Estimate for Alternative 2 – East Spencer Sewer Line Focused Excavation and Venting
Emerson Power Transmission Site
Ithaca, New York

Item No.	Description	Estimated Quantities	Units	Unit Price	Estimated Amount
Replacement of Sewer Lines					
1	Investigation of Piping	1	LS	$ 10,000	$ 10,000
2	Investigation of Migration Pathways	1	LS	$ 10,000	$ 10,000
3	Mobilization/Demobilization	1	LS	$ 10,000	$ 10,000
4	Excavation	320	CY	$ 200	$ 64,000
5	Pipe Removal and Disposal	1	LS	$ 35,000	$ 35,000
6	Transportation and Disposal of Excavated Waste	544	TONS	$ 110	$ 59,840
7	Backfill with Select Fill	320	CY	$ 25	$ 8,000
8	Sanitary Sewer Piping	1	LS	$ 75,000	$ 75,000
9	Manhole Replacement	2	EACH	$ 5,000	$ 10,000
10	Venting System	1	LS	$ 40,000	$ 40,000
11	Permitting	1	LS	$ 20,000	$ 20,000
12	Road Closures	1	LS	$ 25,000	$ 25,000
13	Road Paving	1	LS	$ 30,000	$ 30,000
				Subtotal Capital Costs	**$ 396,840**
				Administrative and Engineering (30%)	**$ 119,052**
				Contingency (20%)	**$ 79,368**
				Total Estimated Capital Cost	**$ 595,260**
				Rounded To	**$ 596,000**
Operation and Maintenance of Vapor Mitigation Systems					
14	System Operation & Maintenance	47	EACH	$ 750	$ 35,250
				Subtotal O&M Costs	**$ 35,250**
				Contingency (20%)	**$ 7,050**
				Annual O&M Costs	**$ 42,300**
				Present Worth of O&M for 15 Years at 7% Discounted Rate	**$ 385,265**
				Rounded To	**$ 386,000**
				TOTAL PRESENT WORTH	**$ 982,000**

Assumptions:

1. Investigation of piping to verify existing conditions cost estimate includes excavation of test pits to verify the condition of the sewer pipes if adequate engineering drawings are not available.

2. Investigation of migration pathways cost estimate includes fully evaluating all possible migration pathways into residential properties; including, but not limited to, laterals, electrical lines, phone lines, and any other possible opening into the home.

3. Mobilization/demobilization estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to complete the alternative.

4. Excavation cost estimate includes the cost of labor, materials, and equipment necessary to remove all pavement and soil necessary to expose the sewer piping and remove unconsolidated material around the pipe.

5. Pipe removal and disposal cost estimate includes the cost of labor, materials, and equipment necessary to remove all of the identified sanitary sewer lines and properly dispose of the piping.

6. Transportation and disposal of excavated waste cost estimate includes the cost of transportation, and treatment and/or disposal of all soil and pavement excavated. This cost is dependent upon the waste classification of the excavated material and assumes that the waste is classified as non-hazardous. Assumes a conversion of 1.7 tons per cubic yard.

7. Backfill with select fill cost estimate includes the cost of labor, materials, and equipment necessary to fill all excavated areas surrounding the sanitary sewer piping with select fill.

8. Sanitary sewer piping cost estimate includes the cost of labor, materials, and equipment necessary to install the new replacement piping and reconnect to laterals.

9. Manhole replacement is the estimated cost for replacing manholes in all of the existing manhole locations and reconnecting to the sanitary sewer header.

10. Venting cost estimate assumes standpipes with wind driven turbines or barometric pressure actuated valving to induce a vacuum from the newly installed sewer line trench.

11. Permitting is the cost estimate for obtaining permits and access agreements for the construction work.

12. Road closures cost estimate includes the closure and securing all sections of road during the prescribed work period.

13. Road paving cost estimate includes the repaving of the sections of road which were removed to install the new sanitary sewer lines in compliance with applicable standards.

14. O&M cost estimate includes the assumed annual cost for maintenance, replacement parts, contractor repairs, electricity, and inspections for all existing mitigation systems that have currently been installed within the designated study area.

Table 9

Cost Estimate for Alternative 3 – Soil Vapor Extraction on Sewer Lines
Emerson Power Transmission Site
Ithaca, New York

Item No.	Description	Estimated Quantities	Units	Unit Price	Estimated Amount
Installation of SVE System on Sewer Lines					
1	SVE Pilot Test	1	LS	$ 50,000	$ 50,000
2	Investigation of Migration Pathways	1	LS	$ 10,000	$ 10,000
3	Mobilization/Demobilization	1	LS	$ 10,000	$ 10,000
4	Preparation and Trenching	1	LS	$ 100,000	$ 100,000
5	Transportation and Disposal of Excavated Soil	2,100	TONS	$ 110	$ 231,000
6	Backfill with Flowable or Select Fill	1	LS	$ 50,000	$ 50,000
7	Piping and Offsite Equipment	1	LS	$ 500,000	$ 500,000
8	Treatment System Equipment and Enclosures	1	LS	$ 400,000	$ 400,000
9	Permitting	1	LS	$ 20,000	$ 20,000
10	Road Closures	1	LS	$ 30,000	$ 30,000
11	Road Paving	1	LS	$ 75,000	$ 75,000
				Subtotal Capital Costs	**$ 1,476,000**
				Administrative and Engineering (30%)	**$ 442,800**
				Contingency (20%)	**$ 295,200**
				Total Estimated Capital Cost	**$ 2,214,000**
				Rounded To	**$ 2,214,000**
Operation and Maintenance of SVE System					
12	System Operation & Maintenance	1	LS	$ 75,000	$ 75,000
				Subtotal O&M Costs	**$ 75,000**
				Administrative and Engineering (30%)	**$ 22,500**
				Contingency (20%)	**$ 15,000**
				Annual O&M Costs	**$ 112,500**
				Present Worth of O&M for 5 Years at 7% Discounted Rate	**$ 461,272**
				Rounded To	**$ 462,000**
Operation and Maintenance of Vapor Mitigation Systems					
13	System Operation & Maintenance	47	EACH	$ 750	$ 35,250
				Subtotal O&M Costs	**$ 35,250**
				Contingency (20%)	**$ 7,050**
				Annual O&M Costs	**$ 42,300**
				Present Worth of O&M for 15 Years at 7% Discounted Rate	**$ 385,265**
				Rounded To	**$ 386,000**
				TOTAL PRESENT WORTH	**$ 3,062,000**

Assumptions:

1. SVE pilot test cost estimate includes all labor, materials and equipment necessary to perform the SVE pilot test and to evaluate the results of the pilot test.

2. Investigation of migration pathways cost estimate includes fully evaluating all possible migration pathways into residential properties; including, but not limited to, laterals, electrical lines, phone lines, and any other possible opening into the home.

3. Mobilization/demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to complete the alternative.

4. Preparation and trenching cost estimate includes the cost of labor, materials, and equipment necessary to remove all pavement and soil to reach the depth necessary for installation of the SVE line.

5. Transportation and disposal of excavated waste cost estimate includes the cost of transportation, and treatment and/or disposal of all soil and pavement excavated. Assumes 1,240 cubic yards of material removed and conversion of 1.7 tons per cubic yard. This cost is dependent upon the waste classification of the excavated material and assumes that the waste is classified as non-hazardous.

6. Backfill with flowable or select fill cost estimate includes the cost of labor, materials, and equipment necessary to fill all excavated areas surrounding the SVE piping with flowable and/or select fill.

7. Piping and offsite equipment cost estimate includes the cost of labor, materials, and equipment necessary to install the SVE lines running parallel with the sewer line.

8. Treatment system equipment and enclosures cost estimate includes the cost of labor, materials, and equipment necessary for installing treatment systems and enclosures at the facility, as well as connecting treatment equipment to the SVE line.

9. Permitting is the cost estimate for obtaining permits and access agreements for the construction work.

10. Road closures cost estimate includes the closure and securing all sections of road during the prescribed work period.

11. Road paving cost estimate includes the repaving of the sections of road which were removed to install the new sanitary sewer lines in compliance with applicable standards.

12. The O&M cost estimate for the SVE system includes the cost of any annual costs associated with permits, rental fees, equipment maintenance, system sampling, and utilities associated with the SVE system.

13. O&M cost estimate includes the assumed annual cost for maintenance, replacement parts, contractor repairs, electricity, and inspections for all existing mitigation systems that have currently been installed within the designated study area.

Table 10

Cost Estimate for Alternative 4 – Blanket Mitigation
Emerson Power Transmission Site
Ithaca, New York

Item No.	Description	Estimated Quantities	Units	Unit Price	Estimated Amount
Vapor Mitigation					
1	Mitigation	58	EACH	$ 18,000	$ 1,044,000
2	Post-Mitigation Air Sampling	58	EACH	$ 3,000	$ 174,000
				Subtotal Capital Costs	**$ 1,218,000**
				Administrative and Engineering (30%)	**$ 365,400**
				Contingency (20%)	**$ 243,600**
				Total Estimated Capital Cost	**$ 1,827,000**
				Rounded To	**$ 1,827,000**
Operation and Maintenance of Vapor Mitigation Systems					
3	Operation & Maintenance	105	EACH	$ 750	$ 78,750
				Subtotal O&M Costs	**$ 78,750**
				Contingency (20%)	**$ 15,750**
				Annual O&M Costs	**$ 94,500**
				Present Worth of O&M for 15 Years at 7% Discounted Rate	**$ 860,698**
				Rounded To	**$ 861,000**
				TOTAL PRESENT WORTH	**$ 2,688,000**

Assumptions:

1. The mitigation cost estimate includes the total system installation cost including all permitting fees, labor, and materials for the total number of properties in the study area.

2. The post-mitigation air sampling cost estimate includes the cost of completing air sampling in each home in which a mitigation system was installed to ensure acceptable indoor air quality.

3. O&M cost estimate includes the assumed annual cost for maintenance, replacement parts, contractor repairs, electricity, and inspections for all existing mitigation systems that have currently been installed and all mitigation systems that will be installed as part of this alternative within the designated study area.

Table 11

Cost Estimate for Alternative 5 – Air Sampling and Mitigation
Emerson Power Transmission Site
Ithaca, New York

Item No.	Description	Estimated Quantities	Units	Unit Price	Estimated Amount
Vapor Mitigation					
1	Initial Sampling Event	58	EACH	$ 3,000	$ 174,000
2	Mitigation	18	EACH	$ 18,000	$ 324,000
3	Post-Mitigation Air Sampling	18	EACH	$ 3,000	$ 54,000
				Subtotal Capital Costs	**$ 552,000**
				Administrative and Engineering (30%)	**$ 165,600**
				Contingency (20%)	**$ 110,400**
				Total Estimated Capital Cost	**$ 828,000**
				Rounded To	**$ 828,000**
Operation and Maintenance of Vapor Mitigation Systems					
4	Operation & Maintenance	65	EACH	$ 750	$ 48,750
				Subtotal O&M Costs	**$ 48,750**
				Contingency (20%)	**$ 9,750**
				Annual O&M Costs	**$ 58,500**
				Present Worth of O&M for 15 Years at 7% Discounted Rate	**$ 532,813**
				Rounded To	**$ 533,000**
Indoor Air Sampling Cost					
5	Air Sampling	40	EACH	$ 3,000	$ 120,000
				Subtotal Air Sampling Costs	**$ 120,000**
				Contingency (20%)	**$ 24,000**
				Air Sampling Costs	**$ 144,000**
				Present Worth of Air Sampling at 7% Discounted Rate	**$ 344,019**
				Rounded To	**$ 345,000**
				TOTAL PRESENT WORTH	**$ 1,706,000**

Assumptions:

1. The initial sampling event cost estimate includes the cost for sampling indoor air in the 58 residential properties in the study area that do not have installed mitigation systems or are pending the installation of mitigation systems.

2. The mitigation cost includes the total cost for installing a mitigation system, including all permitting fees, labor, and materials, under the assumption that 18 properties will be offered mitigation following the initial sampling event and based on current standards.

3. The post-mitigation air sampling cost estimate includes the cost of completing air sampling in each home in which a mitigation system was installed to ensure acceptable indoor air quality.

4. O&M cost estimate includes the assumed annual cost for maintenance, replacement parts, contractor repairs, electricity, and inspections for all existing mitigation systems that have currently been installed and all mitigation systems that will be installed as part of this alternative within the designated study area.

5. The annual air sampling cost estimate includes the cost of completing air sampling in each home not receiving a mitigation system based on the original air sampling results every three years for years one through ten, and then year fifteen (i.e. years 3, 6, 9, and 15). It is assumed that all of these homes will test clean and will not require mitigation.

Appendix A – Laboratory Data package and QA/QC Summary Report (on CD)

Data Usability Summary Report
for Soil Vapor Study along Sanitary Sewer
EPT facility
Ithaca, New York
July 29 and 30, 2008

Introduction

This Data Usability Summary Report (DUSR) includes 16 soil vapor samples and a trip blank collected near the Emerson Power Transmission Facility in Ithaca, New York, from July 29 and 30, 2008. The samples were analyzed by Centek Laboratories, LLC of Syracuse, New York, for volatile organic compounds (VOCs), by U.S. Environmental Protection Agency (EPA) Method TO-15. The data were reviewed in accordance with the method and chain-of-custody criteria outlined in the National Functional Guidelines of Organic (October 1999) Data Review. The validated soil vapor analytical results are presented in Table 1 of the South Hill Sanitary Sewer Network Alternatives Analysis Report.

Volatile Organic Compounds

Sixteen soil vapor samples and a trip blank were analyzed for VOCs by EPA Method TO-15. The data were reviewed for surrogate recovery, matrix spike/matrix spike duplicate (MS/MSD) recovery, blank contamination, instrument performance, calibration, and calculation criteria. The data satisfied the criteria for MS/MSD recovery, blank contamination, instrument performance and calculation.

The positive or non-detectable results for several analytes were qualified "C", as estimated because of exceedences in the continuing calibrations. Several positive sample results were qualified "I", as estimated, because of elevated internal standard recoveries. Several positive sample results were qualified "S", as estimated, because of elevated surrogate standard recovery.

Overall Assessment of the Data

The data presented are acceptable as qualified for site characterization activities.