Immediate Soil Vapor Investigation and Vapor Intrusion Summary Report Axiohm OU2 Offsite (C755012) Ithaca, New York

Prepared for

New York State Department of Environmental Conservation
625 Broadway
Albany, New York 12233

Prepared by

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April 2009
Revision: FINAL
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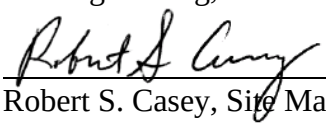
Christopher J. Canonica, P.E., Program Manager — Date
EA Engineering, P.C.



23 April 2009
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EA Science and Technology

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1. INTRODUCTION

1.1 PROJECT BACKGROUND

The New York State Department of Environmental Conservation (NYSDEC) tasked EA Engineering, P.C., and its affiliate EA Science and Technology (EA) to perform an Immediate Soil Vapor Investigation (ISVI) for the Axiohm OU2 Offsite Project (NYSDEC Site No. C755012). The site is located within the South Hill neighborhood in the city of Ithaca, Tompkins County, New York (Figure 1). The immediate objective of project was to evaluate soil vapor medium within, adjacent to, and above sewer lines within the study area. Figure 2 illustrates the approximate boundary of the study area. Based on evaluation of soil vapor analytical data, NYSDEC in conjunction with New York State Department of Health (NYSDOH) identified properties of concern along the sewer lines and conducted vapor intrusion (VI) evaluations at these locations.

EA's completed activities for this work assignment are being conducted under the NYSDEC State Superfund Standby Contract (Work Assignment No. D004438-19). EA performed the field investigation activities for the ISVI in September 2007, December 2007, April 2008, and November 2008. The VI evaluations were conducted in January 2008, April 2008, July 2008, and November 2008.

1.2 SITE HISTORY

The South Hill neighborhood is located within and to the southeast of the city of Ithaca, Tompkins County, New York. Three historic manufacturing facilities are located in the area, which include Emerson Power Transmission (EPT) facility located to the west of South Aurora Street, the former Axiohm facility located at 950 Danby Road, and the Therm, Inc. (Therm) facility located east of the other properties on Hudson Street Extension. A map illustrating the locations of these facilities and the sewer system of the South Hill neighborhood is provided as Figure 3.

1.2.1 Emerson Power Transmission

The original plant buildings opened originally as the Morse Chain Company facility in 1906, by Morse Industrial Corporation. The facility originally manufactured steel roller chain for the automobile industry. Borg-Warner Corporation began ownership of the facility from approximately 1928 through 1983 and continued as a manufacturer of automotive parts and power transmission equipment. From the 1950s through the 1970s, activities at the site included metal stamping, solvent degreasing, and purification of spent solvents including trichloroethene (TCE) by distillation, copper plating, cadmium plating, and wire drawing[1]. Machines utilized to perform these operations were reportedly not equipped with oil drip pans in the 1950s, and solvents used

[1] New York State Department of Environmental Conservation. 1994. Record of Decision – Morse Industrial Corporation Inactive Hazardous Waste Site (Site No. 7-55-010). December.

to clean the residual oil from the floors appear to have been flushed into the plant's sanitary sewer system. A metal scrap conveyor and several solvent degreaser distillers were installed in the early 1960s. In 1973, a TCE distiller was removed from the site, while all usage of TCE ceased in 1983.

In 1983, Borg-Warner sold the Morse Industrial Corporation to Emerson Electric Company and in the late 1980s the manufacturing plant became known as EPT. EPT currently operates the facility as a manufacturer of roll chain, bearings, and clutching for the power transmission industry. Under EPT's ownership, TCE has not been utilized by the facility.

In February 1987, EPT notified the NYSDEC that TCE was found in oil skimmed from the surface of an on-site fire water reservoir. Subsequent to emptying and cleaning the fire water reservoir, an immediate environmental investigation was completed to assess groundwater in the vicinity of the reservoir. Groundwater samples collected from monitoring wells around the perimeter of the reservoir indicated that groundwater had been impacted with TCE.

In July 1988, EPT entered into a Consent Order with NYSDEC to complete a Remedial Investigation (RI)/Feasibility Study (FS) to investigate TCE contamination in groundwater. Based on the results of the RI, NYSDEC requested immediate action be taken to address groundwater contamination associated with the reservoir. An Interim Remedial Measure (IRM) was initiated as an amendment to the existing Consent Order; in August 1991, EPT installed and began operation of a groundwater pump and treat system at the site. Included in the amended Consent Order, NYSDEC required EPT to initiate a soil vapor monitoring program to assess the potential for impacted soil vapor to migrate off-site.

As part of the FS, EPT conducted pilot tests utilizing a two-phase vacuum extraction system for groundwater and soil vapor treatment. Results of the pilot test indicated that the two-phase extraction system would enhance remediation at the site; therefore, the existing groundwater pump and treat system was modified to accommodate vacuum extraction as set forth in the NYSDEC Record of Decision (ROD) 1994. In addition to system enhancements, the ROD recommended excavation of on-site petroleum-contaminated soil, continued groundwater monitoring, and continuation of the soil vapor monitoring program.

In February 2009, NYSDEC issued a Proposed ROD Amendment, which included proposal for an upgrade to the existing extraction system to provide more effective hydraulic control of groundwater and increase contaminant mass removal, in combination with *in situ* remediation of the groundwater plume. Additional provisions included removal of weather petroleum, installation of mitigative measures to limit VI from occurring into on-site buildings, and assessment of remedial action alternatives to control and/or mitigate migration of soil vapor into neighborhoods surrounding the site.

1.2.2 Axiohm

Axiohm (the former National Cash Register [NCR]) was constructed to the south of the EPT facility in the 1950s. The Axiohm site is topographically up gradient of the EPT site. NCR operated as a manufacturer of adding machines and cash registers, and maintained an active printer business on-site. Manufacturer activities included metal plating and head treating operations, each utilizing industrial solvents. Nine underground storage tanks (USTs) were on-site for over 30 years during NCR's operation at the site. Seven of the tanks were removed in 1986. The facility was taken over by Axiohm and subsequently closed in 2000. The property is currently known as the South Hill Business Campus and is home to a number of small commercial and industrial operations.

A RI was completed at the site in 2006-2007, with a RI report approved by the NYSDEC in January 2008. The RI evaluated subsurface soils, groundwater, and soil vapor at suspected contamination areas and at areas down gradient of former manufacturing operations including the UST areas. The RI report indicated that chlorinated organic solvents had impacted groundwater and soil vapor at the site.

According to the NYSDEC Brownfield Cleanup Program (BCP) Fact Sheet for the site, a remedial action to address on-site contamination was enacted in 2008. The remedial actions objectives included the removal of two former 9,000 gal USTs and contaminated soil surrounding the tanks, and treatment of groundwater via *in-situ* chemical oxidation (ISCO) via the injection of potassium permanganate to address TCE, dichloroethene (DCE), and vinyl chloride (VC) impacts in groundwater[2].

In November 2008, S&W Redevelopment of North America, LLC issued a Final Engineering Report on behalf of the South Hill Business Campus, LLC for BCP Site No. C755012. The report documents the implementation of remedial activities conducted at the site completed through September 2008. The objective of the remedial activities was to achieve Track 4 cleanup levels under the NYSDEC BCP (Title 14 Section 27-1415), which relies on institutional and engineering controls consistent with the proposed commercial end use.

Remedial actions implemented at the site included the excavation and removal of soil adjacent to the two former 9,000 gal underground dilution tanks, injection of 4,958 lbs of potassium permanganate, and 13,600 gal of solution into 10 injection trenches west of the southern portion of the site building. In addition, under an IRM a sub-slab depressurization system was installed in the on-site building to mitigate potential soil vapor intrusion. A Site Management Plan (SMP) was developed to define actions to maintain engineering controls and implement a groundwater and indoor air monitoring program.

[2] New York State Department of Environmental Conservation, 2008. Fact Sheet for South Hill Business Campus (Site No. 7-55-012). March.

1.2.3 Therm, Inc.

Therm operates as a manufacturer of industrial and aeronautical turbine components, and has been located on the eastern portion of the South Hill neighborhood since the mid-1930s. An online search of the Right-To-Know Network databases showed that Therm obtained permitting for storm and treatment plant effluent, including PCE and TCE, for dates ranging from January 1995 to February 1997. Available PCE and TCE monitoring records indicated that no violations had been issued through February 1997.

1.2.4 South Hill Sewer Line Investigations

Previous investigations conducted by EPT and the South Hill Business Campus detected impacted soil vapor in the vicinity of the sanitary sewer lines on South Hill. A portion of the South Hill sanitary sewer line originates beneath the building at the former Axiohm facility and extends in a northerly direction across the eastern portion of the EPT property, then continues along Danby Road/South Aurora Street to Columbia Street. The Danby Road sewer line connects with the former Axiohm sewer line just north of Coddington Road on the eastern side of the EPT facility. At Columbia Street, the line connects with Hudson Street sewer line, a portion of which originates from the Therm manufacturing facility. The former Axiohm/Danby Road line, connected with the Hudson Street lines then runs west one block to Turner Place, then turns northward again and runs two blocks to East Clinton Street. An illustration of the approximate South Hill sewer system network is provided in Figure 3.

1.3 OBJECTIVES

The purpose of the ISVI and VI evaluations at the Axiohm OU2 Offsite was to evaluate the concentrations of volatile organic compounds (VOCs) in soil vapor within, adjacent to, and above the South Hill sewer lines and assess the potential for VI into commercial and residential properties connected to the sewer lines.

The ISVI sampling program consisted of soil vapor point installation and sampling at 18 locations. The soil vapor locations are described below with reference to the areas of the sanitary sewer system evaluated and the intent of the sampling. Locations of the soil vapor sampling points are provided on Figure 4.

Southern Portion of Sanitary Sewer System between former Axiohm facility and the Ithaca College lateral:

- Four locations (SV-04, SV-05, SV-06, and SV-07) directly above the Ithaca College lateral line to evaluate the extent of soil vapor concentrations of VOCs within the utility trench.

- Two permanent bedrock soil vapor points (SV-01P and SV-02P) at the termination of the Ithaca College lateral line and the intersection with the former Axiohm sewer line west of Danby Road were installed to investigate soil vapor in the vicinity of a detection of TCE

(2,200 µg/m^3). The shallow soil vapor point was installed to assess shallow (approximately 15 ft below ground surface [bgs]) bedrock vapor in the immediate vicinity of the former Axiohm sewer line utility trench. The deeper (approximately 25 ft bgs) soil vapor point was installed to identify VOC concentrations at greater depth within the bedrock formation.

- One location (SV-08) south of the ICS Development Partners (930 Danby Road) offices approximately 275 ft east of the former Axiohm sewer line and 350 ft south of the Ithaca lateral line. This soil vapor point was installed to evaluate soil vapor away from the South Hill sewer lines.

Central Portion of Sanitary Sewer System between Ithaca College lateral and the Dandy Road Sewer line connection with former Axiohm sewer line to the east of EPT:

- Two locations (SV-09 and SV-10) east of the properties located between Danby Road and EPT's upper access road. These points were installed to assess the potential for VI and evaluate soil vapor away from the South Hill sewer lines.

- One location (SV-12) directly above the lateral line from the Danby Road sewer line prior to the connection with former Axiohm sewer line. This point was installed to evaluate concentrations of VOCs in the Danby Road sewer lateral line utility trench.

- One location (SV-11) directly above the former Axiohm sewer line just down gradient of the Danby Road sewer line connection. This point was installed to compare soil vapor concentrations with the soil vapor concentrations from the Danby Road sewer lateral.

Northern Portion of Sanitary Sewer System adjacent to the South Hill Elementary School lateral and the Dandy Road Sewer/former Axiohm sewer line to the east of EPT:

- Two locations (SV-01 and SV-02) west of the Danby Road/former Axiohm sewer line and adjacent to the EPT plant. These points were installed adjacent to the sewer lines to assess soil vapor near the sewer system in this area.

Eastern Portion of Sanitary Sewer System including the upper Therm sewer line and the lower portion where the Hudson line and Therm lines comingle along Columbia Street:

- Two locations (SV-16 and SV-17) north of the Therm facility, one directly above the Pearsall Place line and one above the Therm discharge sewer line. These points were installed to evaluate soil vapor within the utility trench from the Therm facility.

- One location (SV-15) directly above the Therm sewer line to the east of Hawthorne Place along the footpath. This point was installed to evaluate soil vapor within the utility trench down gradient from the Therm facility.

- Two locations (SV-13 and SV-14) directly above the Columbia Street sewer line just after the Hudson Street connection and prior to the connection with Danby Road/former Axiohm sewer line. These points were installed to evaluate soil vapor within the utility trench along Columbia Street.

The VI evaluation sampling program was performed at 26 structures located within the study area at locations identified by the NYSDEC and NYSDOH. A preliminary screening of sub-slab vapor was also completed at six structures for evaluation purposes as directed by the NYSDEC and NYSDOH.

This Summary Report was completed to discuss the field investigation activities and summarize the ISVI and VI sampling results.

1.4 REPORT ORGANIZATION

A summary of field activities completed in September and December 2007, and January, April, July, and November 2008 is provided in Section 2. Section 3 defines the analytical results of the field sampling activities. Analytical results are summarized in table format.

The following are provided as appendices:

- **Appendix A**—Daily Field Reports
- **Appendix B**—Soil Vapor Boring Logs
- **Appendix C**—Soil Vapor Sampling Forms
- **Appendix D**—Indoor Air/Sub-slab Vapor Sampling Forms
- **Appendix E**—Data Usability Summary Report
- **Appendix F**—Laboratory Analytical Data, Form Is, Chain of Custody Forms

2. FIELD INVESTIGATION ACTIVITIES

Section 2 presents the approach of the field investigation activities that were performed to meet the objectives of the ISVI and VI evaluations. EA's approach for implementing the work assignment included field sampling protocols designed to evaluate the presence or absence of potential contaminants of concern (COCs) in soil vapor, sub-slab vapor, indoor/outdoor air, soil, and surface water collected from within the study area through laboratory analysis.

The field investigation activities occurred in September and December 2007; and January, April, July, November 2008, and included the following activities:

- ***Soil Vapor Sampling—***Temporary and permanent soil vapor points were installed and sampled. Subsurface soil samples were collected from selected locations during the installation of soil vapor points. Additionally, one surface water sample was collected from a stream located west of the two permanent soil vapor points.

- ***Sub-Slab Vapor Sampling—***During the VI evaluations, structures with competent basement slabs were sampled for sub-slab vapor. Sub-slab vapor was collected from selected structures during a preliminary screening investigation (July 2008) to evaluate potential VOC impacts to the subsurface environment and for use in evaluating the need for additional VI evaluation.

- ***Indoor and Outdoor Ambient Air Sampling—***Basement indoor air and/or first-floor indoor air samples were collected at selected structures. Outdoor air samples were collected at locations representative of outdoor air ambient conditions for each day that indoor air sampling was conducted.

- ***Structure Inspection/Inventory and Owner Questionnaire—***An inspection/inventory of general structure conditions and completion of the NYSDOH Indoor Air Quality Questionnaire and Building Inventory were completed for each structure sampled during the VI evaluations.

Copies of daily field reports are provided in Appendix A. A summary of the soil vapor sampling is detailed in Table 1. Table 2 presents the overall analytical sampling program.

2.1 SOIL VAPOR POINTS

2.1.1 Temporary Soil Vapor Point Installation

EA and NYSDEC representatives supervised the installation of five temporary soil vapor points on 18 September 2007, 5 December 2007, and 17 April 2008. Figure 4 illustrates the locations of the soil vapor sampling points. Sampling locations were selected in consultation with the NYSDEC representative. Nothnagle Drilling Inc., from Scottsville, New York, performed the

drilling and soil vapor point installation at the 15 locations previously mentioned. The soil vapor points were installed using Geoprobe macro-cores to install stainless steel drive points to the required depth (i.e., top of bedrock, 1 ft above utility line). Two additional temporary soil vapor points were installed by EA personnel on 4 November 2008. These points were installed utilizing a stainless steel hand auger to drive to the sample depth. Sampling depth intervals were determined by depth to bedrock at the sampling location or the invert elevation of the sewer line at the sampling location.

Once the sampling depth was reached, a 6-in. stainless steel sampling screen was attached to a dedicated section of 0.25-in. diameter Teflon tubing and placed in the open bore hole. The borehole was then backfilled with sand to a minimum of 6 in. above the stainless steel sampling screen. Granular bentonite pellets were then used to backfill to the ground surface, hydrating concurrently with placement. A typical soil vapor point construction diagram is depicted in Figure 5. The soil vapor points were allowed to set for a minimum 24 hours before sample collection commenced. The soil boring spoils were reworked into the surrounding ground surface. Soil boring logs are provided in Appendix B.

2.1.1.1 Subsurface Soil Sampling

During installation of the temporary soil vapor sampling points on 4 November 2008, subsurface soil samples were collected from the set depth of the soil vapor point using a stainless steel hand auger. The soil samples were visually inspected and described according to the Unified Soil Classification System and screened with a photo ionization detector (PID). One subsurface soil sample was collected from each of the borings completed for soil vapor points SV-16 and SV-17.

To avoid cross-contamination of samples, the stainless steel hand auger was cleaned initially and prior to being reused. The following decontamination procedures were performed between temporary soil vapor point subsurface soil sampling locations:

- Wash and scrub with low-phosphate laboratory grade detergent
- Rinse with deionized water
- Air dry.

Subsurface soil samples were submitted under standard chain of custody to Hampton-Clarke Veritech Laboratories of Fairfield, New Jersey for analysis of VOCs by United States Environmental Protection Agency (USEPA) Method 8260B. Hampton-Clarke Veritech is an approved NYSDOH Environmental Laboratory Approval Program (ELAP)-certified laboratory. All soil samples were analyzed in accordance with NYSDEC Analytical Services Protocol (ASP).

2.1.2 Permanent Soil Vapor Point Installation

EA and NYSDEC representative supervised the installation of two boreholes just west of the intersection of the Ithaca College sewer lateral and the Axiohm sewer line. The open boreholes

were initially intended to determine if shallow bedrock groundwater would be encountered at this location and for the purpose of installing groundwater monitoring wells.

Borings were completed by Nothnagle Drilling using hollow-stem augers (HSAs) and air rotary technologies. HSAs were used to drill through overburden soils and weathered bedrock, while air rotary techniques were utilized to core through bedrock to the desired depth. Soil samples were collected from the boring cuttings and screened using a PID. Soil characteristics, PID readings, and recovery data were recorded on boring logs for each boring. The Unified Soil Classification System was used to characterize the overburden and bedrock material. At the request of the NYSDEC representative, a grab sample was collected from above the bedrock interface and submitted under standard chain of custody to Hampton-Clarke Veritech for analysis of VOCs by USEPA Method 8260B.

Because groundwater was not encountered, borings SV-01P and SV-02P were completed as permanent soil vapor sampling points at the request of the NYSDEC representative. Boring SV-01P was completed to a depth of 15 ft bgs, while boring SV-02P was completed at a depth of 25 ft bgs to allow for bedrock vapor sampling at alternate depths. At each boring, a 6-in. stainless steel sampling screen was attached to a dedicated section of 0.25-in. diameter Teflon tubing and placed in the open bore hole at the selected sample interval. The boreholes were then backfilled with sand to a minimum of 6 in. above the screened interval. Granular bentonite pellets were then used to backfill to a minimum of 2 ft above the sand layer, hydrating concurrently with placement. Sand was used as backfill from the hydrated bentonite layer to the ground surface, with a flush mount protective cover installed at grade with a concrete pad. A permanent soil vapor point construction diagram is included as Figure 6.

The permanent soil vapor points were allowed to set for a minimum 24 hours before sample collection commenced. The soil boring spoils were reworked into the surrounding ground surface. Soil boring logs are provided in Appendix B.

Per the NYSDEC representative, a surface water grab sample was collected from a surface water flow observed to the west of the completed permanent soil vapor points. One sample was collected and submitted under standard chain of custody to Hampton-Clarke Veritech for analysis of VOCs by USEPA Method 8260B.

2.1.3 Soil Vapor Sampling

After installation, soil vapor points were allowed to set for 24 hours prior to sampling. The following procedures were followed during soil vapor sampling:

- An air pump (Gil-Air 5 model) was used to purge approximately one vapor point volume of air/vapor from the sampling point into a tedlar bag. The tedlar bag was closed and the purge air release into a calibrated ppbRAE. The ppbRAE reading was recorded on the field sampling form.

- Helium tracer gas testing was conducted at selected sampling locations to ensure that the soil vapor samples were not affected by ambient air being drawn into the sampling points.

- A 6-L Summa® canister equipped with a flow regulator and vacuum gauge were used to collect the soil vapor samples. The canisters and flow regulators were batch certified clean by the laboratory prior to sampling. The flow controllers were regulated by the laboratory to collect at 41.7 mL/minute over a 2-hour sample collection period.

- The sample canisters were connected to the sample tubing using a compression fitting and placed on the ground adjacent to the sampling point.

Duplicate samples were collected at soil vapor location SV-04 in December 2007, at SV-13 in April 2008, and at SV-02P in November 2008. Soil vapor sampling logs are provided in Appendix C.

Soil vapor samples were shipped under standard chain of custody to Air Toxics in Folsom, California. Air Toxics is a NYSDOH ELAP-certified laboratory. Soil vapor samples were analyzed for VOCs using USEPA Method TO-15 (USEPA TO-15).

2.2 VAPOR INTRUSTION EVALUATIONS

A major component of this work assignment included VI evaluations at commercial and residential structures identified as properties of concern by NYSDEC and NYSDOH. The VI evaluations were conducted during January, April, and November 2008. Additionally, sub-slab vapor samples were collected from selected structures in July 2008 as a preliminary screening assessment. Structures included in the VI evaluations are shown on Figure 7.

2.2.1 Structure Inspection/Inventory and Owner Questionnaire

Guidance for Evaluating Soil Vapor Intrusion (SVI) in the State of New York (Final, October 2006) (SVI Guidance) and NYSDEC Department of Remediation *Draft DER-10 Technical Guidance for Site Investigation and Remediation* (December 2002) protocol were followed during the planning and implementation of the VI evaluations.

EA inspected the general site conditions at each structure. The pre-sampling inspection included completion of the NYSDOH Indoor Air Quality Questionnaire and Building Inventory, documentation of weather conditions outside and temperatures inside, ambient air screening using field equipment (i.e., ppbRAE Model PGM-7240 ppb VOC Monitor [ppbRAE]), and selection of air sampling locations. Product inventories were completed for the basement area of each structure. Completed NYSDOH Indoor Air Quality Questionnaire and Building Inventory forms and photo logs for each structure sampled during the field investigation are provided in Appendix D.

2.2.2 Sub-Slab Vapor Sampling

Sub-slab vapor samples were collected during VI evaluations in January, April, and November 2008. In addition, sub-slab vapor samples were collected from four structures in July 2008 as a preliminary screening assessment. The following procedures were followed for sub-slab vapor point installation and sampling. A typical sub-slab vapor point construction diagram is included as Figure 8.

2.2.2.1 Sub-Slab Vapor Point Installation

The following procedures were followed for the selection and installation of all sub-slab vapor points within the structures sampled during the field investigation.

- A visual assessment of the condition of the basement floor was completed. The locations of the sub-slab vapor point were selected to be out of the line of traffic, away from major cracks and other floor penetrations (sumps, pipes, etc.), and a minimum of 5 ft from an exterior wall.

- Once the location was determined, a ⅜-in. diameter hole was drilled approximately 2-in. below the concrete floor slab using an electric hammer drill. A 1-in. diameter drill bit was then used to over drill the top ½ in. of the borehole to create an annular space for the surface seal.

- Concrete dust and flooring material was swept away from the drill hole and wiped with a dampened towel.

- Teflon-lined polyethylene tubing (¼-in. outside diameter × ⅛-in. inside diameter, and approximately 3-ft long) was then inserted into the borehole drilled in the floor, extending no further than 2 in. below the bottom of the floor slab.

- Melted beeswax was then poured around the tubing at the floor penetration and allowed to set tightly around the tubing.

- A dedicated 60-cm^3 syringe was then used to purge approximately 100 ml of air/vapor from the sampling point. The syringe was capped and the purge air released outside the building as to not interfere with the basement indoor air sample collection. The purge air was discharged into a ppbRAE and the associated reading was recorded on the field sampling form. Sub-slab vapor points installed during the November 2008 VI evaluation were leak tested using helium tracer gas procedures in accordance with the NYSDOH Guidance.

- A 6-L Summa® canister (provided by an independent laboratory) with a vacuum gauge and flow controller were connected to the sample tubing using a compression fitting and placed on the floor adjacent to the sampling point. The canisters were batch certified

clean in accordance with USEPA Method TO-15 and under a vacuum pressure of no less than -25 in. of mercury in Hg or a replacement canister was used. Flow controllers were regulated to collect at 3.8 mL/minute over a 24-hour collection period.

- The serial number of the canister and associated regulator were recorded on the field sampling form. Sample identification including sample identification, sample start date/time, vacuum gauge pressure, and required analysis (USEPA Method TO-15) were recorded on the canister identification tag and the field sampling form.

- A digital photograph was taken of the canister setup and the surrounding area.

2.2.2.2 Sub-slab Vapor Sampling

One sub-slab vapor sample was collected from the temporary sub-slab vapor points installed at each of the structures containing a poured concrete slab. Following the 24-hour collection period, the canister valves were closed to terminate sample collection. Flow controller ending gauge pressures and sample end times were recorded on the canister identification tags and the field sampling forms. Once sample collection was terminated, the canister and flow controllers were removed from the sample tubing and placed into a shipping box. All pertinent sample information was recorded on the associated chain of custody and repackaged into the originating box. Sub-slab vapor samples were sent to Air Toxics Ltd., Folsom, California for VOC analysis by USEPA Method TO-15.

Upon completion of the sampling, the temporary sub-slab sampling points were removed and sealed with hydraulic cement.

2.2.3 Indoor Air and Outdoor Ambient Air Sampling

Basement indoor air samples were collected from each structure as part of the VI evaluations. Basement indoor air samples were collected during the January, April, and November 2008 sampling events. Additional first-floor indoor air samples were collected at two structures during the January 2008 VI evaluation. Basement air samples were collected at two structures not containing poured concrete foundations during the preliminary screening event in July 2008.

2.2.3.1 Indoor Air Sampling

A total of 31 basement indoor air samples and 3 first-floor indoor air samples were collected at structures during the VI evaluations. In accordance with the NYSDOH SVI Guidance, indoor air samples were set up to collect a representative air sample from within the breathing zone (i.e., 3-5 ft above the floor). A 6-L Summa® canister with a vacuum gauge and flow controller were used to collect the indoor air samples. The canisters were batch certified clean in accordance with USEPA Method TO-15 and under a vacuum pressure of no less than -25 in. of mercury (Hg). Flow controllers were regulated to collect at 3.8 mL/minute over a 24-hour collection period.

Prior to initiating the sampling, the serial number of the canisters and associated regulators were recorded on the field sampling forms. Field sampling forms included the collection of canister/regulator serial numbers, sample identifications, sample start date/times, vacuum gauge pressures, and required analysis (USEPA Method TO-15).

Following the 24-hour collection period, the canister valves were closed to terminate sample collection period. Flow controller ending gauge pressures and sample end times were recorded on the canister identification tags and the field sampling forms. Once sample collection was terminated, the canisters and flow controllers were removed from the sample tubing and placed into a shipping box. All pertinent sample information was recorded on the associated chain of custody and repackaged into the originating box. Indoor air samples were sent to Air Toxics Ltd., Folsom, California for VOC analysis by USEPA Method TO-15.

2.2.3.2 Outdoor Ambient Air Sampling

A total of seven outdoor ambient air samples were collected concurrent with soil vapor, sub-slab vapor, and indoor air sampling to represent outdoor ambient air quality for select sampling events. One outdoor ambient air sample was collected during the December 2007 soil vapor sampling event and six outdoor ambient air samples (two samples per event) were collected during the VI evaluations.

In accordance with the NYSDOH SVI Guidance, outdoor ambient air samples were set up to collect a representative air sample from within the breathing zone (i.e., 3-5 ft above the ground surface) during a sample period corresponding with other sample types. If sample locations were unable to achieve the elevated sampling zone, dedicated Teflon-lined polyethylene tubing was used to reach the breathing zone. A 6-L Summa® canister with a vacuum gauge and flow controller were used to collect the outdoor ambient air samples. The canisters were batch certified clean in accordance with USEPA Method TO-15 and under a vacuum pressure of no less than -25 in. of mercury (Hg). Flow controllers were regulated to collect at 3.8 mL/minute over a 24-hour collection period for VI evaluations and 41.7 mL/minute over a 2-hour collection period for soil vapor sampling.

Prior to initiating the sampling, the serial number of the canisters and associated regulators were recorded on the field sampling forms. Field sampling forms included the collection of canister/regulator serial numbers, sample identifications, sample start date/times, vacuum gauge pressures, and required analysis (USEPA Method TO-15).

Following the sample collection period, the canister valves were closed to terminate the sample collection. Flow controller ending gauge pressures and sample end times were recorded on the canister identification tags and the field sampling forms. Once sample collection was terminated, the canisters and flow controllers were removed from the sample tubing and placed into a shipping box. Pertinent sample information was recorded on the associated chain-of-custody and repackaged into the originating box. Outdoor ambient air samples were sent to Air Toxics Ltd., Folsom, California for VOC analysis by USEPA Method TO-15.

2.3 FIELD DUPLICATE SAMPLING

Field quality control sampling included collection of duplicate samples. Field duplicates were collected at the rate of 1 duplicate per 20 original samples per sample type (i.e., soil vapor, sub-slab vapor, basement indoor air, subsurface soil, and surface water).

2.3.1 Air/Vapor Field Duplicate Sampling

Field duplicates collected at soil vapor and sub-slab vapor points, a stainless steel in-line "tee" was used. This duplicate sampling method splits the flow coming from a sampling point into two separate canisters. At indoor air duplicate sampling locations, two canisters were set up adjacent to each other for sample collection.

A total of 10 duplicate air/vapor samples were collected during the field investigations. Five sub-slab vapor duplicates, two basement indoor air duplicates, and three soil vapor duplicates were collected for quality control purposes.

2.3.2 Soil/Water Field Duplicate Sampling

One duplicate sample and matrix spike/matrix spike duplicate were collected for subsurface soil and surface water samples for quality control purposes.

3. FIELD SAMPLING RESULTS

The following section presents the analytical results of the ISVI and VI evaluations. Historical data from previous investigations in the South Hill neighborhood identified potential COCs as chlorinated volatile organic compounds (CVOCs) more specifically 1,2-dichloroethane (1,2-DCA), *cis*-1,2-dichloroethene (*cis*-1,2-DCE), *trans*-1,2-dichloroethene (trans-1,2-DCE), methylene chloride, PCE, 1,1,1-trichloroethane (1,1,1-TCA), TCE, and vinyl chloride. Therefore, the results discussed in the following section are limited to the above mentioned CVOCs.

An analytical summary table for soil vapor and corresponding outdoor ambient air data is provided as Table 3. An analytical summary table for VI evaluation data is provided in Table 4. A summary table for the subsurface soil analytical data is provided in Table 5.

Figures 9-A through 9-D depict all the detected VOC results for soil vapor samples. Figures 10-A and 10-B depict the detected CVOC analytical results of the VI evaluations, specifically those associated with a decision matrix and air guidelines presented in the NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York.

Copies of data usability summary reports (DUSR) for the soil vapor, sub-slab vapor, basement and first-floor indoor air, and outdoor ambient air analytical data are provided in Appendix E. Analytical Form Is are provided in Appendix F.

3.1 SOIL VAPOR RESULTS

A total of 18 soil vapor samples, 1 outdoor ambient air sample, and 3 soil vapor duplicate samples were collected during the ISVI and are identified below.

- 18 soil vapor samples (SV-01 through SV-02, SV-04 through SV-17, SV-01P and SV-02P)
- One outdoor ambient air sample (December 2007)
- Three soil vapor duplicate samples (September 2007 and April/November 2008).

Soil vapor samples were collected at four locations in September 2007, five locations in December 2007, five locations in April 2008, and four locations in November 2008. As outlined in Section 1.3, soil vapor samples were collected directly above, adjacent to, and in the vicinity of the South Hill neighborhood sewer system based on sections of the system. The following soil vapor sampling results are presented based on the area of the sewer system evaluated. Soil vapor samples were analyzed for full scan VOCs by USEPA Method TO-15. The validated laboratory data sheets (analytical results Form Is) associated with each sample point are presented in Appendix E.

Concentrations of PCE were detected in 9 of 18 soil vapor samples. PCE concentrations ranged from 0.78 µg/m^3 (SV-01) to 2,200 µg/m^3 (SV-14). TCE concentrations were also detected in 9 of 18 soil vapor samples at concentrations ranging from 0.52 µg/m^3 (SV-13) to 210 µg/m^3 (SV-04). The highest concentrations of TCE were detected in soil vapor samples SV-04 (210 µg/m^3) and SV-05 (170 µg/m^3). CVOC concentrations of 1,1,1-TCA were also detected in soil vapor samples. Notable concentrations of 1,1,1-TCA were detected in soil vapor samples SV-04 (71 µg/m^3), SV-05 (72 µg/m^3), and SV-01P (21 µg/m^3). Validated VOC analytical results for soil vapor samples are provided in Table 3.

3.1.1 Southern Portion of Sanitary Sewer System

The southern portions of the sewer system evaluated during this investigation receive sanitary discharge from the sewer lines originating at the former Axiohm facility and Ithaca College. The soil vapor samples were collected from within and directly above the Ithaca College lateral line (SV-04, SV-05, SV-06, and SV-07) utility trench, at multiple depth intervals (SV-01P and SV-02P) from within the bedrock adjacent to and below the connection point of the Ithaca College lateral and the former Axiohm sewer lines, as well as a location (SV-08) away from these lines. The detected VOC analytical results for soil vapor samples collected from within the southern portion of the sanitary sewer system are presented on Figure 9-A.

The soil vapor samples (SV-04 and SV-05) detecting the highest concentration of TCE and 1,1,1-TCA were collected directly above the Ithaca College sewer lateral to the west of Danby Road. Soil vapor samples (SV-06 and SV-07) collected up gradient, above the lateral located to the east of Danby Road, were non-detect for CVOCs. The permanent soil vapor sample (SV-01P) collected from the shallow bedrock (15 ft bgs) below and to the west of the former Axiohm sewer line also detected concentrations of TCE (21 µg/m^3) and 1,1,1-TCA (21 µg/m^3), while the permanent soil vapor sample (SV-02P) collected from the deeper bedrock interval (25 ft bgs) had no detection of CVOCs.

In addition, PCE concentrations were detected in soil vapor samples SV-04 (20 µg/m^3) and SV-05 (12 µg/m^3). These two samples were collected from above the Ithaca College sewer lateral. Soil vapor sample (SV-08) collected away from the sewer lines reported no detections of CVOCs.

3.1.2 Central Portion of Sanitary Sewer System

Central portions of the sanitary sewer system evaluated during this investigation receive discharge from the Danby Road lateral and the former Axiohm sewer lines. Soil vapor samples were collected from two locations (SV-09 and SV-10) away from the sewer lines, one location (SV-12) directly above the Danby Road sewer lateral line, and one location (SV-11) above the former Axiohm sewer line at the connection point with the Danby Road sewer lateral. Soil vapor sample SV-11 detected concentrations of TCE (13 µg/m^3), PCE (4.0 µg/m^3), and 1,1,1-TCA (1.20 µg/m^3) above the former Axiohm sewer line on the eastern portion of EPT. No CVOCs were detected in soil vapor sample SV-12 collected from above the Danby Road lateral. Lower concentrations of PCE were detected in soil vapor sample collected at SV-09 (0.68 µg/m^3) and 1,1,1-TCA in soil

vapor sample SV-10 (1.10 µg/m^3). The detected VOC analytical results for soil vapor samples collected from within the central portion of the sanitary sewer system are presented on Figure 9-B.

3.1.3 Northern Portion of Sanitary Sewer System

The northern portion of the South Hill neighborhood sewer system assessed during this investigation included two soil vapor samples located west of the former Axiohm and Danby Road combined sewer line. Concentrations of PCE were detected in soil vapor sample SV-01 (0.78 µg/m^3) and 1,1,1-TCA concentrations in soil vapor sample SV-02 (3.0 µg/m^3). The detected VOC analytical results for soil vapor samples collected from within the northern portion of the sanitary sewer system are presented on Figure 9-C.

3.1.2 Eastern Portion of Sanitary Sewer System

The evaluation of sanitary sewer system located in the eastern portion of the study area receives sanitary sewer discharge from the Therm facility and the Hudson Street sewer system. The two most prevalent CVOCs detected in soil vapor samples collected from this area were PCE and TCE. The highest concentration of PCE was detected at soil vapor sample (SV-14) collected above the Columbia Street Sewer Lateral which is located down gradient of the confluence of the Hudson Street sewer lines and the Therm sewer lines. An additional soil vapor sample SV-13, collected from above the Columbia Street sewer line down gradient of SV-14, detected PCE concentrations at 88 J µg/m^3. PCE concentrations were detected in soil vapor points SV-15, SV-16, and SV-17 at 120 µg/m^3, 17 µg/m^3, and 60 µg/m^3, respectively. These soil vapor points were collected directly above the sewer lines originating from Therm and were located up gradient of soil vapor samples SV-13, SV-14, and SV-15. The detected VOC analytical results for soil vapor samples collected from within the eastern portion of the sanitary sewer system are presented on Figure 9-D.

Additionally, TCE concentrations were detected in soil vapor samples collected from SV-13 (0.52 µg/m^3), SV-14 (37 µg/m^3), SV-15 (150 µg/m^3), SV-16 (1.8 µg/m^3), and SV-17 (16 µg/m^3). Soil vapor point SV-15 represents the highest concentration of TCE found along sewer lines located on the eastern portion of the South Hill sewer system. Soil vapor point SV-15 was located directly above a lower portion of the sewer line originating at the Therm facility. Soil vapor samples SV-13 and SV-14 were collected above the Columbia Street sewer lateral which is connected to both the Hudson Street sewer lines and the Therm sewer lines. Soil vapor samples SV-16 and SV-17 were collected from directly above the sewer lines originating at Therm and were located closer to the facilities main sewer discharge line.

3.2 VAPOR INTRUSION RESULTS

VI evaluations were conducted at 28 structures within the study area. A total of 73 air/vapor samples were collected during the VI evaluations in January, April, July, and November 2008 and are detailed below:

- 27 sub-slab vapor samples
- 31 basement indoor air samples
- Three first-floor indoor air samples
- Five outdoor air ambient air samples
- Seven duplicate samples.

The objective of sub-slab vapor sampling was to assess the potential and current (when collected in conjunction with indoor/outdoor air) exposures associated with VI and characterize subsurface vapor in the study area. New York State currently does not have any standards, criteria, or guidance values (SCGs) for VOC concentrations in sub-slab vapor.

The objective of indoor air sampling was to evaluate current exposures to VOCs in air. Indoor air detections of VOCs does not necessarily indicate that VI is occurring or actions need to be taken to address exposure. The NYSDOH has developed air guideline values for some CVOCs including, PCE (100 µg/m^3), TCE (5 µg/m^3), and methylene chloride (60 µg/m^3). These guidance values are presented in Table 3.1 of the NYSDOH SVI Guidance document. Indoor air sampling was conducted concurrently with sub-slab vapor and outdoor air sampling to assess VI and the potential for human health exposures.

3.2.1 Sub-slab Vapor and Indoor Air Sampling Results

A number of CVOCs, including PCE, TCE, methylene chloride, and 1,1,1-TCA, were detected in both sub-slab vapor and indoor air samples collected from structures located within the study area. A summary of concentration ranges and the frequency of detections are shown in the table below. Additional CVOCs outlined in the introduction to Section 3 (1,2-DCA, *cis*-1,2-DCE, *trans*-1,2-DCE, and vinyl chloride) are not included in the summary table based on detection frequencies below five percent.

VAPOR INTRUSION EVALUATION			
USEPA Method TO-15	Contaminants of Concern	Concentration Range Detected (µg/m^3)	Frequency of Detection[a]
VOCs	Methylene chloride	2.90 - 440	10/73
	PCE	0.61 - 190	21/73
	TCE	0.45 - 220	20/73
	1,1,1-TCA	0.67 - 250	19/73
[a] Number of samples with concentrations exceeding the laboratory method detection limit.			

For each structure the sub-slab vapor, basement indoor air, and outdoor air samples collected during the VI evaluations were submitted for full scan VOCs via USEPA Method TO-15. Validated analytical results for each structure is provided in Table 4 and CVOC results are shown on Figures 10-A and 10-B. Each structure is referred to by its numeric designation (e.g., Structure-03) other than its address to protect the privacy of its owner. A summary of structure results where either current or future potential VI appeared to be occurring is detailed in the following sections.

Structure 06

Preliminary screening of two sub-slab vapor sampling points at Structure 06 was conducted during July 2008. Initial sub-slab vapor sample results detected concentrations of PCE (2.4 µg/m^3), TCE (2.8 J µg/m^3, 1.2 µg/m^3), and 1,1,1-TCA (13 J µg/m^3). As a follow-up to the July 2008 screening, two additional sub-slab vapor and two basement indoor air samples were collected in November 2008. Sub-slab vapor and basement indoor air samples collected from Structure 06 during the November 2008 VI evaluation detected concentrations of methylene chloride above the NYSDOH air guideline of 60 µg/m^3 which was developed to be protective of public health. In addition, CVOCs including PCE, TCE, and 1,1,1-TCA were again detected in both sub-slab vapor and basement indoor air samples collected at the structure. Structure 06 is connected to the Columbia Street sewer line between South Aurora Street and Turner Place.

Structure 07

Basement indoor air samples were collected at Structure 07 during July and November 2008. No sub-slab vapor samples were collected during either of the VI evaluations as there was no existing concrete slab. Concentrations of TCE were detected in the basement air during both sampling events and ranged from 0.71 µg/m^3 (July 2008) to 1.1 µg/m^3 (November 2008). Structure 07 is connected to the South Aurora Street/Danby Road sewer line between Hillview Place and Columbia Street.

Structure 09

Sub-slab vapor samples were collected at Structure 09 during the VI preliminary screening event in July 2008. Based on detections of PCE (190 µg/m^3), TCE (63 µg/m^3), and 1,1,1-TCA (250 µg/m^3) in sub-slab vapor in July 2008, the structure was sampled again in November 2008 with both sub-slab vapor and basement indoor air samples being collected. Consistent with the July 2008 analytical results, concentrations of PCE (110 µg/m^3), TCE (49 µg/m^3), and 1,1,1-TCA (190 µg/m^3) were detected in the sub-slab vapor. Methylene chloride was also detected in the sub-slab vapor sample at a concentration of 86 µg/m^3 during the November sampling event. The basement indoor air sample, collected in conjunction with the sub-slab vapor sample, also detected concentrations of PCE (10 µg/m^3) and 1,1,1-TCA (34 µg/m^3). In addition, methylene chloride was detected in the basement indoor air sample above the NYSDOH air guideline of 60 µg/m^3 at a concentration of 440 µg/m^3. Structure 09 is connected to the Columbia Street sewer line.

Structure 10

Sub-slab vapor samples were collected from Structure 10 during the July 2008 preliminary screening event. Sub-slab vapor concentrations of PCE (13 µg/m^3), TCE (220 µg/m^3), and 1,1,1-TCA (12 µg/m^3) were detected in the sample. Therefore, additional sub-slab vapor and basement indoor air sampling was conducted at Structure 10 during the November 2008 VI evaluation. The November 2008 sub-slab vapor results were comparable to the July 2008 results with detections of PCE (2 µg/m^3), TCE (61 µg/m^3), and 1,1,1-TCA (1.6 µg/m^3) being reported in the sample.

However, none of these compounds were detected in the basement indoor air sample. Structure 10 is also connected to the Columbia Street sewer line.

Structure 11

During the July 2008 preliminary screening sampling event, a sub-slab vapor sample was collected at Structure 11. Analytical results of the sub-slab vapor sample revealed the detection of TCE (56 µg/m^3) and an estimated concentration of 1,1,1-TCA (0.9 µg/m^3). Structure 11 was resampled during the November 2008 VI evaluation and included the collection of sub-slab vapor and basement indoor air samples. Concentrations of TCE were reported in the sub-slab vapor sample at a concentration of 77 µg/m^3 and in the basement indoor air sample at a concentration of 0.86 µg/m^3. No detection of 1,1,1-TCA was reported in either of these samples. Structure 11 is connected to the Columbia Street sewer line.

3.3 SUBSURFACE SOIL SAMPLING RESULTS

Subsurface soil sample results from soil borings completed for SV-16, SV-17, and SV-01P were compared with 6 NYCRR Part 375 Guidelines for Unrestricted Use. An estimated low-level concentration of TCE was detected in the subsurface soil sample collected at SV-01P (0.0063 mg/kg). No VOC analytes were detected above the applicable SCG values. Detected VOC analytical results for soil samples are provided in Table 5.

3.4 SURFACE WATER SAMPLING RESULTS

No VOCs were detected above the laboratory method detection limits in the surface water sample.

3.5 DATA USABILITY SUMMARY REPORTS

Environmental Data Services, Inc. validated analytical data packages submitted to EA by Air Toxics, Ltd and Hampton-Clarke Veritech. Analytical data packages are submitted as sample delivery groups (SDGs) based on the number of samples within each shipment receipted at the laboratory for analysis. The SDGs were reviewed for completeness and compliance as defined by the requirements for NYSDEC ASP Category B deliverables.

Environmental Data Services, Inc. completed data validation for 12 SDGs and submitted 10 DUSRs for the SDGs reviewed. Overall, the data were acceptable for their intended use; several samples were qualified for various reasons and are identified in the associated tables. There were rejections of data from two samples in SDG 811602. Several compounds were rejected from soil sample analysis for SV-01P and the associated duplicate sample due to severally low internal recoveries. Specific compounds rejected from the soil samples included 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, bromoform, isoproplybenzene, styrene, and 1,1,2,2-tetrachloroethane.