SANBORN, HEAD & ASSOCIATES, INC.
95 High Street ▪ Portland, ME 04101
P (207) 761-9300 ▪ F (207) 761-9339
www.sanbornhead.com

December 12, 2007

File No. 2755.00

Mr. Mitchell E. Meyers
IBM Corporate Environmental Affairs
8976 Wellington Road
Manassas, Virginia 20110

Re: SemiAnnual Report
Soil Vapor Monitoring Through October 2007
Comprehensive Operation, Maintenance and Monitoring Program
Endicott, New York

Dear Mr. Meyers:

We have enclosed our report summarizing soil vapor monitoring conducted in the Village of Endicott, and the Town of Union New York through October 2007. The monitoring is being conducted as a component of the Comprehensive Operations, Maintenance and Monitoring Plan (COM&M Plan). The work is part of IBM's required activities under Administrative Order on Consent #A7-0502-0104 (Order) as agreed upon between IBM and the New York Department of Environmental Conservation (NYSDEC).

We understand that this report will be submitted to the NYSDEC as a part of required deliverables under the Order. Thank you for the opportunity to be of service on this important project.

Very truly yours,

SANBORN, HEAD & ASSOCIATES, INC.

Daniel B. Carr, P.E., P.G.
Principal and Vice President

Erica M. Bradstreet
Senior Project Geologist

David Shea, P.E.
Senior Associate Principal
Project Reviewer.

SANBORN, HEAD & ASSOCIATES, INC.
95 High Street ▪ Portland, ME 04101
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www.sanbornhead.com

SEMIANNUAL REPORT
SOIL VAPOR MONITORING THROUGH OCTOBER 2007
Comprehensive. Operations, Maintenance & Monitoring Program
Endicott, NY

Prepared for
IBM Corporation

Prepared by
Sanborn, Head & Associates, Inc.

File 2755.00
December 2007

TABLE OF CONTENTS

iii Executive Summary

1.0 INTRODUCTION 1
1.1 Background 1
1.2 Scope of Work 2
1.3 Climatic Conditions and Groundwater Levels During the Monitoring Period 2
1.3.1 Climactic Conditions 2
1.3.2 Groundwater Levels 3

2.0 DATA AND FINDINGS 4
2.1 New Soil Vapor Monitoring Completion EN07-28 4
2.1.1 Observed Soil Texture and Moisture Conditions 5
2.1.2 Profiles of PCE and TCE in Soil and Vapor 6
2.1.3 Distribution of PCE Mass 7
2.2 Overall Trends in Groundwater Quality 8
2.3 Overall Trends in Soil Vapor Concentrations 8
2.3.1 Soil Vapor Concentrations In Samples from Foundation Depth 9
2.3.2 Soil Vapor Concentrations In Samples from Depth 10
2.4 Quality Assurance/Quality Control 11

3.0 DISCUSSION OF APPARENT VAPOR CONCENTRATION TRENDS 12
3.1 Summary Overview 12
3.2 IBM's Remediation Efforts 13
3.3 Influence of Infiltration Conditions on Vapor Attenuation 13

4.0 CONCLUSIONS AND RECOMMENDATIONS 15

TABLES

Table 1 Summary of Soil Vapor Monitoring Implants

FIGURES

Figure 1 Location Plan

Figure 2 Summary of Precipitation Records

Figure 3 Soil and Soil Vapor Profile EN07-28

Figure 4 Comparison of TCE Soil Vapor Concentrations in Samples from Foundation Depth - 2004 and 2007

Figure 5 Comparisons of TCE Soil Vapor Concentrations in Samples from Water Table Depth

APPENDICES:

Appendix A Limitations

Appendix B Field Sampling and Laboratory Analysis

Appendix B.1 Summary of Field Sampling
Appendix B.2 Climatologic Data and Plots
Figure B.2.1 – Summary of Daily Precipitation and Barometric Pressure Records
Figure B.2.2 - Summary of Barometric Pressure and Temperature Data

Appendix B.3 Time Series Plots – Figures B.1 through B.37

Appendix B.4 Plan View Graphics – Soil Vapor Samples
Appendix B.4.1 – Summary of Plan View Graphics
Appendix B.4.2 TCE In Soil Vapor Samples from Foundation Depth
Appendix B.4.3 TCE In Soil Vapor Samples from Water Table Depth

Appendix B.5 Boring Logs and Data
Appendix B.5.1 Summary
Figure B.5 – Location Plan
Appendix B.5.2 Boring Logs – logs for EN-387A and B from both GSC and SHA
Appendix B.5.3 GSC Table of Analytical Laboratory Data for Soil samples
Appendix B.5.4 Soils Laboratory Data

Appendix C Background Definitions, Equations and Concepts

Appendix D Compact Disc of Data and Data Usability Assessment

Appendix D.1 Table D.1- Summary of Analytical Laboratory Data October 2006 through October 2007
Appendix D.2 Data Usability Assessment

Appendix D.3 Analytical Laboratory Reports on Compact Disc (Select Copies)

EXECUTIVE SUMMARY

This report presents the findings of routine soil vapor monitoring in the Groundwater Vapor Project area within the Village of Endicott and Town of Union, New York. The monitoring is being conducted at fixed locations within and along the border of properties to which IBM offered ventilation systems to address vapor intrusion potential. The monitoring program has been in place for over three years and is intended to track the presence of certain volatile organic compounds (VOCs), principally trichloroethene (TCE), that drove the decision for IBM to offer ventilation systems.

This report presents the findings of sampling and laboratory analysis conducted every other month from April through October 2007. It also presents a review of apparent trends in groundwater and soil vapor concentrations over the entire period of monitoring, which began in August 2004. Since early June 2004 IBM has substantially expanded the extraction of VOC-containing groundwater employing new engineered pumping wells activated as recently as May 2006.

Although above-normal precipitation has been recorded during this period, water level monitoring has indicated that the groundwater extraction operations have lowered groundwater levels, substantially dewatering the upper aquifer in places. Groundwater monitoring has indicated improvements in water quality with reductions in TCE concentrations typically by ¼ to ½ order of magnitude.TCE concentrations have declined by 50% on the average (GSC, 2007) or are about ½ of the concentrations found prior to expanding groundwater extraction operations. Although substantial progress has been made in reducing groundwater concentrations, the reductions have been of a magnitude such that concentration gradients and vapor migration potential across the vadose zone may only be marginally reduced.

During this same period, concentrations of TCE in soil vapor have generally declined by ½ order of magnitude to several orders of magnitude, out of proportion to improvements in groundwater quality, particularly at foundation depth. Although there is some spatial correlation among improvements in soil vapor and groundwater pumping, a reduced presence of TCE in soil vapor has also been observed where additional groundwater extraction has not been implemented. The data support that the reduction in soil vapor concentrations, and hence reduced vapor intrusion potential, reflect the influence of:

- IBM's groundwater remediation efforts which have reduced VOC concentrations in groundwater and substantially lowered water levels; and

- Suppression of vapor migration by natural processes associated with above-average precipitation during the period which may be reversible under extended dry weather conditions.

Although there may be some debate as to how the data trends for soil vapor monitoring points relate to changes in substructure soil vapor concentrations, we believe that the data support that fewer properties would require ventilation if vapor intrusion investigations began now.

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1.0 INTRODUCTION

This document is a Semi-Annual Report summarizing the findings of routine soil vapor monitoring completed through October 2007 under IBM's Comprehensive Operations, Maintenance and Monitoring Plan (COM&M Plan). The monitoring is being conducted pursuant to the Administrative Order on Consent No. #704014 (Order) executed by the IBM Corporation (IBM) and the New York State Department of Environmental Conservation (NYSDEC). The objective of this work is to monitor for changes in the presence of certain volatile organic compounds (VOCs) that drove decisions for installation of ventilation systems to address potential for vapors to enter human occupied structures (vapor intrusion potential).

Sanborn Head & Associates, Inc. (SHA) prepared this report for IBM's submittal to NYSDEC and the New York State Department of Health (NYSDOH), collectively referred to as the "Agencies", as a component of deliverables that IBM agreed to provide under the COM&M Plan. The field sampling, analytical laboratory testing and the preparation of this report were completed in accordance with the Soil Vapor Monitoring Plan dated September 29, 2004 (Monitoring Plan) as subsequently modified with approval of the Agencies. SHA's work and this document are subject to the limitations outlined in the text to follow and in Appendix A.

1.1 Background

IBM has installed and is maintaining ventilation systems in buildings within certain areas of the Village of Endicott, and Town of Union, New York. The ventilation systems were installed to address vapor intrusion potential, which may be associated with VOCs present in the groundwater that IBM has been remediating. The areal extent of properties offered ventilation systems, or the geographic limits of ventilation, are shown on Figure 1. Trichloroethene (TCE) is the primary VOC found in soil vapor within the largest contiguous ventilation area. Other compounds including 1,1,1-Trichloroethane (TCA), tetrachloroethene (PCE) and their biochemical breakdown products are also found in this area, but at lower frequencies of detection and generally at lower concentrations. The available data also indicate multiple sources of VOC vapors not associated with IBM activities.

The limits of ventilation were established based on concurrent sampling of indoor air, substructure soil vapor, and ambient air at representative properties. The sampling was conducted starting in an area where vapor intrusion potential was perceived to be greater, which has been referred to as the "Core Area," and proceeded outward across areas of lower perceived vapor intrusion potential. The limits of ventilation were largely established through sampling conducted in the first four months of 2003 and refined through sampling over two subsequent heating seasons. The soil vapor monitoring program began in August 2004. Collection, field screening, and laboratory analysis of soil vapor samples was conducted monthly for fifteen consecutive months beginning in August 2004 and ending in October 2005. With the Agencies' approval, sampling has been conducted every other month since that time.

The monitoring program includes regular collection and analysis of vapor samples from permanent installations, referred to as "implants" which are located within and along the periphery of the ventilation areas. Monitoring of groundwater at wells located near the soil vapor implants is also performed on a regular basis. The implant locations are shown on Figure 1, relative to the ventilation areas and nearby monitoring wells.

Where the depth to water table was sufficient, the soil vapor monitoring completions included one implant installed proximate to the water table position at the time of installation (water table depth) and one installed at a depth of 7 to 8 feet below ground surface (bgs), which is roughly equivalent to foundation depth for structures with basements (foundation depth).

Data from the water table depth implants have been considered indicative of soil vapor concentration trends as might be driven primarily by changes in groundwater quality. The data from foundation depth implants have been used to assess possible trends in soil vapor concentrations that may be indicative of changes in vapor intrusion potential. In some locations where the water table is relatively deep, intermediate depth implants have also been monitored. The implant completion details are summarized in Table 1.

1.2 Scope of Work

Since submittal of the prior report[1], routine bi-monthly soil vapor monitoring has been conducted in June, August, and October 2007. An additional soil vapor monitoring installation designated EN07-28 was drilled and installed in early June 2007 and was sampled along with the other locations.

In total, samples were collected from implants installed at 35 geographic locations. Monitoring of groundwater levels and quality was conducted by others during this period. Graphical summaries depicting groundwater and soil vapor data for TCE are presented in Appendix B.3 as Figures B.1 through B.37. A tabular summary of soil vapor data recorded during the last 12 months is provided on compact disk in Appendix C.

1.3 Climatic Conditions and Groundwater Levels During the Monitoring Period

The soil vapor sampling was conducted under a variety of climatic conditions and under conditions of variable groundwater levels. Climatic and groundwater level records recorded by others during the year of monitoring were reviewed as a context for the findings discussed in Section 2.0. Plots depicting records of daily precipitation, temperature, and barometric pressure prepared based on data available from the Greater Binghamton Airport (GBA) are included in Appendix B.2.

1.3.1 Climactic Conditions

Soil vapor concentrations are influenced by changes in the moisture content of soil located between the water table and the ground surface (vadose zone). The efficiency of vapor transport by diffusion and advection is known to be inversely proportional to soil moisture content.

[1] Sanborn, Head & Associates, Inc., June, 2007, Annual Report, Soil Vapor Monitoring Through April2007.

Infiltration of incident precipitation is also expected to strip VOCs from the vapor phase and physically displace vapor from the soil pore space. Additional discussion of these mechanisms is included in Section 3.0.

In general, infiltration of water into the vadose zone is expected to increase during wet winter and spring weather when evapotranspiration is minimal, and decline during dry weather in the growing season when deciduous trees are in leaf and actively withdrawing moisture from the subsurface. The soil moisture condition across the vadose zone at a given time reflects the antecedent infiltration conditions.

Figure 2 depicts the deviation from the historical monthly average precipitation from January 1997 through October 2007 based on records from the Greater Binghamton Airport[2] (GBA). This information is presented as a context for the historical soil vapor monitoring and the most recent period. A review of Figure 2 reveals that wetter than average conditions have been recorded since late 2003 after the ventilation limits had largely been established. With the exception of March, July, and October, below average precipitation was recorded since February 2007. As of October 2007, the cumulative deviation from monthly average precipitation was about +26 inches.

As shown on Figures B.1 and B.2 in Appendix B, the last three soil vapor sampling events were generally conducted under a range of barometric pressure conditions. During the June sampling, barometric pressure was rising, it remained steady during the August sampling, and fell slightly during the October sampling. No precipitation was recorded during sampling in June; however, approximately 1/2 inch and 1&1/3 inches of rain was recorded in August and October.

1.3.2 Groundwater Levels

Since June 2004, IBM has substantially expanded extraction and treatment of VOC-containing groundwater, which has altered groundwater levels and flow directions and induced changes in groundwater quality within the monitoring area. As reported by Groundwater Sciences Corporation (GSC)[3], the more recent activities have been focused south of Monroe Street and north of East Main Street and have included initiation of long-term pumping from new test wells EN-499T and EN-447T in May 2006, augmented by extraction from EN-215T. The new extraction wells are centered on the largest contiguous ventilation area and their operation has lowered groundwater levels, in places, substantially dewatering the upper aquifer. Figure 1 depicts groundwater contours and dewatered "dry" areas as interpreted by GSC as of January

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[2] *Figure 2 depicts deviation from historical monthly average precipitation statistics based on the preceding 53 year period of record. The monthly precipitation records for the period, and monthly average statistics were obtained from the National Oceanic and Atmospheric Administration (NOAA), National Climactic Data Center (NCDC) for the monitoring station at the GBA about 10 miles northeast and about 700 feet higher in elevation than the soil vapor monitoring area.*

[3] Groundwater Sciences Corporation, March 6, 2007, OU#3 and MA-A IRM Sequencing Plan.

2007[4]. Based on this depiction, in our Annual Report of June 2007 we noted that water levels had declined by about 3 to 11 feet in wells nearby implants, resulting in decreased saturated thickness and increased separation distance between the water table and the "water table depth" implants. At about 60 percent of the soil vapor monitoring locations, the water level data recorded in the first two months of 2007 reflected increased distance between the "water table depth" implant and the water table. At about 25 percent of the locations, the distance between the deepest implant and the water table had about doubled.

Water levels have continued to decline at 24, or 65 percent, of the soil vapor monitoring locations. At ten locations where water levels had not declined as of January/February 2007, these now have exhibited water levels approximately 2 feet lower, perhaps reflecting the recent period of below-normal precipitation. These ten locations are generally further away from pumping centers. Water levels are at least marginally higher at ten other locations.

2.0 DATA AND FINDINGS

The data obtained from the routine soil vapor monitoring are discussed below following a summary of data and observations associated with the new implant completion. Overall, the data from sampling of soil vapor monitoring points continue to support the geographic limits of ventilation as being conservative to mitigate vapor intrusion potential in accordance with criteria established for the project by the Agencies. As discussed further in Section 2.2, soil vapor concentrations at foundation depth near and within the limits of ventilation have generally declined, or have not materially increased, at the majority of monitoring locations since the limits of ventilation were established.

2.1 New Soil Vapor Monitoring Completion EN07-28

In June 2007, IBM elected to construct an additional implant to monitor soil vapor conditions near a new monitoring well, EN-387A, located about 150 feet southeast of the former Ideal Cleaners property. EN-387A is believed to be directly downgradient of this former dry cleaner site where PCE and associated chlorinated ethenes are found in the subsurface.

Figure 3 depicts data, observations, and inference derived from installation and sampling of the new implant designated EN07-28. The information is depicted in profiles prepared to summarize subsurface conditions believed to be relevant to vapor migration potential and depicts the observed soil and soil vapor concentration profiles. Similar soil texture, moisture, and vapor profiles for other soil vapor monitoring locations were depicted in reports to the Agencies of June 2005[5] and March 2006[6]. Detailed soil profiling has been established by SHA and accepted

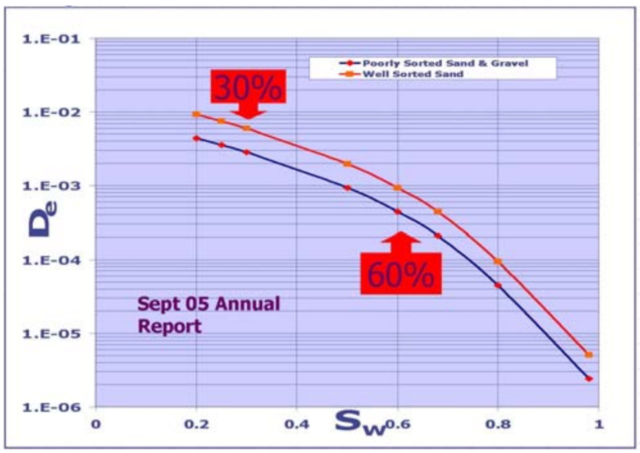
[4] Groundwater Sciences Corporation, April 13, 2007, Annual Groundwater Status Report, *Figure 3-2, Groundwater Elevation Contour Map Upper Aquifer Water Table – January 24, 2007, received electronically April 13, 2007*.

[5] Sanborn, Head & Associates, Inc. June 1, 2005, Quarterly Report, Soil Vapor Monitoring Through April 2005. and March 30, 2006, Semi-Annual Report, Soil Vapor Monitoring through February 2006,

in published guidance as a technique to refine an assessment of vapor migration potential through improvement of the site specific conceptual model[7]. A glossary of definitions, concepts and equations referenced below is included as Appendix C.

As with the prior profiles, Figure 3 depicts implant completion depths along with data for certain soil texture characteristics and gravimetric water content (W_g) data derived from soils and analytical laboratory testing. The soil texture characteristics include the percent fines content (< 200 sieve size), and the effective particle size (D_{10}). A line plot also depicts estimated water saturation across the profile, expressed as a percentage of the soil pore space (S_w) based on estimates of soil dry bulk density.

Exhibit A – D_e as a Function of Water Saturation



Variability in diffusive transport and the concept of an "effective diffusion coefficient" (D_{eff}), accounting for variable soil texture and moisture was presented in the September 2005 report[8]. The adjacent diagram was presented, demonstrating that D_{eff} can range over three orders of magnitude with differing moisture content and texture for the soils found in the study area. As shown, D_{eff} is drops by nearly an order of magnitude from near the lower end of observed S_w at 30% to S_w of 60%. Beyond 60% S_w, D_{eff} declines steeply. Accordingly, the presence of relatively thin high moisture content soils can largely control diffusive transport.

2.1.1 Observed Soil Texture and Moisture Conditions

As shown on Figure 3, the top 9 ft of the soil profile encountered in nearby boring EN-387B included well sorted sands inter-bedded with silt. Between 9 and 31.5 ft bgs, alternating layers of well-sorted sands and poorly sorted sands and gravel were encountered. The observed presence of roots, cinders, and/or coal particles in the first 4 ft of soil is indicative of fill and increased organic carbon content conducive to sorption of VOCs. Petroleum staining, sheens, and odors were noted for the interval from 21 to 30 ft. The silt/clay aquitard defining the bottom the uppermost water bearing zone was encountered at 31.5 ft. Soil vapor implants were constructed

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[6] Sanborn, Head & Associates, Inc., March 30, 2006, Quarterly Report, Soil Vapor Monitoring Through February 2006.

[7] Carr, D.B., May 2007, "Better Understand Vapor Intrusion", *Short Course Lecture*, New England Environmental Business Council, Burlington, MA.

[8] Sanborn, Head & Associates, Inc., September 16, 2005, Annual Report – Soil Vapor Monitoring, *pgs 10 and 11.*

at 19 ft bgs (within a few feet of the observed water table), at 10 ft bgs (near the top of poorly sorted sand & gravel), and at 7 ft bgs (between layers of silty soils).

The laboratory measurements of W_g are reflected in the estimated S_W profile that was calculated assuming bulk densities ranging from 96 to 125 pounds per cubic foot (lb/ft^3) for silt-rich well-sorted sand and the more dense sand & gravel, respectively. The data indicate S_w exceeding 60% associated with silty soils at about 9.0 ft, 3.5 to 5 ft, and 20 ft bgs. Based on the observed profile, the total volume of water estimated to be present in the vadose zone is on the order of 43 inches, which is equivalent to 2.2 to 2.8 years of infiltration under average conditions (15 to 20 inches per year as per GSC Supplemental Groundwater Assessment Report, December 2003). The estimated D_{eff} ranges over three orders of magnitude. Assuming a steady-state diffusive transport, the observed concentration gradient would be inversely proportional to D_{eff} such that the steepest concentration gradients would be observed where D_{eff} is smallest.

2.1.2 Profiles of PCE and TCE in Soil and Vapor

The second to last column on Figure 3 depicts PCE and TCE concentration profiles for samples of soil collected by GSC from boring EN-387B. PCE concentrations ranged from less than 0.46 to 1,800 µg/kg, and TCE concentrations ranged from < 0.6 to 4.45 µg/kg. As shown on the table of data in Appendix B.5, cis-1,2-dichlorethene (cDCE) and vinyl chloride (VC) were also detected in soil samples at concentrations up to 2,300 and 550 µg/kg, respectively. The soil concentrations for PCE exhibit gradients that somewhat mirror that observed for soil vapor: an apparent steep gradient from 21 to 17 ft bgs; a relatively modest decline in concentration from 15 to about 7 ft bgs, and about an order of magnitude decline from about 7 to 5 ft bgs. The presence of these and other VOCs in soil samples can be explained by historical and on-going upward vapor transport from the water table and partitioning among phases.

The apparent increase in PCE to greater than 100 µg/kg below 20 ft bgs is coincident with the detection of diesel range petroleum hydrocarbons at up to 12,000 milligrams per kilogram (mg/kg), a concentration that implies the presence of separate-phase oil. The VOCs are more soluble in oil than water and tend to accumulate in the oil. The presence of petroleum may also explain the greater proportion of biochemical breakdown products including cDCE and VC, which increase in concentration below the depth where oil was observed. Higher concentrations of PCE and cDCE are found below 26 ft bgs, approximately 0.5 and 1.5 ft into the silt-clay.

The inferred soil vapor concentrations profiles for both PCE and TCE at EN07-28 as shown in the last column on Figure 3 exhibit three intervals:

- An interval showing several orders of magnitude potential decrease from proximate to the water table to the deepest implant. Vapor transport by diffusion in this interval is believed to be limited by the moisture content of the capillary fringe;

- An interval showing a relatively modest decrease in concentration from the implant nearest water table depth to the intermediate depth implant across relatively low moisture content soils found from 9 to 20 ft bgs; and

- An interval showing about an order of magnitude decrease in concentration between the intermediate depth and foundation depth across high moisture content inter-bedded well sorted sands and silt soils.

Groundwater samples withdrawn from nearby well EN-387A have exhibited the presence PCE and biochemical dechlorination breakdown products TCE through VC at concentrations in tens to thousands of micrograms per liter (µg/L) with mass ratios of breakdown products to PCE of 26:1 to 8:1. Concentrations appear to have increased about an order of magnitude from early May 2007 to August 2007 with increasing prevalence of PCE. Entrainment of VOC-containing separate phase oil into the samples could explain the apparent increase.

Assuming equilibrium partitioning according to Henry's law, we would expect to find soil vapor concentrations on the order of 10s of thousands to 100s of thousands of micrograms per cubic meter ($\mu g/m^3$) with cDCE and VC at the highest concentration. The presence of separate phase oil may suppress the volatility of the compounds and certainly contributes to biological degradation which also may limit vapor transport.

2.1.3 Distribution of PCE Mass

By integrating the observed PCE concentrations vertically across the soil profile to a depth of 31.5 ft, we estimate that the equivalent of about 2.8 grams of PCE per square meter of soil column[9] (g/m^2), may be present, or about 2.8 million micrograms per square meter ($\mu g/m^2$). Based on this data we estimate that:

- Just less than 11% of the total PCE mass in the entire profile would be accounted for in the vadose zone. Although this is a relatively small proportion of the total, it implies about 300,000 $\mu g/m^2$ of PCE residing in the vadose zone in vapor, dissolved, and sorbed phases;

- About 10% of the mass would be found in the zone from about 20 to 28 ft bgs spanning the water table and capillary fringe where petroleum hydrocarbons were found in soil samples;

- The majority of PCE mass, about 75% or 2.1 $grams/m^2$, would be found below the water table in the last 3.5 feet of granular soil from 28 to 31.5 ft bgs. Virtually all of the cDCE and VC mass would be found in the last few feet of granular soil above the aquitard; and

- About 10% of the total PCE mass may be diffused into the silt-clay aquitard.

The total mass estimates for intervals of granular soils below the capillary fringe are probably biased low because the soil samples likely were somewhat drained of water and/or oil during collection. This is particularly true for the interval of well sorted sand found from 22 to 26 ft bgs.

[9] *The estimate of total PCE mass present was developed by multiplying the recorded soil concentration data for samples in two-foot and 0.5 foot increments expressed in mass per unit dry weight by estimates of soil dry bulk density and assuming a square meter of surface area. The resultant value represents an approximation of the total mass present in the 31.5-foot thick column of soil with horizontal dimensions of 1 meter by 1 meter and is presented as a general comparison only. The actual mass will vary with spatial variations in concentration and other factors.*

Accordingly, we expect greater than 90% of the total mass to be present beneath the capillary fringe.

Based on a limited analytical assessment of theoretical equilibrium partitioning, we estimate that only a few percent of the total PCE may be present in vapor phase; with between 5 and 10 percent in aqueous phase, and the bulk of the mass sorbed to the soil solids[10]. As such, mass in inter-granular moisture and sorbed to the soil solids constitute a source for vapor-phase.

2.2 Overall Trends in Groundwater Quality

Overall trends in groundwater concentrations are discussed as a context for the review of soil vapor data to follow, with the presumption that the data are related in a cause-effect relationship. Groundwater quality data compiled by Groundwater Sciences Corporation (GSC) have been posted on graphical plots included as Appendix B.3. In general, these plots show less than one-half an order of magnitude variation in TCE concentrations in samples of groundwater. This observation is consistent with recent statements by GSC which indicate that, on the average, TCE concentrations in groundwater have declined by about 50%; or are lower by a factor of 2, or by less than one-half order of magnitude. Additional detail regarding recent groundwater quality data and inference can be found in an October 11, 2007 report by GSC[11].

As discussed above, data for four samplings of well EN-387A suggest about an order of magnitude increase in concentration. As the VOC presence in this area is a mature condition, we believe that this apparent increase is probably not indicative of a trend in groundwater quality but may reflect a high bias due to entrainment of VOC-containing separate phase oil.

As discussed in Section 3.0, the soil vapor data has shown little temporal correlation with groundwater data. Generally, the magnitude of the observed improvement in groundwater quality have been small relative to the observed seasonal fluctuations in soil vapor, and too small to drive large changes in concentration gradients that in turn drives upward diffusive transport.

2.3 Overall Trends in Soil Vapor Concentrations

Plan view graphics prepared to aid in communicating soil vapor concentration trends are included as Figures 4 and 5, and are embedded in the report text to follow. A series of plan view figures are included in Appendix B.4 that depict TCE concentrations in soil vapor samples at

[10] An *approximation, computed based on the observed soil moisture and PCE concentration profile assuming linear sorption in accordance with an uniform aqueous to sorbed phase distribution coefficient (Kd) 1.2 to 2.2 milliliters per gram (ml/g) and a unitless Henry's law coefficient (H) of 0.6. Site-specific testing has indicated that sorption is a non-linear process where Kd values may vary from 0.9 to about 5 ml/gram with dissolved concentrations ranging from 500 to 5 μg/L, respectively. The actual partitioning will be influenced by the presence of other VOC species and other factors not accounted for in this analysis.*

[11] Groundwater Sciences Corporation, October 11, 2007. Semiannual Groundwater Data Summary Report. Village of Endicott/Town of Union, Broome County, New York.

seasonal high and low concentration milestones over the three years. The series of images provide a sense for seasonal and longer-term trends in soil vapor concentrations.

2.3.1 Soil Vapor Concentrations In Samples from Foundation Depth

The data from three years of monitoring indicate a declining presence of VOCs, including TCE, at foundation depth. Exhibits B and C depict images generated based on TCE data collected in the first three months of monitoring and the latest heating season, respectively

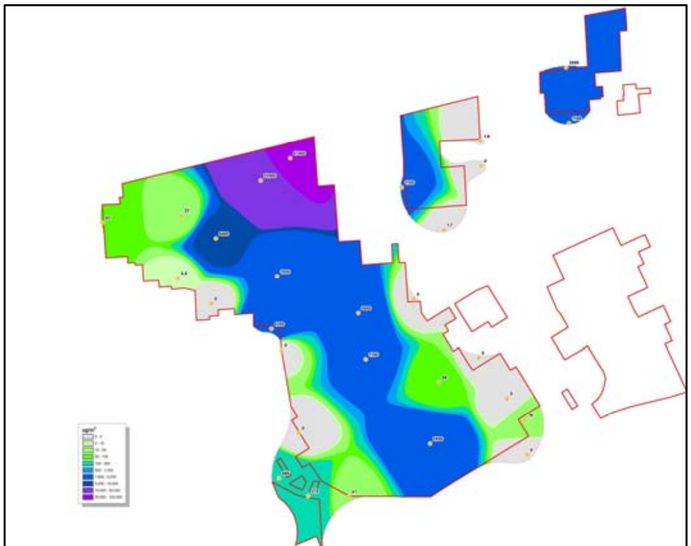
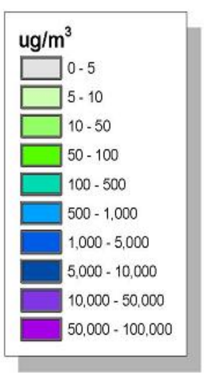


Exhibit B: TCE in Soil Vapor Samples at Foundation Depth, August to October 2004.

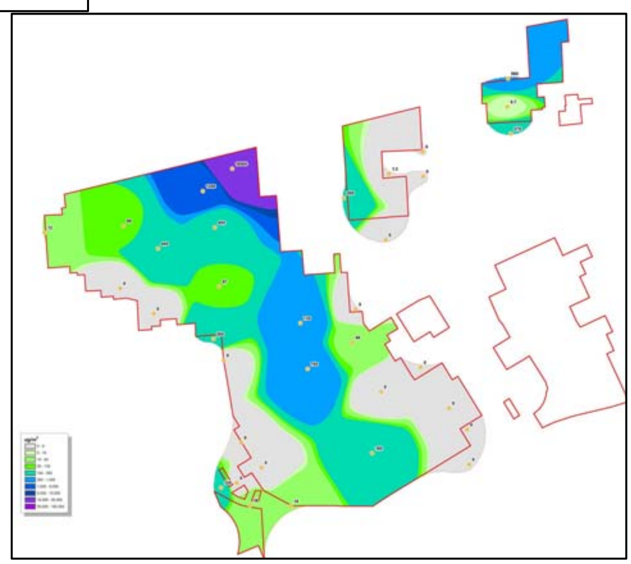
←

The data used to generate Exhibit B were shown to be comparable to vapor concentrations recorded beneath nearby homes and hence can be considered a baseline condition at the time the ventilation limits were established.

Exhibit C: TCE in Soil Vapor Samples from Foundation Depth 2006-2007 Heating Season (December 2006 through April 2007) ↓



Note that the color gradations are in ½ order of magnitude increments from the nominal detection limit of about 5 micrograms per cubic meter (μg/m^3) to 100,000 μg/m^3.



The data set for Exhibit C was recorded about 2 years after vapor intrusion investigations ended and about 1&1/2 years after IBM initiated accelerated groundwater extraction and treatment operations. Comparing Exhibits B and C, it is notable that:

- The number of locations exhibiting greater than 1,000 μg/m^3 as indicated by the darkest blue and purple colorations is substantially reduced from eleven to two;

- Reductions in the TCE soil vapor presence have been observed near and away from areas where new groundwater pumping has been initiated;

- The reductions at foundation depth approach or exceed an order of magnitude, well out of proportion to the improvements in water quality which are on the average less than one-half order of magnitude; and

- TCE was no longer detected, at least seasonally, in samples from foundation depth at more locations (nearly twice the locations seasonally, including locations installed after the first three months of monitoring).

It is our opinion that the apparent reduction in TCE concentrations reflects reduced vapor intrusion potential such that it is probable that fewer properties would require ventilation if vapor intrusion sampling were conducted in structures under current conditions.

As can been seen through a review of the time series plots in Appendix B.3 and the sequence of plan view graphics in Appendix B.4.2, soil vapor samples from foundation depth continue to exhibit seasonal increases and decreases in concentration superimposed on a progressive downward trend. The data continue to show a consistent spatial pattern of declining concentrations in fall through spring followed by increasing concentrations during spring and summer months. We continue to believe that the observed cyclic pattern can be explained by time-variable infiltration through the vadose zone. Figure 4 provides a comparison of graphics from data sets recorded during August to October, and during the heating season, which consistently show reduced TCE concentrations under the range of seasonal conditions.

2.3.2 Soil Vapor Concentrations In Samples from Depth

Plan view graphics depicting data recorded for soil vapor samples from near original water table depth that were collected in 2004 and 2007 are depicted on Figure 5. Comparison of the images provided as figures 5A and 5B indicates that TCE concentrations have generally declined on the order of ½ order of magnitude or less in the area north of Tracy Street and west of Roosevelt Avenue. Elsewhere, concentrations are generally similar or have declined marginally. Review of the graphics in Appendices B.3 and B.4.1 indicate a smaller magnitude of seasonal fluctuations in concentration compared to the data from foundation depth, and hence a more consistent progressive downward trend in concentration.

The overall pattern of declining vapor concentrations at depth does appear to mirror areas where the groundwater withdrawals have been increased and upper aquifer has been largely dewatered. It is particularly notable that concentrations have declined at three of the four monitoring locations nearest Washington Avenue where many deep basements are present below storefront properties and where near all the land surface is covered by buildings or pavement. We believe that the data support a proportional decrease in vapor intrusion potential.

The ½ order of magnitude decline in concentrations at many locations is more proportional to, but generally greater than the apparent improvement in water quality. Notable exceptions to the overall pattern of declining concentrations include:

- EN04-13 and EN04-15, where TCE concentrations have declined about two orders of magnitude since the monitoring began. In both cases, vapor concentrations at foundation depth and groundwater quality have not materially changed outside of seasonal variability. The boring log for monitoring well EN-449 indicates the presence of silt-rich soil between the water table and the deep implant that may impede upward vapor migration from the water table. The log for the well near EN04-15 does not offer similar detail to assess a possible reason for the decline in concentration.

- EN04-03 and EN04-17 where TCE concentrations have increased about an order of magnitude and ½ order of magnitude, respectively. For EN04-17, the apparent increase in concentration at depth may reflect impedance of diffusive transport due to increased soil moisture in relatively thick silt-rich zone between the foundation level and deep monitoring depths[12]. The quality of the boring log for the well associated with EN04-03 is not sufficient to support a possible rationale.

2.4 Quality Assurance/Quality Control

The following is a summary of Quality Assurance/Quality Control (QA/QC) measures taken in accordance with Project Data Quality Objectives (DQO). QA/QC measures include the use of tracer gas in the field, field screening of soil vapor samples, and laboratory measures for quality assurance samples including duplicates, equipment blanks, and laboratory control samples. New Environmental Horizons, Inc. (NEH) completed an independent data validation and usability assessment of the data.

QA/QC measures taken during the last three monitoring events included:

- Field screening Tedlar bag samples for carbon dioxide (CO_2), oxygen (O_2), and methane (CH_4);

- Collection and analysis of field duplicates for approximately 10% of the samples, and calculation of the relative percent difference (RPD) between the sample and the associated duplicate (RPD less than 30% is acceptable according to the Plan);

- Analysis of equipment blanks, which were collected and submitted on each day of sampling performed over the sampling period; and

- Analysis of laboratory control samples.

[12] *The boring log for EN-401 indicates the presence of wet SAND & SILT from about 14.5 to 15.5 ft. and moist to wet SAND & GRAVEL from 16 to 20 ft bgs; in both instances depths between the foundation depth and water table depth implants.*

All data collected during the period were considered usable and met the project data quality objectives. Less than 1% of the data were subject to data qualifier "flags" as noted on Table D.1, indicating the results were "estimated" values. Copies of the NEH Data Usability Assessment reports are included in Appendix D.2.

In October 2007, forty samples, or less than half of the samples submitted to the laboratory for analysis were inadvertently pressurized at the laboratory to 15 pounds per square inch (psi) instead of 5 psi, resulting in increased sample dilution factors and proportionally increased reporting limits. Based on a cursory review of the data, the reporting limits realized for these samples ranged typically from 6.6 to 14 $\mu g/m^3$; exceeding the expected 5.4 $\mu g/m^3$ reporting limit for field samples. As this is a one-time occurrence that represents an aberration in sample handling at the laboratory it is not expected to materially influence the monitoring program.

3.0 DISCUSSION OF APPARENT VAPOR CONCENTRATION TRENDS

This section provides a summary of the apparent soil vapor concentration trends and possible mechanisms contributing to the observed conditions. The mechanisms are discussed following a summary overview.

3.1 Summary Overview

It is our opinion based on our observation of soil vapor and groundwater quality data for the three year period that the apparent reductions in vapor concentrations at certain locations and reduced vapor intrusion potential in certain areas are attributable to:

- IBM's groundwater remediation efforts which have reduced VOC concentrations in groundwater and substantially lowered groundwater levels; and

- Suppression of vapor migration by natural processes associated with above-average precipitation during the period from late 2003 to 2007.

The spatial pattern of reductions in vapor concentrations in samples from the deeper implants correlated to areas of dewatering, and the order of magnitude vapor concentration reduction (generally 1/2 or less), support the assertion that groundwater remediation efforts are reducing vapor migration potential. The recent period of above-average precipitation followed a five- to ten-year period of generally below-normal precipitation and substantial establishment of the limits of ventilation. TCE concentrations at foundation depth have declined out of proportion to the improvement in groundwater quality and soil vapor at depth. Natural mechanisms associated with increased water infiltration, including physical displacement of vapors, vapor to aqueous phase partitioning, and decreased effectiveness of diffusion can explain the decline in vapor concentrations at foundation depth.

3.2 IBM's Remediation Efforts

As documented in prior reports by GSC, IBM has substantially expanded groundwater extraction and treatment operations that have influenced groundwater levels, groundwater flow directions, and groundwater concentrations across much of the soil vapor monitoring area. Through identification and targeted pumping from new areas of greater saturated thickness and enhancement of existing pumping systems, groundwater withdrawals have substantially increased. As discussed in Section 2.3 and elaborated on below, we believe that these remediation efforts can partially explain the apparent improvement in soil vapor conditions.

If on the average, groundwater concentrations have declined by 50% (GSC), a proportional decline in potential concentration gradients across the vadose zone would result with time. As concentration gradients drive transport by diffusion, a 50% reduction, or source concentrations decreased by a factor of two, would imply potential for reducing upward diffusive flux by one-half over the long term, all other factors being equal. Neglecting VOC mass remaining in soil moisture and soil solids, lowering of groundwater levels would be expected to further decrease the concentration gradient for diffusion over the long term by increasing the transport distance. However, given the observed VOC mass in the vadose zone and below the original water table, we believe that the beneficial effects of decreased groundwater concentrations and water levels will take substantially more time to fully manifest. Accordingly, we believe that reduced groundwater concentrations alone cannot explain the observed reduction in soil vapor concentrations.

The majority of VOC mass in the subsurface will remain just above and below the new water table position. Assuming partitioning in accordance with the concepts outlined in Section 2.13, we estimate that dewatering may remove on the order of a few percent of the total mass[13]. The rate of further removal from the soil column by natural processes will be limited by aqueous- and vapor-phase diffusion and infiltration which work counter-current to one another. Although IBM is beginning longer-term testing of the reinjection of clean water to improve hydraulic exchanges, it remains to be seen how effective reinjection will be.

3.3 Influence of Infiltration Conditions on Vapor Attenuation

Although there is some debate in scientific communities as to how well soil vapor trends resulting from infiltration variability are reflected in substructure concentrations, we believe that the aggregate data support a correlation between increased infiltration and reduction in vapor intrusion potential in that:

- Reduced vapor concentrations are observed both at foundation depth and near water table depth where vapor concentrations are less likely to be influenced by the presence or absence of a foundation.

[13] *The estimate of the proportion of VOC mass removal was developed Assuming 50 percent drainage of soil exhibiting a porosity of about 0.29 and equilibrium partitioning among aqueous and sorbed phases.*

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- The vapor concentrations observed at the beginning of the monitoring program for foundation depth samples were similar in magnitude to those observed in nearby substructure soil vapor samples.

The historical precipitation records depicted on Figure 2 support increased soil moisture as a plausible explanation for observed reductions in vapor concentrations. The data indicate that vapor intrusion investigations began after a prolonged period of below normal precipitation of duration sufficient to substantially lower moisture contents across the vadose zone. For about the last three years, above average precipitation has been observed. As might be expected, the increase in precipitation had been accompanied by an observed increase in attenuation of vapor concentrations from water table to foundation depth, particularly in areas of greater vadose zone thickness and hence greater residence time for moisture.

Patterns of attenuation from water table depth to foundation depth over time support that vapor attenuation consistently varies by as much as four orders of magnitude across the monitoring area. Accordingly, the use of uniform vapor attenuation factors to assess vapor intrusion potential at all locations in a study area may greatly underestimate or overestimate potential human exposure. This observation was presented in the first quarterly soil vapor monitoring report[14] where data for only 60 percent of the monitoring locations indicated concentrations within one-half order of magnitude at water table and foundation depth, with greater than one-half to three orders of magnitude difference between depths elsewhere. The data since that time support that the degree of attenuation from water table depth to foundation depth varies temporally by as much as one to two orders of magnitude. Our findings are consistent with recent publications by USEPA and others[15] which support up to four orders of magnitude variability in vapor attenuation for a given source concentration in groundwater.

We believe that soil moisture conditions resulting from the period of above-average precipitation will likely continue to influence vapor concentrations for some time. The soil moisture profiles that we have observed at five drilling locations contain about 30 to over 100 inches of water in about 17 to 40 feet of vadose zone. At estimated average infiltration rates of 15 to 20 inches per year, about 2 to 6 years would be required to exchange the moisture. It follows that areas underlain by a greater thickness of vadose zone are expected to show a greater time lag to wet and dry cycles.

Increased infiltration during wet weather is likely to increase transport of VOC mass from the vadose zone to the saturated zone. Considering infiltration and partitioning between vapor, sorbed, and water phases, multiple exchanges of pore water would be required to substantially remove the VOC mass that may be presently residing in the vadose zone. However, until

[14] Sanborn, Head & Associates, Inc., December 1, 2004, First Quarterly Report, Soil Vapor Monitoring, Comprehensive Operations, Maintenance & Monitoring Program, Endicott, NY.

[15] Helen Dawson, USEPA, Hers, I, and Truesdale, R, September 26, 2007, "Analysis of Empirical Attenuation Factors in EPA's Expanded Vapor Intrusion Database", *Conference Proceedings, AWMA Conference Vapor Intrusion: Learning from the Challenges.* Providence Rhode Island. , *Groundwater AF by Soil Type.*

concentrations within the saturated zone are further reduced, vapor migration by diffusion and advection counter-current to infiltration will limit the rate of mass removal via infiltration.

The observed presence of VOCs in soil above the water table at the EN07-28 monitoring location is believed to reflect the aggregate effects transport by diffusion over the history of infiltration conditions. Moreover, if the observed distribution of VOC mass at this location is generally representative of conditions across the ventilation area, infiltration through the vadose zone is not likely to be a major contributor of mass to the saturated zone. Delayed yield of VOC containing water from storage was postulated by GSC[16] as an explanation for temporal increases in groundwater concentrations following initial dewatering. Diffusion from the silt-clay aquitard in conjunction with a reduced lateral volumetric flux of groundwater may also explain the data.

4.0 CONCLUSIONS AND RECOMMENDATIONS

IBM has conducted an extensive program of soil vapor monitoring over three years to track changes in the presence of VOCs that drove ventilation decisions for this project. The work has included collection and analysis of soil vapor samples from permanent monitoring locations inside and along the immediate periphery of ventilation areas in accordance with protocols outlined in an Agency-approved Monitoring Plan. In addition, IBM has voluntarily funded soil profiling, the installation of additional soil vapor monitoring points, and modeling to better understand transport mechanisms.

We highlight the following observations and conclusions derived through this work:

- The data continue to support the areal limits of ventilation as conservative in that all of the monitoring locations near the ventilation limits have exhibited only trace concentrations, or a stable or declining VOC presence.

- The data recorded for monitoring locations, including some within and adjacent to the Core Area where vapor migration potential was perceived to be the greatest, support reductions in vapor concentrations and vapor intrusion potential approaching or exceeding one order of magnitude. However, the apparent reductions in vapor concentrations are disproportionate to improvements in water quality conditions; the observed trends are believed to in-part reflect suppression of vapor migration by natural processes resulting from above-average precipitation. It should be noted that the reduction due to increased soil moisture conditions may be reversed under extended dry weather..

- Data and observations derived from soil profiling at a new soil vapor implant confirm what has been inferred on a theoretical basis. A substantial amount of VOC mass may reside in the vadose zone in aqueous and sorbed phases. Transfer between phases would buffer beneficial effects of improved groundwater quality. The mass is large relative to the rate of

[16] Groundwater Sciences Corporation, March 6, 2007, OU#3 and MA-A IRM Sequencing Plan.

removal by infiltration, advection, and diffusion and its presence would contribute to the longevity of the vapor intrusion potential. IBM is voluntarily proceeding with a program of soil profiling that is intended to further assess the distribution and partitioning of VOC mass.

- Although substantial progress has been made in reducing groundwater concentrations, to date the reductions have been of a magnitude such that concentration gradients and vapor migration potential across the vadose zone may only be marginally reduced.

Finally, we conclude that the aggregate data and inference derived from the soil vapor monitoring program and related work support that traditional approaches to assess vapor intrusion potential through use of simplified linear models of vapor attenuation are not supported. Within this study area, groundwater to foundation depth and indoor air attenuation has been observed to vary spatially, and temporally, by several orders of magnitude. As such, extrapolation of vapor intrusion potential and human exposure using data from one part of the study area and other times may greatly over- or under-predict actual conditions.

We recommend that the frequency of soil vapor monitoring remain on a bi-monthly basis or six times per year to continue to capture the seasonal variation and to provide sufficient data to discern seasonal from longer-term trends.

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TABLES

TABLE 1
Summary of Soil Vapor Monitoring Implants
Semiannual Report - Soil Vapor Monitoring Through October 2007
Comprehensive Operations, Maintenance, and Monitoring Program

Endicott, New York

Location Designation [1]	Installation Date	Implant Type [2]: Remediation Progress Monitoring	Implant Type [2]: Ventilation Perimeter Monitoring	Subsurface Conditions at Installation: Nearby Monitoring Well [3]	Subsurface Conditions at Installation: Date Recorded/ Depth to Water Table [4]	Subsurface Conditions at Installation: Nominal Implant Depth (ft. bgs)	Subsurface Conditions at Installation: Inferred Stratum Screened	Completion Details	Groundwater Conditions At Installation: Distance Above Water Table[5] (ft)	Groundwater Conditions At Installation: Vadose Zone Between Shallow and Deep Implants[6] (ft)	Groundwater Conditions At Installation: Saturated Screened Interval[7] (ft)	January/February Groundwater Conditions: Distance Above Water Table[5] (ft)	January/February Groundwater Conditions: Saturated Screened Interval[7] (ft)	January/February Groundwater Conditions: Difference[8] (ft)
EN04-1S	Jul-04		X	EN-094	7/26/04 28.47	8	Fill Over Sand	0-1' Concrete Surface Seal 1-6.8 Bentonite Seal 6.8-8.5' Sand Filter Pack 8-8.5' Screened Interval	5.5	13.5	10.5	5.6	10.4	-0.1
EN04-1D	Jul-04					23	Sand	0-1' Concrete Surface Seal 1-22' Bentonite Seal 22-23' Glass Bead Filter Pack 22.5-23' Screened Interval						
EN04-2S	Jul-04	X		EN-450	8/5/04 25.17	8	Fill	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	5.2	11	4.8	10	0	-4.8
EN04-2D	Jul-04					20	Sand & Gravel	0-1' Concrete Surface Seal 1-19' Bentonite Seal 19-20' Glass Bead Filter Pack 19.5-20' Screened Interval						
EN04-3S	Jul-04		X	EN-203	7/26/04 24.86	8	Sand	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	5.9	10	10.1	9.1	6.9	-3.2
EN04-3D	Jul-04					19	Sand	0-1' Concrete Surface Seal 1-18' Bentonite Seal 18-19' Glass Bead Filter Pack 18.5-19' Screened Interval						
EN04-4S	Jul-04		X	EN-022	8/5/04 22.98	8	Fill	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	6	8	0	6	0	0
EN04-4D	Jul-04					17	Gravel	0-1' Concrete Surface Seal 1-16' Bentonite Seal 16-17' Glass Bead Filter Pack 16.5-17' Screened Interval						
EN04-5S	Jul-04		X	EN-459A	8/18/04 40.01	8	Sand & Gravel	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	5	25	10	1.9	13.1	3.1
EN04-5D	Jul-04					34	Sand	0-1' Concrete Surface Seal 1-33' Bentonite Seal 33-34' Glass Bead Filter Pack 33.5-34' Screened Interval						
EN04-6S	Jul-04		X	EN-310	7/29/04 <28	8	Sand	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	1	18	0	1	0	0
EN04-6D	Jul-04					27	Sand & Gravel	0-1' Concrete Surface Seal 1-26' Bentonite Seal 26-27' Glass Bead Filter Pack 26.5-27' Screened Interval						
EN04-7S	Jul-04	X		EN-311	7/28/04 43.7	8	Sand Over Sand & Gravel	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	9.7	25	1.3	4.8	6.2	4.9
EN04-7D	Jul-04					34	Poorly Sorted Sand	0-1' Concrete Surface Seal 1-33' Bentonite Seal 33-34' Glass Bead Filter Pack 33.5-34' Screened Interval						

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EN04-8S	Jul/Aug-02	X		EN-430	4/16/04 20.84	8	Sand & Gravel	0-2' Concrete Surface Seal 2-6.75' Bentonite Seal 6.75-7.75' Glass Bead Filter Pack	8	2.8	2.2	9.9	0.3	-1.9
EN04-8D	Jul/Aug-02					12	Sand & Gravel	0-2' Concrete Surface Seal 2-10.5' Bentonite Seal 10.5-11.7' Glass Bead Filter Pack						
EN04-9S	Jul/Aug-02	X		EN-279	11/3/03 26.23	8	Welll Sorted Sand	0-2' Concrete Surface Seal 2-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	6	11	8	14	0	-8
EN04-9D	Jul/Aug-02					20	Well Sorted Sand	0-2' Concrete Surface Seal 2-19' Bentonite Seal 19-20' Glass Bead Filter Pack 19.5-20' Screened Interval						
EN04-10S	Jul/Aug-02	X		EN-077	11/3/04 26.18	8	Gravel	0-2' Concrete Surface Seal 2-6.5' Bentonite Seal 6.5-7.5' Glass Bead Filter Pack 7-7.5' Screened Interval	6.3	11.2	1.3	4.8	2.8	1.5
EN04-10D	Jul/Aug-02					20	Well Sorted Sand	0-2' Concrete Surface Seal 2-18.7' Bentonite Seal 18.7-19.7' Glass Bead Filter Pack						
EN04-11S	Jul-04	X		EN-215A	7/29/04 28.17	8	Well Sorted Sand	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8.5' Sand Filter Pack 8-8.5' Screened Interval	7.2	11.5	7.2	14.4	0	-7.2
EN04-11D	Jul-04					21	Well Sorted Sand	0-1' Concrete Surface Seal 1-20' Bentonite Seal 20-21' Glass Bead Filter Pack 20.5-21' Screened Interval						
EN04-12S	Jul-04	X		EN-214A	7/30/04 25.18	8	Sand & Gravel	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	6.2	10	11.8	14.4	3.6	-8.2
EN04-12D	Jul-04					19	Sand & Gravel	0-1' Concrete Surface Seal 1-18' Bentonite Seal 18-19' Glass Bead Filter Pack 18.5-19' Screened Interval						
EN04-13S	Jul-04	X		EN-449	7/29/04 36.05	8	Well Sorted Sand	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	6	21	13.5	13.4	6.1	-7.4
EN04-13D	Jul-04					30	Sand & Gravel	0-1' Concrete Surface Seal 1-29' Bentonite Seal 29-30' Glass Bead Filter Pack 29.5-30' Screened Interval						
EN04-14S	Jul-04	X		EN-462	8/5/04 40.09	8	Sand & Gravel	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	5	25	4	4.8	4.2	0.2
EN04-14D	Jul-04					34	Poorly Sorted Sand	0-1' Concrete Surface Seal 1-33' Bentonite Seal 33-34' Glass Bead Filter Pack 33.5-34' Screened Interval						

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EN04-15S	Jul-04		X	EN-162	7/29/04 35.33	8	Well Sorted Sand	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	5.3	21	6.2	4.4	7.1	0.9
EN04-15D	Jul-04					30	Sand & Gravel	0-1' Concrete Surface Seal 1-29' Bentonite Seal 29-30' Glass Bead Filter Pack 29.5-30' Screened Interval						
EN04-16S	Jul-04	X		EN-206	7/27/04 39.54	8	Fill	0-1' Concrete Surface Seal 1-7.3' Bentonite Seal 7.3-8.5' Sand Filter Pack 8-8.5' Screened Interval	5.5	24.5	10.5	9.3	6.7	-3.8
EN04-16D	Jul-04					34	Sand & Gravel	0-1' Concrete Surface Seal 1-33' Bentonite Seal 33-34' Glass Bead Filter Pack 33.5-34' Screened Interval						
EN04-17S	Jul-04	X		EN-401	7/29/04 35.5	8	Sand & Gravel	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	7.5	19	3.5	10.3	0.7	-2.8
EN04-17D	Jul-04					28	Sand & Gravel	0-1' Concrete Surface Seal 1-27' Bentonite Seal 27-28' Glass Bead Filter Pack 27.5-28' Screened Interval						
EN04-18S	Jul-04		X	EN-217A	7/29/04 36.69	8	Sand & Gravel	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	5.9	22	5.3	9.9	1.3	-4
EN04-18D	Jul-04					31	Sand & Gravel	0-1' Concrete Surface Seal 1-30' Bentonite Seal 30-31' Glass Bead Filter Pack 30.5-31' Screened Interval						
EN04-19S	Jul-04	X		EN-426	7/26/04 35.39	8	Sand & Gravel	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	5.9	20.5	4.6	6.8	3.7	-0.9
EN04-19D	Jul-04					29.5	Sand & Gravel	0-1' Concrete Surface Seal 1-28.5' Bentonite Seal 28.5-29.5' Glass Bead Filter Pack						
EN04-20S	Jul-04					8	Gravel	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval		25.5				
EN04-20I	Jul-04		X	EN-207	7/27/04 43.2	24	Gravel	0-1' Concrete Surface Seal 1-23' Bentonite Seal 23-24' Glass Bead Filter Pack 23.5-24' Screened Interval	7.7	9.5	4.3	6.6	5.4	1.1
EN04-20D	Jul-04					36	Sand	0-1' Concrete Surface Seal 1-20' Formation Material 20-33.5' Bentonite Seal 33.5-35.5' Glass Bead Filter Pack						

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EN04-21S	Jul-04		X	EN-468	10/14/04 34.43	7.5	Sand & Gravel	0-1' Concrete Surface Seal 1-6.5' Bentonite Seal 6.5-7.5' Glass Bead Filter Pack 7-7.5' Screened Interval	12	14.5	4	13.7	2.3	-1.7
EN04-21D	Jul-04					23	Sand & Gravel	0-1' Concrete Surface Seal 1-12' Formation Material 12-22' Bentonite Seal 22-23' Glass Bead Filter Pack 22.5-23' Screened Interval						
EN04-22S	Jul/Aug-02	X		EN-80* and EN-393*	7/27/04 18.75	8	Well Sorted Sand	0-2' Concrete Surface Seal 2-7.1' Bentonite Seal 7.1-7.5' Glass Bead Filter Pack 7.5-8' Screened Interval	2.8	7	6	3.2	5.6	-0.4
EN04-22D	Jul/Aug-02					16	Well Sorted Sand	0-2' Concrete Surface Seal 2-15' Bentonite Seal 15-16' Glass Bead Filter Pack 15.5-16' Screened Interval						
EN04-23S	Jul-04		X	EN-174	7/30/04 26.48	8	Well Sorted Sand	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	3.5	14	4.5	3.1	4.9	0.4
EN04-23I	Jul-04					15	Well Sorted Sand	0-1' Concrete Surface Seal 1-14' Bentonite Seal 14-15' Glass Bead Filter Pack 14.5-15' Screened Interval		7				
EN04-23D	Jul-04					23	Well Sorted Sand	0-1' Concrete Surface Seal 1-22' Bentonite Seal 22-23' Glass Bead Filter Pack 22.5-23' Screened Interval						
EN04-24S	Jul-04		X	EN-65	7/29/04 22.89	8	Fill	0-1' Concrete Surface Seal 1-6.5' Bentonite Seal 6.5-8.5' Sand Filter Pack 8-8.5' Screened Interval	3.9	9.5	17.8	3.2	18.5	0.7
EN04-24D	Jul-04					19	Poorly Sorted Sand	0-1' Concrete Surface Seal 1-18' Bentonite Seal 18-19' Glass Bead Filter Pack 18.5-19' Screened Interval						
EN04-25S	Aug-04		X	EN-395	7/29/04 18.88	8	Fill	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	1.4	8.5	5	1.3	5.1	0.1
EN04-25D	Aug-04					17.5	Sand & Gravel	0-1' Concrete Surface Seal 1-16.5' Bentonite Seal 16.5-17.5' Glass Bead Filter Pack						
EN04-26S	Jul-04	X		EN-304	7/30/04 17.39	8	Sand & Gravel	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	3.4	5	6.6	3.5	6.5	-0.1
EN04-26D	Jul-04					14	Sand & Gravel	0-1' Concrete Surface Seal 1-13' Bentonite Seal 13-14' Glass Bead Filter Pack 13.5-14' Screened Interval						
EN04-27S	Jul-04		X	EN-417A	7/29/04 8.91	8	Fill	0-1' Concrete Surface Seal 1-6' Bentonite Seal 6-7' Glass Bead Filter Pack 6.5-7' Screened Interval	0.9	-	14	2.4	12.5	-1.5

TABLE 1
Summary of Soil Vapor Monitoring Implants
Semiannual Report - Soil Vapor Monitoring Through October 2007
Comprehensive Operations, Maintenance, and Monitoring Program
Endicott, New York

Location Designation[1]	Installation Date	Implant Type[2]: Remediation Progress Monitoring	Implant Type[2]: Ventilation Perimeter Monitoring	Subsurface Conditions at Installation: Nearby Monitoring Well[3]	Subsurface Conditions at Installation: Date Recorded/ Depth to Water Table[4]	Subsurface Conditions at Installation: Nominal Implant Depth (ft. bgs)	Subsurface Conditions at Installation: Inferred Stratum Screened	Completion Details	Groundwater Conditions At Installation: Distance Above Water Table[5] (ft)	Groundwater Conditions At Installation: Vadose Zone Between Shallow and Deep Implants[6] (ft)	Groundwater Conditions At Installation: Saturated Screened Interval[7] (ft)	January/February Groundwater Conditions: Distance Above Water Table[5] (ft)	January/February Groundwater Conditions: Saturated Screened Interval[7] (ft)	January/February Groundwater Conditions: Difference[8] (ft)
EN07-28S	Jun-07		X	EN-387A	6/5/2007 22	7	Well Sorted Sand	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	3	11	9.5	-	-	-
EN07-28I	Jun-07					10	Sand & Gravel	0-1' Concrete Surface Seal 1-9' Bentonite Seal 9-10' Glass Bead Filter Pack 9.5-10' Screened Interval						
EN07-28D	Jun-07					19	Well Sorted Sand	0-1' Concrete Surface Seal 1-18' Bentonite Seal 18-19' Glass Bead Filter Pack 18.5-19' Screened Interval						
EN05-29S	4/18/2005	X		EN-437	8/5/04 23.87	7.5	Well Sorted Sand	0-1' Concrete Surface Seal 1-5.5' Bentonite Seal 5.5-7.5' Glass Bead Filter Pack 7-7.5' Screened Interval	3.9	11	11.1	14.5	0.5	-10.6
EN05-29I	4/18/2005					12.5	Well Sorted Sand	0-1' Concrete Surface Seal 1-11' Bentonite Seal 11-12.5' Glass Bead Filter Pack 12-12.5' Screened Interval						
EN04-29D	Jul-04					20	Well Sorted Sand	0-1' Concrete Surface Seal 1-19' Bentonite Seal 19-20' Glass Bead Filter Pack 19.5-20' Screened Interval						
EN04-30S	Jul-04	X		EN-438	8/5/04 26.02	9	Well sorted Sand	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	6	11	8	11.6	2.4	-5.6
EN04-30D	Jul-04					20	Well Sorted Sand	0-1' Concrete Surface Seal 1-19' Bentonite Seal 19-20' Glass Bead Filter Pack 19.5-20' Screened Interval						
EN04-31S	Aug-04		X	EN-453	8/25/04 19.48	10	Well sorted Sand	0-1' Concrete Surface Seal 1-9' Bentonite Seal 9-10 Glass Bead Filter Pack 9.5-10' Screened Interval	0.5	8	12	6.5	6.0	-6
EN04-31D	Aug-04					19	Well Sorted Sand	0-1' Concrete Surface Seal 1-18' Bentonite Seal 18-19' Glass Bead Filter Pack 18.5-19' Screened Interval						
EN04-32S	Aug-04		X	EN-457A	8/23/04 21.36	8	Well sorted Sand	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	3.4	9	5	8.4	0	-5
EN04-32D	Aug-04					18	Sand	0-1' Concrete Surface Seal 1-17' Bentonite Seal 17-18' Glass Bead Filter Pack 17.5-18' Screened Interval						

TABLE 1
Summary of Soil Vapor Monitoring Implants
Semiannual Report - Soil Vapor Monitoring Through October 2007
Comprehensive Operations, Maintenance, and Monitoring Program
Endicott, New York

Location Designation [1]	Installation Date	Implant Type [2]		Subsurface Conditions at Installation				Completion Details	Groundwater Conditions At Installation			January/February Groundwater Conditions		
		Remediation Progress Monitoring	Ventilation Perimeter Monitoring	Nearby Monitoring Well [3]	Date Recorded/ Depth to Water Table [4]	Nominal Implant Depth (ft. bgs)	Inferred Stratum Screened		Distance Above Water Table [5] (ft)	Vadose Zone Between Shallow and Deep Implants [6] (ft)	Saturated Screened Interval [7] (ft)	Distance Above Water Table [5] (ft)	Saturated Screened Interval [7] (ft)	Difference [8] (ft)
EN05-33S	Apr-05	X		EN-162	4/19/04 34.36	7.5	Well Sorted Sand	0-1' Concrete Surface Seal 1-5.8' Bentonite Seal 5.8-7.5' Glass Bead Filter Pack 7-7.5' Screened Interval	2.3	22.5	6.2	1.4	7.1	0.9
EN05-33I21	Apr-05					21.5	Well Sorted Sand	0-1' Concrete Surface Seal 1-19' Bentonite Seal 19-21.5' Glass Bead Filter Pack 21-21.5' Screened Interval						
EN05-33I29	Apr-05					29	Poorly Sorted Sand and Gravel	0-1' Concrete Surface Seal 1-27.7' Bentonite Seal 27.7-29' Glass Bead Filter Pack 28.5-29' Screened Interval						
EN05-33D	Apr-05					32	Well Sorted Sand	0-1' Concrete Surface Seal 1-30' Bentonite Seal 30-32' Glass Bead Filter Pack 31.5-32' Screened Interval						
EN05-34S	Apr-05	X		EN-304	4/18/2004 16.67	8	Well Sorted Sand	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	3.2	4	6.6	3.3	6.5	-0.1
EN05-34I	Apr-05					11	Well Sorted Sand	0-1' Concrete Surface Seal 1-10' Bentonite Seal 10-11' Glass Bead Filter Pack 10.5-11' Screened Interval						
EN05-34D	Apr-05					13.5	Well Sorted Sand	0-1' Concrete Surface Seal 1-12' Bentonite Seal 12-13.5' Glass Bead Filter Pack 13-13.5' Screened Interval						
EN06-35S	Jan-06		X	EN-460A	8/11/04 40.2	8	Well Sorted Sand	0-1' Concrete Surface Seal 1-7.2' Bentonite Seal 7.2-8.5' Glass Bead Filter Pack 7.5-8' Screened Interval	6.2	25.3	10	3.6	12.6	2.6
EN06-35I16	Jan-06					16	Poorly Sorted Sand and Gravel	8.5-14.7' Bentonite Seal 14.7-16.6' Glass Bead Filter Pack 15.5-16' Screened Interval						
EN06-35I24	Jan-06					24	Well Sorted Sand	16.6-22.3' Bentonite Seal 22.3-24.3' Glass Bead Filter Pack 23.5-24' Screened Interval						
EN06-35D	Jan-06					34	Poorly Sorted Sand and Gravel	24.3-33.3' Bentonite Seal 33.3-34.3' Glass Bead Filter Pack 33.8-34.3' Screened Interval						
EN06-36S	Jan-06		X	EN-459A	8/18/04 40.01	8	Well Sorted Sand	0-1' Concrete Surface Seal 1-6.9' Bentonite Seal 6.9-8.6' Sand Filter Pack 7.5-8.0' Screened Interval	7	23.8	10	3.9	13.1	3.1
EN06-36I21	Jan-06					12	Poorly Sorted Sand and Gravel	8.6-10.5 Bentonite Seal 10.5-11.5' Glass Bead Filter Pack 11.5-12.' Screened Interval						
EN06-36I29	Jan-06					22	Well Sorted Sand	12.5-20.9' Bentonite Seal 20.9-22.5' Glass Bead Filter Pack 21.5-22.' Screened Interval						
EN06-36D	Jan-06					33	Poorly Sorted Sand and Gravel	22.5-31.8' Bentonite Seal 31.8-34' Glass Bead Filter Pack 32.5-33' Screened Interval						

TABLE 1
Summary of Soil Vapor Monitoring Implants
Semiannual Report - Soil Vapor Monitoring Through October 2007
Comprehensive Operations, Maintenance, and Monitoring Program
Endicott, New York

Location Designation [1]	Installation Date	Implant Type [2]		Subsurface Conditions at Installation				Completion Details	Groundwater Conditions At Installation			January/February Groundwater Conditions		
		Remediation Progress Monitoring	Ventilation Perimeter Monitoring	Nearby Monitoring Well [3]	Date Recorded/ Depth to Water Table [4]	Nominal Implant Depth (ft. bgs)	Inferred Stratum Screened		Distance Above Water Table [5] (ft)	Vadose Zone Between Shallow and Deep Implants [6] (ft)	Saturated Screened Interval [7] (ft)	Distance Above Water Table [5] (ft)	Saturated Screened Interval [7] (ft)	Difference [8] (ft)
EN06-37S	Jan-06		X	EN-394	7/27/04 22.3	8	Well Sorted Sand	0-1' Concrete Surface Seal 1-7' Bentonite Seal 7-8' Glass Bead Filter Pack 7.5-8' Screened Interval	1.3	12	3.2	2.1	2.4	-0.8
EN06-37I	Jan-06					12	Well Sorted Sand	0-1' Concrete Surface Seal 1-11' Bentonite Seal 11-12' Glass Bead Filter Pack 11.5-12' Screened Interval						
EN06-37D	Jan-06					21	Well Sorted Sand	0-1' Concrete Surface Seal 1-20' Bentonite Seal 20-21' Glass Bead Filter Pack 20.5-21' Screened Interval						

Notes:
1. This table is intended to summarize implant depths, subsurface conditions and completion details for soil vapor monitoring implants used as part of IBM's Comprehensive Operations, Maintenance and Monitoring program in Endicott, New York.

2. Remediation Progress Monitoring implants are intended to monitor ongoing groundwater remediation activities within and on the boundary of the area where IBM is currently remediating groundwater. Ventilation Progress Perimeter Monitoring implants are intended to monitor conditions at or near the limits of the Ventilation Area.

3. The "nearby monitoring wells" field identifies the monitoring well used to characterize groundwater quality proximate to the implant location, typically within 20 feet horizontally. Entries flagged with an asterisk are well locations more remote from the implant location.

4. The "depth to water table" field is based on depth to water measurements recorded from top of well casing (TOC) as measured by SHA and GSC personnel between July 26 and August 5, 2004 and by SHA on April 18 and 19, 2005. Water levels indicated by an asterisk are nominal water levels based on monitoring wells more than approximately 20 feet from the soil vapor implant.

5. The "Distance Above Water Table" field reflects the approximate vertical distance between the deep implant and the water table at the time of implant installation and January/February 2007. During implant installation, drilling depths were generally targeted to 5' above the water table based on current available information. The actual separation will vary with fluctuations in water level conditions and may be greater or less.

6. The "Vadose Zone Between Shallow and Deep Implants" field identifies the thickness of unsaturated soils between the implants and represents to the distance between the top of the glass bead filter pack of the deeper implant and the bottom of the implant screen of the shallow implant.

7. The "Saturated Screened Interval" field lists the approximate thickness of upper aquifer that the well is screened across which is based on boring and well completion logs provided by others and the depth to water table recorded around the time of implant installation and in January/February 2007. The actual saturated screen interval will vary with fluctuations in groundwater levels.

8. The "Difference" field calculates the change in saturated screened interval from around the time of implant installation to January/February 2007. A negative number indicates the water table has dropped at that location. The change in saturated thickness was used to calculate an updated distance above water table for the deep implant at each location.

FIGURES

NOTES

1. This figure is intended to depict soil vapor monitoring locations that have been established and maintained as part of the Comprehensive Operations, Maintenance & Monitoring Program. The locations of the soil vapor monitoring implants are based on taped measurements relative to physical features in the field and are accurate only to the degree implied by the method used.

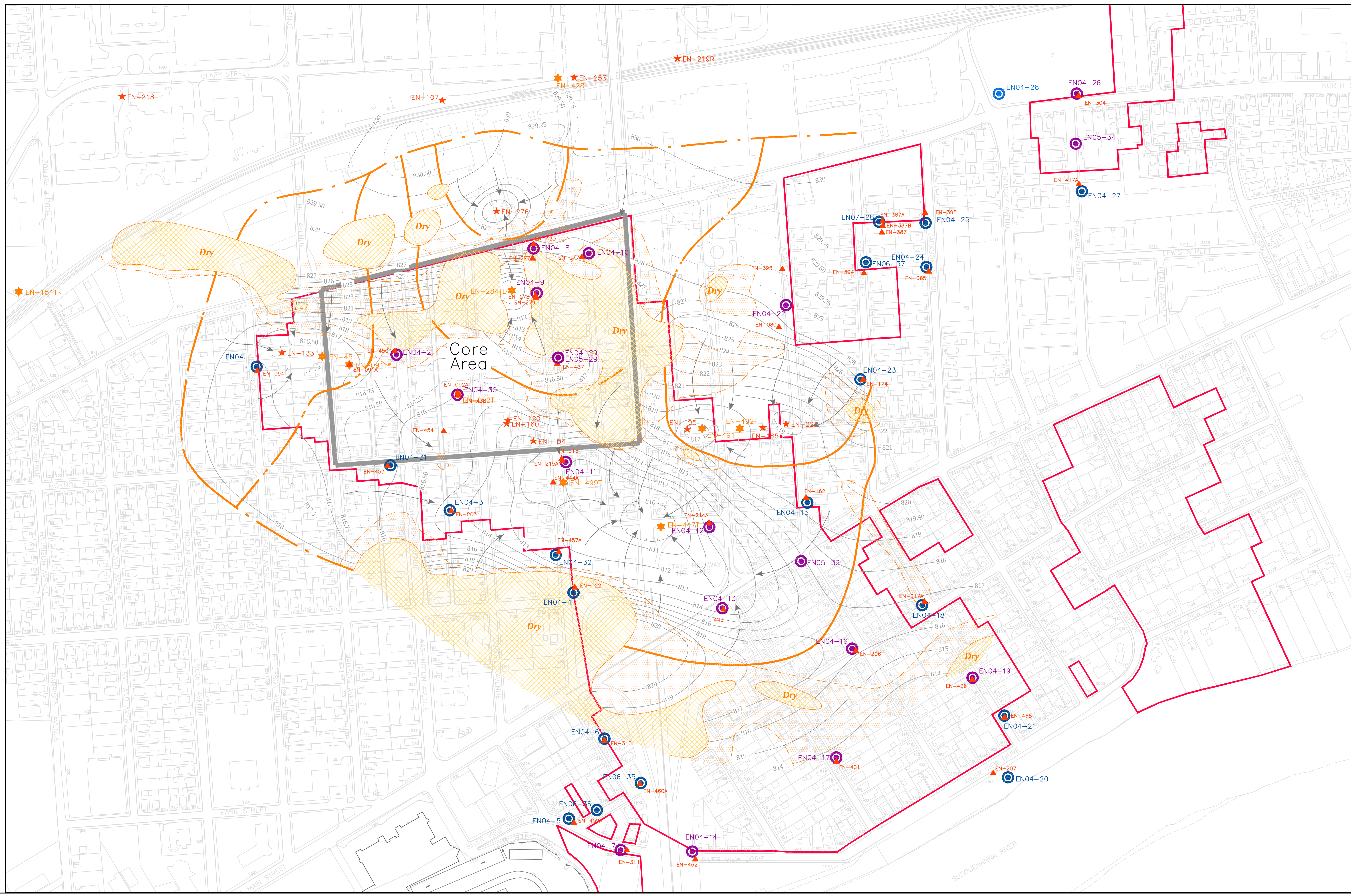
2. The base map information presented below is adapted from four AutoCAD drawings entitled "Endicott2000.dwg", "Union2000.dwg", "Unioneast.dwg", and "Endicottpln.dwg". The drawings were provided by the Broome County mapping division and were received by SHA on October 10, 2002. The building outlines and other site features are based on an AutoCAD drawing entitled "9_03_base.dwg" provided by Groundwater Sciences Corporation (GSC) of Harrisburg, Pennsylvania to SHA in September 2003. The locations of groundwater monitoring and recovery wells are based on an AutoCAD drawing by GSC submitted to SHA on 05/17/2004 entitled "2007N006.dwg". The well locations are reportedly based on field surveys performed in 2003 and 2004. For wells installed in July and August 2004, well locations are based on northing and easting coordinates provided on draft well logs provided to SHA on 09/21/2004.

3. Groundwater contours, flow directions, flow divides, groundwater monitoring and extraction wells, and areas of saturated thickness <2' or "dry" were adapted from a drawing by GSC transmitted to SHA on 4/13/07 entitled 20070123.dwg. The contours represent inferred groundwater elevations based on groundwater measurements from January 24, 2007.

4. The limits of ventilation shown in red encompass properties where IBM has offered to install a ventilation system. The ventilation areas were identified under the review of the New York State Departments of Environmental Conservation and Health based on results of sampling foundation level soil vapor, substructure soil vapor, indoor air, and outdoor air completed between November 2002 and March 2005.

LEGEND

- Limits of Ventilation
- EN04-1 Soil Vapor Monitoring Location – Perimeter Monitoring
- EN04-1 Soil Vapor Monitoring Location – Remediation Progress Monitoring
- EN-430 Upper Aquifer Monitoring Well
- EN-428 Upper Aquifer Interceptor Extraction Well
- 816 Groundwater Elevation Contour (Feet AMSL)
- Inferred direction of groundwater flow
- Area of unsaturated soil in the upper aquifer
- Area where saturated thickness is less than 2'
- Groundwater Divide, Dashed Where Less Constrained



GRAPHICAL SCALE 150' 75' 0 150' 300'

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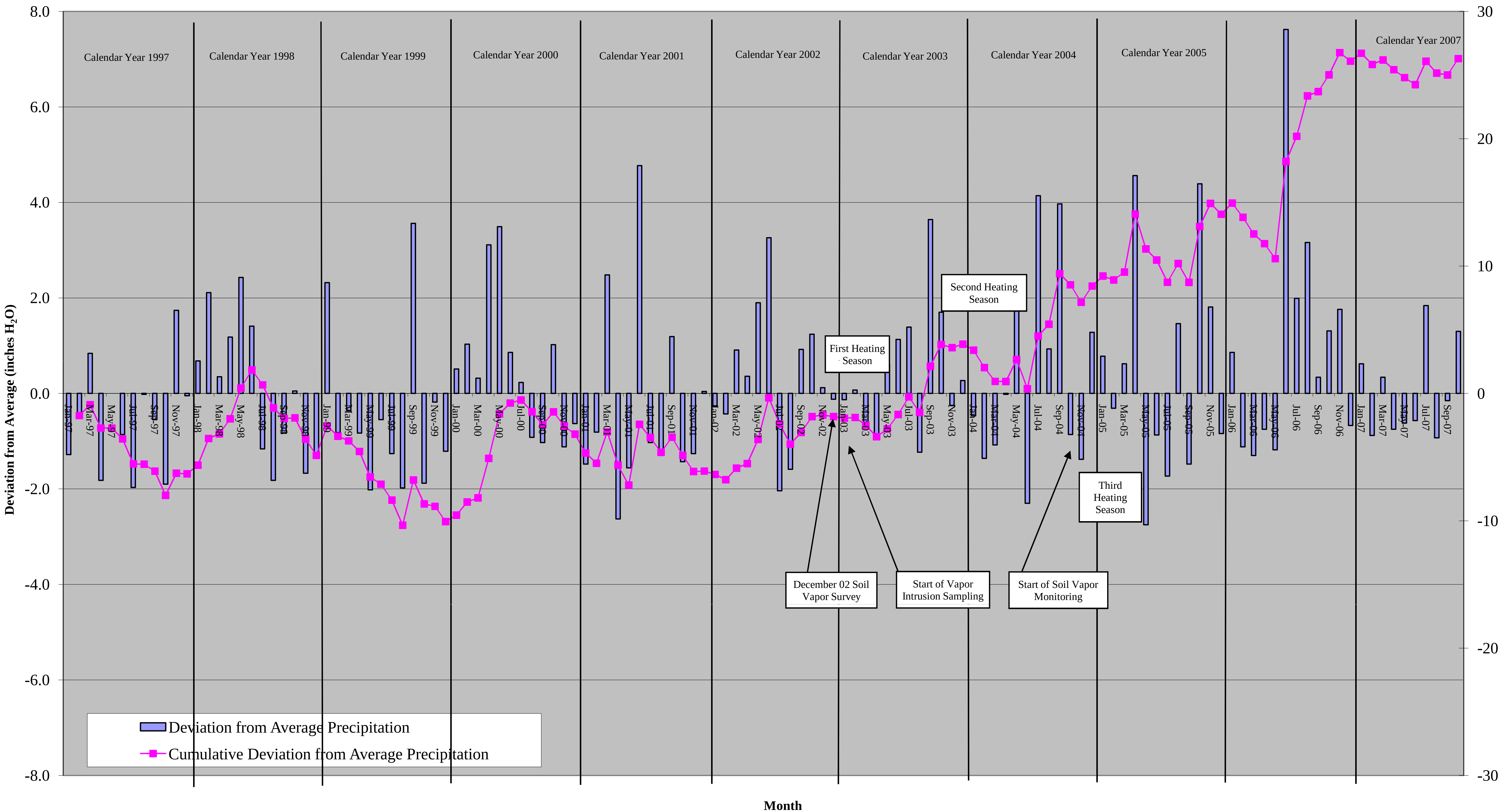
DRAWN BY: EMB
DESIGNED BY: EMB
CHECKED BY: DBC
REVIEWED BY: DS
PROJECT MGR: EMB
PIC: DBC
DATE: NOV 07

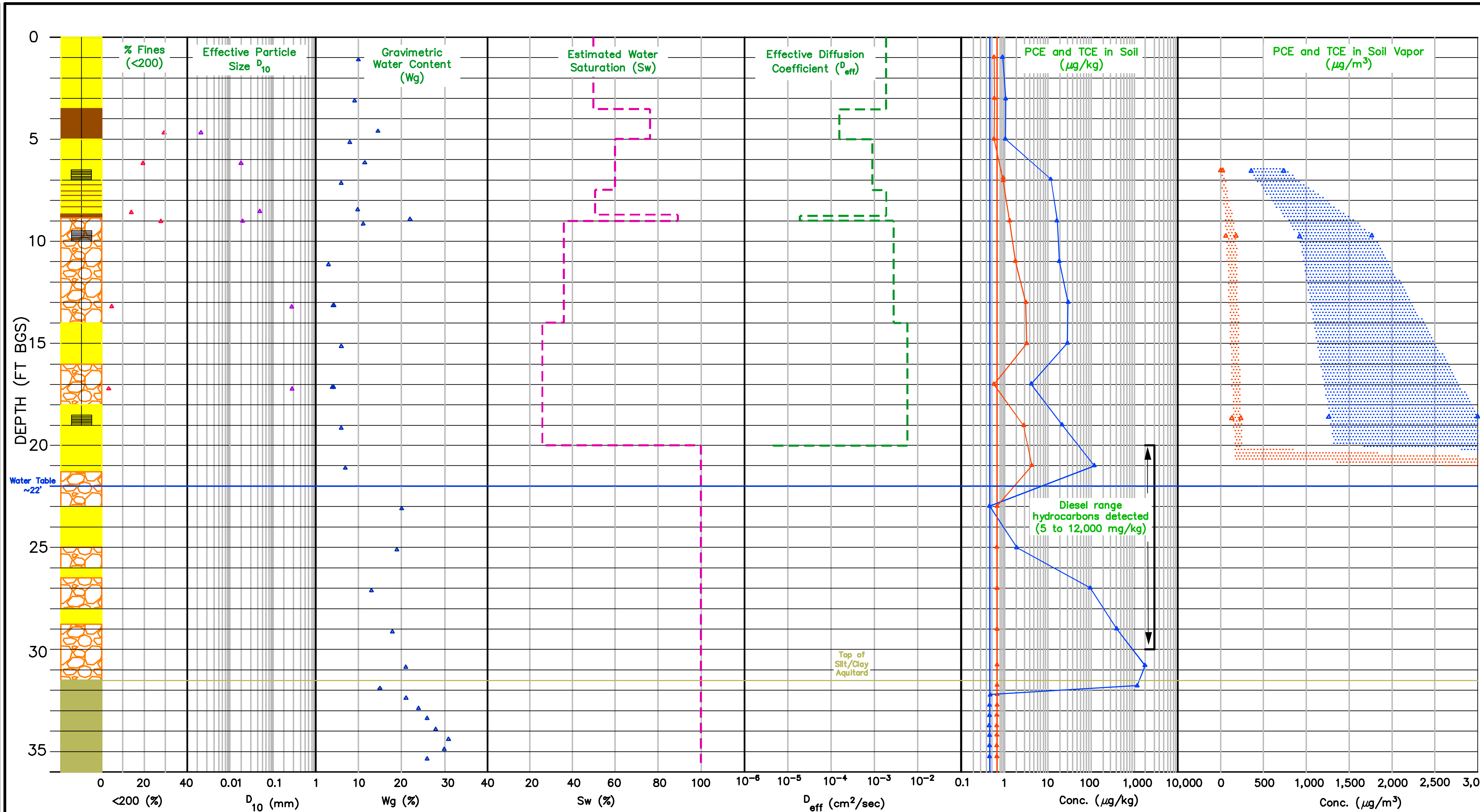
Semiannual Report – Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance & Monitoring Program
Endicott, New York

Soil Vapor Implant Location Plan

PROJECT NUMBER: 2755.00
FIGURE NUMBER: 1

Figure 2
Historical Precipitation Records
Semiannual Report - Soil Vapor Monitoring through October 2007
Endicott, New York





Notes:

1. This figure depicts data and inferences derived from drilling, construction, and sampling of soil vapor implant EN07-28 and boring EN-387B on June 5, 2007. The profile is intended to support a discussion of conditions influencing soil vapor transport and attenuation. The profile depicts field observations and data derived from laboratory testing of samples of soil as well as estimates of soil properties derived from these data as outlined in the report text. The profiles are simplified graphical representations of soil conditions consistent with available data. The actual conditions are likely more complex and will vary from those shown due to seasonal variability in soil moisture and smaller scale differences in soil texture and moisture that cannot be inferred from the available data resolution.

2. Soils laboratory testing was performed on bagged soil samples collected by SHA personnel and transmitted to GeoTesting Express, Ltd. of Boxboro, Massachusetts, where they were analyzed for soil particle distribution and gravimetric moisture content. An additional 24 samples and 12 duplicates were submitted to Severn Trent Laboratories, Inc. of Colchester, Vermont by Groundwater Sciences Corp. of Harrisburg, Pennsylvania. These samples were analyzed for volatile organic compounds by EPA method 8260B and total solids.

3. The lithology above 22 ft bgs was observed and logged by SHA personnel. The lithology below 22 ft bgs is based on the boring log for EN-387B by GSC. Logs are included in Appendix B.5

- Soils predominantly consisting of well sorted sands with varying amounts of silt
- Soils predominantly consisting of poorly sorted sand and gravel
- Silty zone
- Lacustrine silt/clay aquitard
- Soil vapor implant screen

Legend:

- <200 Sieve – % Fines defined as silt and clay fraction the passes through a number 200 sieve
- D_{10} – Effective Particle Size defined as the particle diameter in the particle size distribution curve that corresponds to 10% finer by dry weight. D_{10} has been empirically correlated to hydraulic conductivity.
- W_g – Gravimetric Water Content, point observations of gravimetric moisture content expressed as a percentage of dry soil weight.
- Sw – Estimated Water Saturation expressed as percent water-filled pore space. The estimates are based on measured gravimetric moisture contents assuming typical dry unit weights and particle specific gravities. The actual degree of soil saturation will vary somewhat from these estimates.
- D_{eff} – Effective Diffusion Coefficient as estimated by SHA by using generally accepted analytical relationships supported by soils laboratory data and inference of soil properties. See report text for additional details.
- PCE and TCE in Soil depict laboratory analytical data, PCE in blue and TCE in red. For depth intervals where a duplicate sample was collected, the concentration is the average of the two samples. The reporting limits are marked with vertical lines. See table in Appendix B.5.
- PCE and TCE in Soil Vapor depict the range of analytical laboratory data from the last three sampling rounds, PCE in blue and TCE in red. The soil vapor concentrations at the water table are estimated from groundwater concentrations and Henry's Law constant.

Not to Scale

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DRAWN BY: EMB
DESIGNED BY: EMB/AHH
CHECKED BY: DBC
REVIEWED BY: DS
PROJECT MGR: EMB
PIC: DBC
DATE: DEC 07

Semiannual Report – Soil Vapor Monitoring
Comprehensive Operations, Maintenance, and Monitoring Program
Endicott, New York

Soil And Soil Vapor Profile EN07-28

PROJECT NUMBER: 2755
FIGURE NUMBER: 3

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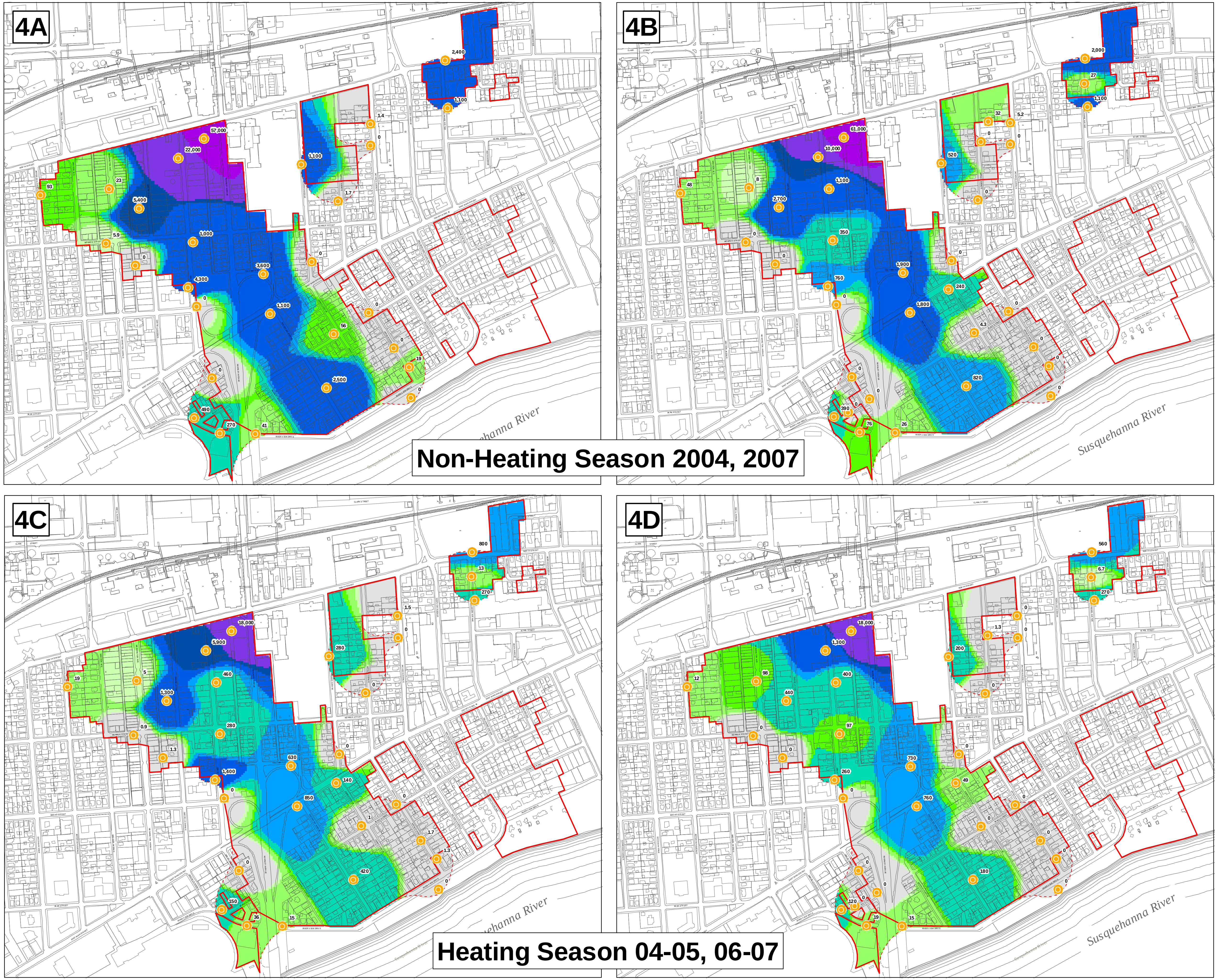
Legend

Limits of Ventilation

Soil Vapor Implant Location. TCE Concentration in micrograms per cubic meter ($\mu g/m^3$)

$\mu g/m^3$
< 5
5 - 10
10 -50
50 -100
100 - 500
500 - 1,000
1,000 - 5,000
5,000 - 10,000
10,000 - 50,000
50,000 - 100,000



Notes:

1. These figures depict TCE concentrations in soil vapor samples at different times and are intended to aid in communicating general temporal trends in soil vapor concentrations consistent with the available data.

The images were created using uniform and consistent spatial statistical algorithms as outlined in more detail in Appendix B.4.1 and are intended not as absolute indicators of the limits of soil vapor concentrations at a given time but a basis of comparison between data from different times.

2. Images labeled as non-heating season display an average of the data recorded between August and October. The heating season images display an average of the data recorded between December and April.

3. See Figure 1 for additional notes and legend.

GRAPHICAL SCALE: 400 200 0 400 800 1,200 Feet

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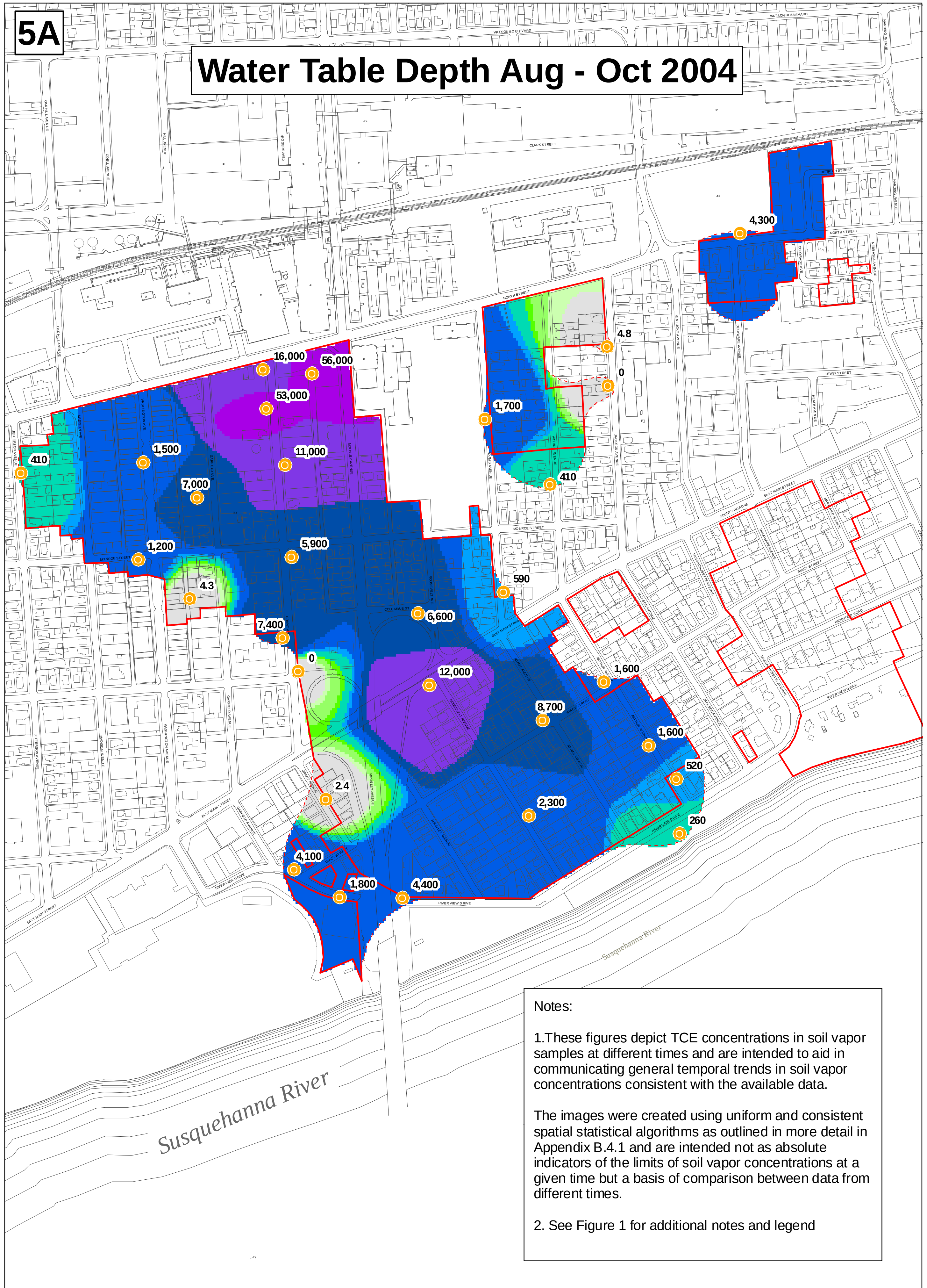
DRAWN BY: SLW
DESIGNED BY: SLW
CHECKED BY: EMB
REVIEWED BY: DS
PROJECT MGR: EMB
PIC: DBC
DATE: December 2007

Semiannual Report - Soil Vapor Monitoring
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

Comparisons of TCE Soil Vapor Concentrations at Foundation Depth

PROJECT NUMBER: 2755

FIGURE NUMBER: 4

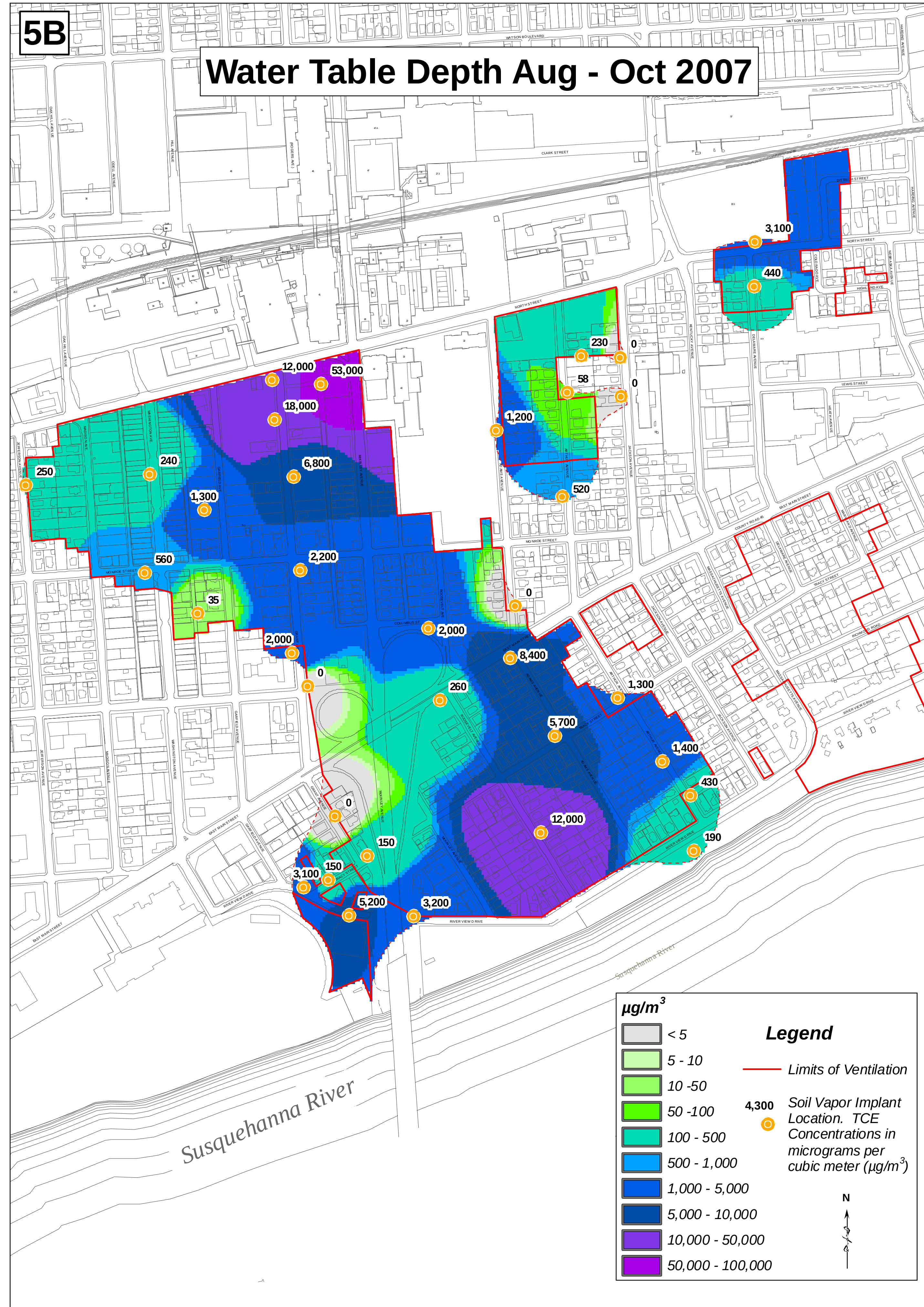


Notes:

1. These figures depict TCE concentrations in soil vapor samples at different times and are intended to aid in communicating general temporal trends in soil vapor concentrations consistent with the available data.

The images were created using uniform and consistent spatial statistical algorithms as outlined in more detail in Appendix B.4.1 and are intended not as absolute indicators of the limits of soil vapor concentrations at a given time but a basis of comparison between data from different times.

2. See Figure 1 for additional notes and legend



GRAPHICAL SCALE
Feet
300 150 0 300 600 900

SHA
ENGINEERS • SCIENTISTS

NO. | DATE | DESCRIPTION | BY

DRAWN BY: SLW
DESIGNED BY: SLW
CHECKED BY: EMB
REVIEWED BY: DS
PROJECT MGR: EMB
PIC: DBC
DATE: December 2007

Semiannual Report - Soil Vapor Monitoring
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

Comparisons of TCE Soil Vapor Concentrations at Water Table Depth

PROJECT NUMBER: 2755

FIGURE NUMBER: 5

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APPENDIX A

LIMITATIONS

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APPENDIX A
LIMITATIONS

1. The conclusions described in this report are based in part on the data obtained from a finite number of soil vapor, ambient air, soil, and groundwater samples from widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until further investigation is initiated. If variations or other latent conditions then appear evident, it may be necessary to re-evaluate the conclusions of this report.

2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are probably more gradual. For specific information, refer to the exploration logs.

3. The conclusions contained in this report are based in part upon various types of chemical data as well as historical and hydrogeologic information developed by previous investigators. While SHA has reviewed that data available to us at the time the report was prepared and information as stated in this report, any of SHA's interpretations and conclusions that have relied on that information will be contingent on its validity. SHA has not performed an independent assessment of the reliability of the data; should additional chemical data, historical information, or hydrogeologic information become available in the future, such information should be reviewed by SHA and the interpretations and conclusions presented herein may be modified accordingly.

4. Sampling and quantitative laboratory testing was performed by others as part of the investigation as noted within the report. Where such analyses have been conducted by an outside laboratory, unless otherwise stated in the report, SHA has relied upon the data provided, and has not conducted an independent evaluation of the reliability of these data.

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APPENDIX B

FIELD SAMPLING AND LABORATORY ANALYSIS

SHA

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APPENDIX B.1

SUMMARY OF FIELD SAMPLING

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APPENDIX B.1

SUMMARY OF FIELD SAMPLING

Soil Vapor Monitoring Program, Endicott, New York

This summary of field sampling is provided for activities completed during monitoring from June through October 2007. Summaries of prior monitoring activities are provided in previous reports.

B.1.1 BACKGROUND

Soil vapor monitoring was conducted at 35 locations in June, August, and October, 2007. Soil vapor implant installation details are provided in Table 1. The implants consist of ¼-inch outside diameter (O.D.) by six-inch long woven stainless steel screen connected to ¼-inch O.D. lab-grade stainless steel tubing. The stainless steel tubing is finished above the ground surface with a compression fitting and gas-tight threaded cap and contained in an 8 or 9-inch diameter flush-mount protective road box.

Three soil vapor implants at one location (EN07-28) were installed on June 5, 2007 and have been sampled during subsequent sampling rounds. Construction of the new implants generally followed procedures used during installation of previous implants. Installation details for the new implants are included in Table 1.

B.1.2 SOIL VAPOR IMPLANT SAMPLING

The soil vapor implants were sampled from June 4th to 7th , August 6th to 9th , and October 9th to 11th. Soil vapor samples were collected generally following procedures described in the approved Monitoring Plan, dated December 1, 2004.

Soil vapor samples were collected in one-liter SUMMA® canisters by connecting the stainless steel implant tubing to a short section of Teflon tubing fitted with an in-line Swagelok® valve. Each vapor implant was purged of one probe volume (estimated at about 10 milliliters [ml] per foot of probe depth) using a disposable syringe. An in-line vacuum gauge was monitored during purging, and the withdrawal rate was adjusted to limit the vacuum to around 2 inches H_2O or below.

Samples for laboratory analysis were collected using an in-line 1-hour flow controller, yielding a collection rate of approximately 0.013 liters per minute or less, a rate comparable to the rate of substructure soil vapor collection as part of the previous vapor intrusion sampling completed in Endicott. Duplicate samples were collected concurrently using an additional Swagelok® "T" fitting and two two-hour controllers to maintain an approximately equivalent sample collection rate.

In addition, a Tedlar bag was collected via a Gillian air pump and was field screened following the same methodology used in previous sampling and described in previous reports. The sample was screened in the field for carbon dioxide (CO_2), oxygen (O_2), and methane (CH_4) using a CES Lantec GEM 2000 four-gas meter, and for volatile organic compounds (VOCs) using a Photovac Model 2020 photo-ionization detector (PID) equipped with a 10.6 eV lamp and a Photovac MicroFID portable flame ionization detector (FID).

B.1.3 QUALITY ASSURANCE/QUALITY CONTROL

Quality Control measures such as field duplicates and blanks and analytical laboratory blanks were taken as required by the Monitoring Plan. Seven duplicates and four equipment blanks were collected each sampling round. QA/QC measures implemented during field sampling activities included:

Confirmation of sample container and metering valve integrity before and after sample collection;

- Sample collection following consistent procedures as outlined in the Monitoring Plan;
- Equipment blanks accompanying empty sample containers to the field, and collected samples back to the lab; and
- Collection of field duplicate samples.

The SUMMA® canisters used for sample collection were "certified clean" by the analytical laboratory to the laboratory reporting limits, and confirmation of the presence of the certification seal or label for each container was noted prior to sample collection. The flow metering valves were cleaned prior to use and the laboratory verified the regulated flow rate. The canister vacuum was noted and recorded before and after the collection of samples.

Equipment blanks consisted of laboratory-certified SUMMA® canisters filled in the field with lab-grade nitrogen, and not opened during the course of its transport. Duplicate samples were collected simultaneously (i.e., over the same time interval) and spatially immediately adjacent to each other.

The collection, transfer of custody, and shipping/transport of the samples to the analytical laboratory was documented using chain-of-custody forms. The laboratory confirmed receipt vacuum and canister identification details and noted any discrepancies.

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APPENDIX B.2

CLIMATOLOGIC DATA AND PLOTS

Figure B.2.1

Summary of Daily Precipitation and Barometric Pressure - GBA

Semiannual Report - Soil Vapor Monitoring

Comprehensive Operations, Maintenance, & Monitoring Program

Endicott, New York

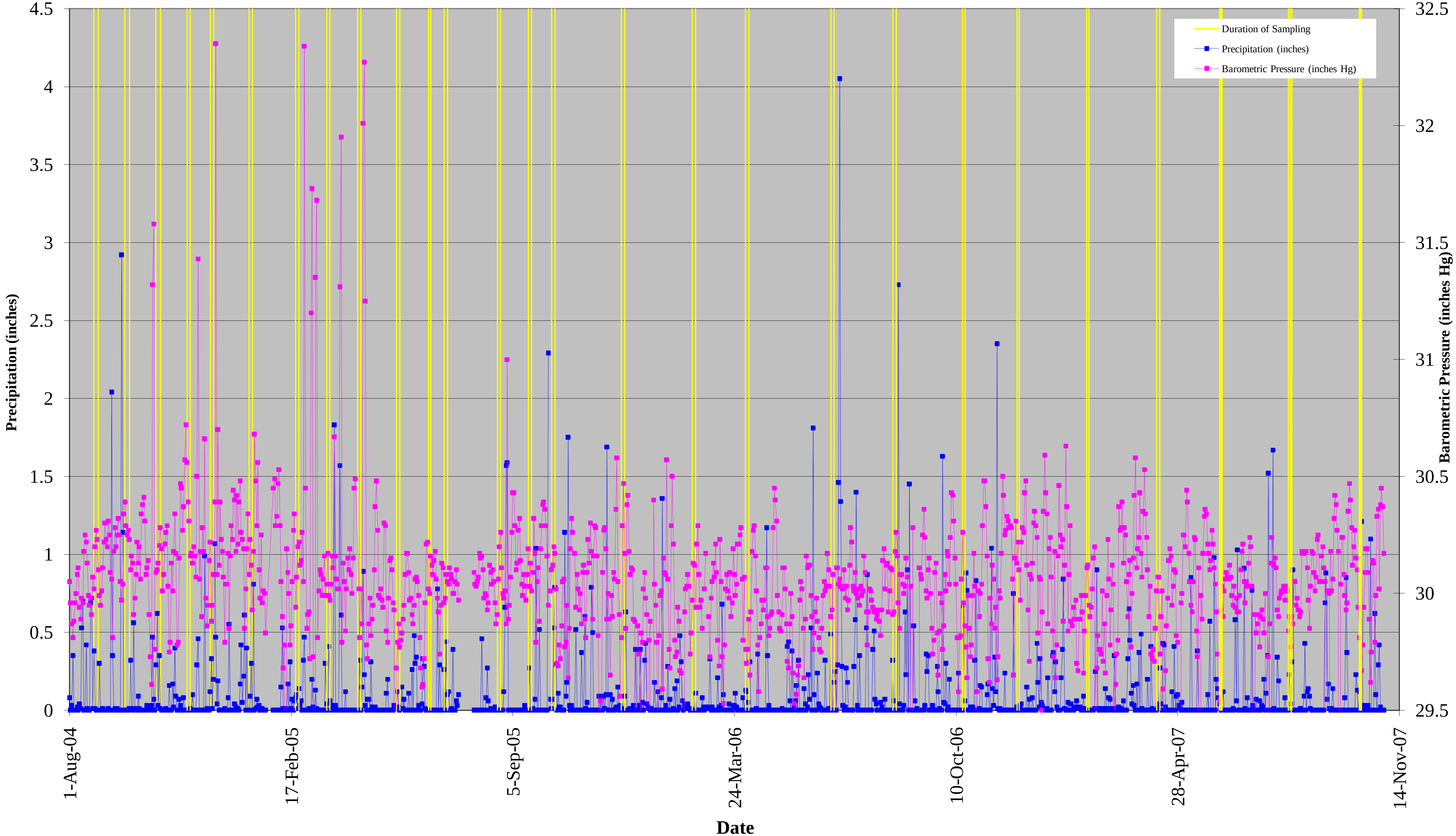

Figure B.2.2

Summary of Daily Barometric Pressure and Temperature - GBA

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Comprehensive Operations, Maintenance, & Monitoring Program

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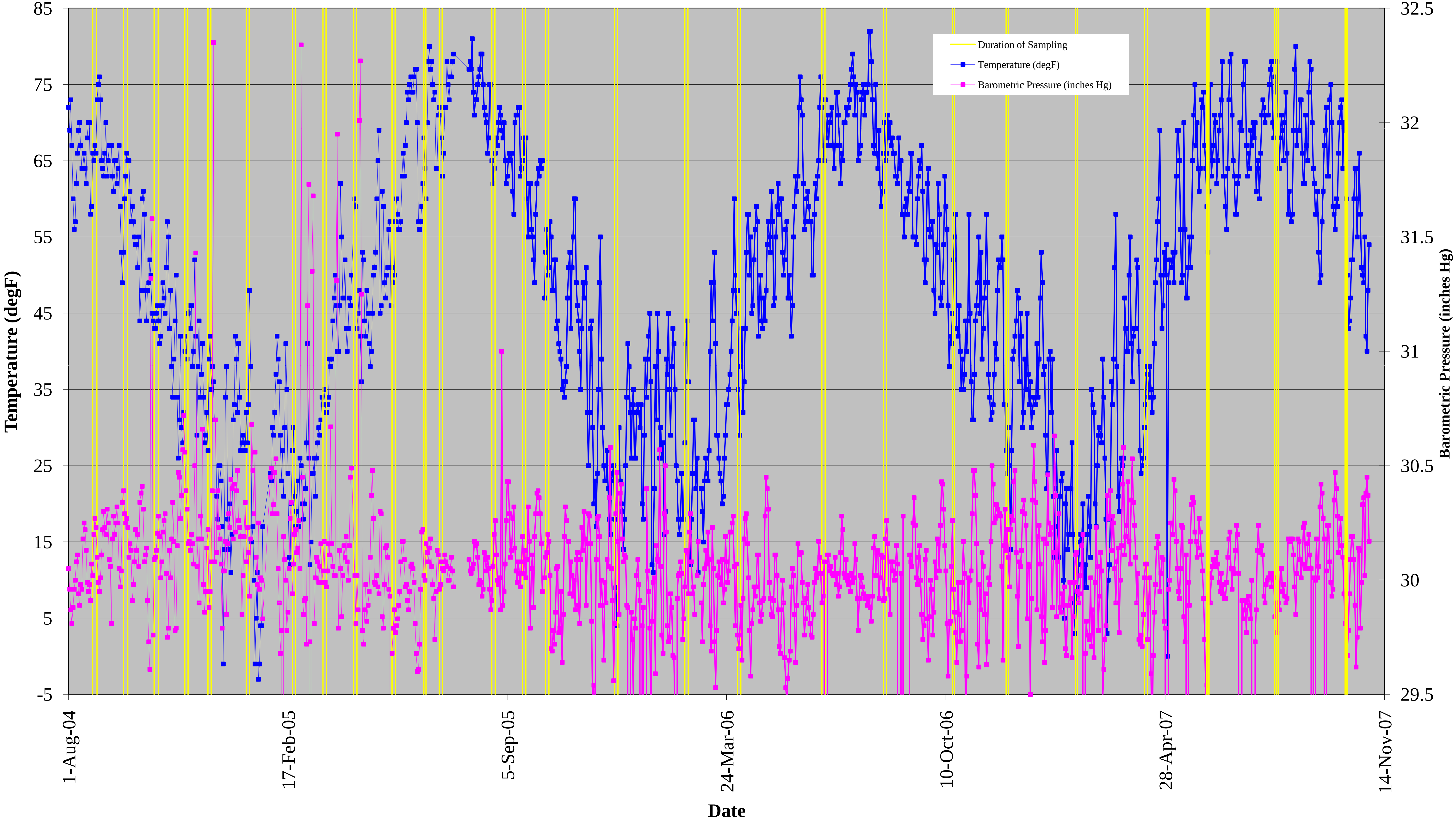

APPENDIX B.3

TIME SERIES PLOTS – FIGURES B.1 through B.37

Figure B.1
TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

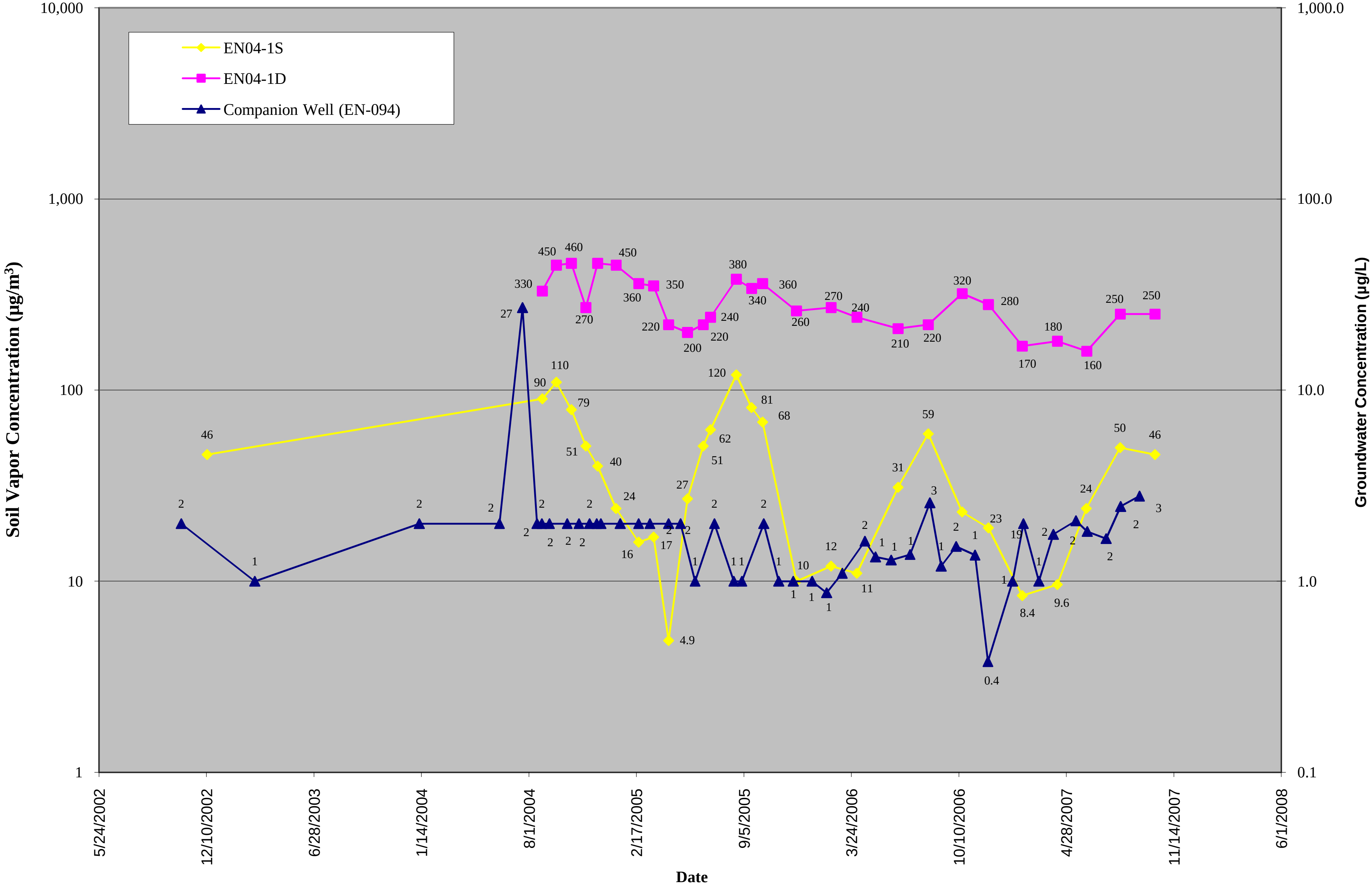

Figure B.2

TCE in Soil Vapor and Groundwater

Semiannual Report - Soil Vapor Monitoring through October 2007

Comprehensive Operations, Maintenance, & Monitoring Program

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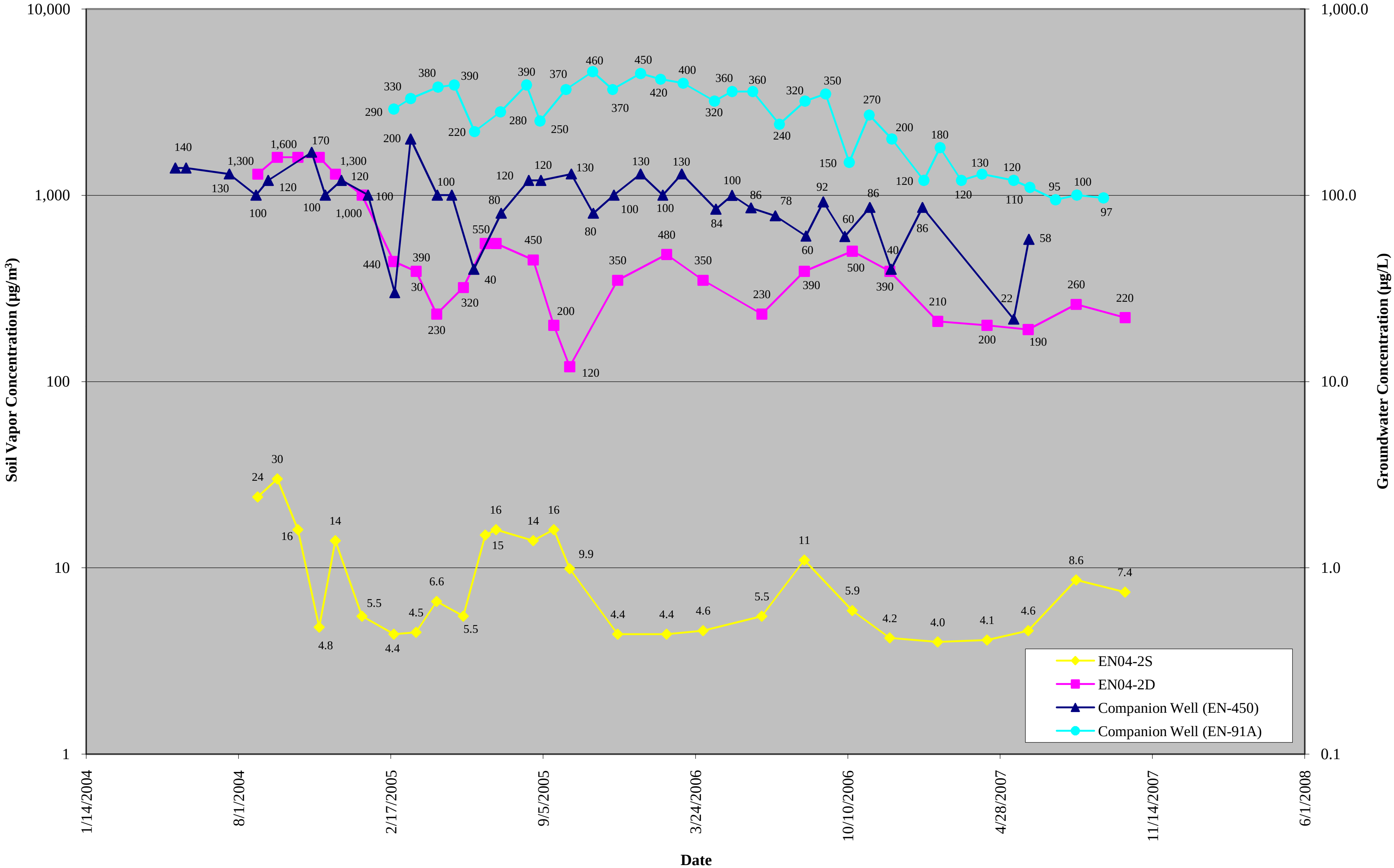

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TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

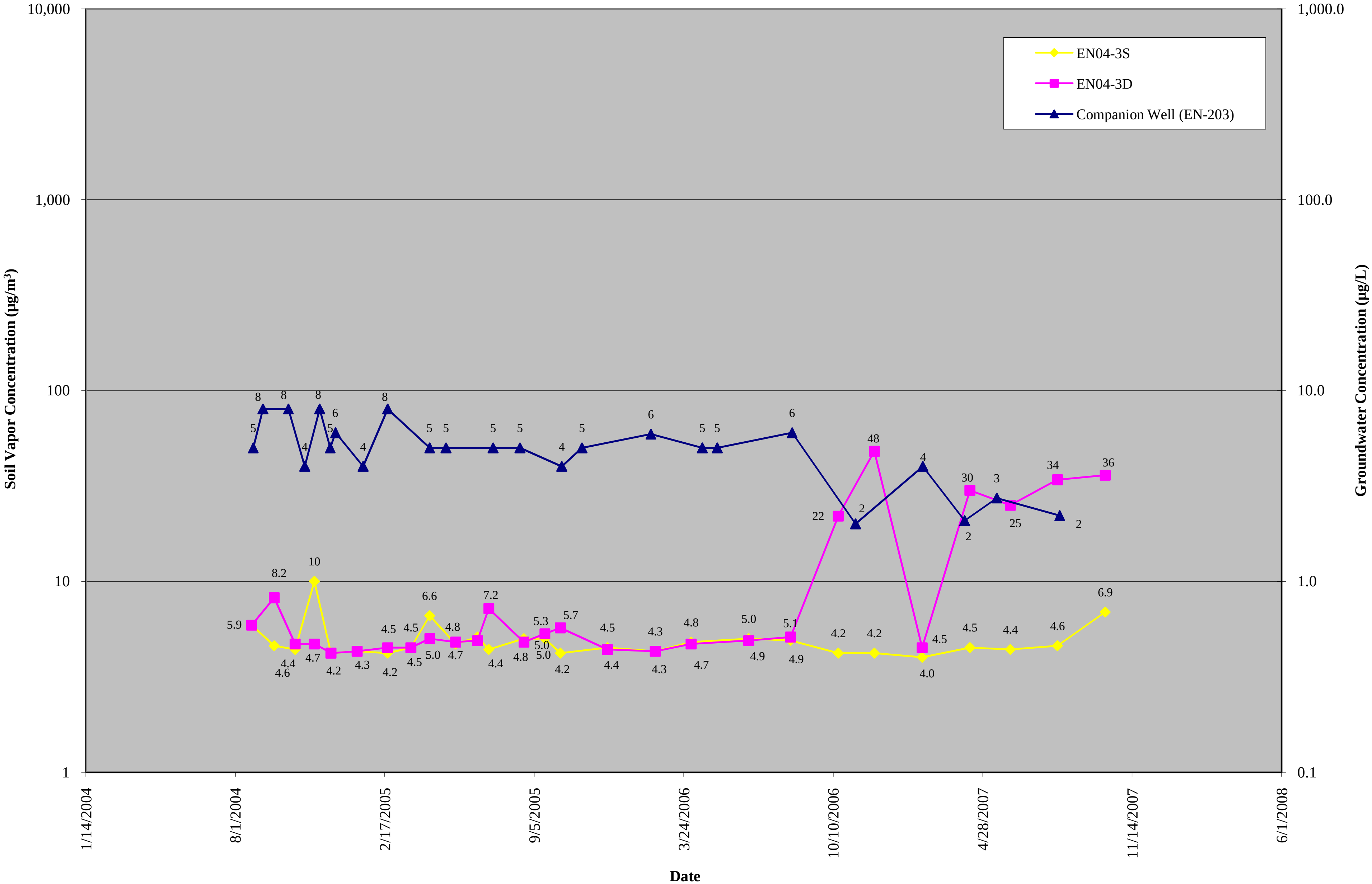

Figure B.4

TCE in Soil Vapor and Groundwater

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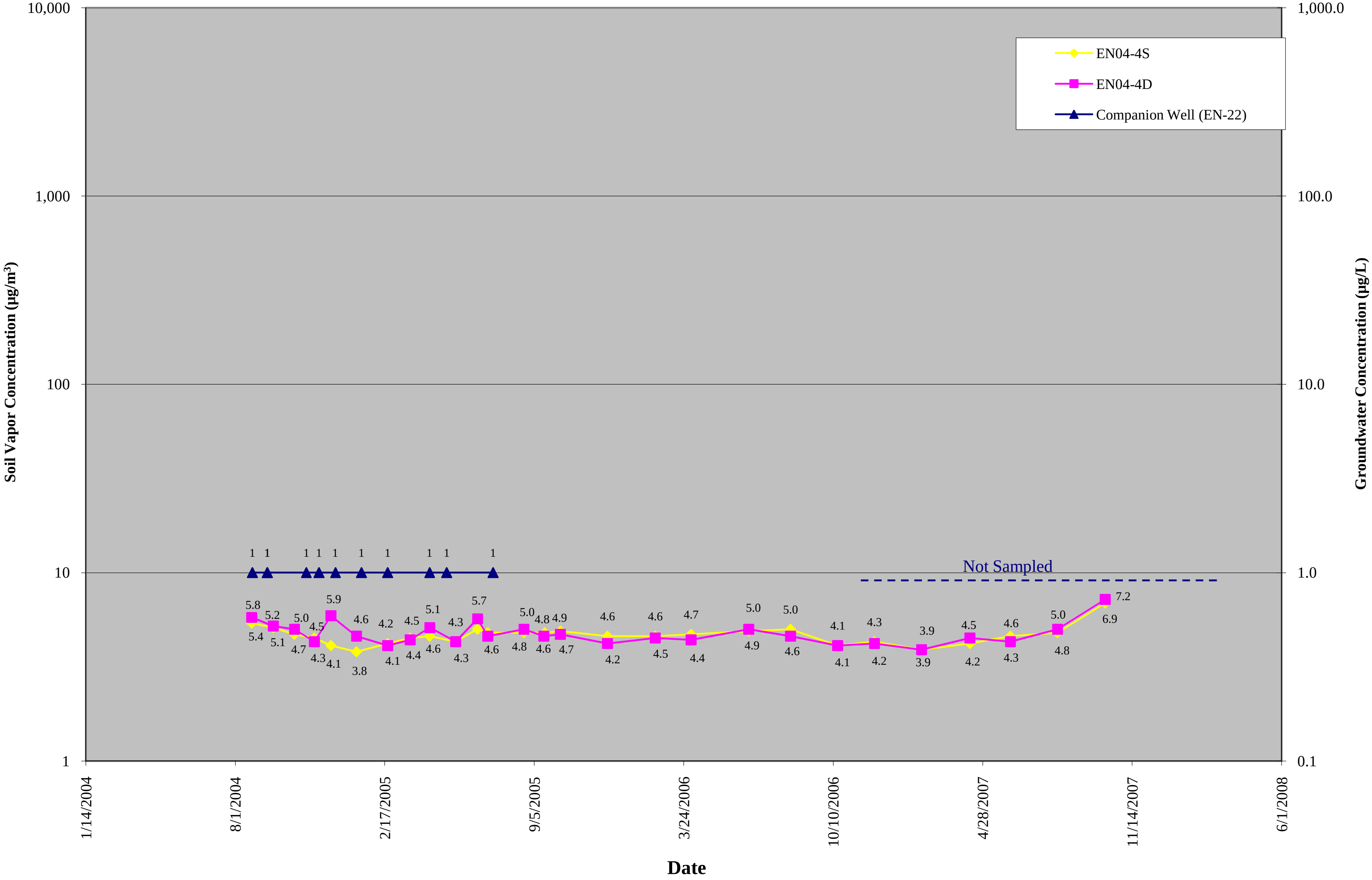

Figure B.5
TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
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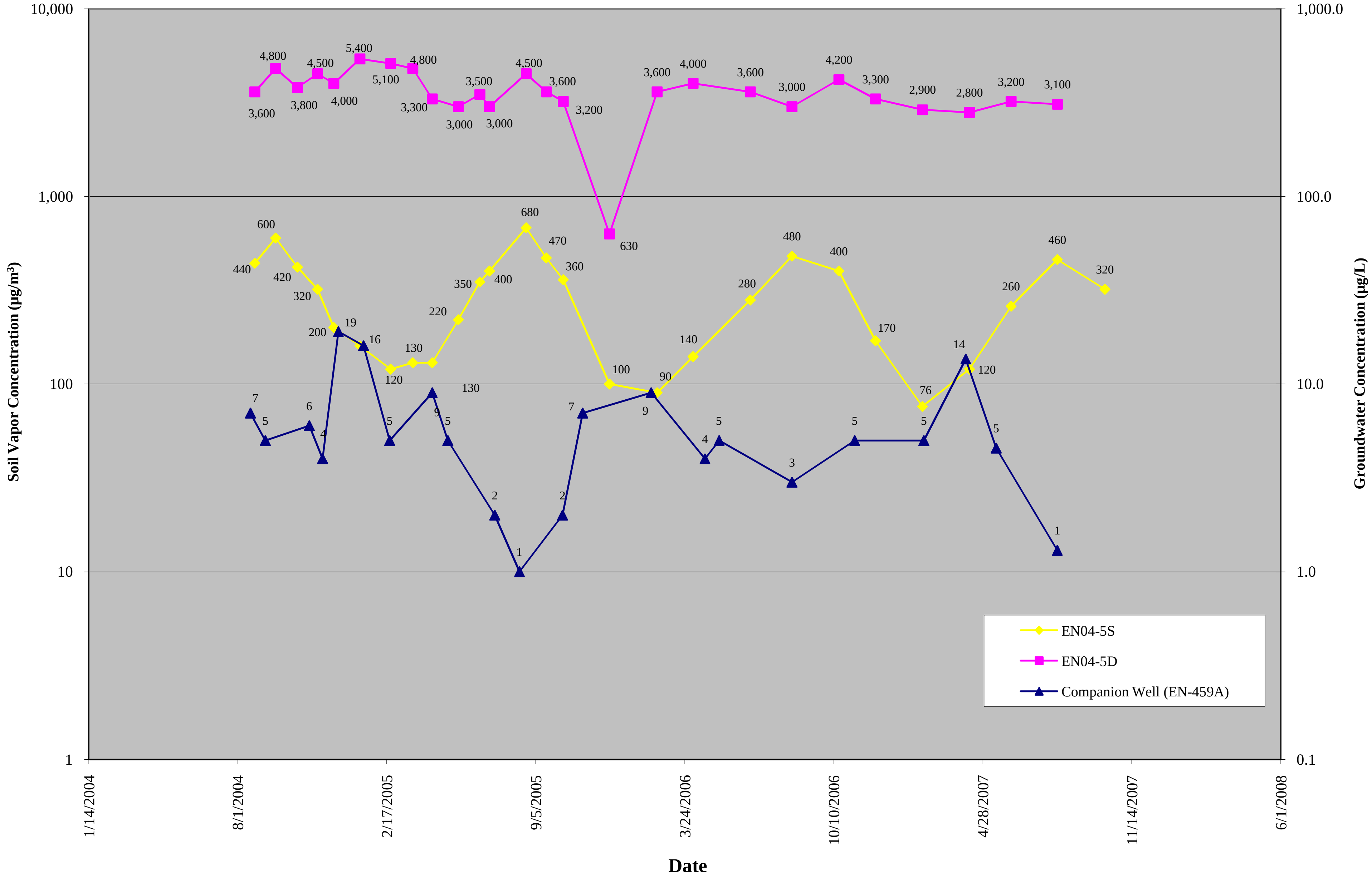

Figure B.6

TCE in Soil Vapor and Groundwater

Semiannual Report - Soil Vapor Monitoring through October 2007

Comprehensive Operations, Maintenance, & Monitoring Program

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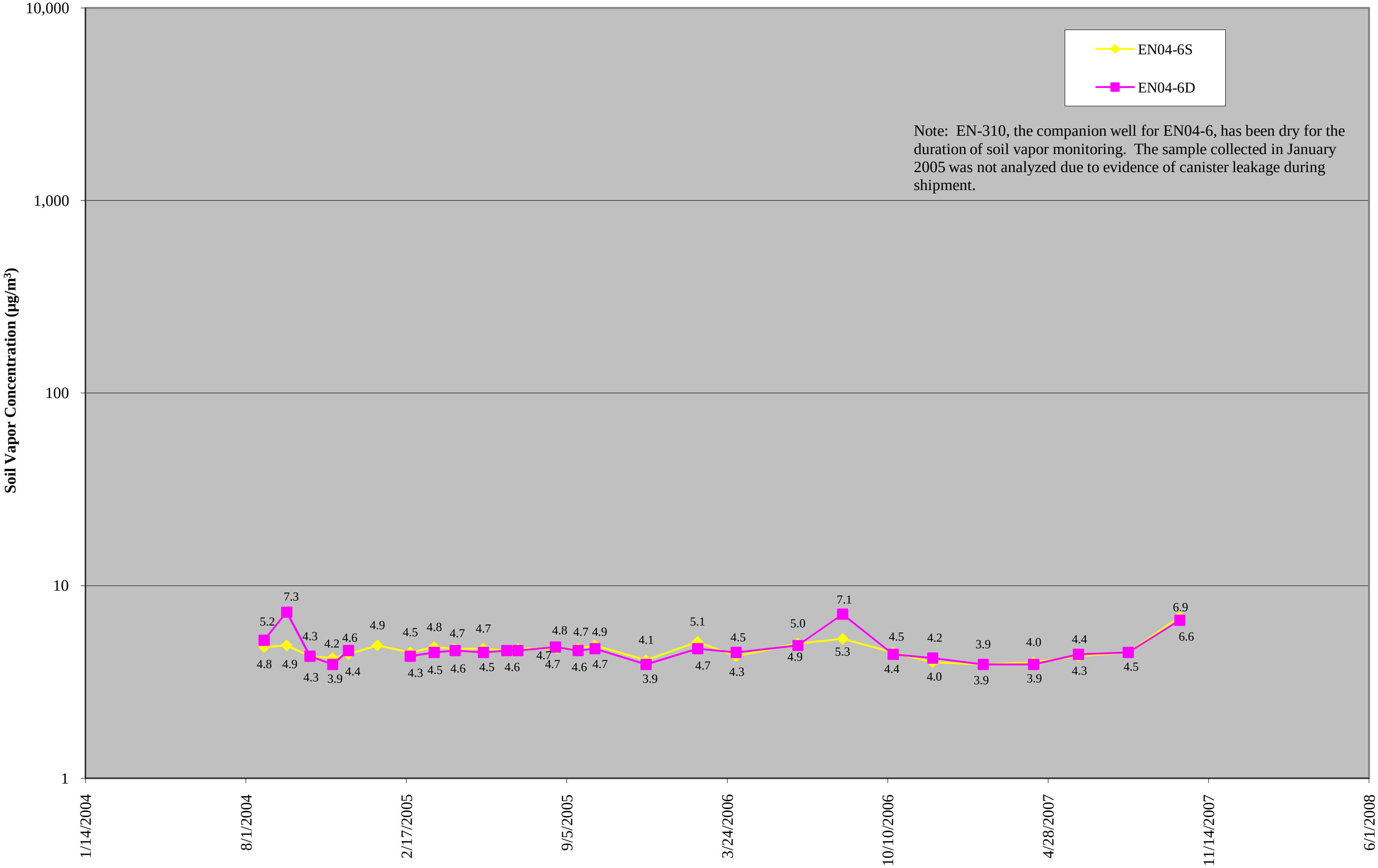

Figure B.7

TCE in Soil Vapor and Groundwater

Semiannual Report - Soil Vapor Monitoring through October 2007

Comprehensive Operations, Maintenance, & Monitoring Program

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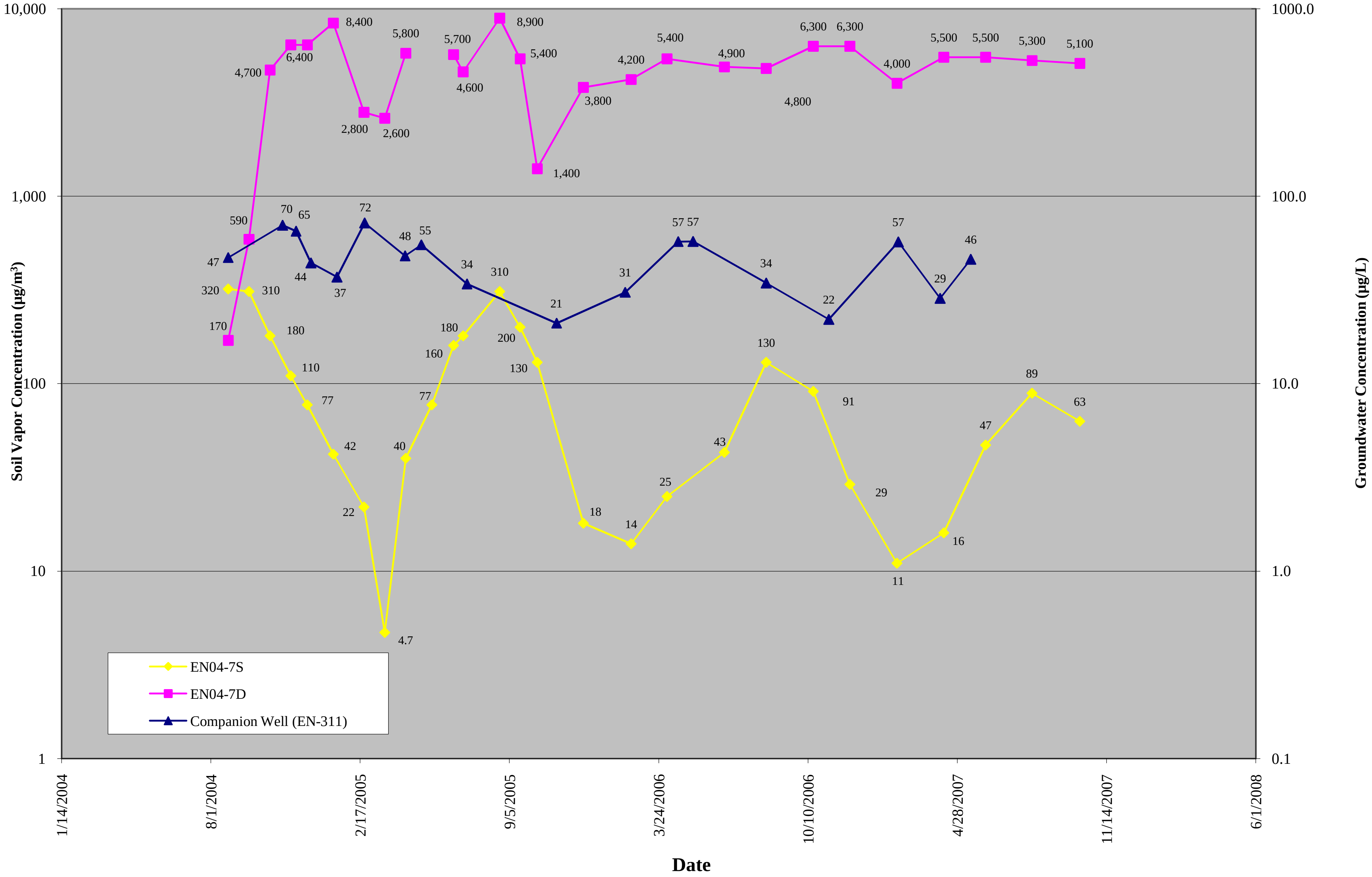


Figure B.8
TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

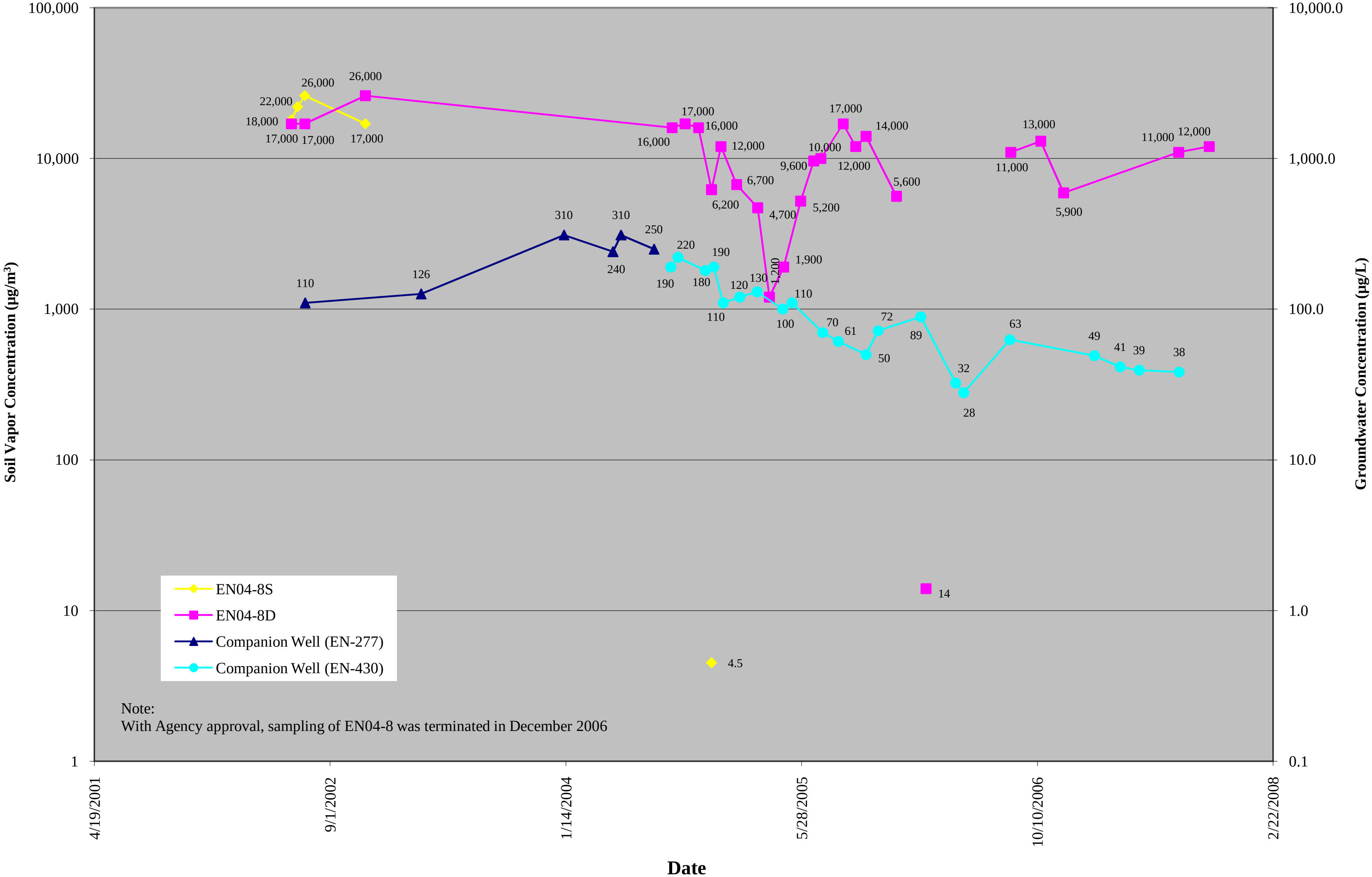
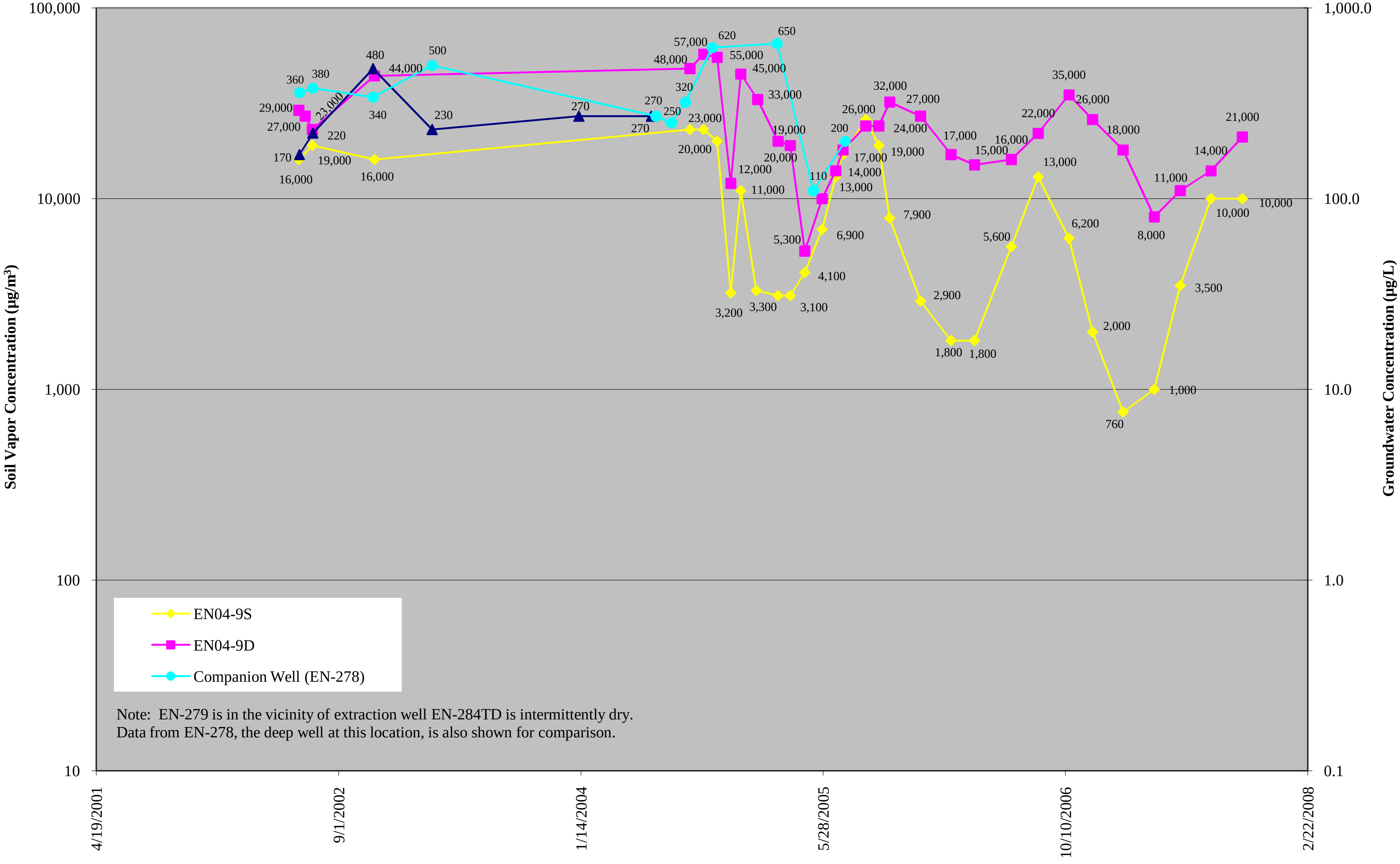


Figure B.9
TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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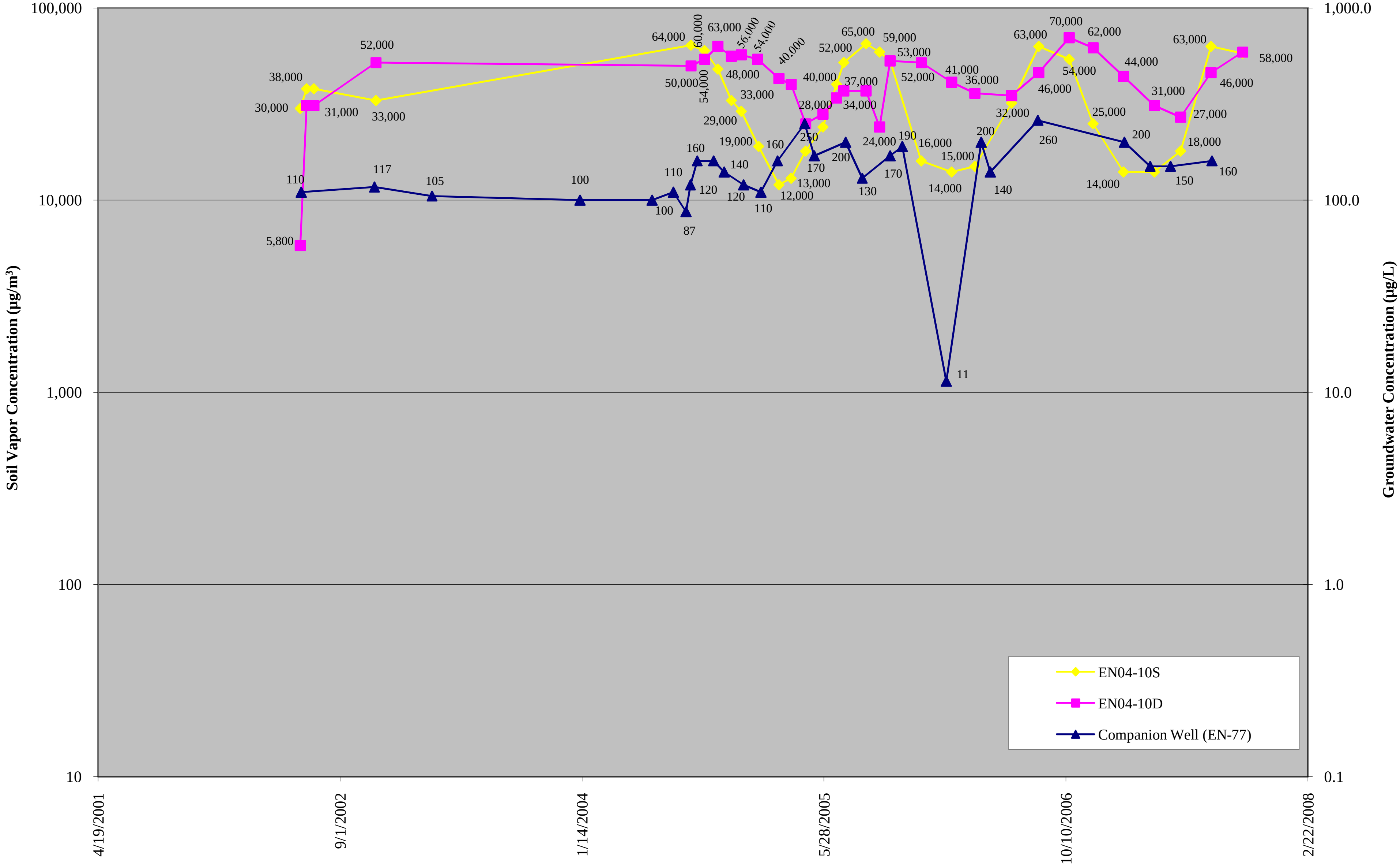
TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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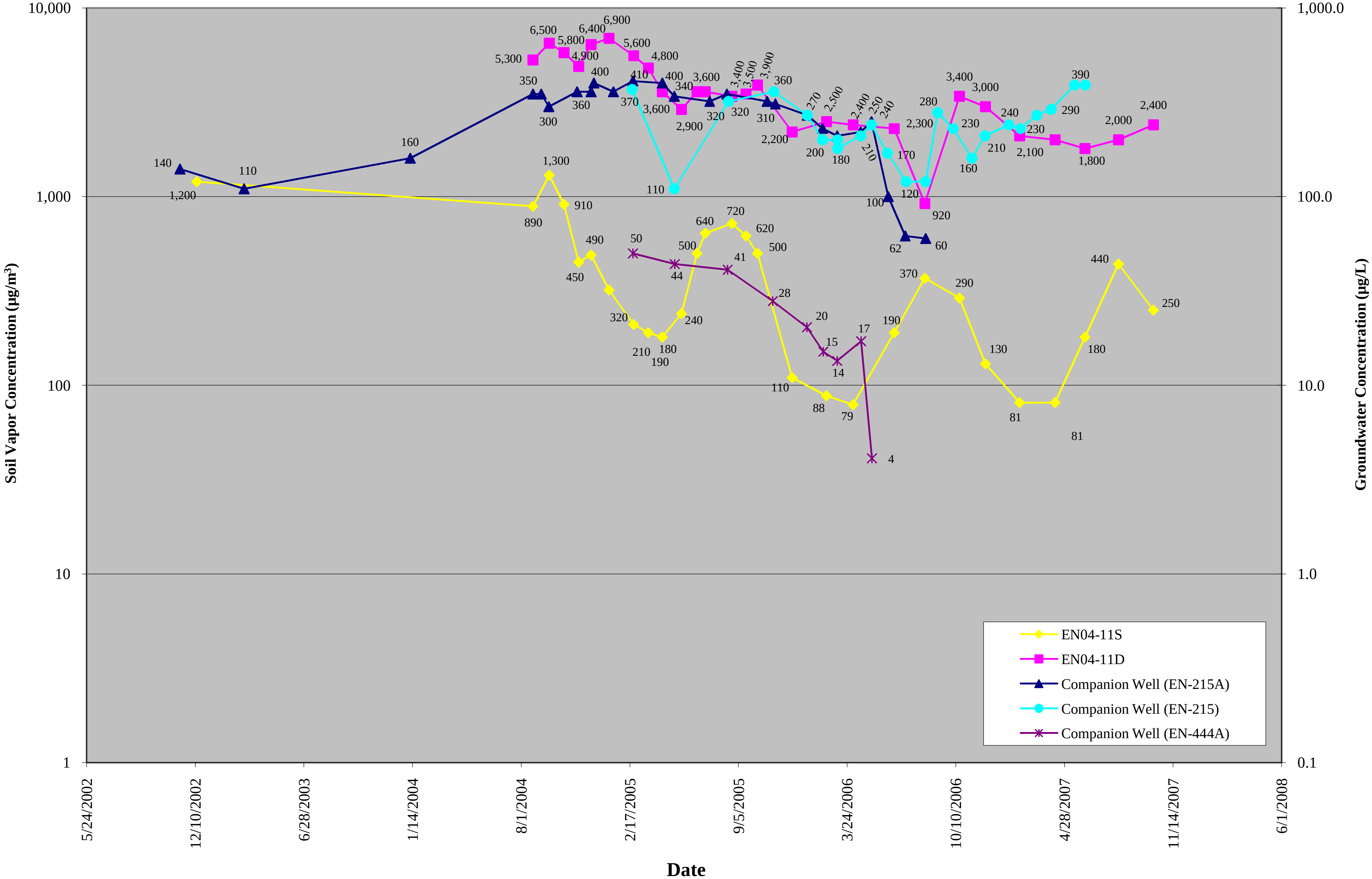
TCE in Soil Vapor and Groundwater

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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TCE in Soil Vapor and Groundwater
Annual Report - Soil Vapor Monitoring through April 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

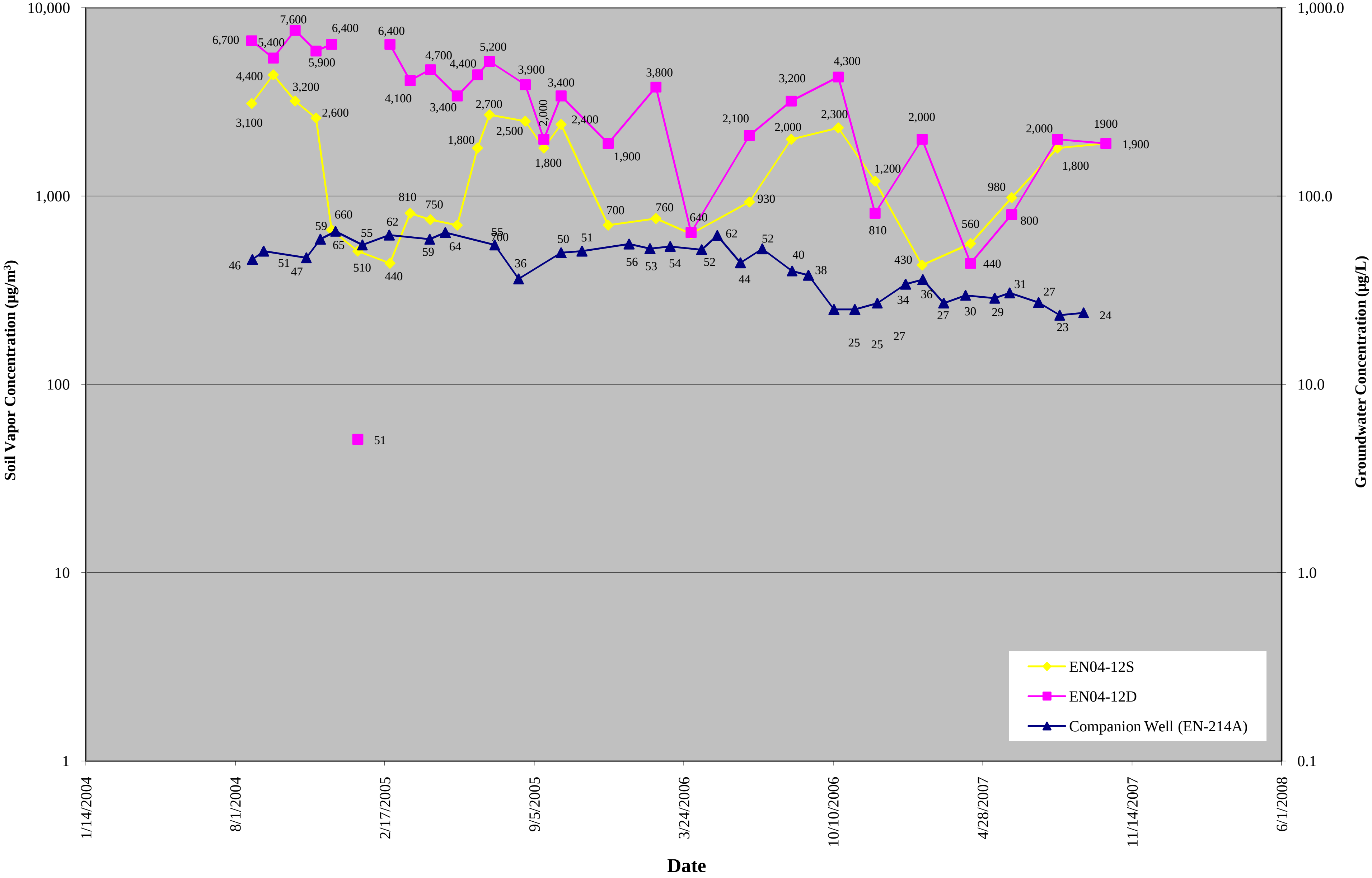
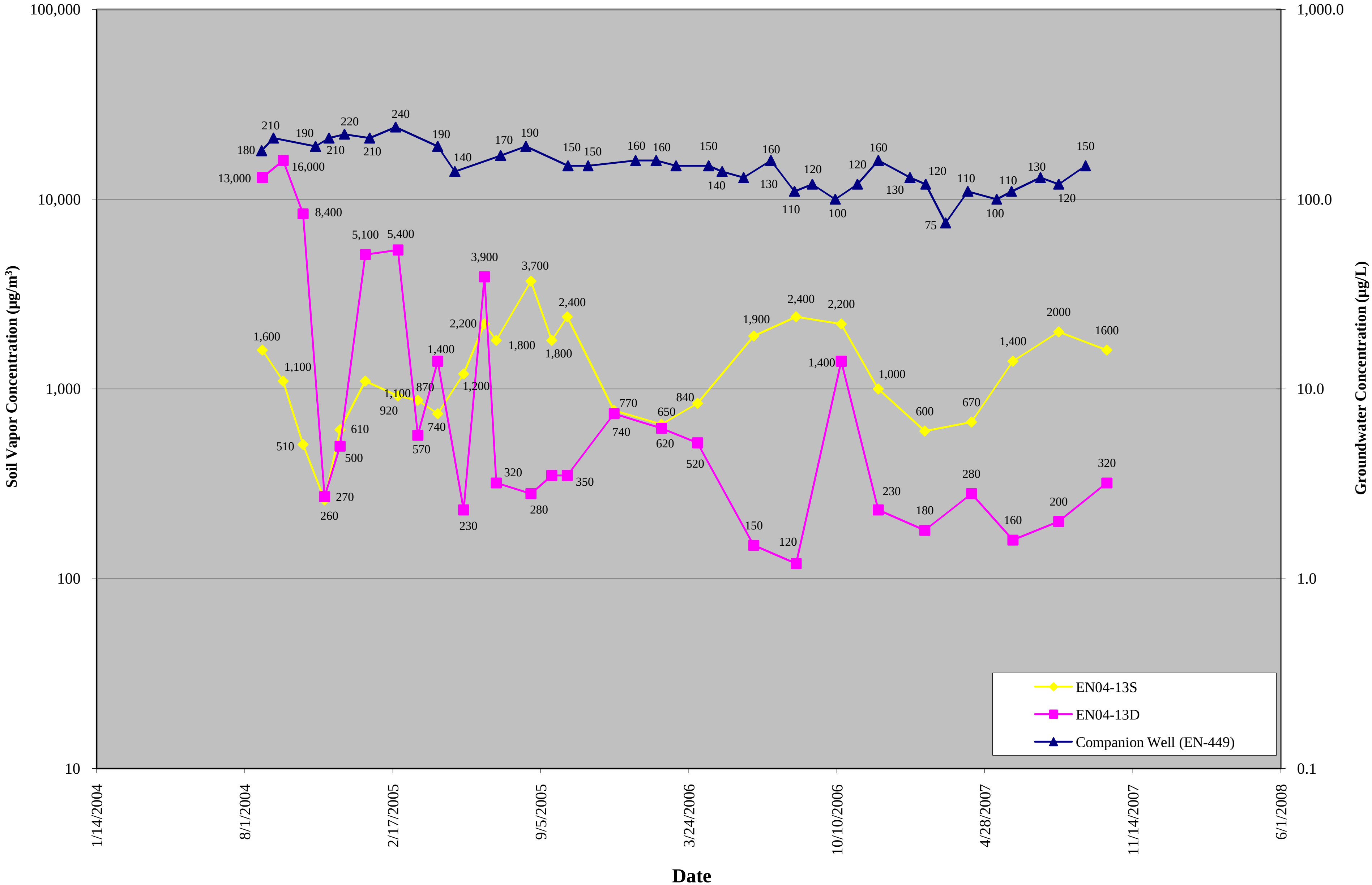


Figure B.13
TCE in Soil Vapor and Groundwater

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
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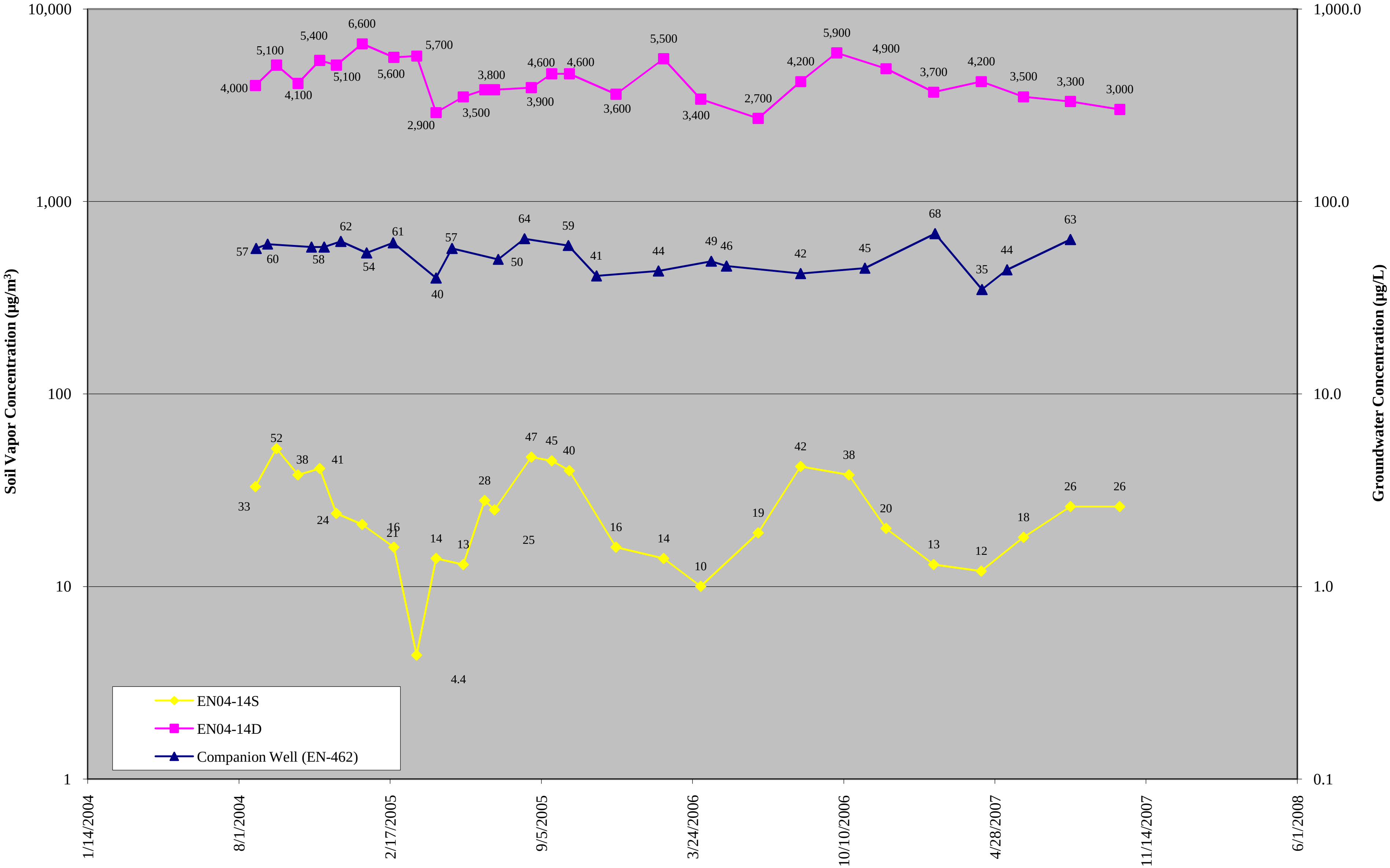

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TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

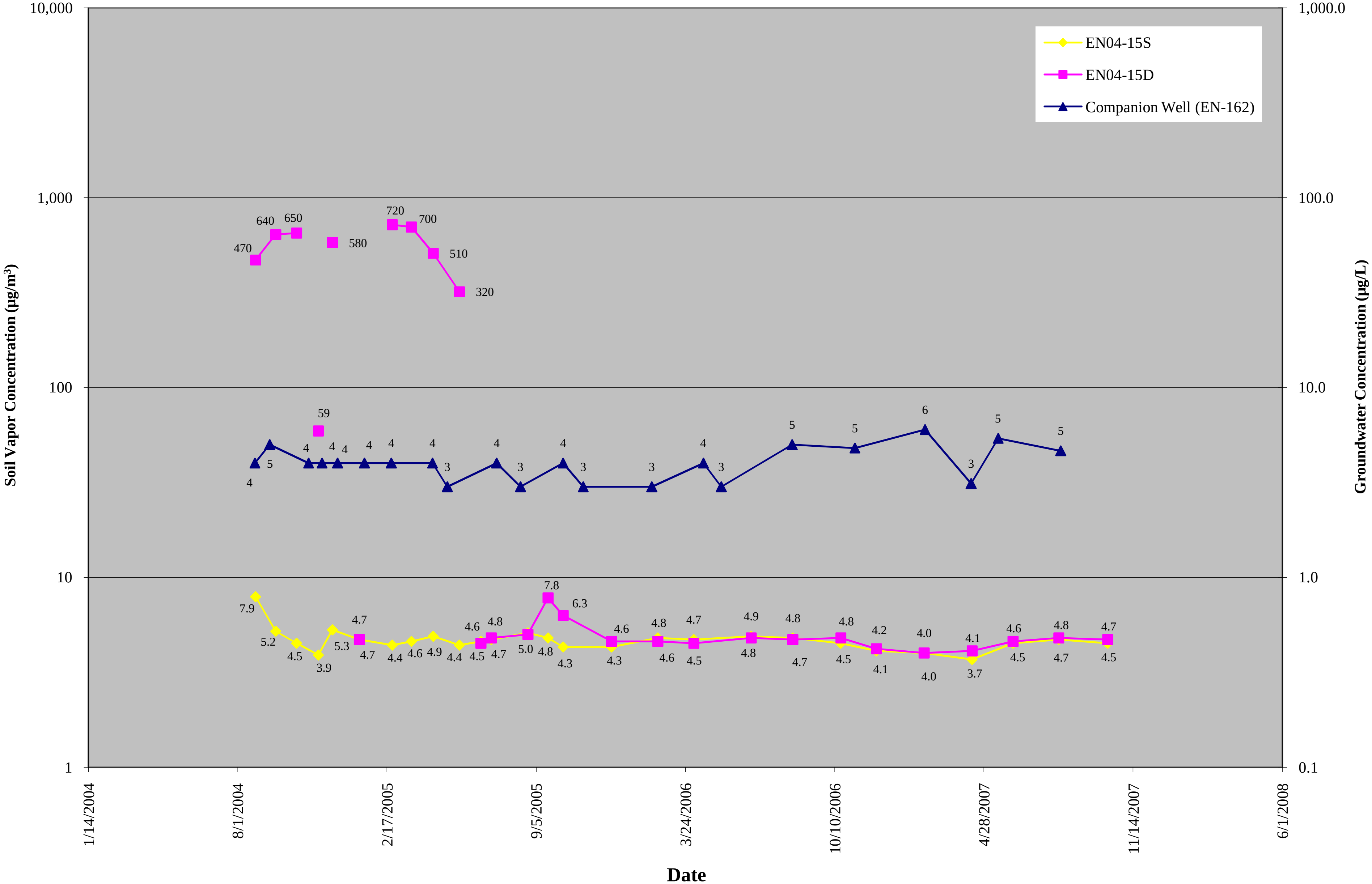

Figure B.16
TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
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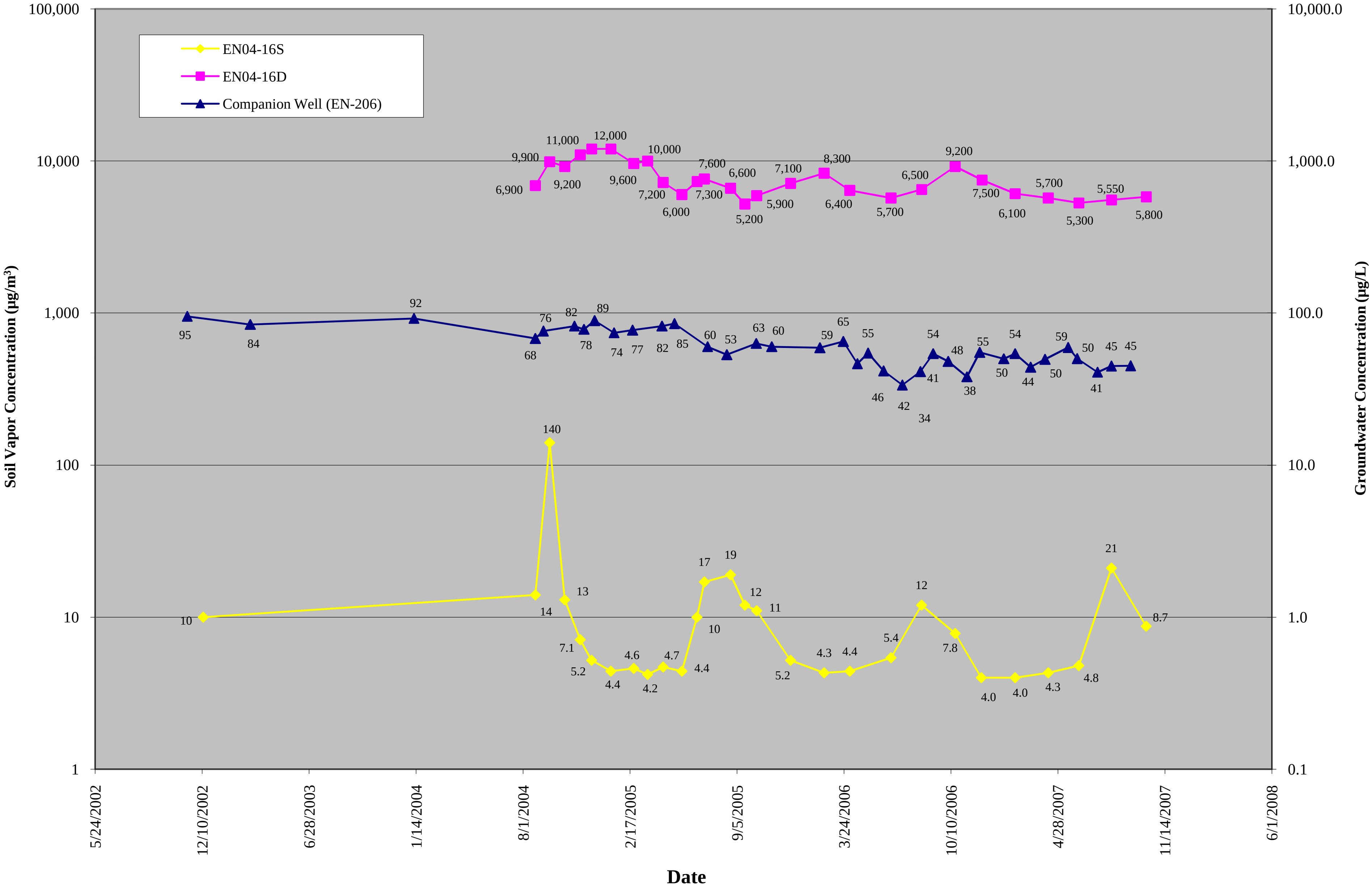

Figure B.17

TCE in Soil Vapor and Groundwater

Semiannual Report - Soil Vapor Monitoring through October 2007

Comprehensive Operations, Maintenance, & Monitoring Program

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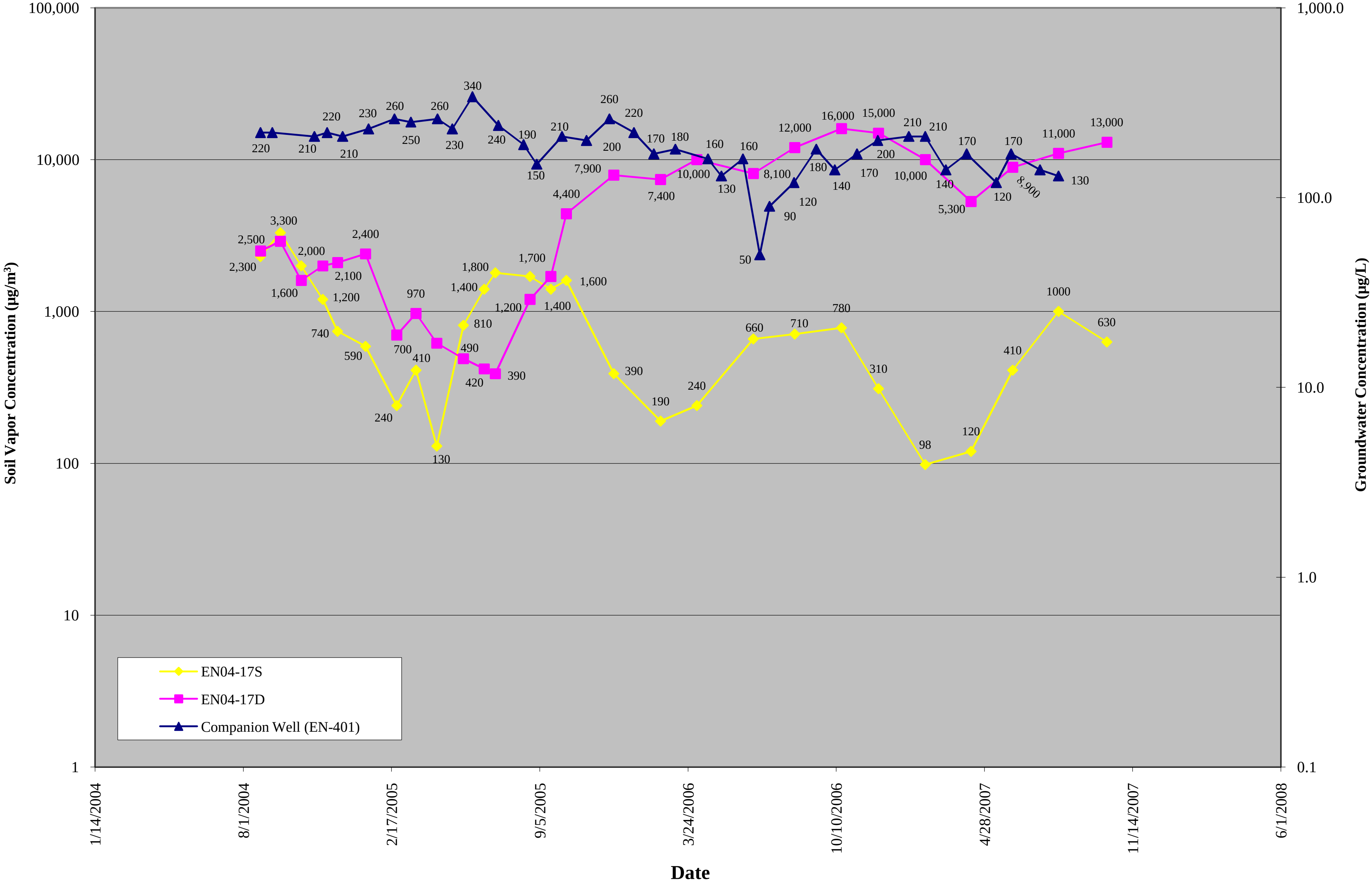

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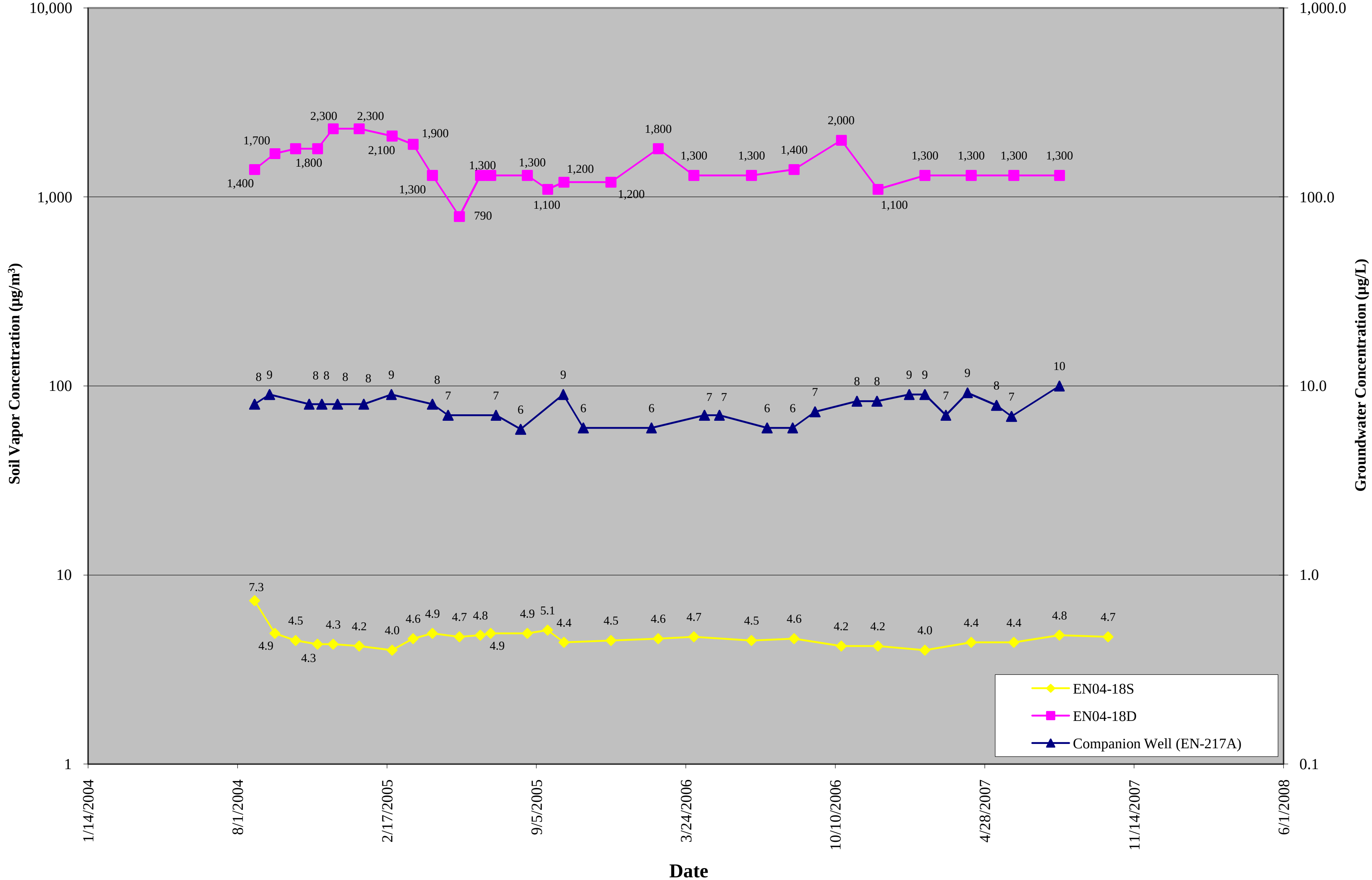
TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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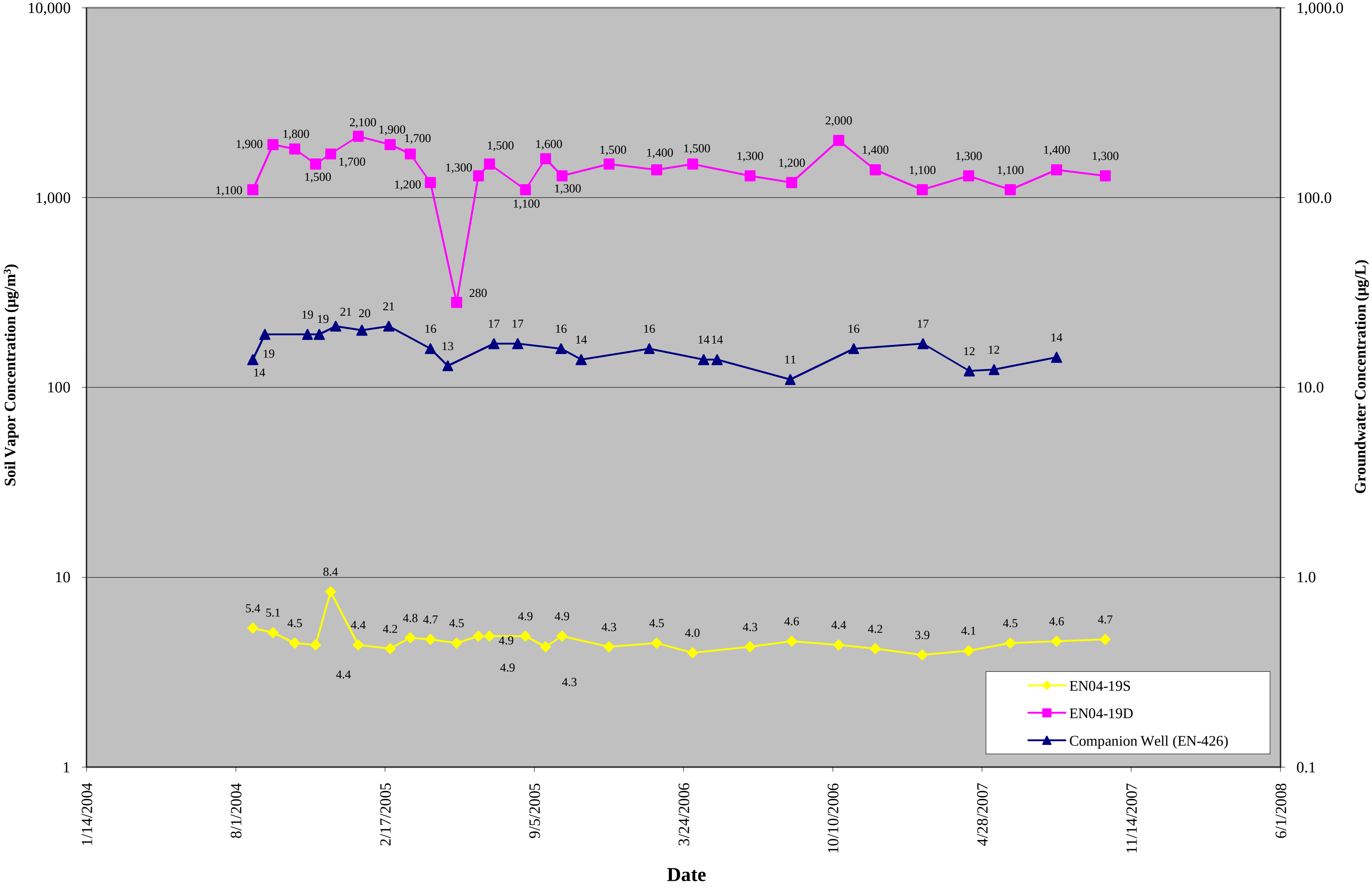
TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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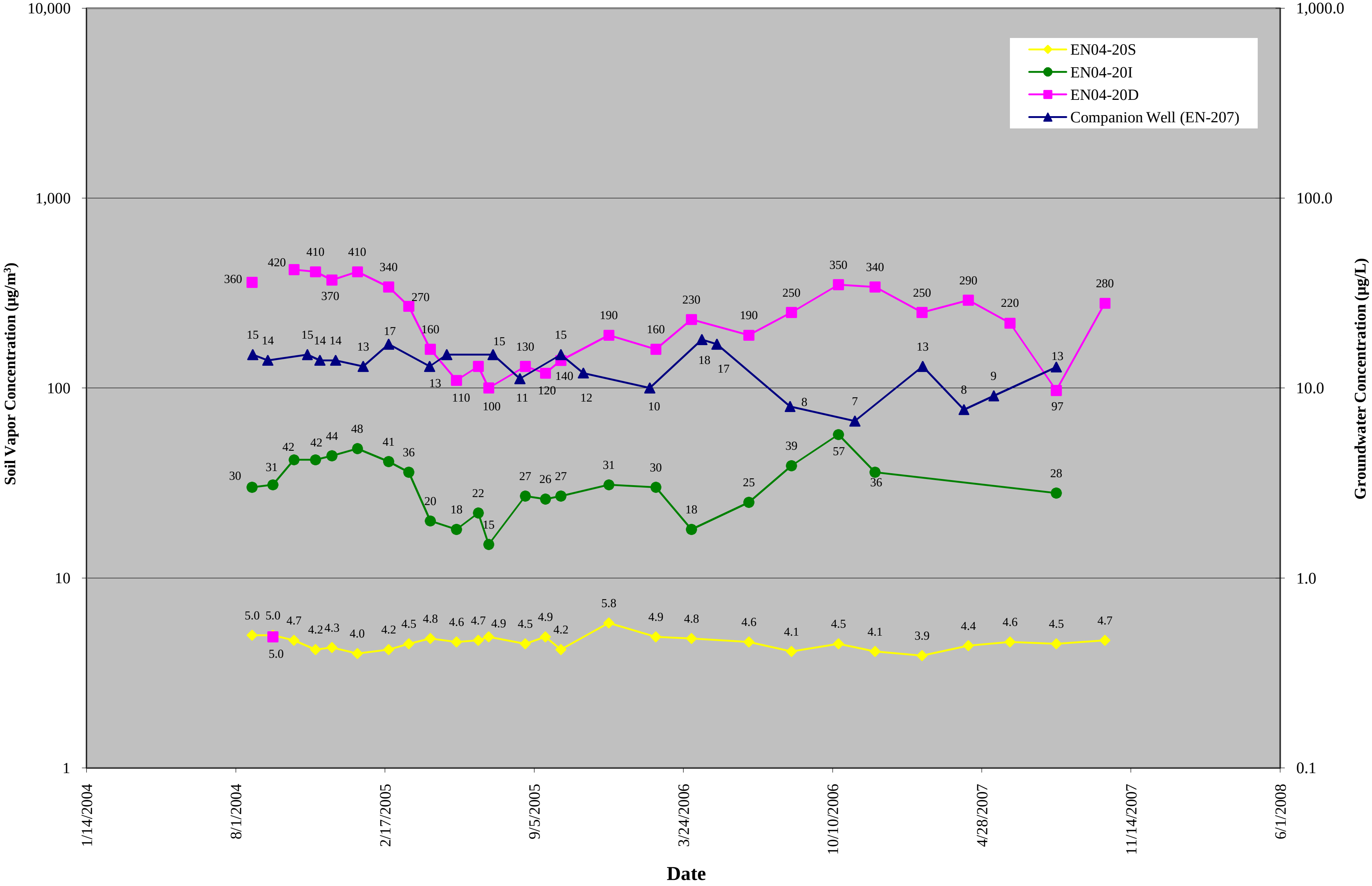
TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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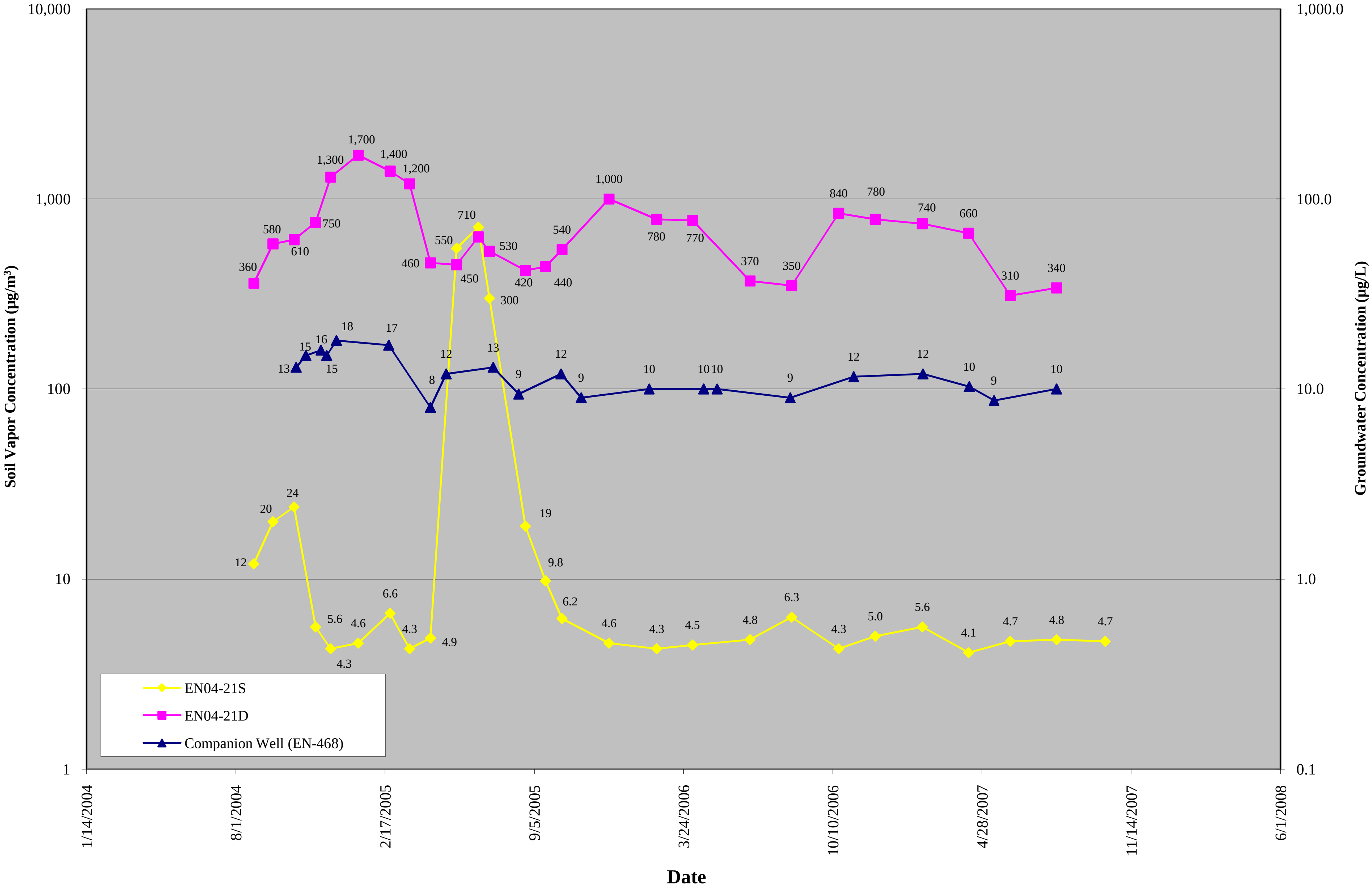
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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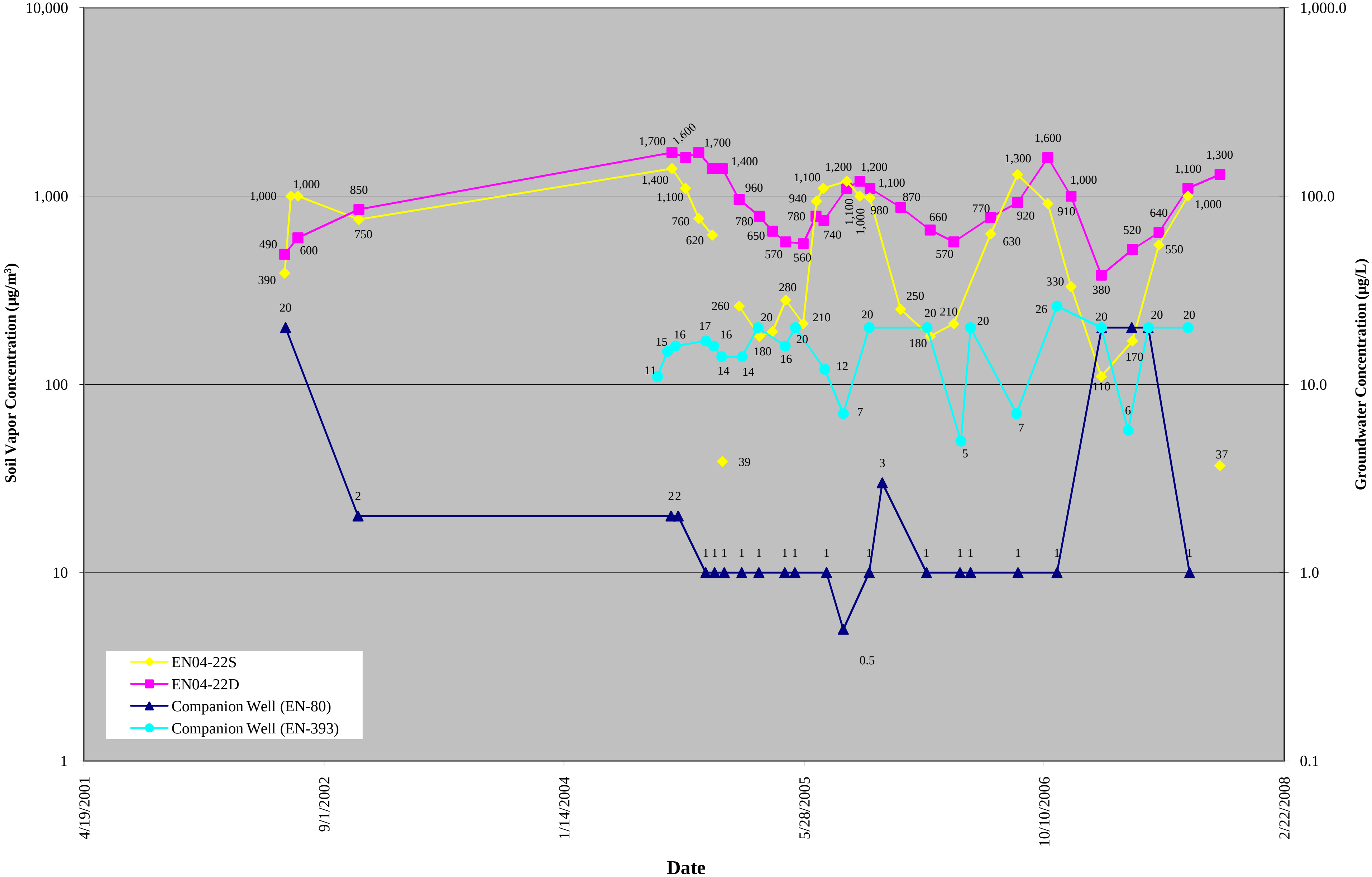
TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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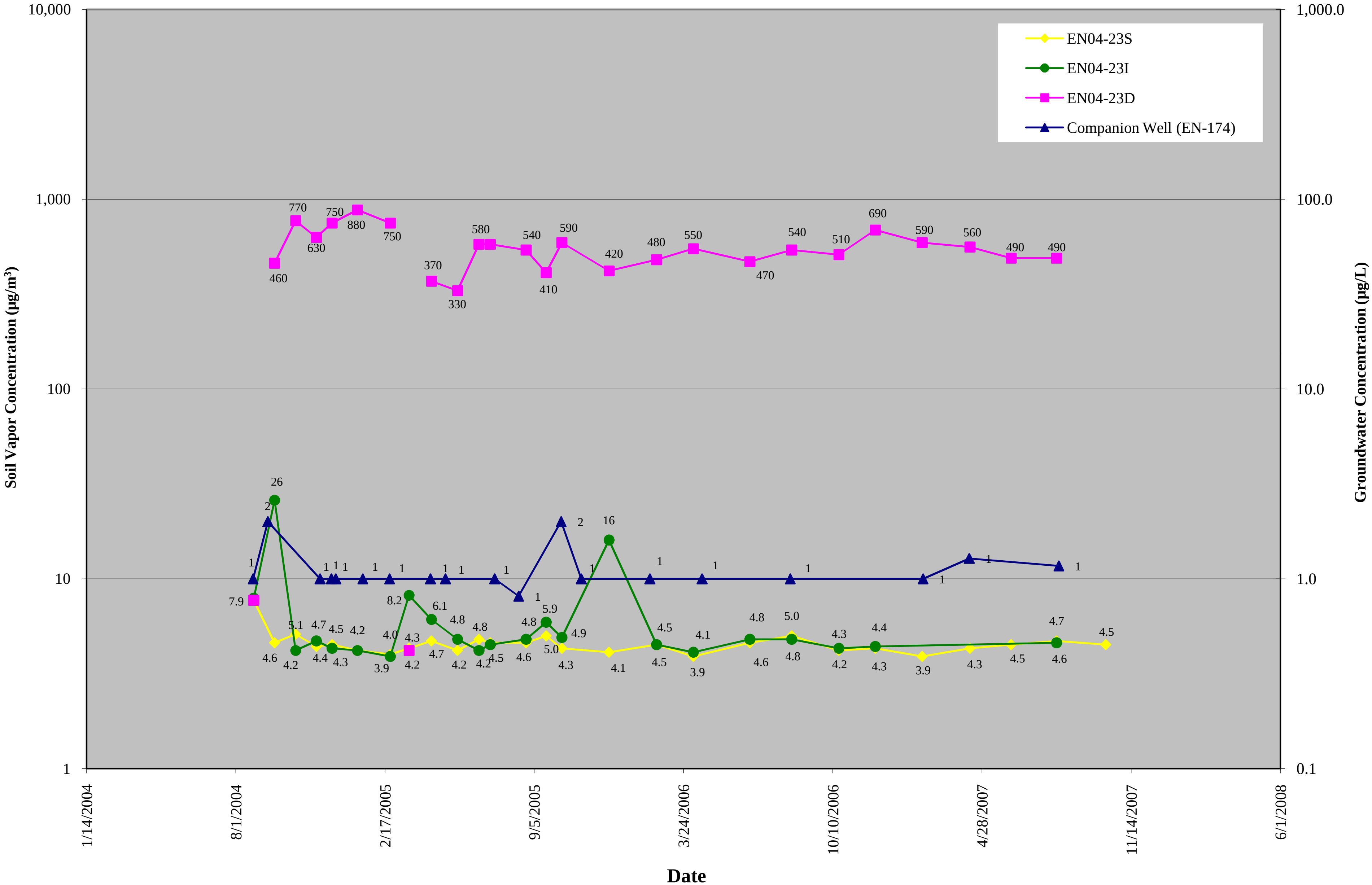
TCE in Soil Vapor and Groundwater

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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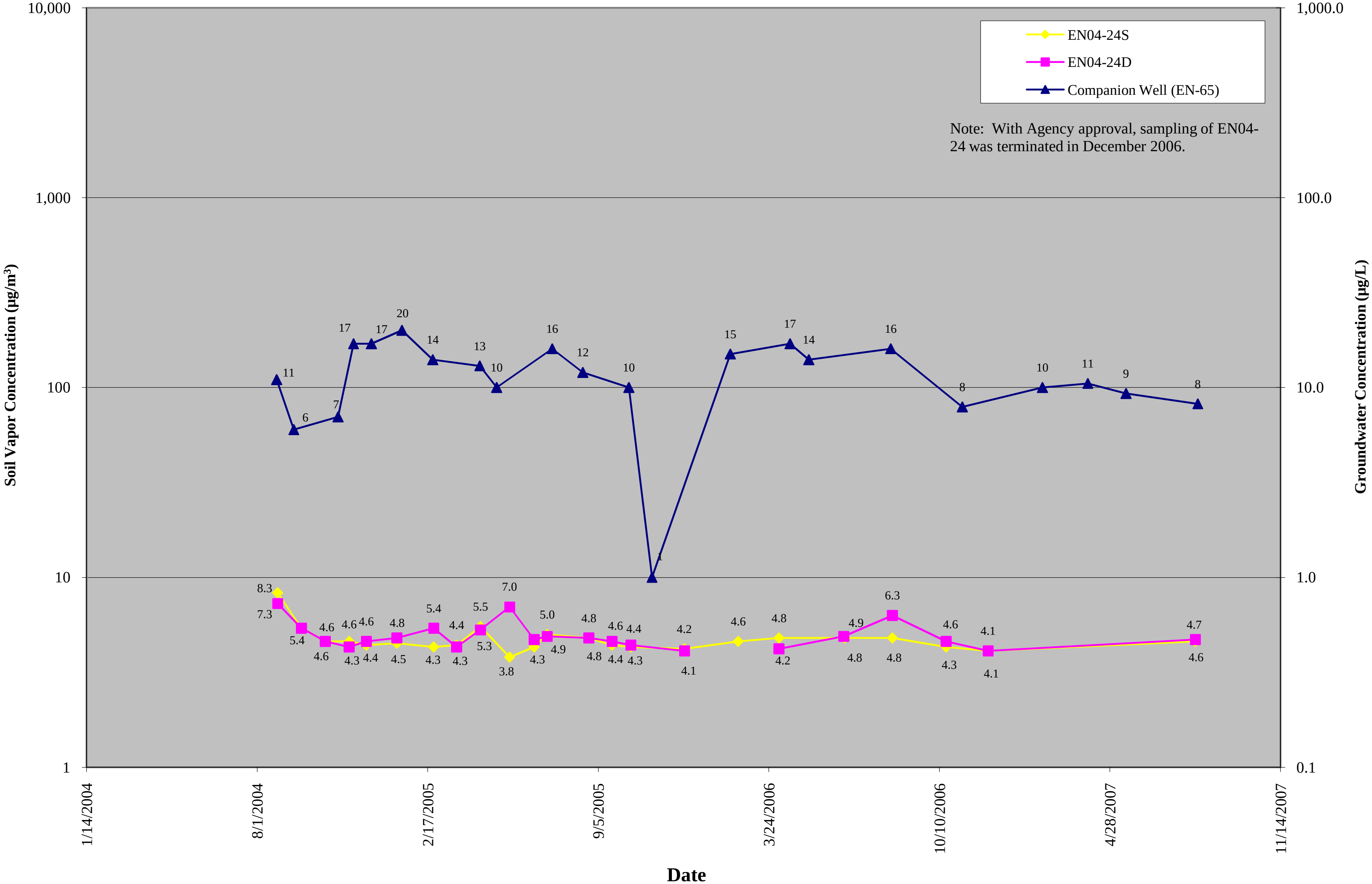
TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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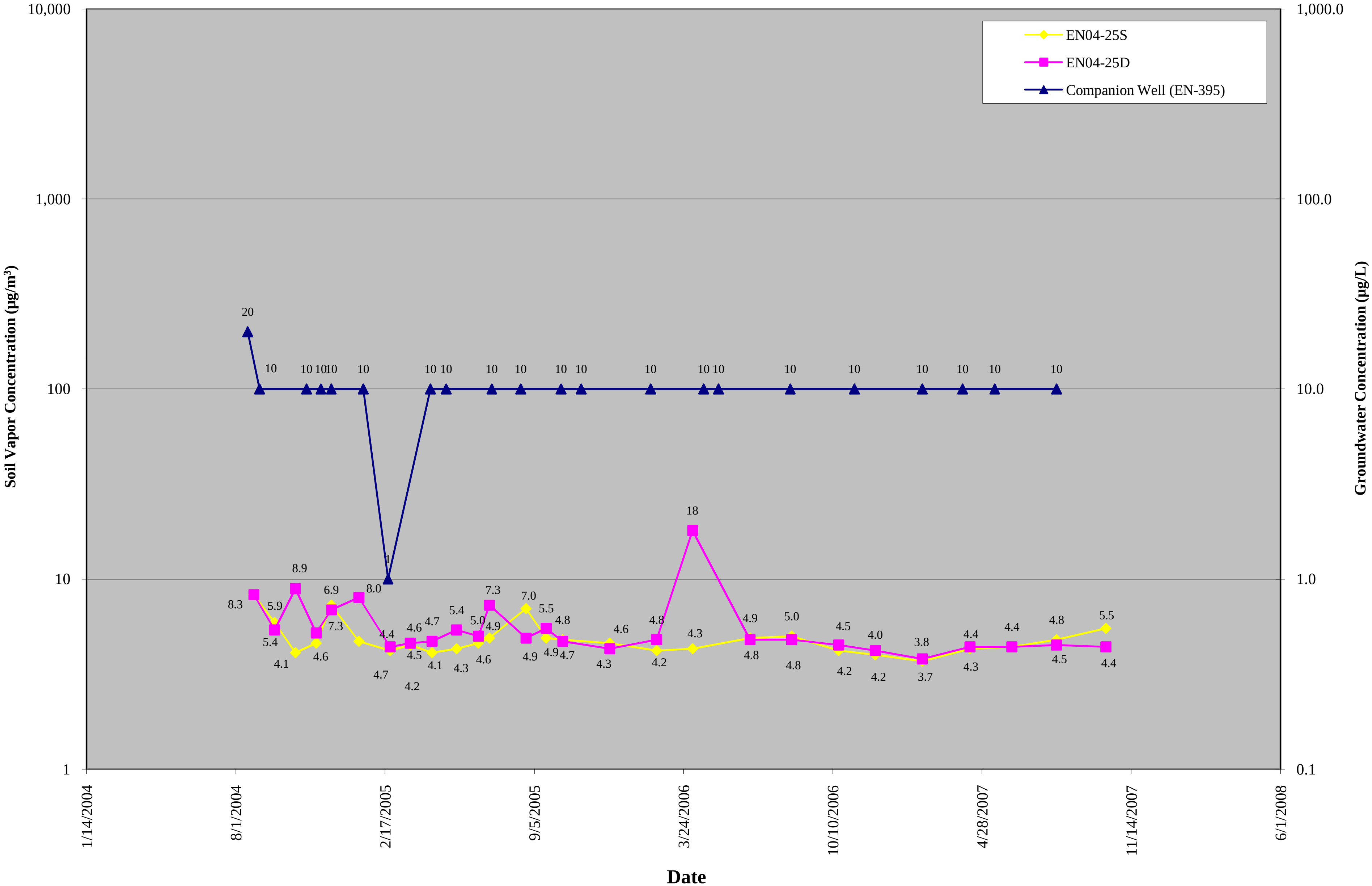
TCE in Soil Vapor and Groundwater

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

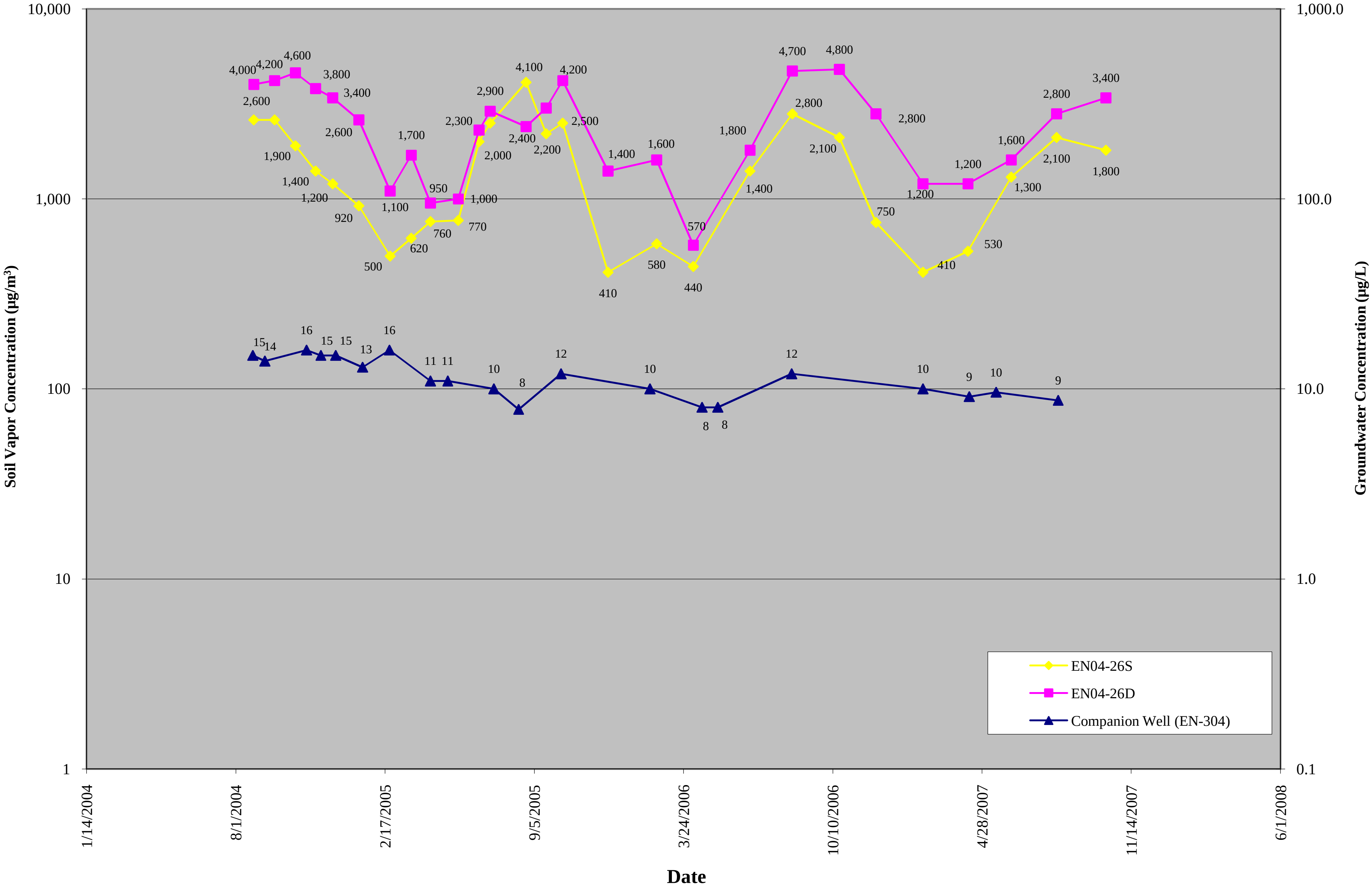


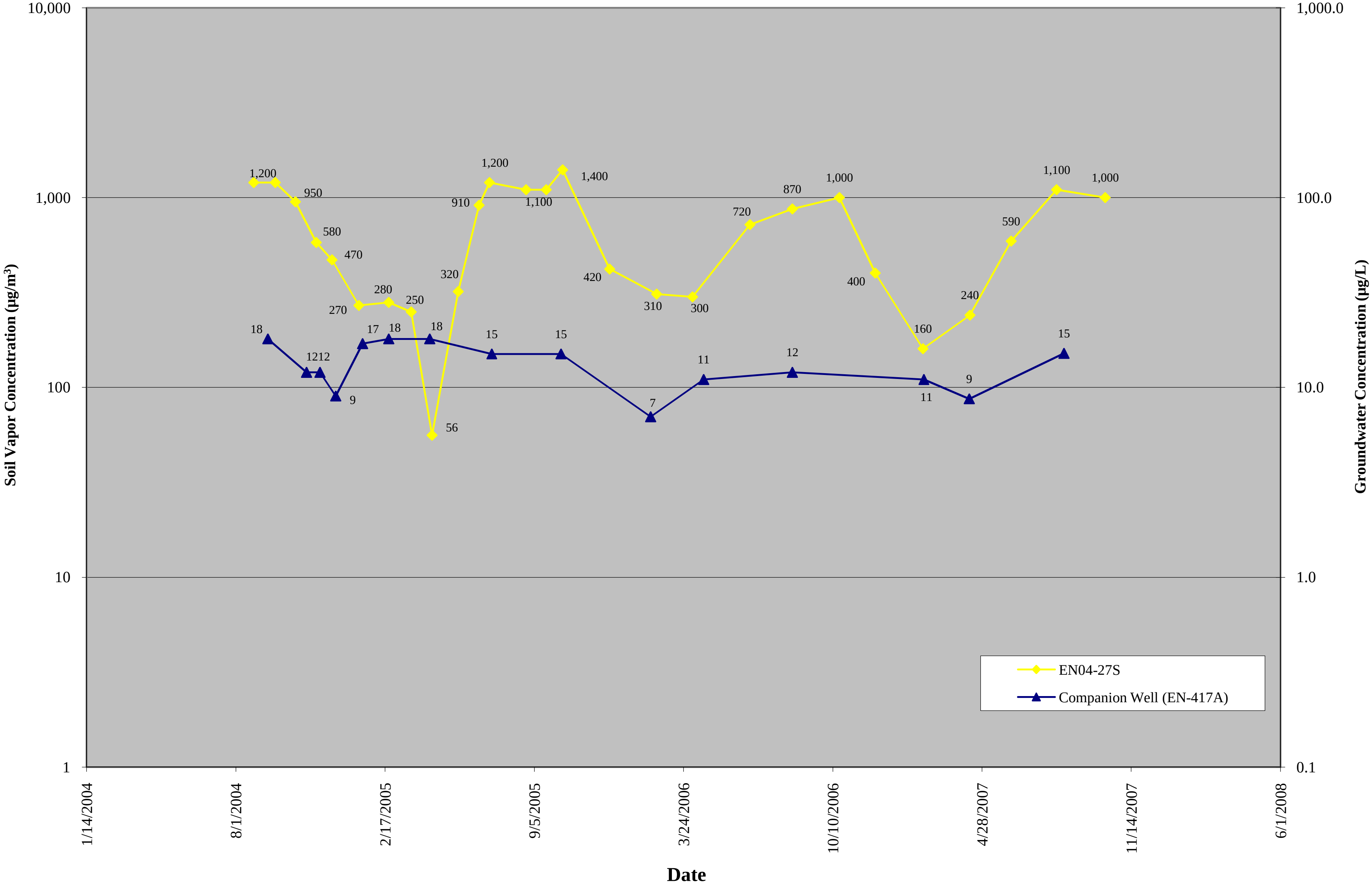
Figure B.27

TCE in Soil Vapor and Groundwater

Semiannual Report - Soil Vapor Monitoring through October 2007

Comprehensive Operations, Maintenance, & Monitoring Program

Endicott, New York



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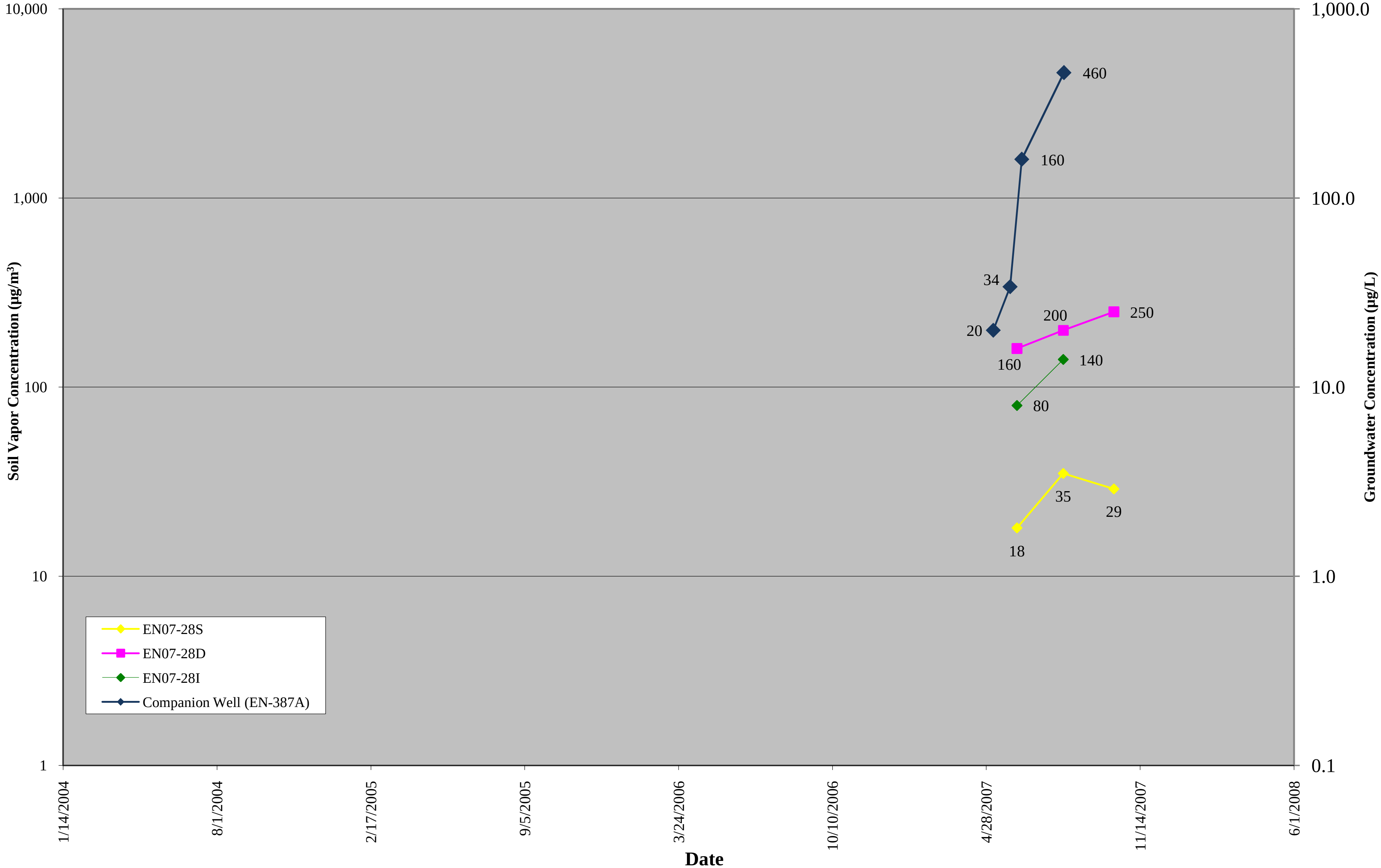
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

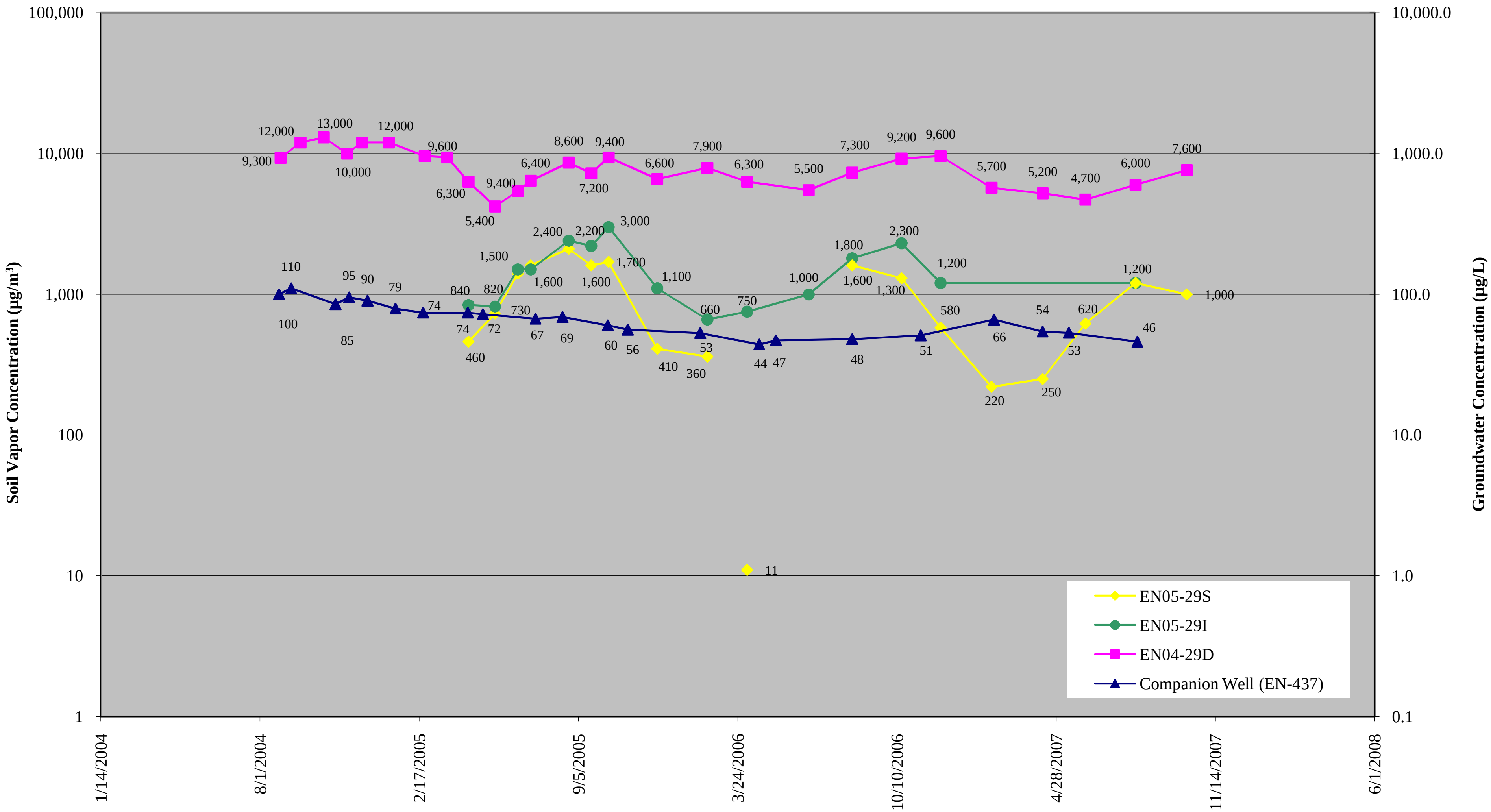


Figure B.30
TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

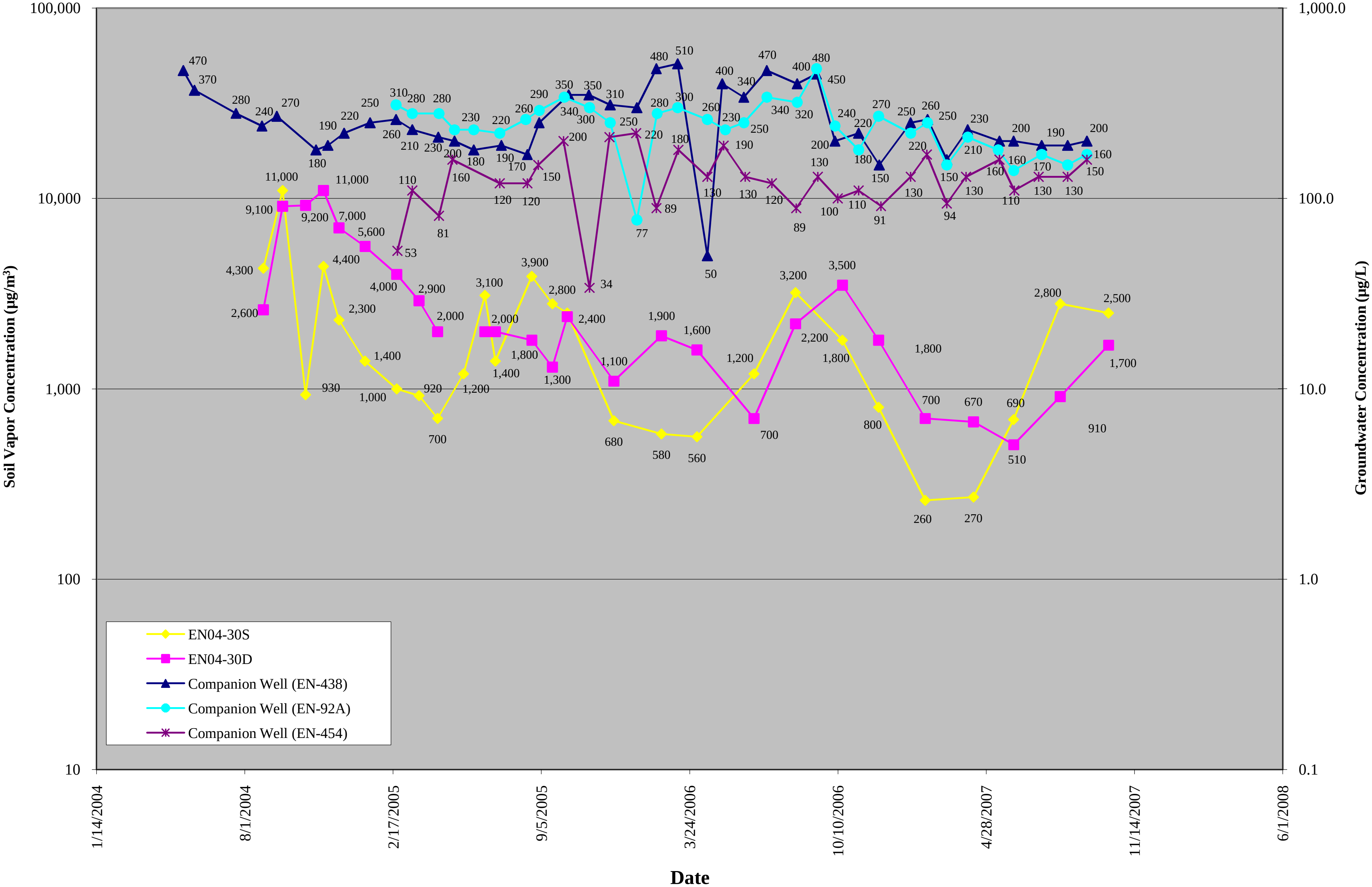
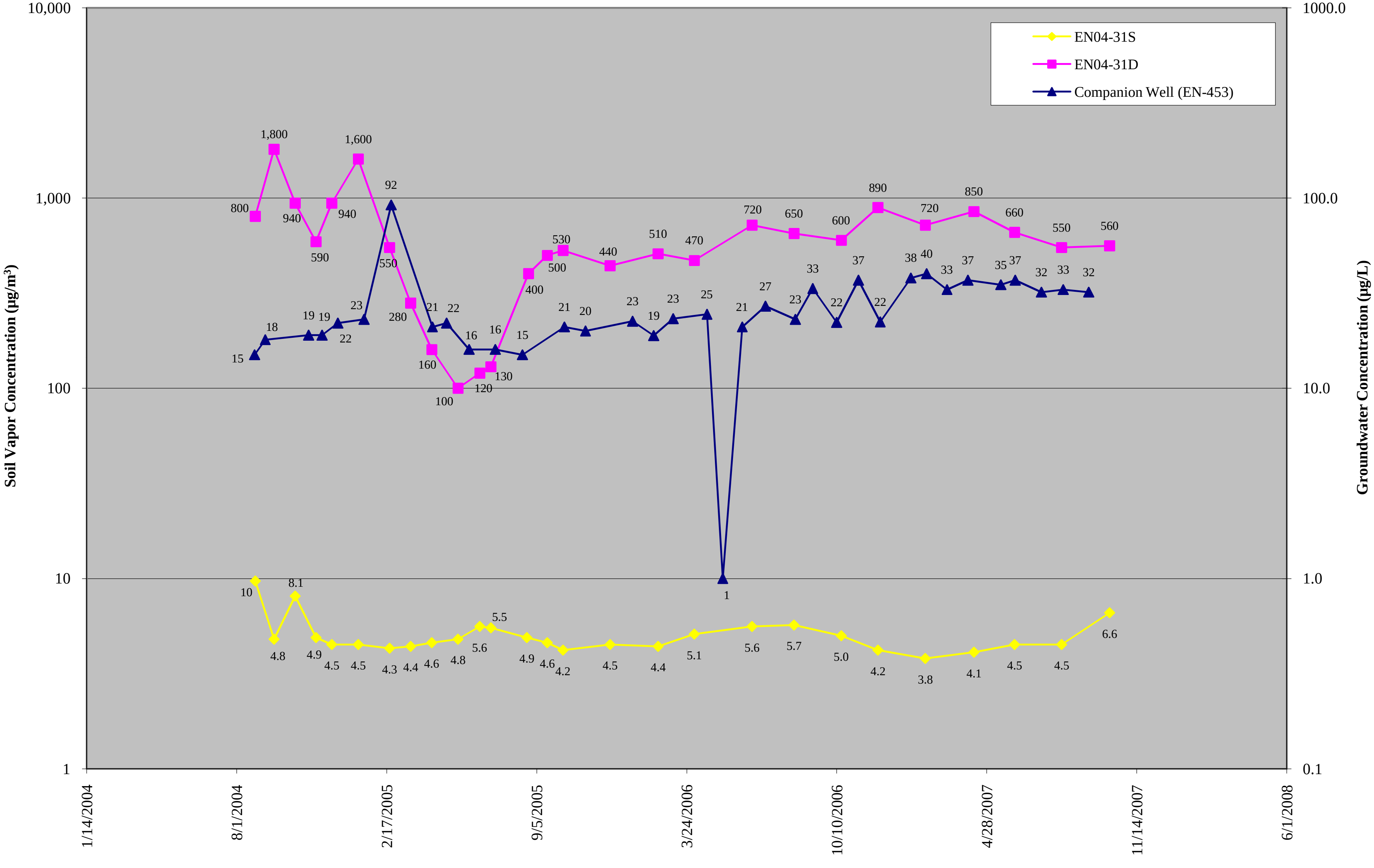


Figure B.31
TCE in Soil Vapor and Groundwater

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

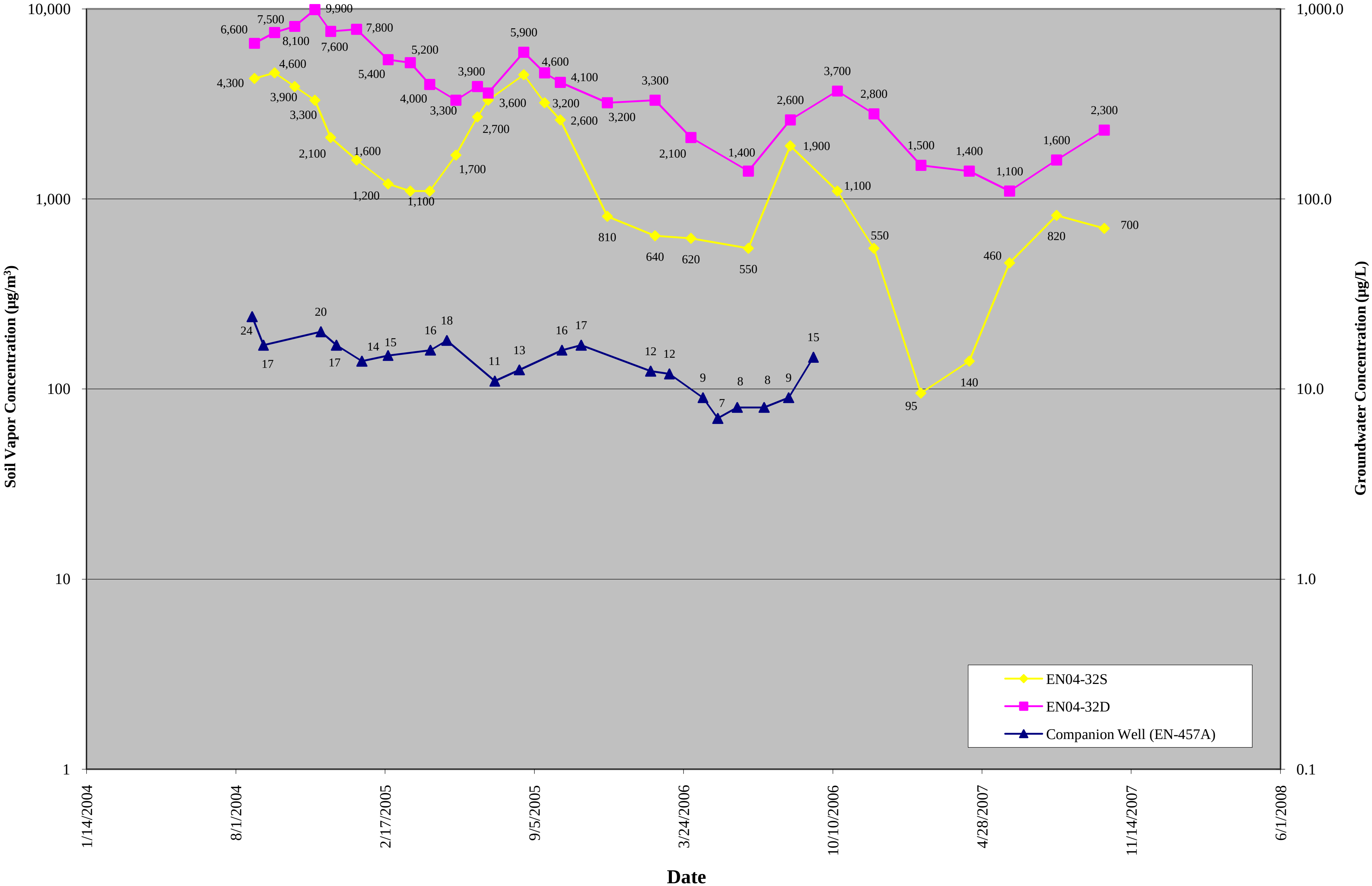
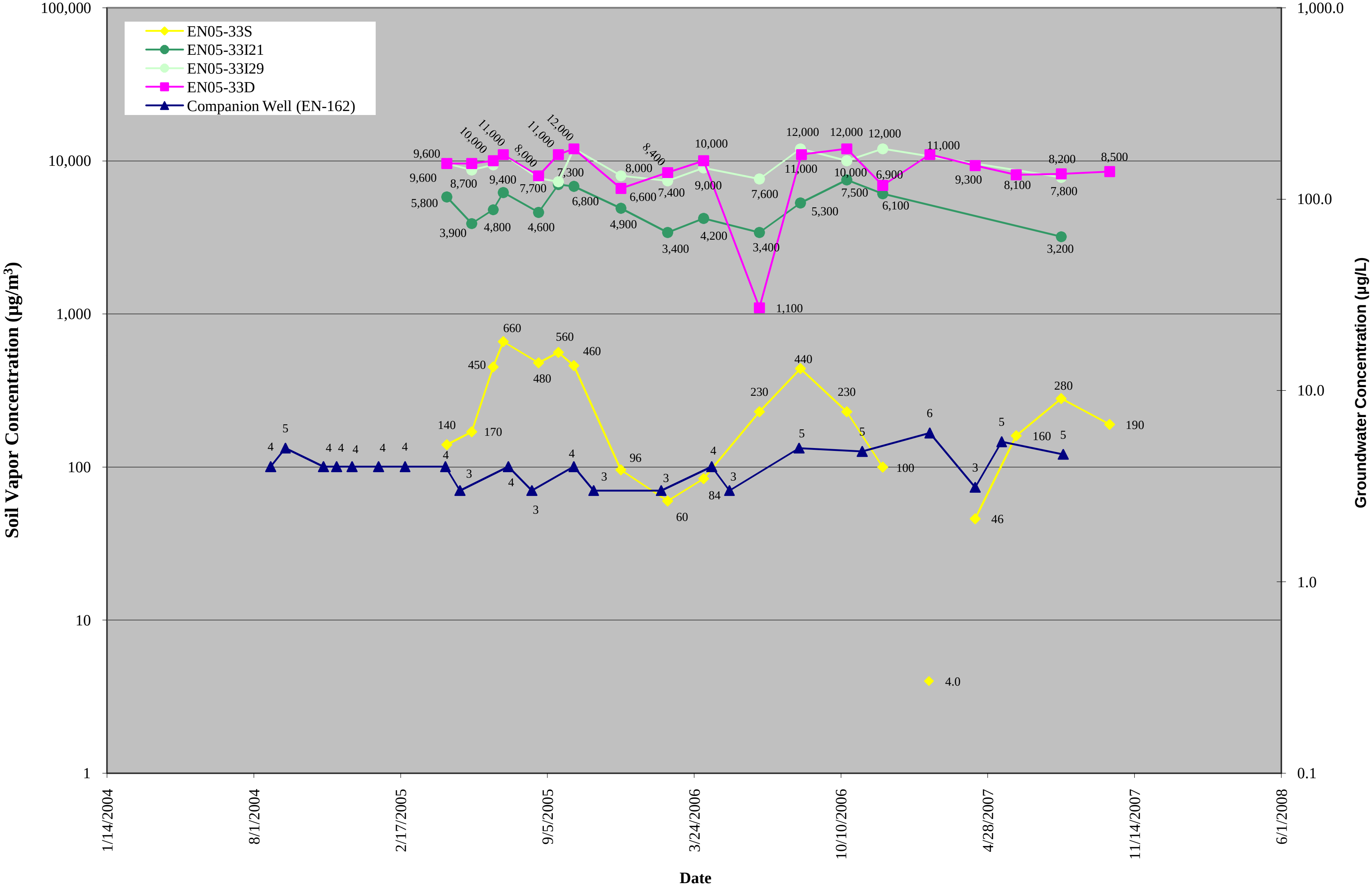


Figure B.33
TCE in Soil Vapor and Groundwater

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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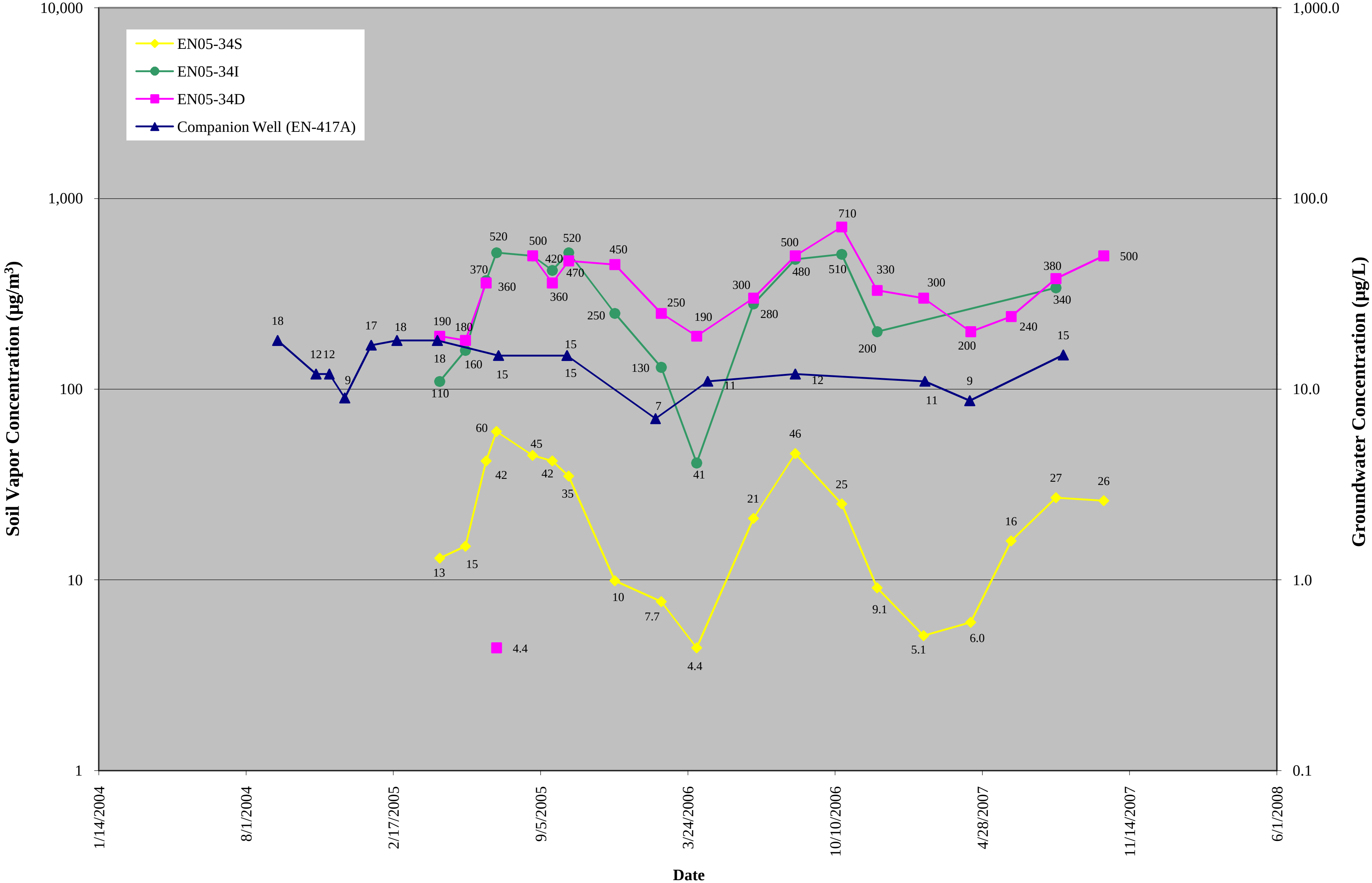
TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



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TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

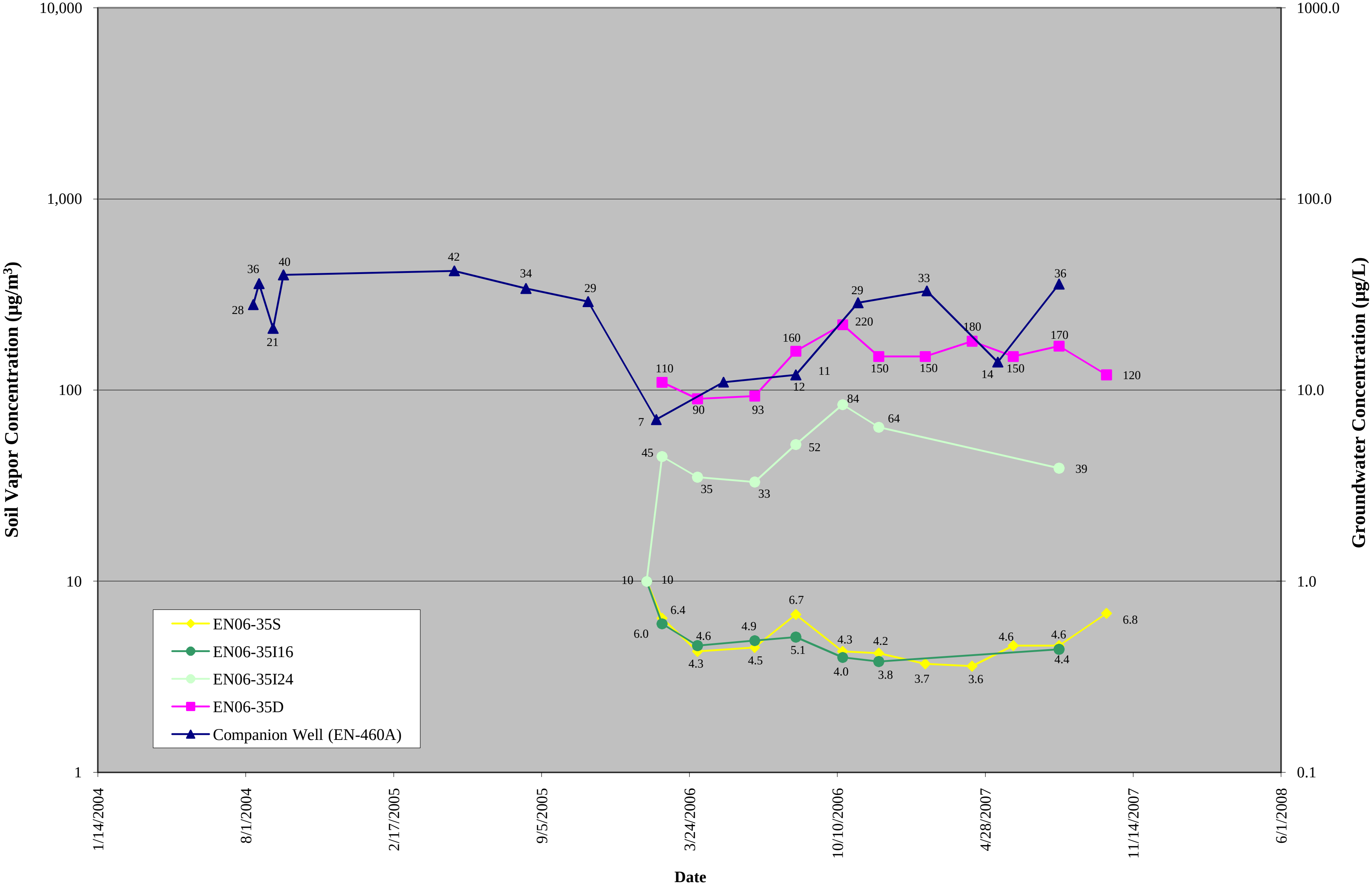

Figure B.36
TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
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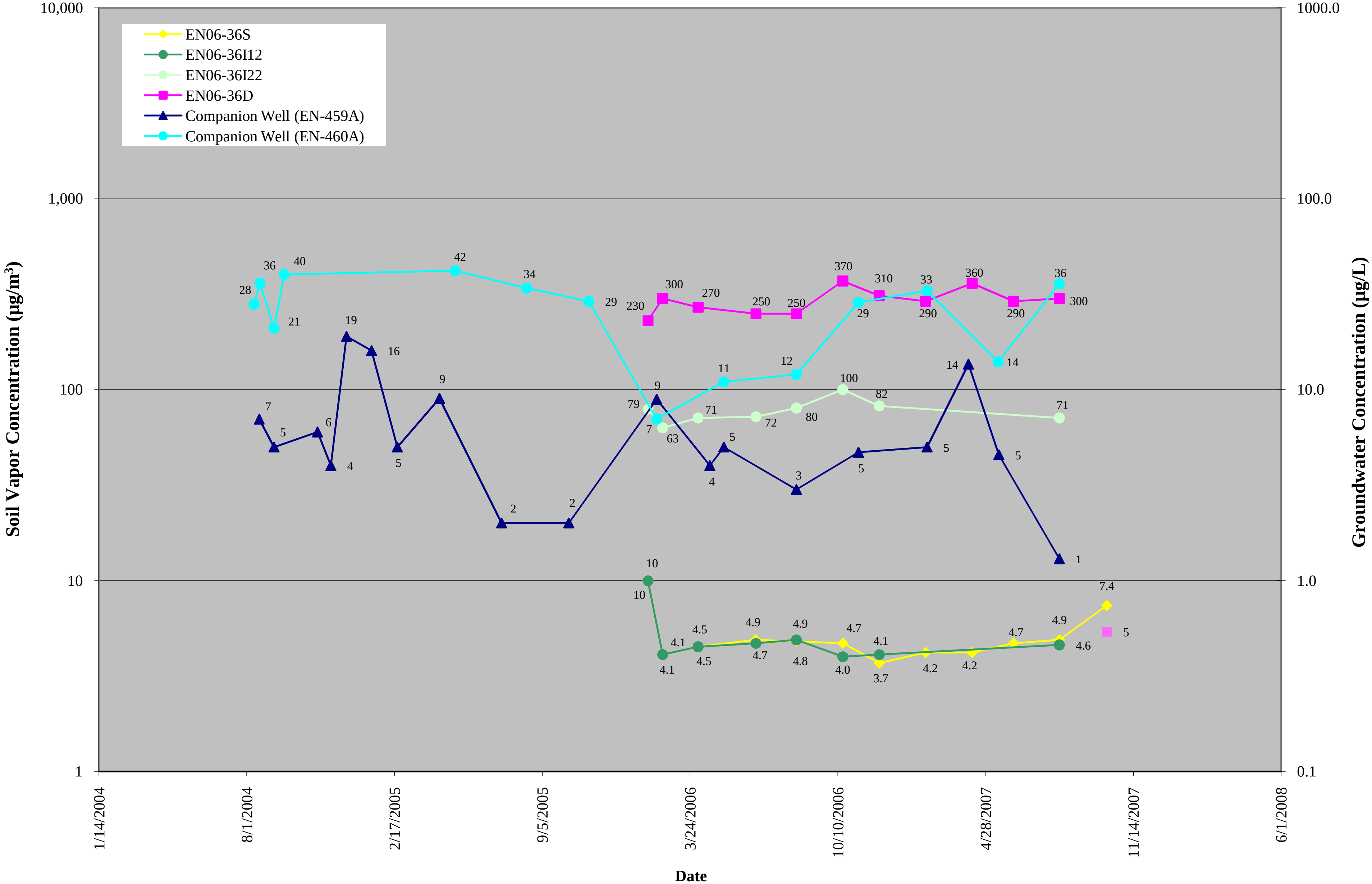
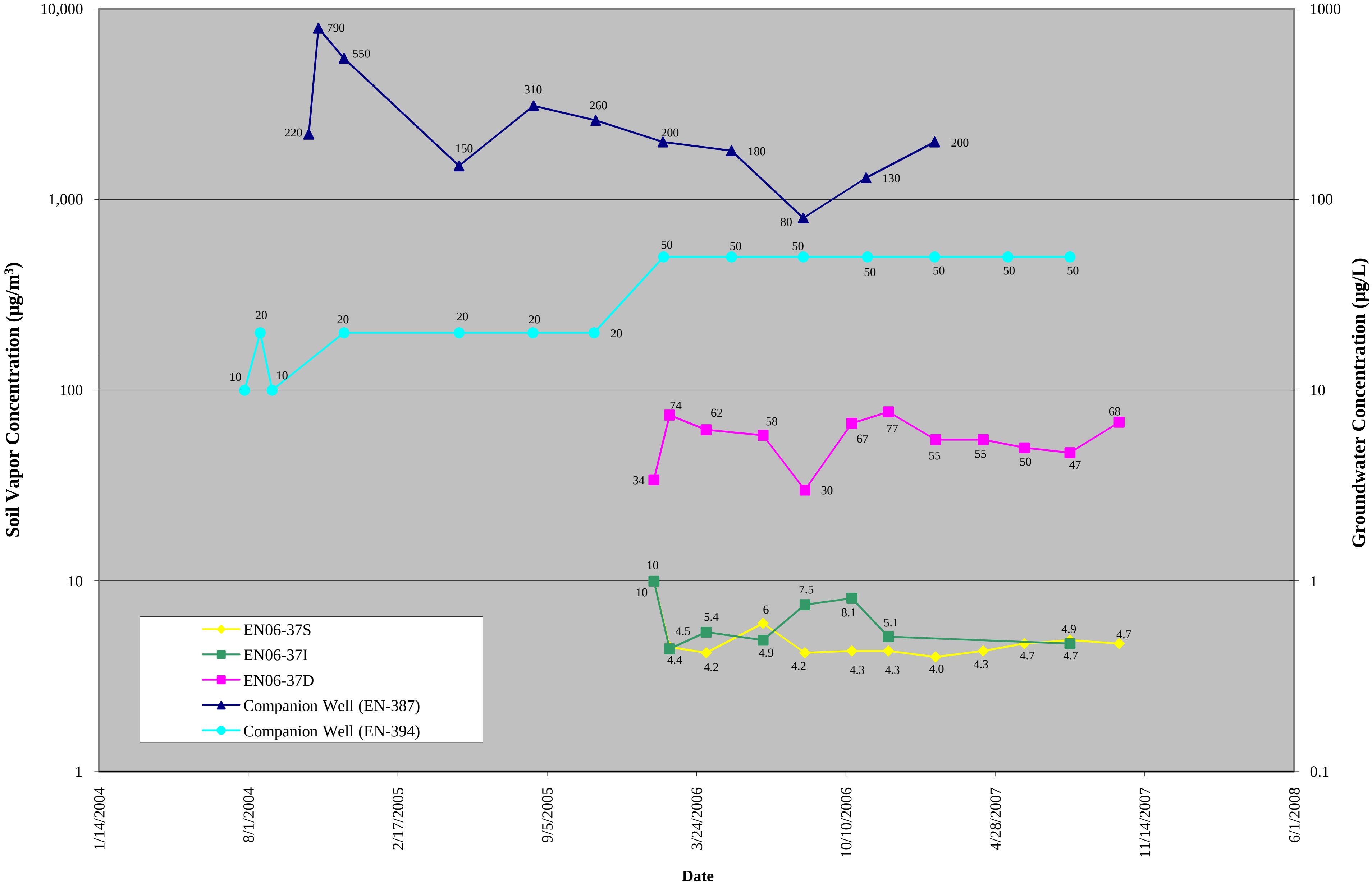


Figure B.37
TCE in Soil Vapor and Groundwater
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York



APPENDIX B.4

PLAN VIEW GRAPHICS – SOIL VAPOR SAMPLES

SHA

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APPENDIX B.4.1

Summary of Plan View Graphics
Semiannual Report, Soil Vapor Monitoring Through October 2007
Soil Vapor Monitoring Program, Endicott, New York

This Appendix and the report contain plan view graphics intended to aid in portraying soil vapor concentration trends consistent with the available data. As noted on the figures, the images were created using uniform and consistent spatial statistical algorithms and are not intended as indicators of the absolute limits of soil vapor concentrations but as basis of comparison among data sets from different times.

The soil vapor data used in the development of the figures were queried from a Microsoft Access ® database of the analytical result through October 2007. The posted values represent the computed arithmetic average of results recorded over the noted time periods. The time period referred to as "Non-Heating Season" includes data recorded between August 1st and October 31st when seasonal high soil vapor conditions have been observed at foundation depth. Graphics depicting soil vapor concentrations during the "Heating Season" reflects data recorded between December 1st and April 30th.

The colored shading shown on the figures was generated using ArcGIS, version 9.2 Geostatistical Analyst, employing an inverse distance weighted interpolation scheme (IDW). Please refer to the attached reference for additional information regarding the IDW interpolation used to develop the spatial transition of shading between actual observations. For each data set, the IDW algorithm was conditioned by specifying a circular distance of 1,000 feet and a distance weighting power function of 10.

The Symbology, or color coding also remains consistent between each image with soil vapor concentrations depicted in shades of green to purple with increasing concentration. Each level of color shading reflects a half order of magnitude interval in micrograms per cubic meter µg/m$^{3.}$ The major color divisions between grey, and shades of green, blue, and purple highlight concentration milestones of <5 µg/m^3, 100 µg/m^3, and 10,000 µg/m^3. A mask was used to display shading within the ventilation limits or within the limits of soil vapor implant locations.
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Geostatistical Analyst

How Inverse Distance Weighted (IDW) interpolation works

related topics

IDW interpolation explicitly implements the assumption that things that are close to one another are more alike than those that are farther apart. To predict a value for any unmeasured location, IDW will use the measured values surrounding the prediction location. Those measured values closest to the prediction location will have more influence on the predicted value than those farther away. Thus, IDW assumes that each measured point has a local influence that diminishes with distance. It weights the points closer to the prediction location greater than those farther away, hence the name inverse distance weighted.

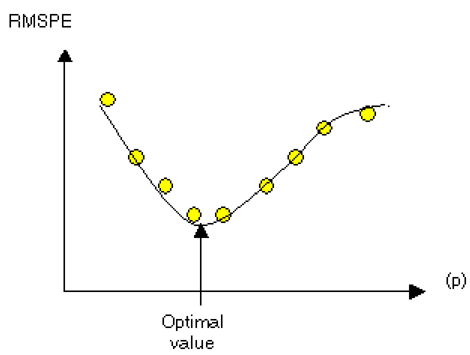
See *Using ArcGIS Geostatistical Analyst* for formula and additional information.

Learn more about the interpolation techniques available in ArcGIS Geostatistical Analyst

The Power function

The optimal power (p) value is determined by minimizing the root mean square prediction error (RMSPE). The RMSPE is the statistic that is calculated from cross-validation. In cross-validation, each measured point is removed and compared to the predicted value for that location. The RMSPE is a summary statistic quantifying the error of the prediction surface. Geostatistical Analyst tries several different powers for IDW to identify the power that produces the minimum RMSPE. The diagram below shows how Geostatistical Analyst calculates the optimal power. The RMSPE is plotted for several different powers for the same dataset. A curve is fit to the points (a quadratic Local Polynomial equation), and from the curve the power that provides the smallest RMSPE is determined as the optimal power.

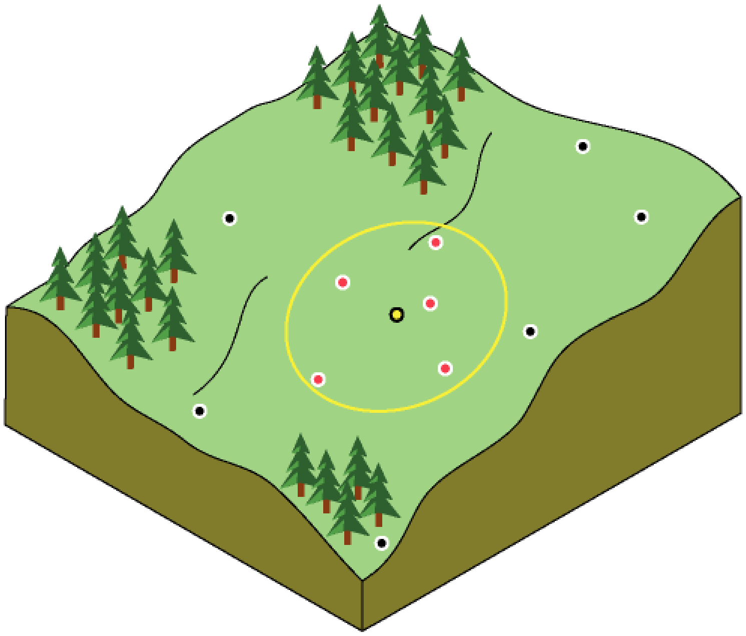
Weights are proportional to the inverse distance raised to the power value p. As a result, as the distance increases, the weights decrease rapidly. How fast the weights decrease is dependent on the value for p. If $p = 0$, there is no decrease with distance, and because each weight λ_i will be the same, the prediction will be the mean of all the measured values. As p increases, the weights for distant points decrease rapidly. If the p value is very high, only the immediate few surrounding points will influence the prediction.



Geostatistical Analyst uses power functions greater than 1. A $p = 2$ is known as the inverse distance squared weighted interpolation.

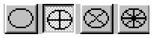
The search neighborhood

Because things that are close to one another are more alike than those farther away, as the locations get farther away, the measured values will have little relationship with the value of the prediction location. To speed calculations you can discount to zero the more distant points with little influence. As a result, it is common practice to limit the number of measured values that are used when predicting the unknown value for a location by specifying a search neighborhood. The specified shape of the neighborhood restricts how far and where to look for the measured values to be used in the prediction. Other neighborhood parameters restrict the locations that will be used within that shape. In the following image, five measured points (neighbors) will be used when predicting a value for the location without a measurement, the yellow point.

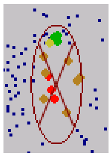


The shape of the neighborhood is influenced by the input data and the surface you are trying to create. If there are no directional influences on the weighting of your data, you'll want to consider points equally in all directions. To do so, you'll probably want the shape of your neighborhood to be a circle. However, if there is a directional influence on your data, such as a prevailing wind, you may want to adjust for it by changing the shape of your neighborhood to an ellipse with the major axis parallel with the wind. The adjustment for this directional influence is justified because you know that locations upwind from a prediction location are going to be more similar at remote distances than locations that are perpendicular to the wind.

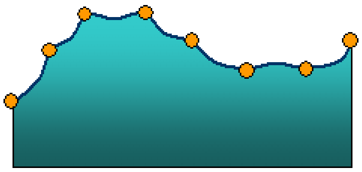
Once a neighborhood shape is specified, you can restrict which locations within the shape should be used. You can define the maximum and minimum number of locations to use, and you can divide the neighborhood into sectors. If you divide the neighborhood into sectors, the maximum and minimum constraints will be applied to each sector. There are several different sectors that can be used and are displayed below.



The points highlighted in the data view of the Searching Neighborhood dialog box identify the locations and the weights that will be used for predicting a location at the center of the ellipse. The neighborhood is contained within the displayed ellipse. In the following example, two points (red) in the sector to the west and one point in the southern sector will be weighted more than 10 percent. In the northern sector, one point (yellow) will be weighted between 3 percent and 5 percent.



When to use IDW



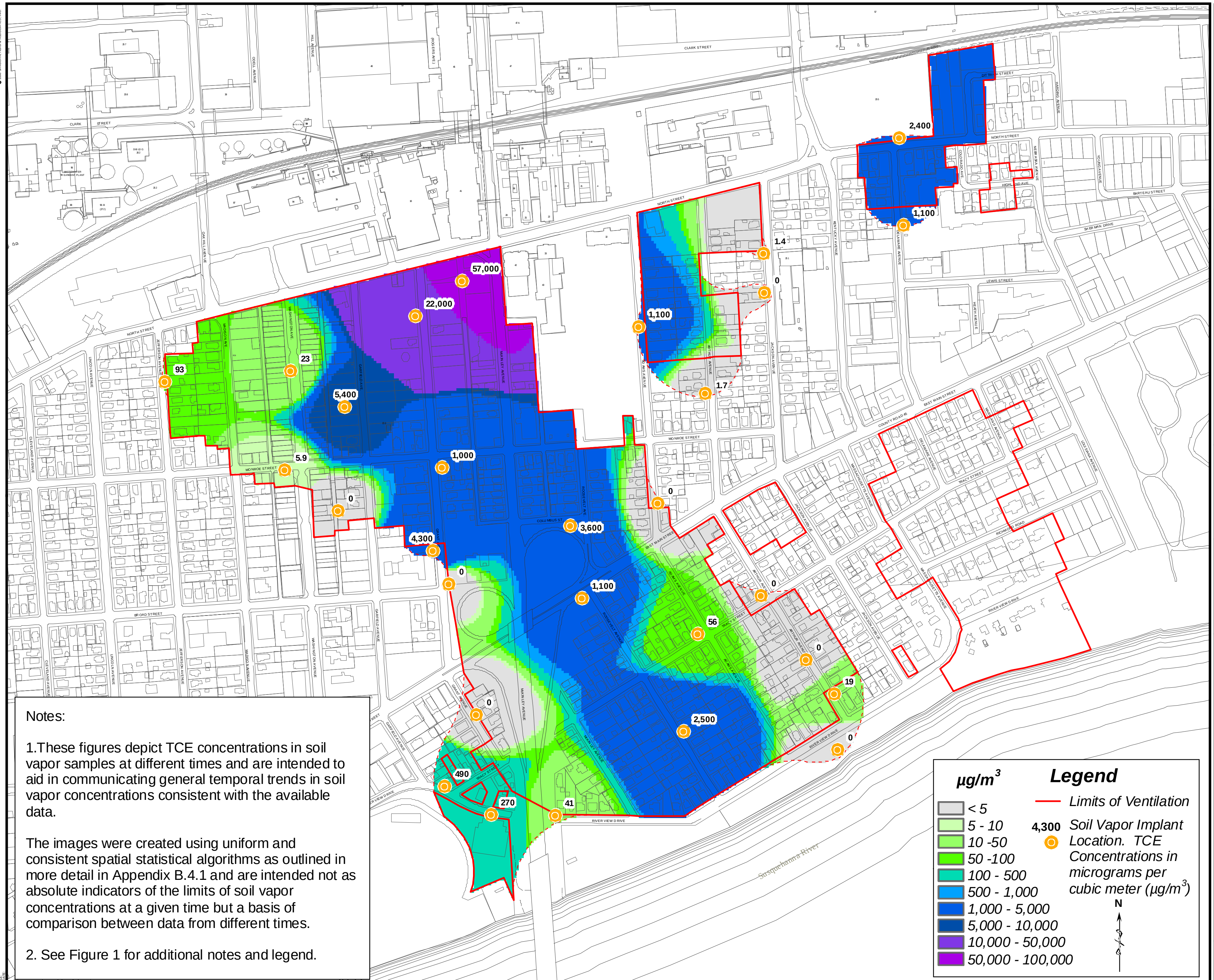
The surface calculated using IDW depends on the selection of a power value (p) and the neighborhood search strategy. IDW is an exact interpolator, where the maximum and minimum values (see diagram above) in the interpolated surface can only occur at sample points. The output surface is sensitive to clustering and the presence of outliers. IDW assumes that the surface is being driven by the local variation, which can be captured through the neighborhood.

APPENDIX B.4.2

TCE IN SOIL VAPOR SAMPLES FROM FOUNDATION DEPTH

SHA

ENGINEERS ■ SCIENTISTS



Notes:

1. These figures depict TCE concentrations in soil vapor samples at different times and are intended to aid in communicating general temporal trends in soil vapor concentrations consistent with the available data.

The images were created using uniform and consistent spatial statistical algorithms as outlined in more detail in Appendix B.4.1 and are intended not as absolute indicators of the limits of soil vapor concentrations at a given time but a basis of comparison between data from different times.

2. See Figure 1 for additional notes and legend.

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

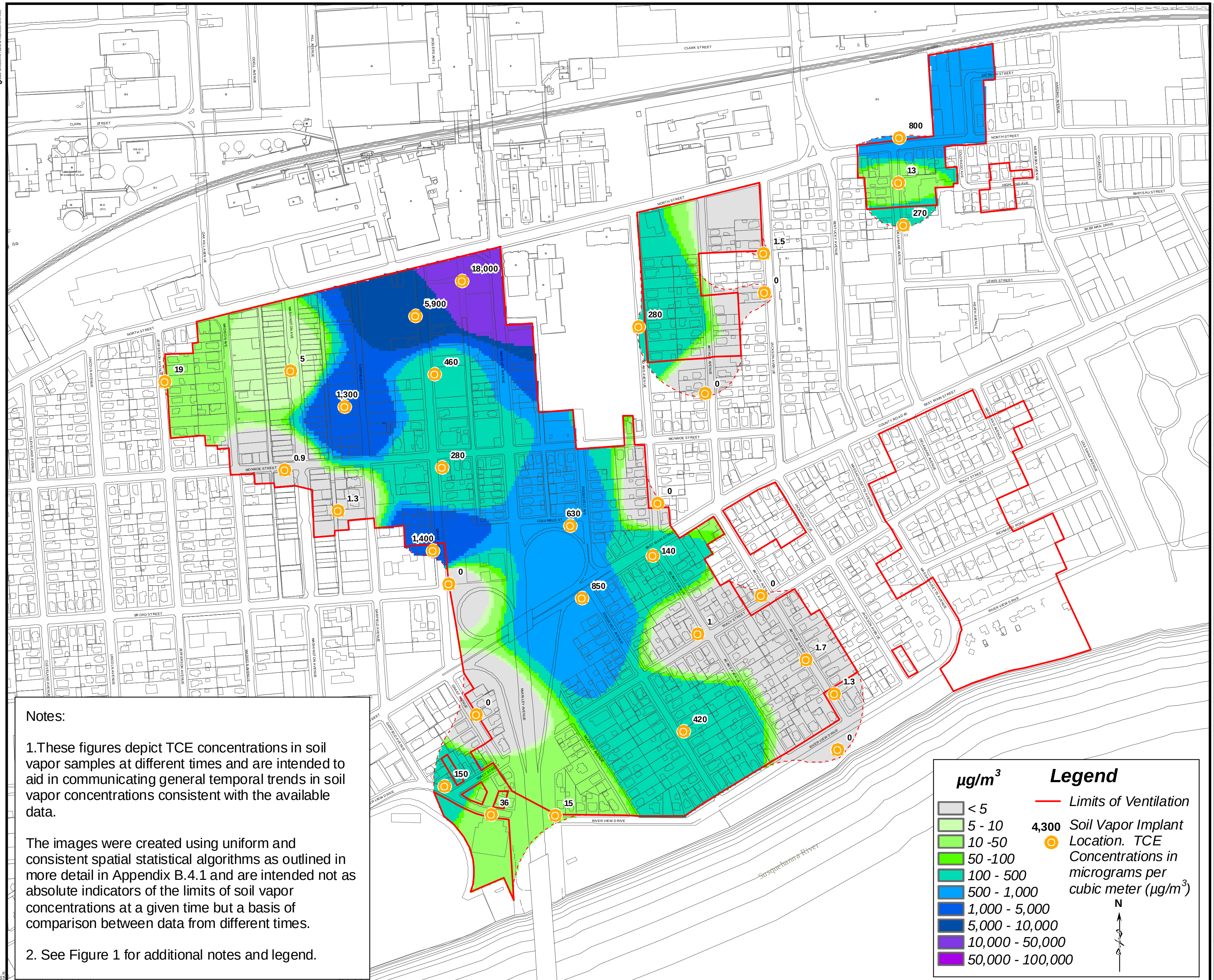
August - October 2004 TCE Soil Vapor Concentrations at Foundation Depth

SHA

DRAWN BY: SLW
DESIGNED BY: SLW
CHECKED BY: EMB
REVIEWED BY: DS
PROJECT MGR: EMB
PIC: DBC
DATE: December 2007

PROJECT NUMBER: 2755

FIGURE NUMBER: B.4.2-1



Notes:

1.These figures depict TCE concentrations in soil vapor samples at different times and are intended to aid in communicating general temporal trends in soil vapor concentrations consistent with the available data.

The images were created using uniform and consistent spatial statistical algorithms as outlined in more detail in Appendix B.4.1 and are intended not as absolute indicators of the limits of soil vapor concentrations at a given time but a basis of comparison between data from different times.

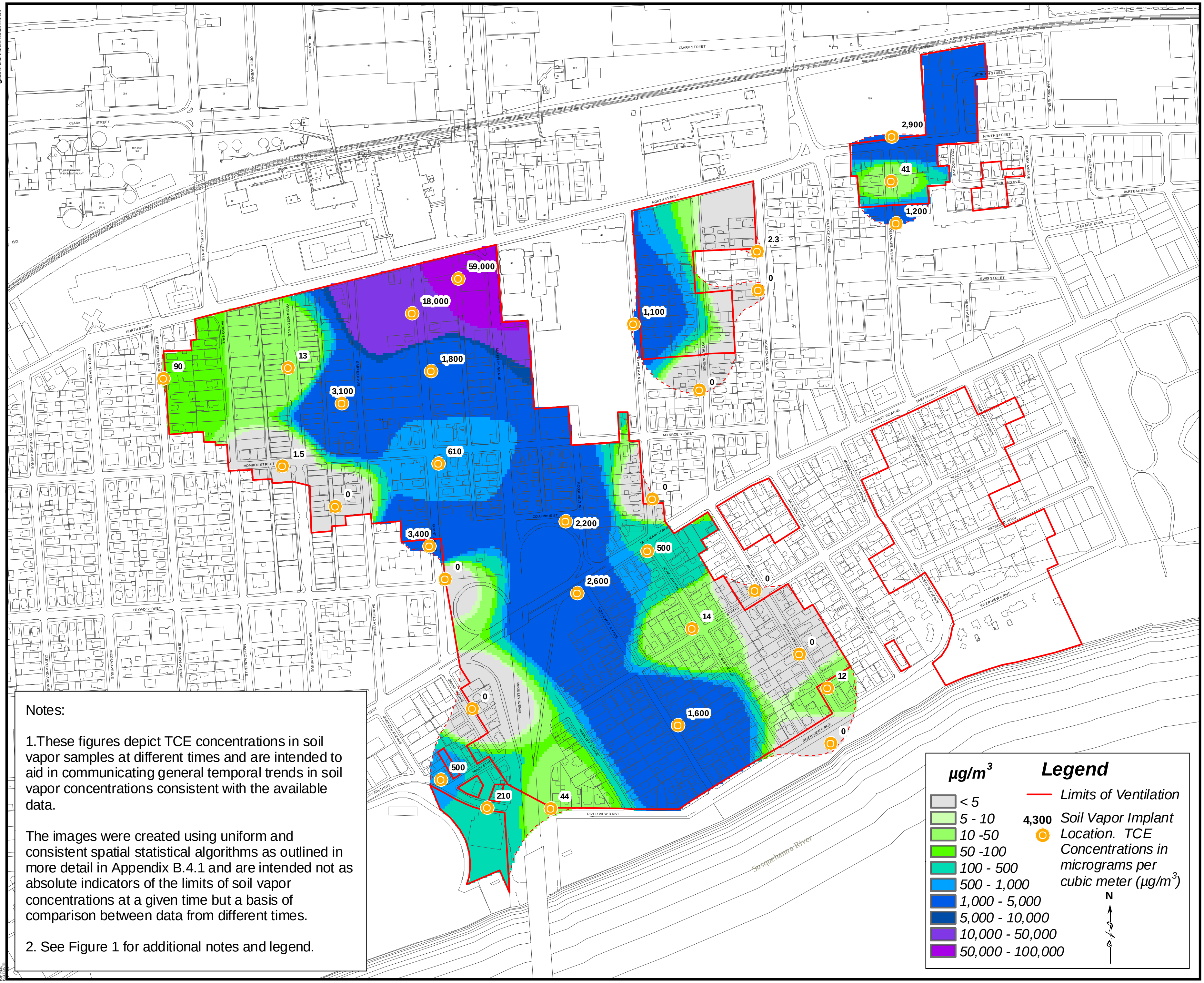
2. See Figure 1 for additional notes and legend.

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

December 2004 - April 2005 TCE Soil Vapor Concentrations at Foundation Depth

PROJECT NUMBER : 2755

FIGURE NUMBER : B.4.2-2



Notes:

1.These figures depict TCE concentrations in soil vapor samples at different times and are intended to aid in communicating general temporal trends in soil vapor concentrations consistent with the available data.

The images were created using uniform and consistent spatial statistical algorithms as outlined in more detail in Appendix B.4.1 and are intended not as absolute indicators of the limits of soil vapor concentrations at a given time but a basis of comparison between data from different times.

2. See Figure 1 for additional notes and legend.

SHA

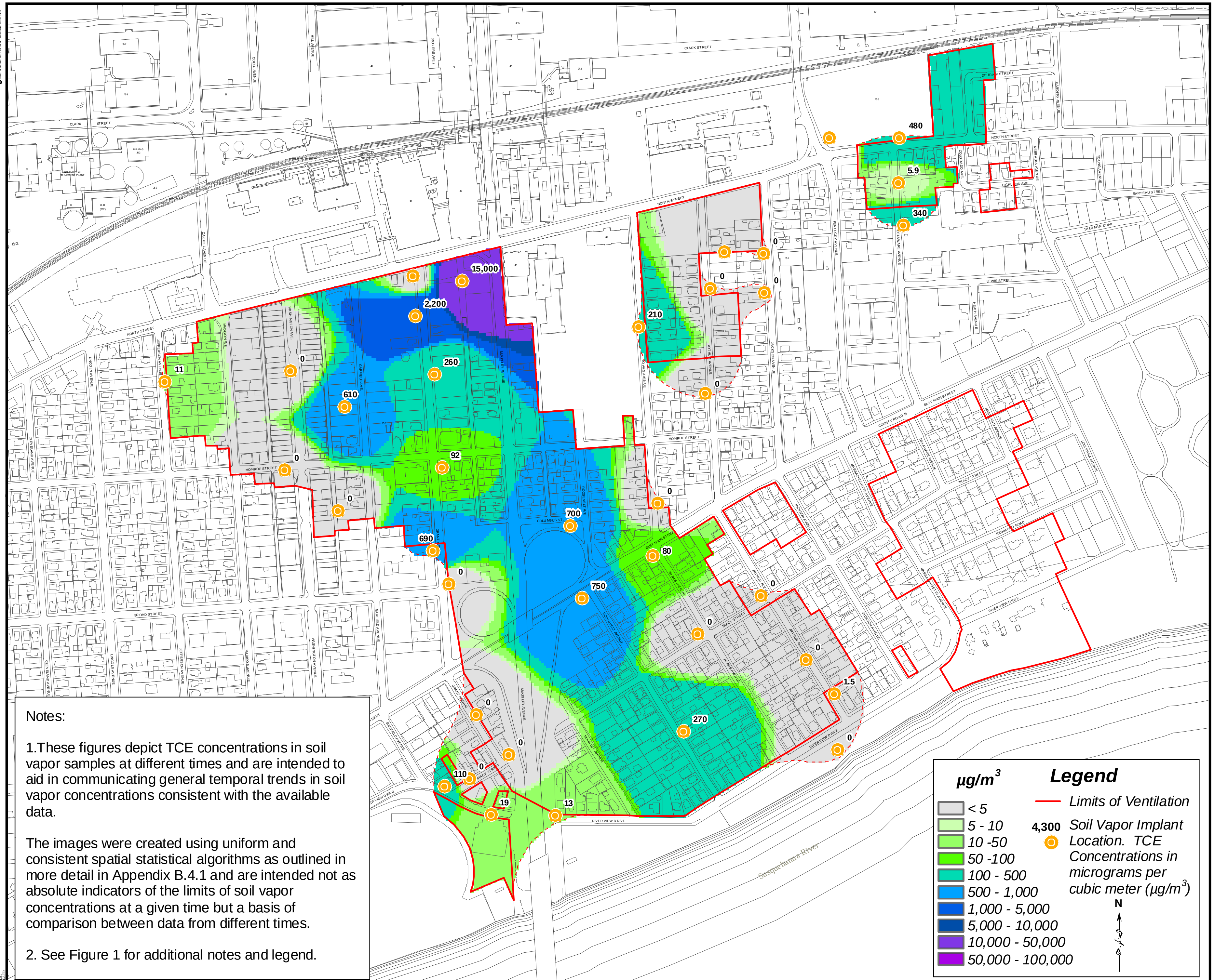
DRAWN BY: SLW
DESIGNED BY: SLW
CHECKED BY: EMB
REVIEWED BY: DS
PROJECT MGR: EMB
PIC: DBC
DATE: December 2007

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

August - October 2005 TCE Soil Vapor Concentrations at Foundation Depth

PROJECT NUMBER: 2755

FIGURE NUMBER: B.4.2-3



Notes:

1.These figures depict TCE concentrations in soil vapor samples at different times and are intended to aid in communicating general temporal trends in soil vapor concentrations consistent with the available data.

The images were created using uniform and consistent spatial statistical algorithms as outlined in more detail in Appendix B.4.1 and are intended not as absolute indicators of the limits of soil vapor concentrations at a given time but a basis of comparison between data from different times.

2. See Figure 1 for additional notes and legend.

GRAPHICAL SCALE
200 100 0 200 400 600 Feet

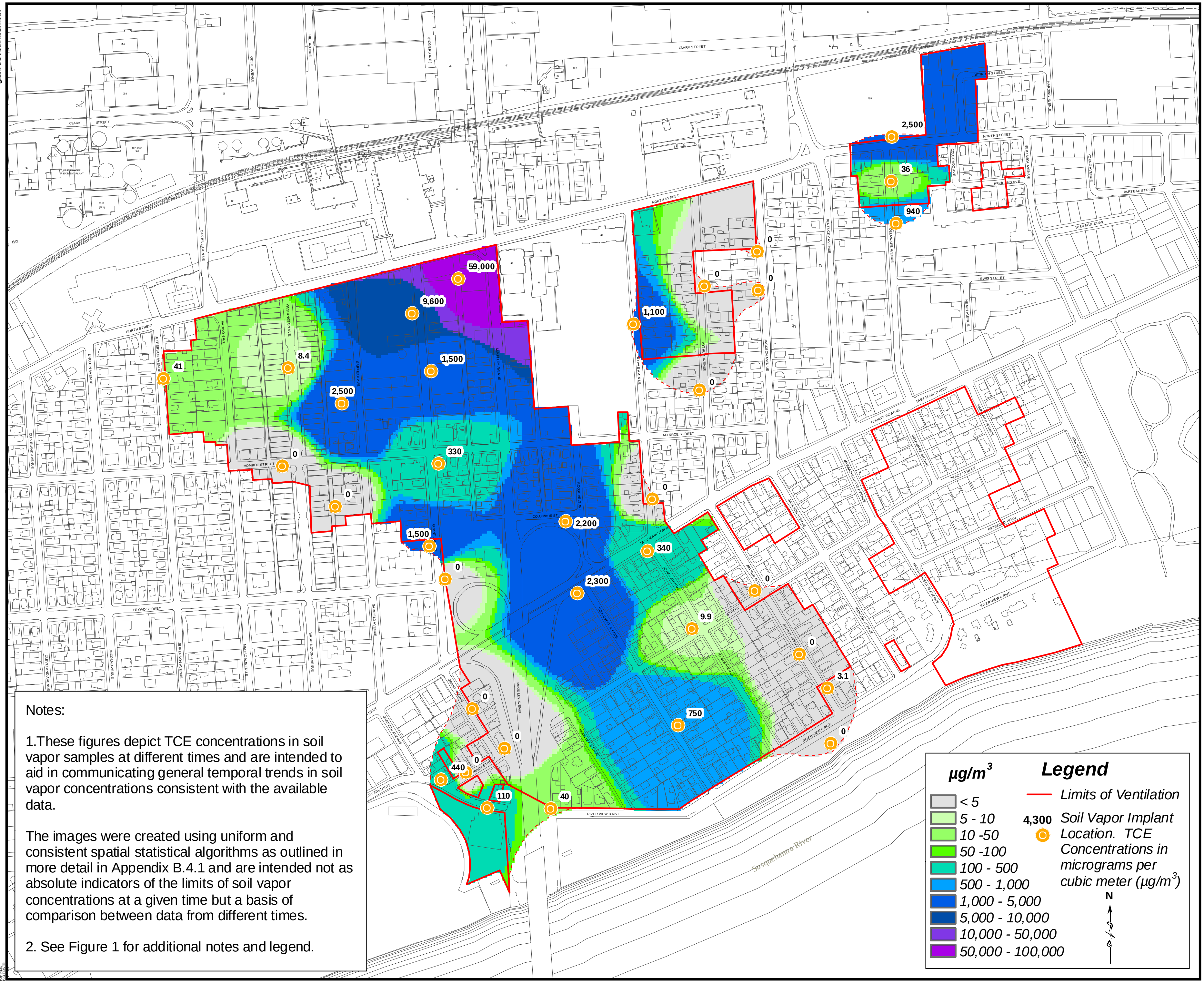
SHA

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

December 2005 - April 2006 TCE Soil Vapor Concentrations at Foundation Depth

PROJECT NUMBER: 2755

FIGURE NUMBER: B.4.2-4



Notes:

1.These figures depict TCE concentrations in soil vapor samples at different times and are intended to aid in communicating general temporal trends in soil vapor concentrations consistent with the available data.

The images were created using uniform and consistent spatial statistical algorithms as outlined in more detail in Appendix B.4.1 and are intended not as absolute indicators of the limits of soil vapor concentrations at a given time but a basis of comparison between data from different times.

2. See Figure 1 for additional notes and legend.

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

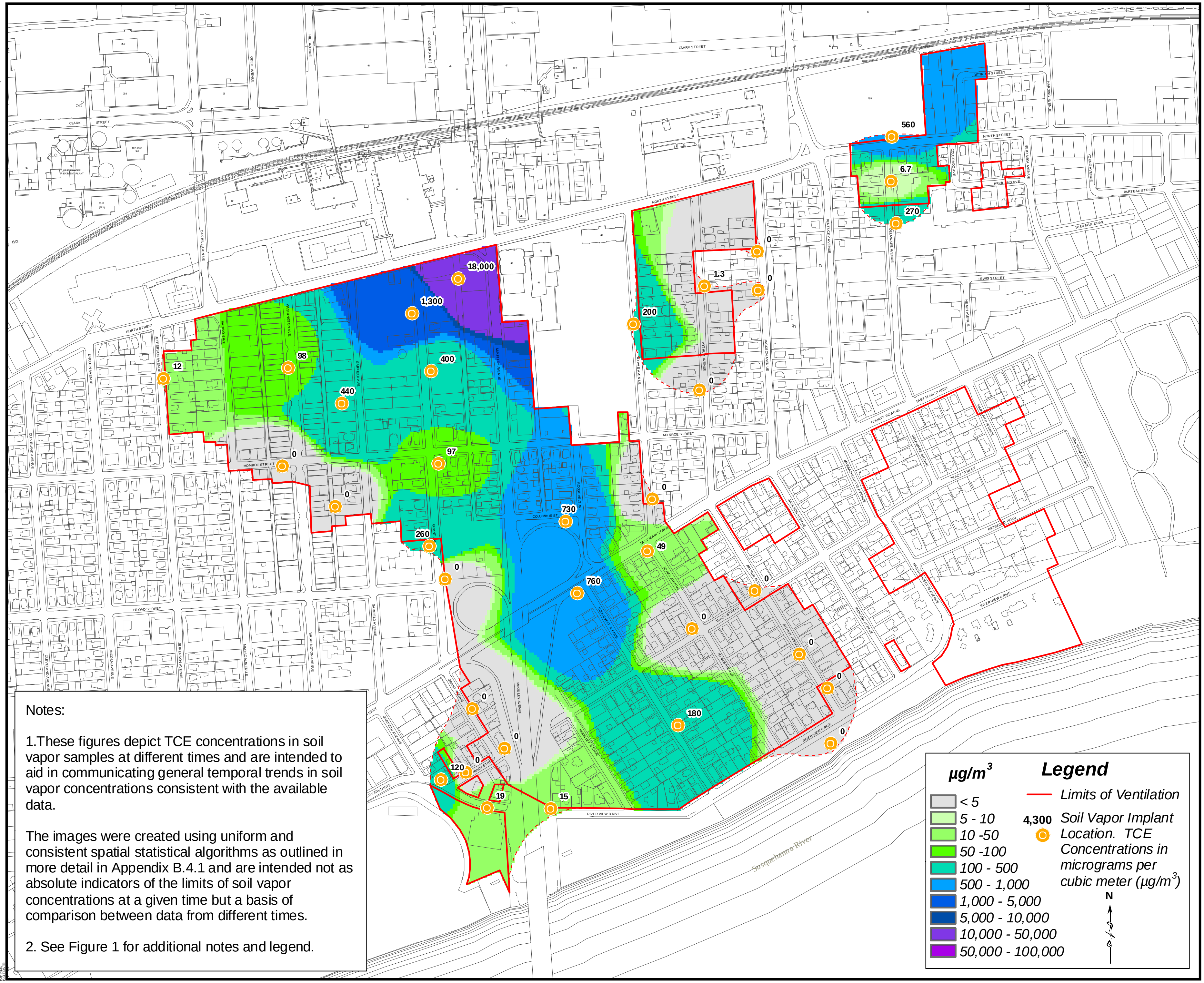
August - October 2006 TCE Soil Vapor Concentrations at Foundation Depth

GRAPHICAL SCALE: 200 100 0 200 400 600 Feet

DRAWN BY: SLW
DESIGNED BY: SLW
CHECKED BY: EMB
REVIEWED BY: DS
PROJECT MGR: EMB
PIC: DBC
DATE: December 2007

PROJECT NUMBER: 2755

FIGURE NUMBER: B.4.2-5



Notes:

1. These figures depict TCE concentrations in soil vapor samples at different times and are intended to aid in communicating general temporal trends in soil vapor concentrations consistent with the available data.

The images were created using uniform and consistent spatial statistical algorithms as outlined in more detail in Appendix B.4.1 and are intended not as absolute indicators of the limits of soil vapor concentrations at a given time but a basis of comparison between data from different times.

2. See Figure 1 for additional notes and legend.

GRAPHICAL SCALE

Feet

200 100 0 200 400 600

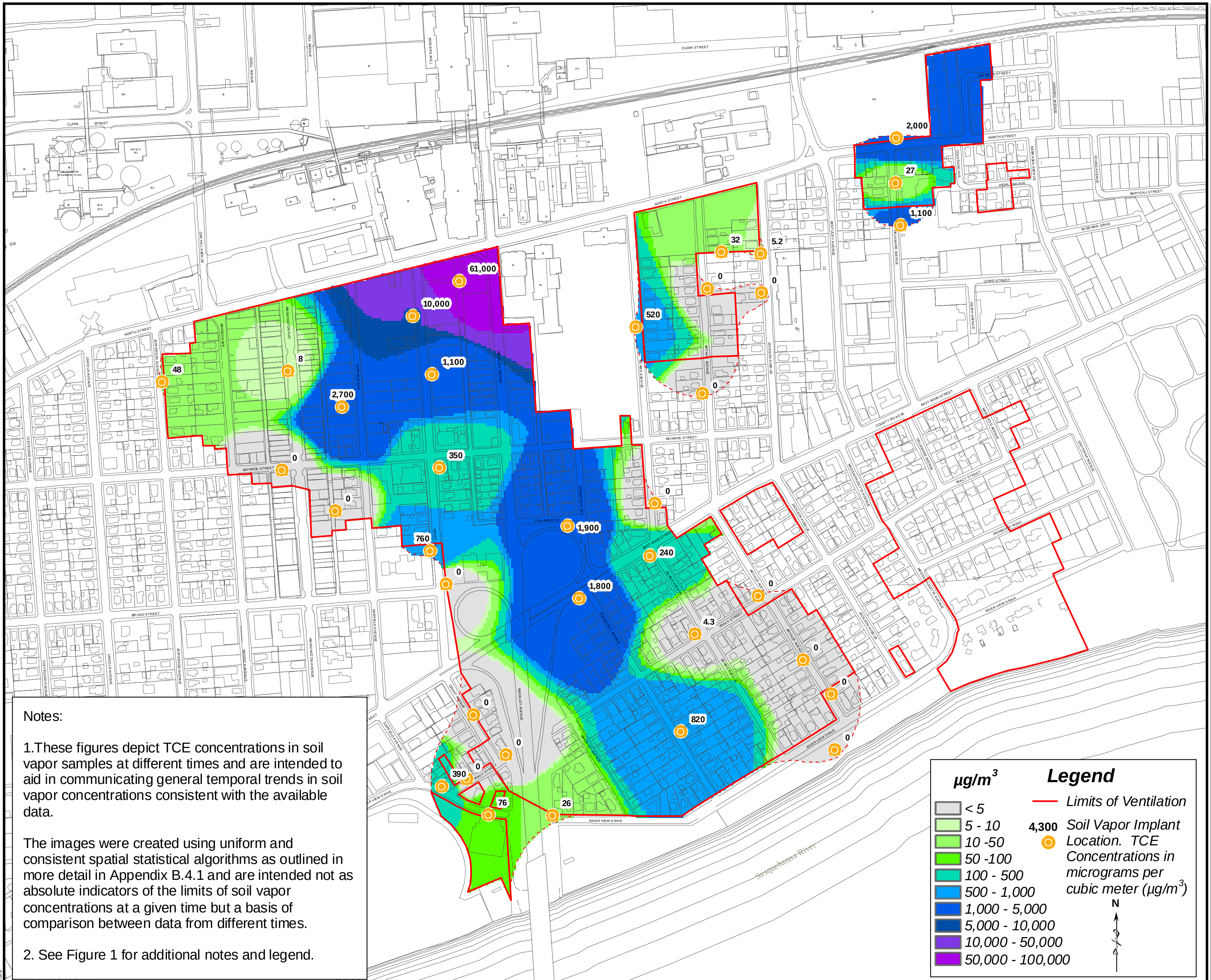
SHA

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

December 2006 - April 2007 TCE Soil Vapor Concentrations at Foundation Depth

PROJECT NUMBER: 2755

FIGURE NUMBER: B.4.2-6



Notes:

1.These figures depict TCE concentrations in soil vapor samples at different times and are intended to aid in communicating general temporal trends in soil vapor concentrations consistent with the available data.

The images were created using uniform and consistent spatial statistical algorithms as outlined in more detail in Appendix B.4.1 and are intended not as absolute indicators of the limits of soil vapor concentrations at a given time but a basis of comparison between data from different times.

2. See Figure 1 for additional notes and legend.

Legend

$\mu g/m^3$
< 5
5 - 10
10 -50
50 -100
100 - 500
500 - 1,000
1,000 - 5,000
5,000 - 10,000
10,000 - 50,000
50,000 - 100,000

Limits of Ventilation

4,300 Soil Vapor Implant Location. TCE Concentrations in micrograms per cubic meter ($\mu g/m^3$)

N

GRAPHICAL SCALE

200 100 0 200 400 600 Feet

SHA

DRAWN BY: SLW
DESIGNED BY: SLW
CHECKED BY: EMB
REVIEWED BY: DS
PROJECT MGR: EMB
PIC: DBC
DATE: December 2007

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

August - October 2007 TCE Soil Vapor Concentrations at Foundation Depth

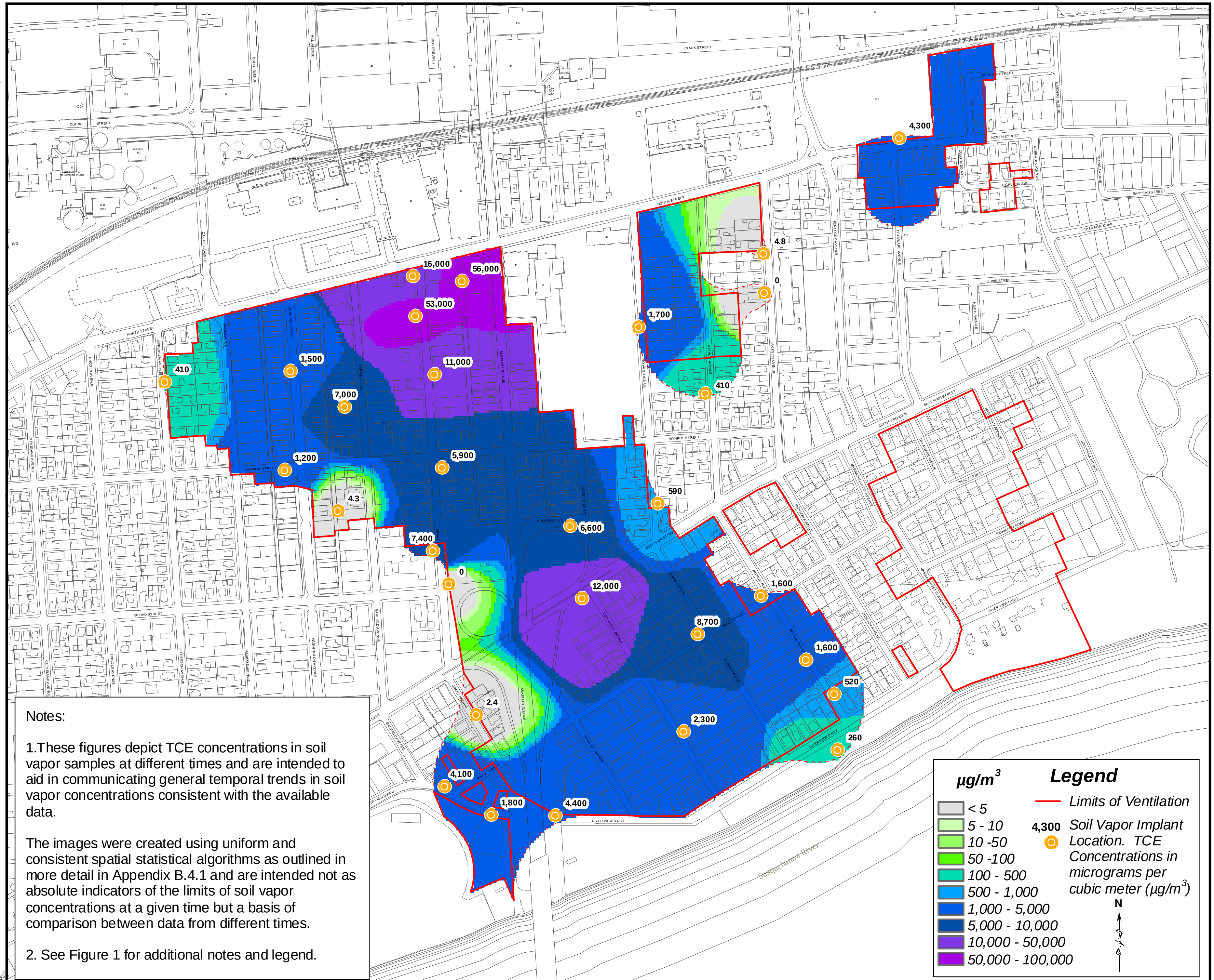
PROJECT NUMBER: 2755

FIGURE NUMBER: B.4.2-7

APPENDIX B.4.3

TCE IN SOIL VAPOR SAMPLES FROM WATER TABLE DEPTH

SHA
ENGINEERS ■ SCIENTISTS



Notes:

1.These figures depict TCE concentrations in soil vapor samples at different times and are intended to aid in communicating general temporal trends in soil vapor concentrations consistent with the available data.

The images were created using uniform and consistent spatial statistical algorithms as outlined in more detail in Appendix B.4.1 and are intended not as absolute indicators of the limits of soil vapor concentrations at a given time but a basis of comparison between data from different times.

2. See Figure 1 for additional notes and legend.

SHA

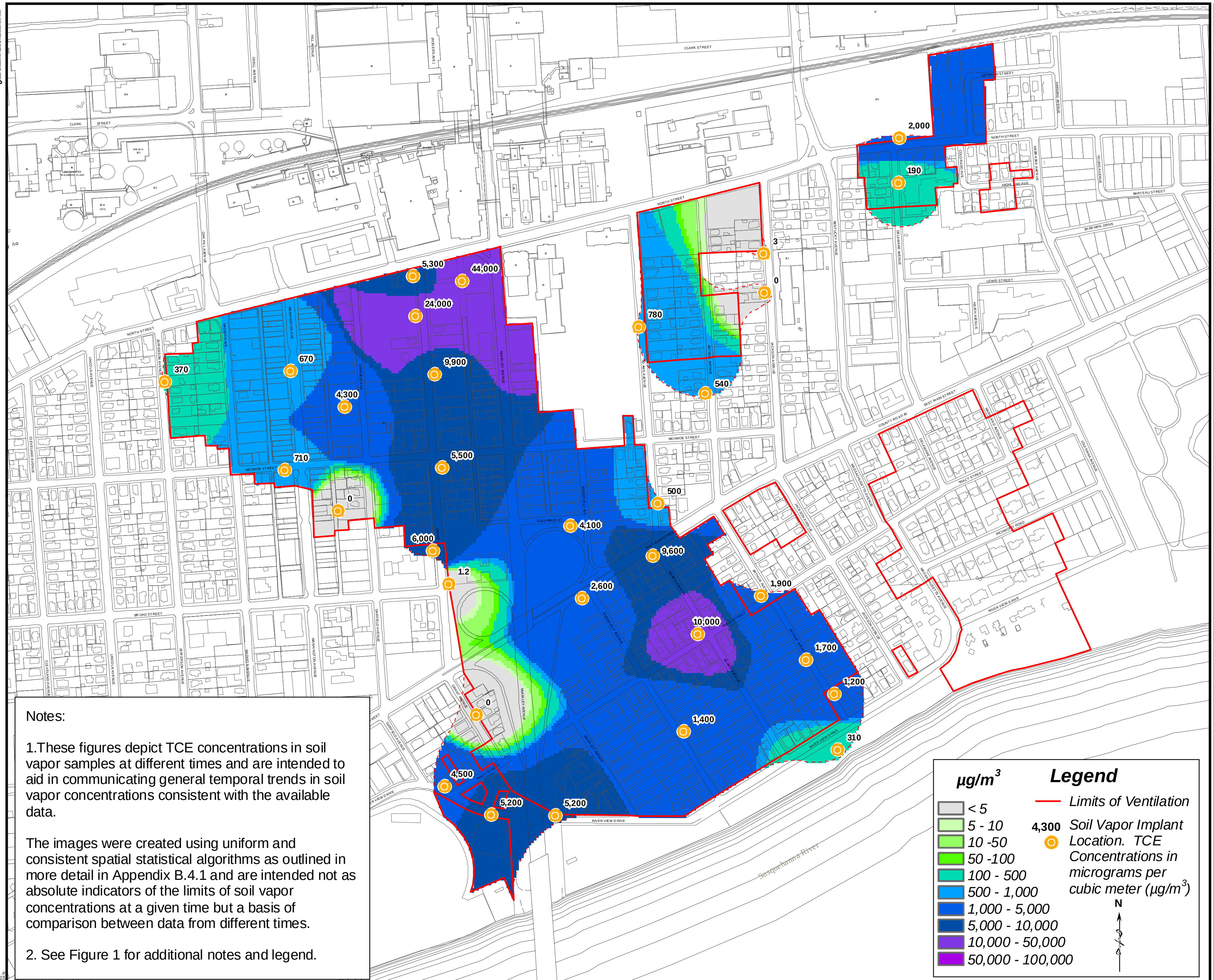
DRAWN BY: SLW
DESIGNED BY: SLW
CHECKED BY: EMB
REVIEWED BY: DS
PROJECT MGR: EMB
PIC: DBC
DATE: December 2007

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

August - October 2004 TCE Soil Vapor Concentrations at Water Table Depth

PROJECT NUMBER: 2755

FIGURE NUMBER: B.4.3-1



Notes:

1.These figures depict TCE concentrations in soil vapor samples at different times and are intended to aid in communicating general temporal trends in soil vapor concentrations consistent with the available data.

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2. See Figure 1 for additional notes and legend.

SHA

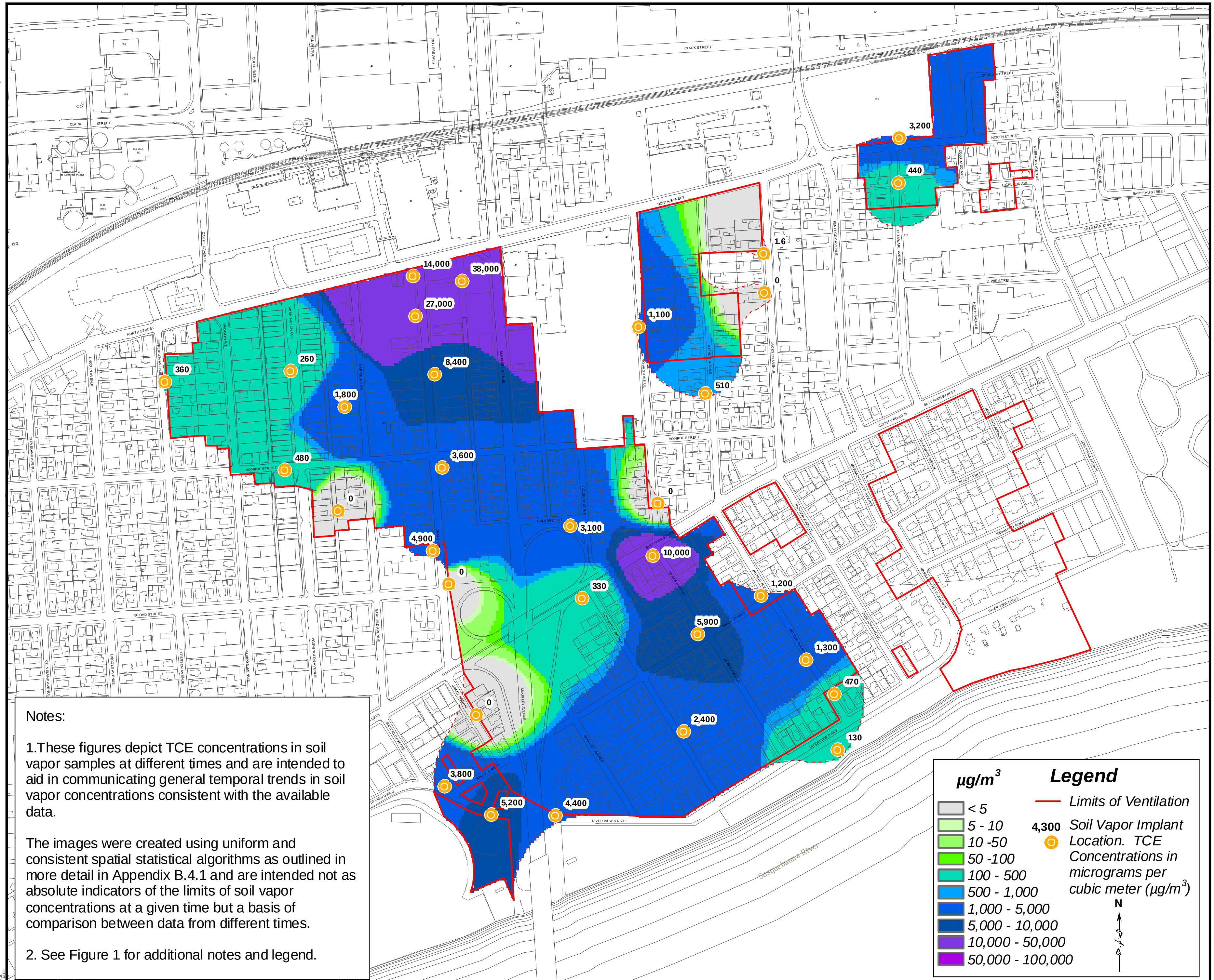
DRAWN BY: SLW
DESIGNED BY: SLW
CHECKED BY: EMB
REVIEWED BY: DS
PROJECT MGR: EMB
PIC: DBC
DATE: December 2007

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

December 2004 - April 2005 TCE Soil Vapor Concentrations at Water Table Depth

PROJECT NUMBER: 2755

FIGURE NUMBER: B.4.3-2



Notes:

1.These figures depict TCE concentrations in soil vapor samples at different times and are intended to aid in communicating general temporal trends in soil vapor concentrations consistent with the available data.

The images were created using uniform and consistent spatial statistical algorithms as outlined in more detail in Appendix B.4.1 and are intended not as absolute indicators of the limits of soil vapor concentrations at a given time but a basis of comparison between data from different times.

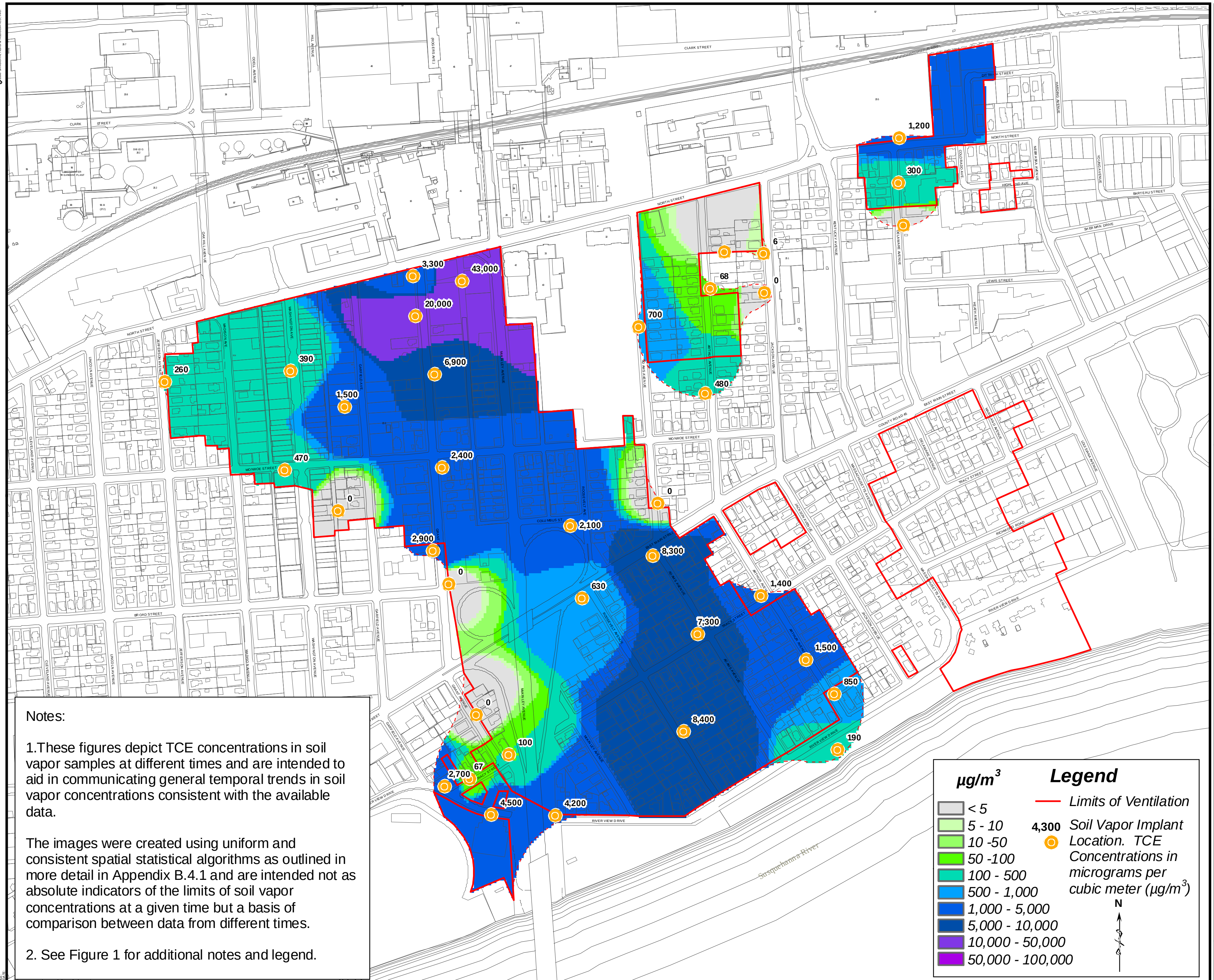
2. See Figure 1 for additional notes and legend.

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

August - October 2005 TCE Soil Vapor Concentrations at Water Table Depth

PROJECT NUMBER: 2755

FIGURE NUMBER: B.4.3-3



Notes:

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2. See Figure 1 for additional notes and legend.

GRAPHICAL SCALE
200 100 0 200 400 600 Feet

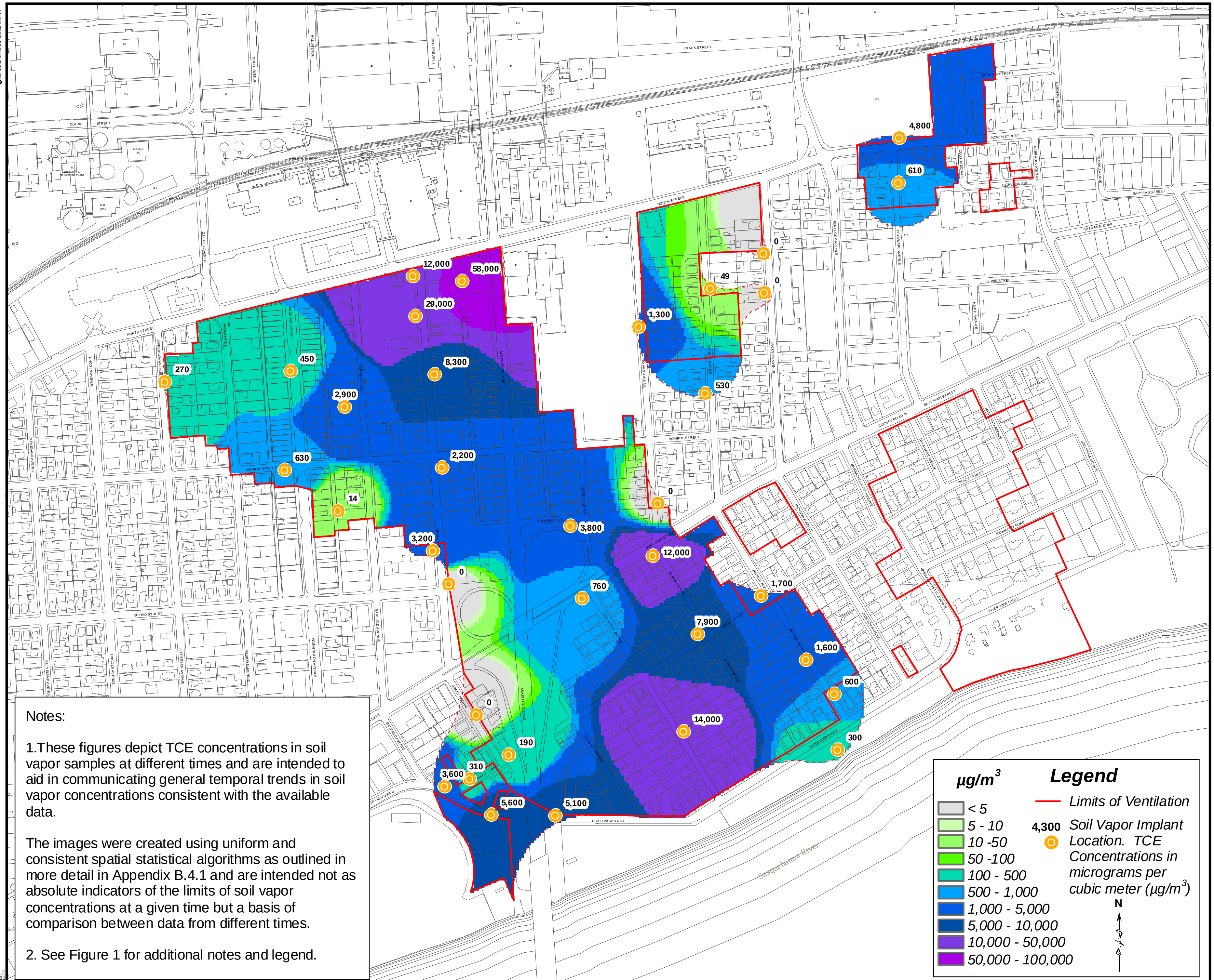
DRAWN BY: SLW
DESIGNED BY: SLW
CHECKED BY: EMB
REVIEWED BY: DS
PROJECT MGR: EMB
PIC: DBC
DATE: December 2007

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

December 2005 - April 2006 TCE Soil Vapor Concentrations at Water Table Depth

PROJECT NUMBER: 2755

FIGURE NUMBER: B.4.3-4



Notes:

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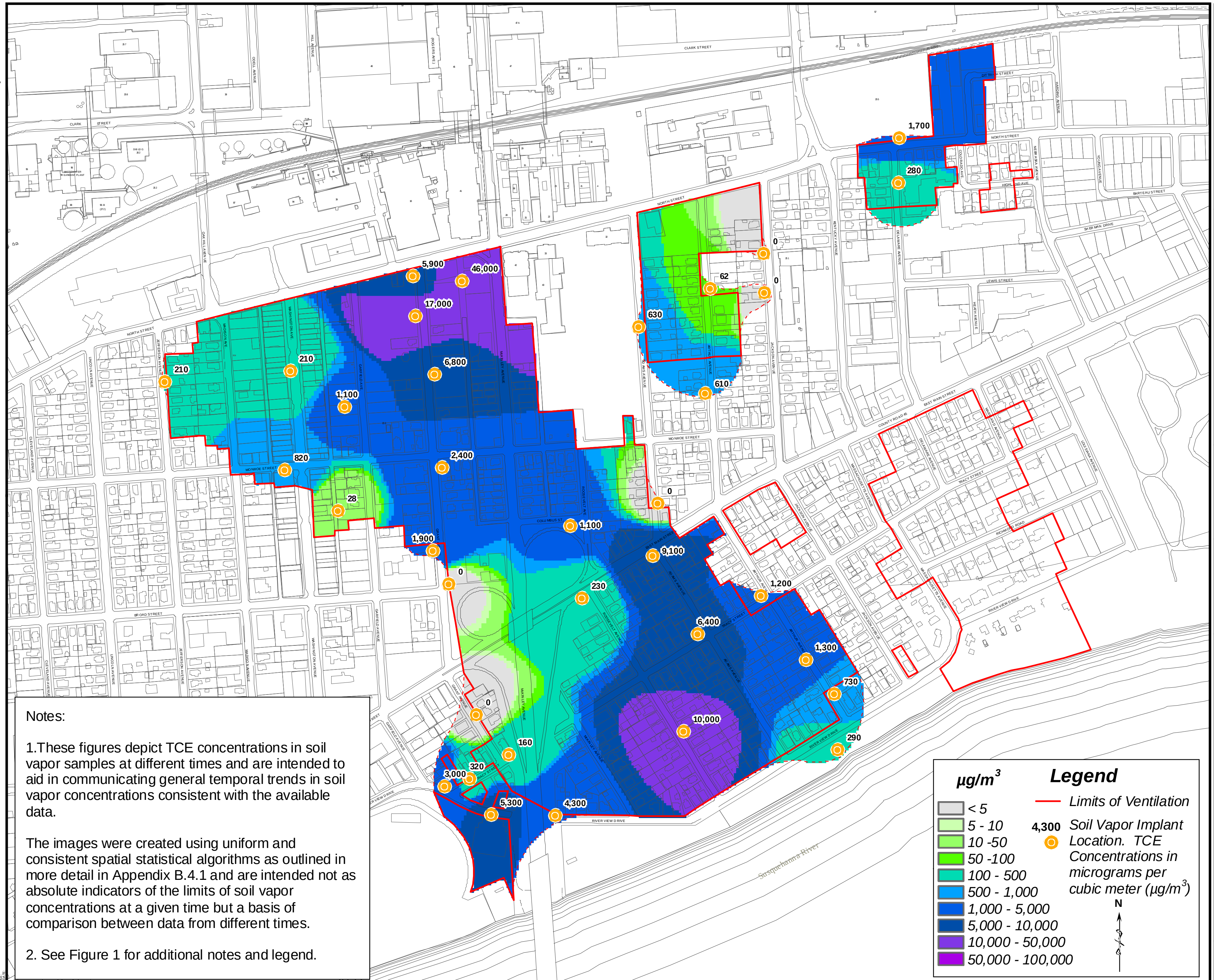
Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

August - October 2006 TCE Soil Vapor Concentrations at Water Table Depth

PROJECT NUMBER: 2755

FIGURE NUMBER: B.4.3-5



Notes:

1.These figures depict TCE concentrations in soil vapor samples at different times and are intended to aid in communicating general temporal trends in soil vapor concentrations consistent with the available data.

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2. See Figure 1 for additional notes and legend.

GRAPHICAL SCALE
Feet
200 100 0 200 400 600

SHA

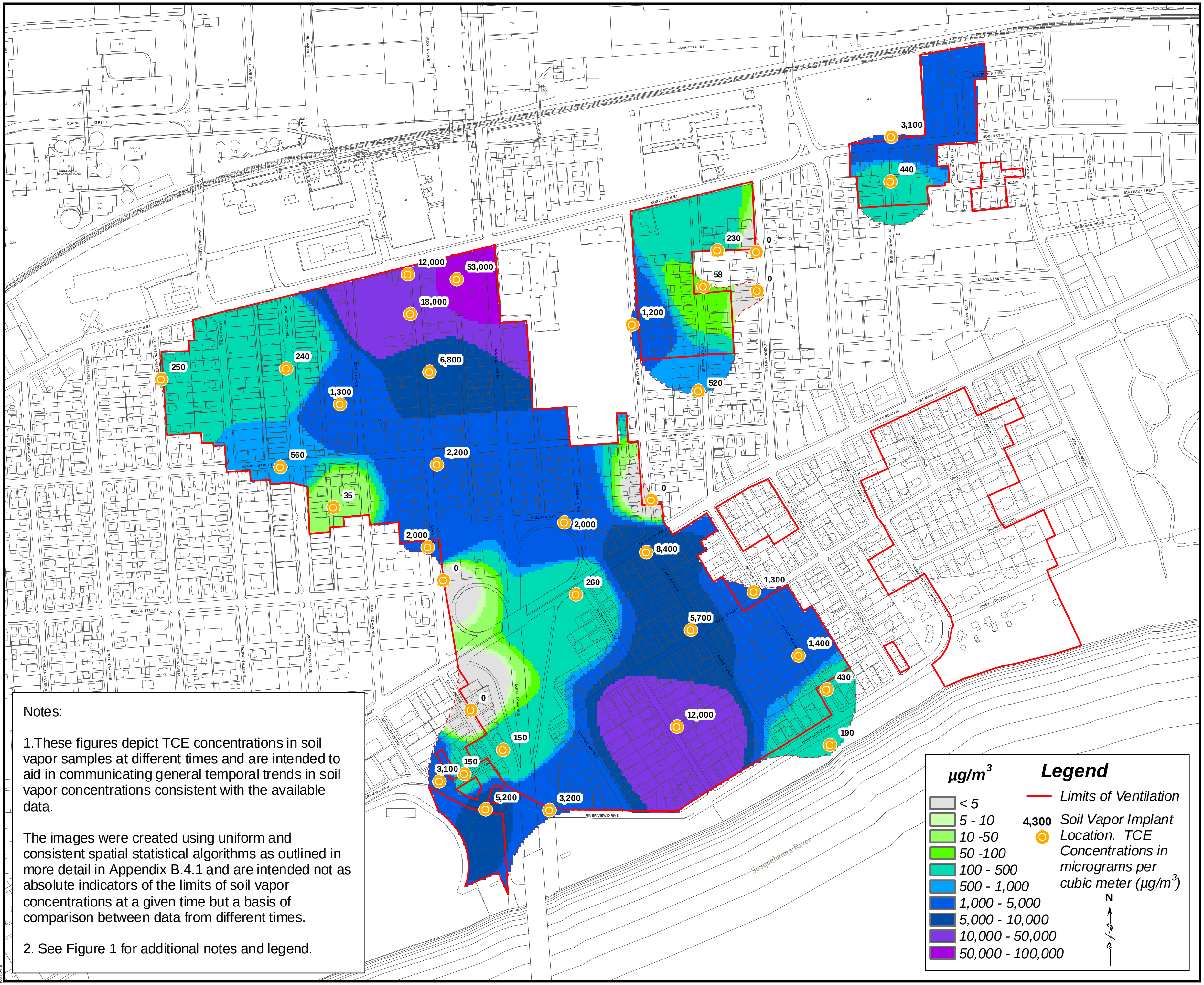
DRAWN BY: SLW
DESIGNED BY: SLW
CHECKED BY: EMB
REVIEWED BY: DS
PROJECT MGR: EMB
PIC: DBC
DATE: December 2007

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

December 2006 - April 2007 TCE Soil Vapor Concentrations at Water Table Depth

PROJECT NUMBER: 2755

FIGURE NUMBER: B.4.3-6



Notes:

1.These figures depict TCE concentrations in soil vapor samples at different times and are intended to aid in communicating general temporal trends in soil vapor concentrations consistent with the available data.

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2. See Figure 1 for additional notes and legend.

GRAPHICAL SCALE

200 100 0 200 400 600 Feet

SHA

DRAWN BY: SLW
DESIGNED BY: SLW
CHECKED BY: EMB
REVIEWED BY: DS
PROJECT MGR: EMB
PIC: DEC
DATE: December 2007

Semiannual Report - Soil Vapor Monitoring through October 2007
Comprehensive Operations, Maintenance, & Monitoring Program
Endicott, New York

August - October 2007 TCE Soil Vapor Concentrations at Water Table Depth

PROJECT NUMBER: 2755

FIGURE NUMBER: B.4.3-7

APPENDIX B.5

BORING LOGS AND DATA

ENGINEERS ▪ SCIENTISTS

APPENDIX B.5.1

Summary of Soil Vapor Implant EN07-28 Installation
Soil Vapor Monitoring Program, Endicott, New York

Appendix B.5 is intended to provide logs and data derived from installation of soil vapor implant EN07-28 on June 5, 2007. EN07-28 was installed near new monitoring well EN-387A and soil boring EN-387B, directly downgradient of the former Ideal Cleaners property. Locations of the implants, monitoring well, and soil boring can be found on Figure B.5.

B.5.1 MONITORING WELL AND SOIL BORING INSTALLATION

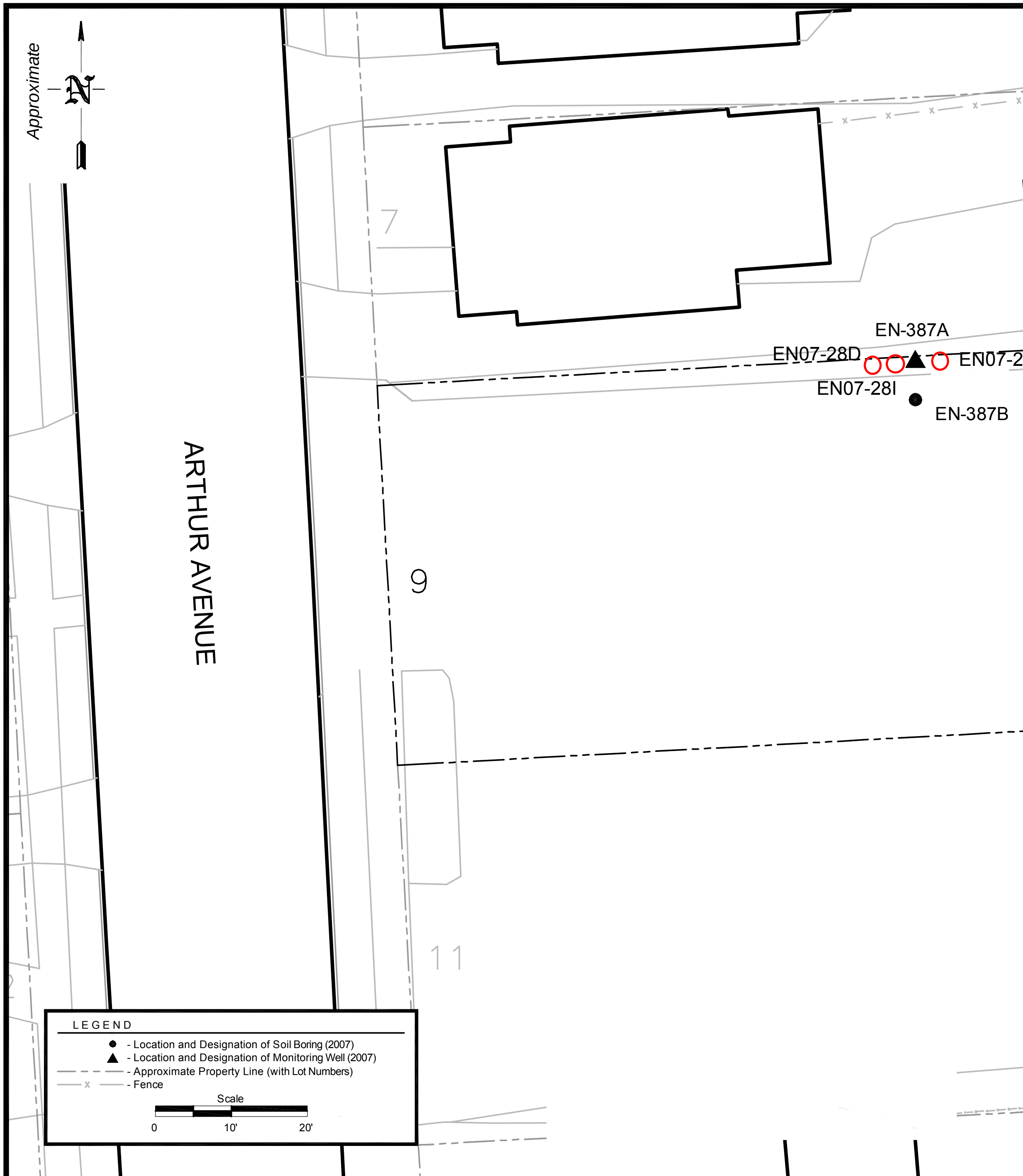
Groundwater Sciences Corporation of Harrisburg, Pennsylvania (GSC) drilled and installed EN-387A; a monitoring well located on the parcel of 9 Arthur Avenue in Endicott on May 4, 2007. The well was installed as a part of investigations of OU#4, the Former Ideal Cleaners property. On June 5, 2007, a soil boring (EN-387B) was drilled approximately five feet south of EN-387A. The monitoring well and soil boring were completed by Parratt Wolff, Incorporated of East Syracuse, New York using a nominal 8-inch diameter hollow stem auger and 3-inch split-spoon sampler. The monitoring well was observed and logged by GSC personnel; see Appendix B.5.2 for the logs.

The soil boring drilling was observed, logged, and sampled by both GSC and SHA. GSC coordinated the drilling services and supervised the field work, logging the soil boring from the ground surface into the lacustrine silt/clay aquitard. They submitted samples collected every two feet to Severn Trent Laboratories, Inc. of Colchester, Vermont, where they were analyzed for volatile organic compounds (VOCs) by EPA method 8260B and total solids. SHA observed drilling and logged the boring to 22 feet below ground surface (bgs), the approximate location of the water table at the time the drilling was completed. SHA submitted selected soil samples to GeoTesting Express of Boxboro, Massachusetts, where they were analyzed for grain size distribution and gravimetric moisture content. The laboratory reports are included as Appendix B.5.4. GSC and SHA's boring logs are located in Appendix B.5.2. The boring was backfilled with bentonite chips after completion.

B.5.2 SOIL VAPOR IMPLANT INSTALLATION

Three soil vapor implants were installed after the completion of the soil boring. Due to the proximity to boring EN-387B, implants were drilled using one-inch outer diameter (O.D) direct push rods to depth without sampling. After reaching depth, the rods were removed from the borehole and a ¼-inch O.D stainless steel mesh screen attached to ¼-inch O.D stainless steel riser was lowered into the borehole. Implant screens were placed based on soil descriptions from boring EN-387B, targeting depths above and below a silty zone and just above the water table. Implant depths and construction details are included in Table 1 and generally follow construction procedures used in the past. The risers were fitted with a gas-tight compression fitting at the ground surface and 9-inch flush-mount road boxes were installed. The implants were sampled approximately 24 hours later concurrent with the routine sampling conducted in June 2007, and have been sampled during subsequent rounds.

S:\PORDATA\2700s\2755.00\Originals\2007 SemiAnnual Report\Appendix B\Appendix B.5\200701212_AppendixB.5.docx6_



Former IBM Endicott Site
Site #704014

Soil Boring Located at
9 Arthur Avenue

DRAWN BY: JPB	DATE: 9/7/07	DRAWING NO.
CHECKED & APPROVED BY: RCW		22007-240-K5

GROUNDWATER SCIENCES CORPORATION

APPENDIX B.5.2

BORING LOGS – EN-378A and B

GROUNDWATER SCIENCES CORPORATION

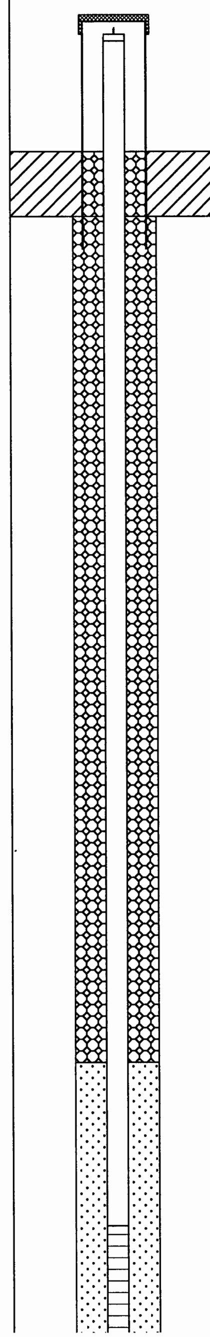
GEOLOGIC LOG: EN-387A

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	*OU#4*	DRILLING CO.:	*Parratt Wolff Inc.*
SITE LOCATION:	*Endicott, New York*	DRILLER:	*R. Navatka/J. Percy*
JOB NO.:	*02007.33.0303*	RIG TYPE:	*Mobiledrill/CME 55*
LOGGED BY:	*S. Fisher/J. Miller*	DRILLING METHOD:	*Hollow Stem Auger*
DATES DRILLED:	*4/20/07, 5/4/07*	DEVELOPMENT DATE:	*5/7/07*
		LOCATION:	*N. edge of open lot at 9 Arthur Ave.*

NOTES: SWL= 23.72 ft below TOC, 5/7/07
TOC elevation: 854.23 ft amsl

SURFACE ELEV.	851.4 ft amsl
EASTING	967458.8
NORTHING	767474.2

DEPTH FEET	BLOW COUNTS	VOC (ppm)	RECOV	SAMP. #	SOIL DESCRIPTION	DEPTH FEET	WELL CONSTRUCTION DETAILS
2						2	2" locking well cap
							Steel standpipe w/ locking Royer-type cap
0	augered to 12 ft	---	---	---	ASPHALT: Asphalt pavement with gravel base	0	Concrete surface apron
					SAND: dark yellowish brown (10 YR 4/2) f-m, w/ c, tr vf and vc, trace of f gravel, loose, moist		
2						2	
4						4	8" dia. HSA borehole (0'-31.5')
6						6	
8						8	2" dia. sch 40 PVC riser (2'-16.5')
10					SAND & GRAVEL: dk yellowish brown, m-c sand with f-m SR-R gravel, moist	10	Bentonite chip annular seal (3'-14')
12	8 10 4 5	0	17"	1	SAND & GRAVEL: dk yellowish brown, pred m-c, some f, tr vf and vc, w/ f-m SR-R gravel of various liths, loose, moist SAND: dk yellowish brown m-c some vf-f, tr vc, quartzose, homogeneous texture, loose, moist	12	
14	6 5 6 6	0	17"	2	SAND: as above, tr fine gravel, fining to f-m, lit vf, tr c, tr silt, loose, moist	14	#00N Sand pack (14'-31.5')
16	6 7 5 5	0	15"	3	SAND: as above, tr silt, changing sharply to c, lit m at 12", quartzose, loose, moist	16	2" dia. 20-slot PVC screen (16.5'-31.5)
18						18	



DEPTH FEET	BLOW COUNTS	VOC (ppm)	RECOV	SAMP. #	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
18-20	9, 6, 6, 9	0	14"	4	SAND: as above, m-c to 8", then f-m, homogenoeus, quartzose, small SR-R pebble at 9", loose, moist	
20-22	6, 5, 7, 12	0	16"	5	SAND: dk yellowish brown, f-m, moist SAND & GRAVEL: f-m w/ SR gravel, loose, wet	#00N Sand pack (14'-31.5')
22-24	11, 12, 5, 4	11.0	12"	6	SAND & GRAVEL: grayish black (N2) pred m-c, lit f, SR gravel, loose, wet SAND: m-c, petroleum odor	
24-26	2, 3, 13, 8	0.1	11"	7	SAND: f-m, lit-tr c, tr gravel, wet SAND: fine, tr silt, petroleum odor	
26-28	6, 12, 14, 14	4.2	22"	8	SAND W/ GRAVEL: dusky yellowish brown (10 YR 2/2) f-m, tr c, tr-lit SR gravel, loose, moist, petroleum odor	2" dia. 20-slot PVC screen (16.5'-31.5)
28-30	12, 9, 8, 10	---	0"	9	SAND: no recovery	
30-32	5, 4, 3, 4	0	18"	10	SAND: dk yell brown to pale yell brown (1- YR 6/2) f-m, loose SILT & CLAY: light olive gray (5 Y 6/1)	Collapsed formation (31.5'-32')

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	*OU#4*	DRILLING CO.:	*Parratt Wolff Inc.*
SITE LOCATION:	*Endicott, New York*	DRILLER:	*D. Waris*
JOB NO.:	*02007.33.0303*	RIG TYPE:	*CME 55*
LOGGED BY:	*S. Fisher/J. Miller*	DRILLING METHOD:	*Hollow Stem Auger*
DATES DRILLED:	*6/5/07*	DEVELOPMENT DATE:	*NA*
		LOCATION:	*Open lot at 9 Arthur Ave., 5 ft S of EN-387A*

NOTES: Soil boring, backfilled upon completion

SURFACE ELEV.	852.2 ft amsl
EASTING	967458.8
NORTHING	767469.2

DEPTH FEET	BLOW COUNTS	VOC (ppm)	RECOV.	SAMP. #	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
0-2	augered, 8, 10, 11	0	16"	1	ASPHALT: Asphalt pavement with gravel base SILT, SAND & GRAVEL: dk yellowish brown (10 YR 4/2) f-m, some c, f-m SR-R gravel throughout, mod yellowish brown (10 YR 5/4) silty sand mass 8-9", coal frag at 14", moist	Asphalt surface cap
2-4	11, 11, 8, 9	0	20"	2	SILT, SAND & GRAVEL: as above, moist SAND & SILT: dk yellowish brown to olive black (5 Y 2/1) silty vf-f sand, sl mottled, tr coal frags	
4-6	8, 6, 5, 5	0	24"	3	CINDERS: loose, angled top contact, moist SILT, SAND & GRAVEL: dusky yellowish brown (10 YR 2/2) to olive gray (5 Y 4/1) mottled, moist	8" dia. HSA borehole (0'-30')
6-8	6, 6, 5, 5	0	18"	4	SAND: dk yellowish brown pred m, some f, tr c, sl more f below 20", moist SAND: dk yellowish brown, pred m, lit f, coarsening w/ depth to pred c, tr vc, to 17", loose, qrtzose, vf-f silty sand below, silt mass at 18", moist	
8-10	2, 5, 8, 24	0	14"	5	SAND: vf-f, laminated, tr silt, tr gravel, cross laminated silty vf sand 8-10", moist, pred m, some f below 10", moist SAND & GRAVEL: f-m sand, f-m SA-SR gravel	
10-12	29, 40, 49, 41	0	22"	6	SAND & GRAVEL: dk yellowish brown m-c, some vc, w/ f SR-R gravel of various liths, some m gravel, occ wthrd silt mass, moist	
12-14	39, 33, 42, 49	0	18"	7	SAND & GRAVEL: as above, loose, moist, pred m-c qrtzose sand below 14", moist	
14-16	9, 10, 9, 10	0	18"	8	SAND: dk yellowish brown, f-m tr vf, quartzose, homogeneous, moist	Bentonite chip backfill (0'-36')
16-18	8, 9, 12, 14	0	18"	9	SAND: as above, coarsening to c w/ vc, cemented sand masses at 11", quartzose, homogeneous SAND & GRAVEL: f-m SR-R gravel of various liths, with m-c, some vc matrix, moist	
18-20	7, 8, 7, 11	0	20"	10	SAND: dk yellowish brown, c w/ vc to 8", pred m some f 8-14", moist, gravelly zone 14-17", m-c, qrtzose, moist below 17"	

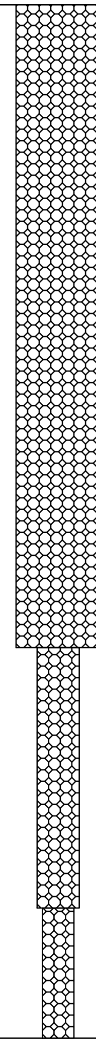
GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: EN-387B

PROJECT: ***OU#4***

DEPTH FEET	BLOW COUNTS	VOC (ppm)	RECOV.	SAMP. #	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
20–22	7 9 12 11	7.1	23"	11	SAND: dk yellowish brown, m-c, tr f, f-m 7-9", moist SAND & GRAVEL: m-c matrix, f-m SR-R gravel of various liths, moist, petroleum stained at 21"	
22–24	5 4 4 6	--	18"	12	SAND W/ GRAVEL: med dk gray (N4) f-m, some c, w/ SR gravel, w/ petrol. odor, wet SAND: fine, tr medium, tr silt, w/ petrol. odor	8" dia. HSA borehole (0'-30')
24–26	6 7 7 11	34	24"	13	SAND: dk yell. brown to olive gray (5 Y 4/1), m-c, angled contact at 4", f-m below, gray staining along contact, fining w/ depth, sl laminated, wet SAND & GRAVEL: dk yell brown w/ olive gray staining, c-vc, lit m, w/ f-m SR-R gravel, petrol odor and staining, wet	
26–28	5 10 14 18	24.5	24"	14	SAND: dk yell brown, f-m , tr c, tr silt, wet SAND W/ GRAVEL: m-c, lit f SR-R gravel, f-m, lit c below 12", tr gravel, tr silt, dk yellowish orange (10 YR 6/6) 13-16", wet	Bentonite chip backfill (0'-36')
28–30	3 4 17 16	9.6	23"	15	SAND: dk yellowish brown, f-m, tr c, wet SAND & GRAVEL: m-c, f SR-R gravel, petroleum odor, wet	
30–32	8 8 11 12	0	24"	16	SAND & GRAVEL: as above SAND W/ GRAVEL: dk yell brown to mod yell brown, m, tr f, wet SILT & CLAY: dusky yellow (5 Y 6/4) laminated, moist	4" dia. casing borehole (30'-34')
32–34	15 14 12 16	0	11"	17	SILT & CLAY: olive gray, lam, clay-rich, occ. pale red (5 R 6/2) clay lams @ 4", 7", and 10", wet	
34–36	10 10 9 8	0	24"	18	SILT & CLAY: as above, wet	3" dia. split spoon borehole (34'-36')

WELL CONSTRUCTION



Project: Endicott Soil Vapor Monitoring
Location: Endicott, NY
SHA Project No.: 2755.00

Log of Boring EN-387B

Ground Elevation: 852.2 feet

Datum: AMSL

Drilling Method: 6" Auger

Sampling Method: 3" Split-spoon

Drilling Company: Parratt Wolff
Foreman: D. Warris
Date Started: 06/05/07 **Date Finished: 06/05/07**
Logged By: EMB **Checked By: DBC**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
06/05/07		22'	EN-387A	---	---

Depth (ft)	Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/ Rec (in)	PID/FID Values (ppmv)	Stratum Log	Stratum Description	Geologic Description	Remarks
0							-----0'-----	Augered through ASPHALT.	
	S-1	0.5 - 2	8 10 11	18/14	0.0			S-1 (0.5 to 2'): Medium dense, brown, fine to coarse SAND, some Silt, trace Gravel, with Cinders. Moist. FILL.	
							SAND		
2	S-2	2 - 4	11 11 8 9	24/20	0.0			S-2 (2 to 3.5'): Medium dense, dark yellowish brown, fine to coarse SAND, some Silt, trace Gravel, with Cinders. Moist. FILL.	
							-----3.5'-----	S-2A (3.5 to 4'): Medium dense, dark gray, fine to coarse SAND, some Silt, with Cinders and Roots. FILL.	
4	S-3	4 - 6	8 6 5 5	24/24	0.0			S-3 (4 to 5'): Medium dense, dark gray, fine to coarse SAND, some Silt, trace Gravel. Moist.	
								S-3A (5 to 6'): Medium dense, dark yellowish brown, fine to coarse SAND, some Silt, trace Gravel. Moist.	
6	S-4	6 - 8	6 6 5 5	24/18	0.0		SILTY SAND	S-4 (6 to 7.5'): Medium dense, dark yellowish brown, fine to coarse SAND, little Silt.	
								S-4A (7.5 to 8'): Brown, fine to medium SAND, some Silt. Silt lamination @ 7.5'. Moist.	
8	S-5	8 - 10	2 5 8 24	24/14	0.0			S-5 (8 to 8.7'): Medium dense, brown, fine to medium SAND, little Silt, with Silt laminations throughout.	
								S-5A (8.7 to 8.9'): Brown, fine to medium SAND, some Silt.	
							-----9'-----	S-5B (8.9 to 9'): Brown, fine to coarse SAND, little Silt.	
							SAND & GRAVEL	S-5C (9 to 10'): Brown, SAND & GRAVEL, little Silt. Moist.	
10									

BORING LOG S:\PORDATA\2700S\2755.00\WORK\GINT LOGS\2755.GPJ 20070412 2400 GUN CLUB.GLB 20070412 2400 GUN CLUB.GDT 11/20/07

Project: Endicott Soil Vapor Monitoring
Location: Endicott, NY
SHA Project No.: 2755.00

Log of Boring EN-387B

Ground Elevation: 852.2 feet

Drilling Method: 6" Auger

Datum: AMSL

Sampling Method: 3" Split-spoon

Drilling Company: Parratt Wolff
Foreman: D. Warris
Date Started: 06/05/07 **Date Finished: 06/05/07**
Logged By: EMB **Checked By: DBC**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
06/05/07		22'	EN-387A	---	---

Depth (ft)	Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/ Rec (in)	PID/FID Values (ppmv)	Log	Stratum Description	Geologic Description	Remarks
10	S-6	10 - 12	29 40 49 41	24/22	0.0			S-6 (10 to 12'): Very dense, medium brown, fine to coarse SAND & GRAVEL, little Silt. Moist.	
12	S-7	12 - 14	39 33 43 39	24/18	0.0		SAND & GRAVEL	S-7 (12 to 14'): Very dense, medium brown, sub angular to subrounded Gravel, some Sand, trace Silt. Moist.	
14	S-8	14 - 16	9 10 9 10	24/18	0.0		-----14'----- SAND	S-8 (14 to 16'): Medium dense, grayish brown, fine to coarse SAND, trace Gravel, trace Silt. Moist.	
16	S-9	16 - 18	8 9 12 14	24/20	0.0		-----16'----- SAND & GRAVEL	S-9 (16 to 18'): Medium dense, grayish brown, fine to coarse SAND, some Gravel, trace Silt. Moist.	
18	S-10	18 - 20	7 8 7 11	24/20	0.0		-----18'----- SAND	S-10 (18 to 18.7'): Medium dense, grayish brown, fine to coarse SAND, trace Gravel, trace Silt. S-10A (18.7 to 19.2'): As above except fine to medium Sand. S-10B (19.2 to 20'): Fine to coarse SAND, trace Gravel, trace Silt.	
20									

BORING LOG S:\PORDATA\2700S\2755.00\WORK\GINT LOGS\2755.GPJ 20070412 2400 GUN CLUB.GLB 20070412 2400 GUN CLUB.GDT 11/20/07

Project: Endicott Soil Vapor Monitoring
Location: Endicott, NY
SHA Project No.: 2755.00

Log of Boring EN-387B

Ground Elevation: 852.2 feet

Drilling Method: 6" Auger

Datum: AMSL

Sampling Method: 3" Split-spoon

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Stab. Time
06/05/07		22'	EN-387A	---	---

Drilling Company: Parratt Wolff
Foreman: D. Warris
Date Started: 06/05/07 **Date Finished: 06/05/07**
Logged By: EMB **Checked By: DBC**

Depth (ft)	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/ Rec (in)	PID/FID Values (ppmv)	Stratum: Log	Description	Geologic Description	Remarks
20	S-11	20 - 22	7 9 12 11	24/23	0.0		SAND	S-11 (20 to 21.3'): Medium dense, medium brown, fine to coarse SAND, trace Gravel, trace Silt.	
							-----21.3'----- SAND & GRAVEL	S-11A (21.3 to 22'): Medium dense, dark gray, fine to coarse SAND & GRAVEL, trace Silt. Wet. Petroleum-like odor.	
22		22		---	12.5		-----22'-----	SHA logging terminated at 22'. No refusal encountered. NOTES: 1. Representatives of Groundwater Sciences Corporation of Harrisburg, Pennsylvania continued to log borehole. Refer to their logs for more details. 2. Soil samples were screened for volatile organic compounds (VOCs) using a Photovac Model 2020 Photoionization Detector (PID) with a 10.6 eV lamp, calibrated to a 100 parts per million by volume (ppmv) isobutylene-in-air standard using a response factor of 1.0. Results are presented in ppmv; the typical detection limit is 1 ppmv. ND indicates not detected. The PID measures relative levels of VOCs. Although PID screening can not be used directly to quantify VOC concentrations or identify individual compounds, the results serve as a relative indicator for the presence of VOCs.	
24									
26									
28									
30									

BORING LOG S:\PORDATA\2700S\2755.00\WORK\GINT LOGS\2755.GPJ 20070412 2400 GUN CLUB.GLB 20070412 2400 GUN CLUB.GDT 11/20/07

APPENDIX B.5.3

GSC TABLE OF ANALYTICAL LABORATORY DATA FOR SOIL SAMPLES

RESULTS OF EN-387B SOIL SAMPLE ANALYSES
OU#4 Focused Feasibility Study
Former IBM Endicott Site, Endicott, NY

Collect Date	Client ID	Boring/ Well ID	Sample Type	Sample Depth (ft. bgs)	Soil Type	Moisture (%)	Total Hydrocarbons - C8 through C40 (mg/kg)	Diesel Range Organics - C10 through C28 (mg/kg)	Moisture (%)	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride	Benzene	Ethylbenzene	Toluene	Total Xylenes	Naphthalene	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	n-Butylbenzene	tert-Butylbenzene	1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	1,4-Dichlorobenzene	2-Butanone	Acetone	Carbon Disulfide
					Units	%	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
06/05/2007	EN387B0-2	EN-387B	Soil	0 - 2	Sand & Gravel	8.3	**4.4** J	<13	10	**0.00092** J	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.017**	<0.005
06/05/2007	EN387B2-4	EN-387B	Soil	2 - 4	Sand & Gravel	8.7	<13	<13	9	**0.0011** J	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	**0.023**	<0.0049
06/05/2007	EN387B4-6	EN-387B	Soil	4 - 6	Sand & Gravel	7.8	<13	<13	8	**0.0011** J	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	**0.0038** J	**0.025**	<0.0052
06/05/2007	EN387B6-8	EN-387B	Soil	6 - 8	Sand & Gravel	6.4	<13	<13	6	**0.019** J	**0.0013** J	<0.0057	<0.0057	<0.0057	**0.0016** J	<0.0057	**0.0013** J	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	**0.0016** J
06/05/2007	EN387B6-8RE	EN-387B	Soil Lab Dup	6 - 8	Sand & Gravel	NA	NA	NA	6	**0.0048** J	<0.0056	<0.0056	<0.0056	**0.0015** J	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	**0.0076** B	<0.0056
06/05/2007	EN387B8-10	EN-387B	Soil	8 - 10	Sand & Gravel	13.7	<14	<14	11	**0.015**	**0.0015** J	**0.0013** J	<0.0052	<0.0052	**0.0013** J	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	<0.0052	**0.012**	**0.0011** J
06/05/2007	EN387B8-10RE	EN-387B	Soil Lab Dup	8 - 10	Sand & Gravel	NA	NA	NA	11	**0.019**	**0.0012** J	<0.0053	<0.0053	**0.0023** J	**0.0012** J	<0.0053	**0.001** J	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	**0.0089** B	<0.0053
06/05/2007	EN387B10-12	EN-387B	Soil	10 - 12	Sand & Gravel	4.2	<13	<13	3	**0.024**	**0.0022** J	**0.0021** J	<0.0047	<0.0047	**0.001** J	<0.0047	**0.001** J	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047	**0.0089**	**0.001** J
06/05/2007	EN387B10-12RE	EN-387B	Soil Lab Dup	10 - 12	Sand & Gravel	NA	NA	NA	3	**0.015**	**0.0015** J	**0.0023** J	<0.0049	**0.0023**	**0.001** J	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	**0.011** B	<0.0049
06/05/2007	EN387B12-14	EN-387B	Soil	12 - 14	Sand & Gravel	4	<13	<13	4	**0.033**	**0.0039** J	**0.0049** J	<0.0055	<0.0055	**0.0014** J	<0.0055	**0.0011** J	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	**0.0099**	**0.001** J
06/05/2007	EN387B12-14RE	EN-387B	Soil Lab Dup	12 - 14	Sand & Gravel	NA	NA	NA	4	**0.029**	**0.0027** J	**0.004** J	<0.005	**0.0019** J	**0.001** J	<0.005	**0.0011** J	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.009** B	<0.005
06/05/2007	EN387B14-16	EN-387B	Soil	14 - 16	Sand & Gravel	4.5	<13	<13	6	**0.026**	**0.003** J	**0.0033** J	<0.0056	<0.0056	**0.0015** J	<0.0056	**0.0012** J	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	**0.011**	**0.0014** J
06/05/2007	EN387B14-16RE	EN-387B	Soil Lab Dup	14 - 16	Sand & Gravel	NA	NA	NA	6	**0.033**	**0.0038** J	**0.0066**	<0.0056	**0.0023** J	**0.0012** J	<0.0056	**0.001** J	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	**0.014** B	<0.0056
06/05/2007	EN387B16-18	EN-387B	Soil	16 - 18	Sand & Gravel	5.6	<13	<13	4	**0.0045** J	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	**0.0094**	<0.0055
06/05/2007	EN387B18-20	EN-387B	Soil	18 - 20	Sand & Gravel	4.9	<13	<13	6	**0.02**	**0.0028** J	**0.0041** J	<0.0055	<0.0055	**0.0012** J	<0.0055	**0.001** J	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	**0.0071** B	<0.0055
06/05/2007	EN387B18-20RE	EN-387B	Soil Lab Dup	18 - 20	Sand & Gravel	NA	NA	NA	6	**0.024**	**0.003** J	**0.0052** J	<0.0056	<0.0056	**0.0013** J	<0.0056	**0.0014** J	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	**0.016**	<0.0056
06/05/2007	EN387B20-22	EN-387B	Soil	20 - 22	Sand & Gravel	6.5	**13000**	**12000**	7	**0.13**	**0.0047** J	**0.0034** J	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	**0.0071**	**0.031** B	<0.0053
06/05/2007	EN387B20-22RE	EN-387B	Soil Lab Dup	20 - 22	Sand & Gravel	NA	NA	NA	7	**0.12**	**0.0042** J	**0.003** J	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	**0.0096**	**0.042**	<0.0053
06/05/2007	EN387B22-24	EN-387B	Soil	22 - 24	Sand & Gravel	18.2	1900	**1500**	20	<0.52	<0.52	**0.2** J	<0.52	**0.55**	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	**1.5**	<0.52
06/05/2007	EN387B24-26	EN-387B	Soil	24 - 26	Sand & Gravel	14.5	1300	**1000**	19	**0.0019** J	<0.0049	**0.093**	**0.005**	**0.23** E	**0.0095**	<0.0049	**0.0017** J	**0.0034** J	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	<0.0049	**0.012** B	<0.0049
06/05/2007	EN387B26-28	EN-387B	Soil	26 - 28	Sand & Gravel	13.1	**6.4** J	**5.1** J	13	**0.1** J	<0.49	**1**	<0.49	**0.1** J	<0.49	<0.49	<0.49	<0.49	<0.49	<0.49	<0.49	<0.49	<0.49	<0.49	<0.49	<0.49	<0.49	**1.4**	<0.49
06/05/2007	EN387B28-30	EN-387B	Soil	28 - 30	Sand & Gravel	14.7	**240**	**270**	18	**0.4** J	<0.5	**1.1**	<0.5	**0.14** J	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**1.3**	<0.5
06/05/2007	EN387B30-32	EN-387B	Soil	30 - 31.5	Sand & Gravel	13.1	<14	<14	21	**1.8**	<0.54	**2.7**	<0.54	**0.23**	<0.54	<0.54	<0.54	<0.54	<0.54	<0.54	<0.54	<0.54	<0.54	<0.54	<0.54	<0.54	<0.54	**1.3**	<0.54
06/05/2007	EN387B318	EN-387B	Soil	31.5 - 32	Silt & Clay	NA	NA	NA	15	**1.2**	<0.46	**1.2**	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	**1.2**	<0.46
06/05/2007	EN387B325	EN-387B	Soil	32 - 32.5	Silt & Clay	NA	NA	NA	21	<0.53	<0.53	**2.3**	<0.53	**0.16** J	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	**1.3**	<0.53
06/05/2007	EN387B33	EN-387B	Soil	32.5 - 33	Silt & Clay	NA	NA	NA	24	<0.0057	<0.0057	**0.0083**	<0.0057	**0.13**	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	<0.0057	**0.0096** B	<0.0057
06/05/2007	EN387B335	EN-387B	Soil	33 - 33.5	Silt & Clay	NA	NA	NA	26	<0.0056	<0.0056	**0.002** J	<0.0056	**0.097**	<0.0056	<0.0056	<0.0056	<0.0056	**0.0029** JB	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	<0.0056	**0.011** B	<0.0056
06/05/2007	EN387B335RE	EN-387B	Soil Lab Dup	33 - 33.5	Silt & Clay	NA	NA	NA	26	<0.0058	<0.0058	<0.0058	<0.0058	**0.002** J	<0.0058	<0.0058	<0.0058	<0.0058	**0.0078** B	**0.0025** J	**0.0021** J	**0.0021** J	**0.0014** J	**0.0032** J	**0.0033** J	**0.0026** J	<0.0058	**0.014** B	<0.0058
06/05/2007	EN387B34	EN-387B	Soil	33.5 - 34	Silt & Clay	NA	NA	NA	28	<0.0054	<0.0054	**0.0014** J	<0.0054	**0.012**	<0.0054	<0.0054	<0.0054	<0.0054	**0.0015** JB	<0.0054	<0.0054	<0.0054	<0.0054	<0.0054	<0.0054	<0.0054	<0.0054	**0.01** B	<0.0054
06/05/2007	EN387B34RE	EN-387B	Soil Lab Dup	33.5 - 34	Silt & Clay	NA	NA	NA	28	<0.0055	<0.0055	<0.0055	<0.0055	**0.0014** J	<0.0055	<0.0055	<0.0055	<0.0055	**0.0047** JB	**0.0016** J	<0.0055	<0.0055	<0.0055	**0.0021** J	**0.0021** J	<0.0055	<0.0055	**0.016** B	<0.0055
06/05/2007	EN387B345	EN-387B	Soil	34 - 34.5	Silt & Clay	NA	NA	NA	31	<0.0059	<0.0059	<0.0059	<0.0059	**0.005** J	<0.0059	<0.0059	<0.0059	<0.0059	<0.0059	<0.0059	<0.0059	<0.0059	<0.0059	<0.0059	<0.0059	<0.0059	<0.0059	**0.017** B	<0.0059
06/05/2007	EN387B345RE	EN-387B	Soil Lab Dup	34 - 34.5	Silt & Clay	NA	NA	NA	31	<0.0061	<0.0061	**0.0013** J	<0.0061	**0.14**	<0.0061	<0.0061	<0.0061	<0.0061	**0.0065** B	**0.0024** J	<0.0061	<0.0061	<0.0061	**0.0026** J	**0.0031** J	**0.0031** J	<0.0061	**0.017** B	<0.0061
06/05/2007	EN387B35	EN-387B	Soil	34.5 - 35	Silt & Clay	NA	NA	NA	30	<0.0058	<0.0058	<0.0058	<0.0058	**0.0032** J	<0.0058	<0.0058	<0.0058	<0.0058	**0.0016** JB	<0.0058	<0.0058	<0.0058	<0.0058	<0.0058	<0.0058	<0.0058	<0.0058	**0.0082** B	<0.0058
06/05/2007	EN387B35RE	EN-387B	Soil Lab Dup	34.5 - 35	Silt & Clay	NA	NA	NA	30	<0.0059	<0.0059	<0.0059	<0.0059	**0.0079**	<0.0059	<0.0059	<0.0059	<0.0059	**0.0024** JB	<0.0059	<0.0059	<0.0059	<0.0059	<0.0059	<0.0059	<0.0059	<0.0059	**0.02** B	<0.0059
06/05/2007	EN387B355	EN-387B	Soil	35 - 35.5	Silt & Clay	NA	NA	NA	26	<0.0055	<0.0055	<0.0055	<0.0055	**0.0023** J	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	<0.0055	**0.0093** B	<0.0055
06/05/2007	EN387B355RE	EN-387B	Soil Lab Dup	35 - 35.5	Silt & Clay	NA	NA	NA	26	<0.0054	<0.0054	<0.0054	<0.0054	**0.0022** J	<0.0054	<0.0054	<0.0054	<0.0054	**0.0026** JB	<0.0054	<0.0054	<0.0054	<0.0054	<0.0054	<0.0054	<0.0054	<0.0054	**0.01** B	<0.0054

NOTES:
1. This table summarizes results of soil sampling at boring EN-387B located about 5 feet south of Upper Aquifer monitoring well EN-387A on the 9 Arthur Avenue property in Endicott, New York. The EN-387B soil boring was advanced to the top of Lacustrine Silt using 6 1/4-inch hollow-stem auger drilling techniques. The soil boring was advanced beyond the augers and into the Lacustrine Silt using 4-inch cased drive and wash drilling technqiues. Soil samples were collected ahead of the augers and casing using 3-inch split-spoons. Upon completion of soil sampling the borehole was backfilled with bentonite. Drilling and soil sampling was performed on June 5, 2007 by Parratt-Wolff, Inc. of East Syracuse, New York and observed and logged by Groundwater Sciences Corporation personnel.

2. Soil samples were collected and analyzed for volatile organic coumpounds (VOCs), total petroleum hydrocarbons (TPHs), and diesel range organics (DROs). Samples collected for VOC analysis were submitted to Severn Trent Laboratories, Inc. of Colchester, Vermont and analyzed using SW-846 Method 8260B. Samples collected for TPH and DRO analyses were submitted to Lancaster Laboratories, Inc. of Lancaster, Pennsylvania. The soil quality results are presented in units of micrograms per kilogram (ug/kg). The data is preliminary as it is has not yet been subject to independent data validation. A "J" qualifier reported by the laboratory signifies an estimated concentration below the reporting limit but above the meothod detection limit. A "B" qualifier reported by the laboratory signifies the analyte was also detected in an associated method blank. An "E" qualifier reported by the laboratory signifies the detected concentration exceeded the upper limit of the instrument calibration range.

3. Other notes:
"ft. bgs - denotes feet below ground surface
"<" - signifies not detected, value given is reporting limit
"NA" - denotes "not analyzed"
"NR" - denotes compound "not reported"

APPENDIX B.5.4

SOILS LABORATORY DATA

ENGINEERS ■ SCIENTISTS

GeoTesting express
a subsidiary of Geocomp Corporation

1145 Massachusetts Avenue
Boxborough, MA 01719
978 635 0424 Tel
978 635 0266 Fax

Transmittal

TO:

Ms. Erica Bradstreet
Sanborn, Head & Associates
95 High Street
Portland, ME 04101

DATE: 6/19/2007	GTX NO: 7530
RE: Routine Soil Vapor/Monitoring/Consulting	

COPIES	DATE	DESCRIPTION
1	6/19/2007	**June 2007 Laboratory Test Reports**

REMARKS:

CC:

SIGNED: Joe P
Joe Tomei – Laboratory Manager

APPROVED BY:
Gary Torosian – Director of Testing Services

GeoTesting
express
a subsidiary of Geocomp Corporation

June 19, 2007

Ms. Erica Bradstreet
Sanborn Head & Associates
95 High Street
Portland, ME 04101

Re: Routine Soil Vapor/Monitoring/Consulting Project (GTX-7530)

Dear Ms. Bradstreet:

Enclosed are the test results you requested for the above referenced project. GeoTesting Express, Inc. (GTX) received six soil samples from you on June 11, 2007. These samples were labeled as follows:

EN-387B S-3A (4-5 ft)
EN-387B S-3 (6 ft)
EN-387B S-5 (8-8.7 ft)
EN-387B S-5B (8.7-8.9 ft)
EN-387B S-7 (12-14 ft)
EN-387B S-9 (16-18 ft)

GTX performed the following test on each of these samples:

Moisture Content (ASTM D 2216)

Grain Size Analysis (ASTM D 422) with Hydrometer

A copy of your test request is attached.

The results presented in this report apply only to the items tested. This report shall not be reproduced except in full, without written approval from GeoTesting Express. The remainder of these samples will be retained for a period of sixty (60) days and will then be discarded unless otherwise notified by you. Please call me if you have any questions or require additional information. Thank you for allowing GeoTesting Express the opportunity of providing you with testing of geosynthetics. We look forward to working with you again in the future.

Respectfully yours,

Joe Tomei
Laboratory Manager

GeoTesting Express, Inc.
1145 Massachusetts Avenue
Boxborough, MA 01719
800 434 1062 Toll Free
978 635 0266 Fax

www.geotesting.com
2662 Holcomb Bridge Road, Suite 310
Alpharetta, GA 30022
770 645 6575 Tel
770 645 6570 Fax

GeoTesting express
a subsidiary of Geocomp Corporation

1145 Massachusetts Avenue
Boxborough, MA 01719
978 635 0424 Tel
978 635 0266 Fax

Geotechnical Test Report June 19, 2007

GTX-7530
Routine Soil Vapor Monitoring/Consulting Project

Endicott, NY

Prepared for:

Sanborn, Head & Associates

GeoTesting express
a subsidiary of Geocomp Corporation

Client:	Sanborn, Head & Associates				
Project:	Routine Soil Vapor/Monitoring/Consulting				
Location:	Endicott, NY			Project No:	GTX-7530
Boring ID:	---	Sample Type:	---	Tested By:	mll
Sample ID:	---	Test Date:	06/19/07	Checked By:	n/a
Depth :	---	Sample Id:	---		

Moisture Content of Soil - ASTM D 2216-05

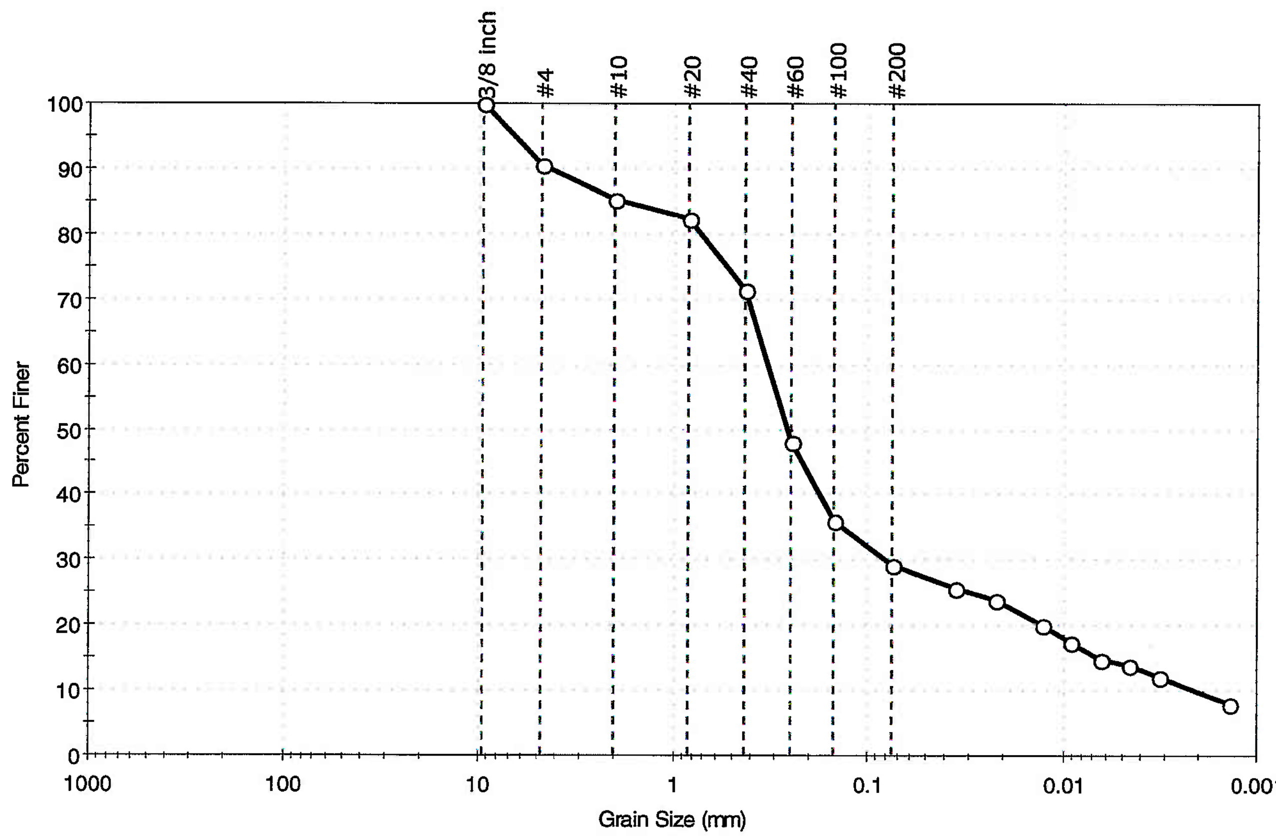
Boring ID	Sample ID	Depth	Description	Moisture Content,%
EN-387B	S-3A	4-5 ft	Moist, brown clayey sand	14.5
EN-387B	S-3	6 ft	Moist, dark brown silty sand	11.4
EN-387B	S-5	8-8.7 ft	Moist, dark brown silty sand	9.6
EN-387B	S-5B	8.7-8.9 ft	Moist, brown silty sand	22
EN-387B	S-7	12-14 ft	Dry, very dark brown gravel with sand	4.4
EN-387B	S-9	16-18 ft	Dry, very dark brown sand with gravel	4.3

Notes: Temperature of Drying : 110º Celsius

GeoTesting express
a subsidiary of Geocomp Corporation

Client:	Sanborn, Head & Associates				
Project:	Routine Soil Vapor/Monitoring/Consulting				
Location:	Endicott, NY			Project No:	GTX-7530
Boring ID:	EN-387B	Sample Type:	bag	Tested By:	mll
Sample ID:	S-3A	Test Date:	06/14/07	Checked By:	jdt
Depth :	4-5 ft	Test Id:	113845		
Test Comment:	---				
Sample Description:	Moist, brown clayey sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	9.5	61.4	29.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	90		
#10	2.00	85		
#20	0.84	82		
#40	0.42	71		
#60	0.25	48		
#100	0.15	36		
#200	0.075	29		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0356	26		
---	0.0222	24		
---	0.0129	20		
---	0.0091	17		
---	0.0065	15		
---	0.0046	14		
---	0.0032	12		
---	0.0014	8		

Coefficients

D_{85} = 1.8056 mm D_{30} = 0.0820 mm
D_{60} = 0.3280 mm D_{15} = 0.0067 mm
D_{50} = 0.2608 mm D_{10} = 0.0021 mm
C_u = N/A C_c = N/A

Classification

ASTM   N/A

AASHTO   Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

printed 6/19/2007 10:00:30 AM

GeoTesting express
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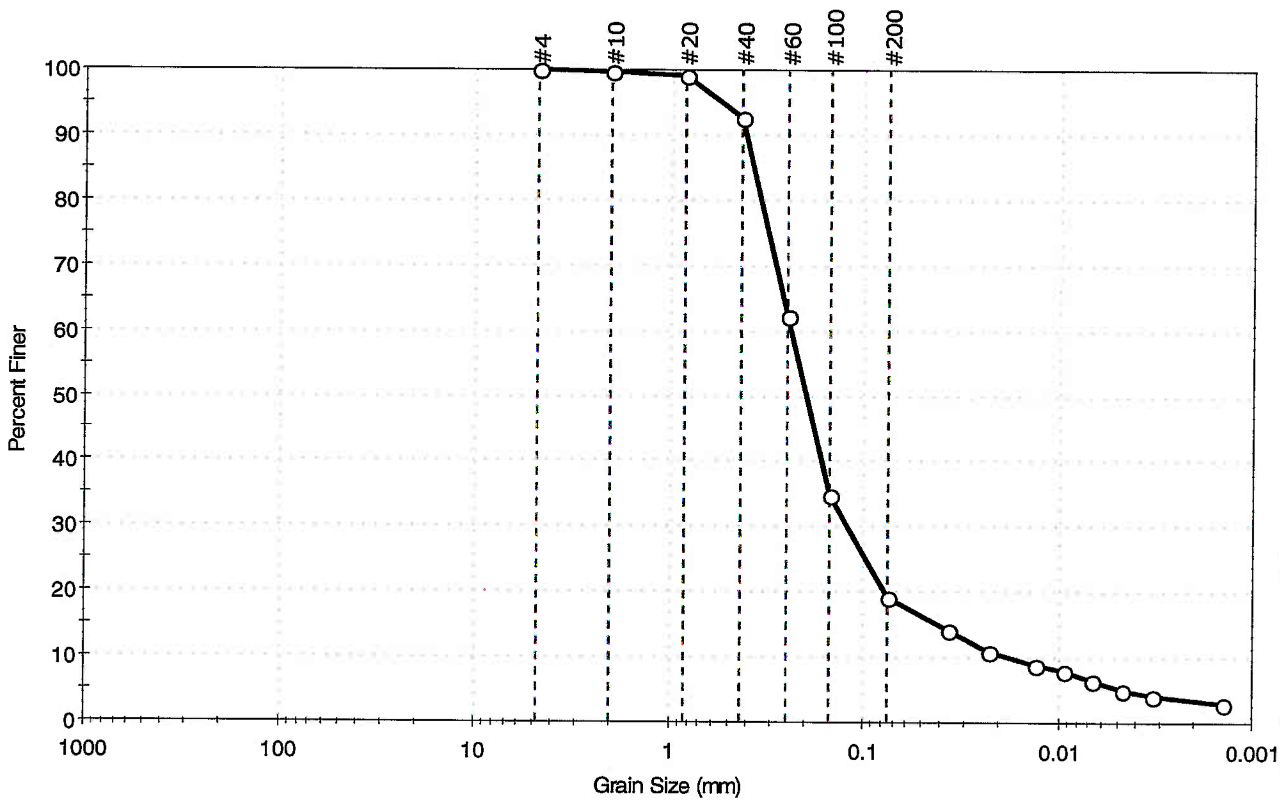
Client:	Sanborn, Head & Associates		
Project:	Routine Soil Vapor/Monitoring/Consulting		
Location:	Endicott, NY	Project No:	GTX-7530
Boring ID: EN-387B	Sample Type: bag	Tested By:	mll
Sample ID:S-3	Test Date: 06/14/07	Checked By:	jdt
Depth : 6 ft	Test Id: 113846		
Test Comment:	---		
Sample Description:	Moist, dark brown silty sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	80.8	19.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.84	99		
#40	0.42	93		
#60	0.25	62		
#100	0.15	35		
#200	0.075	19		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0367	14		
---	0.0230	11		
---	0.0133	9		
---	0.0094	8		
---	0.0067	6		
---	0.0047	5		
---	0.0033	4		
---	0.0014	3		

Coefficients

D_{85} =0.3722 mm D_{30} =0.1210 mm

D_{60} =0.2400 mm D_{15} =0.0415 mm

D_{50} =0.1988 mm D_{10} =0.0178 mm

C_u =N/A C_c =N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

printed 6/19/2007 10:00:47 AM

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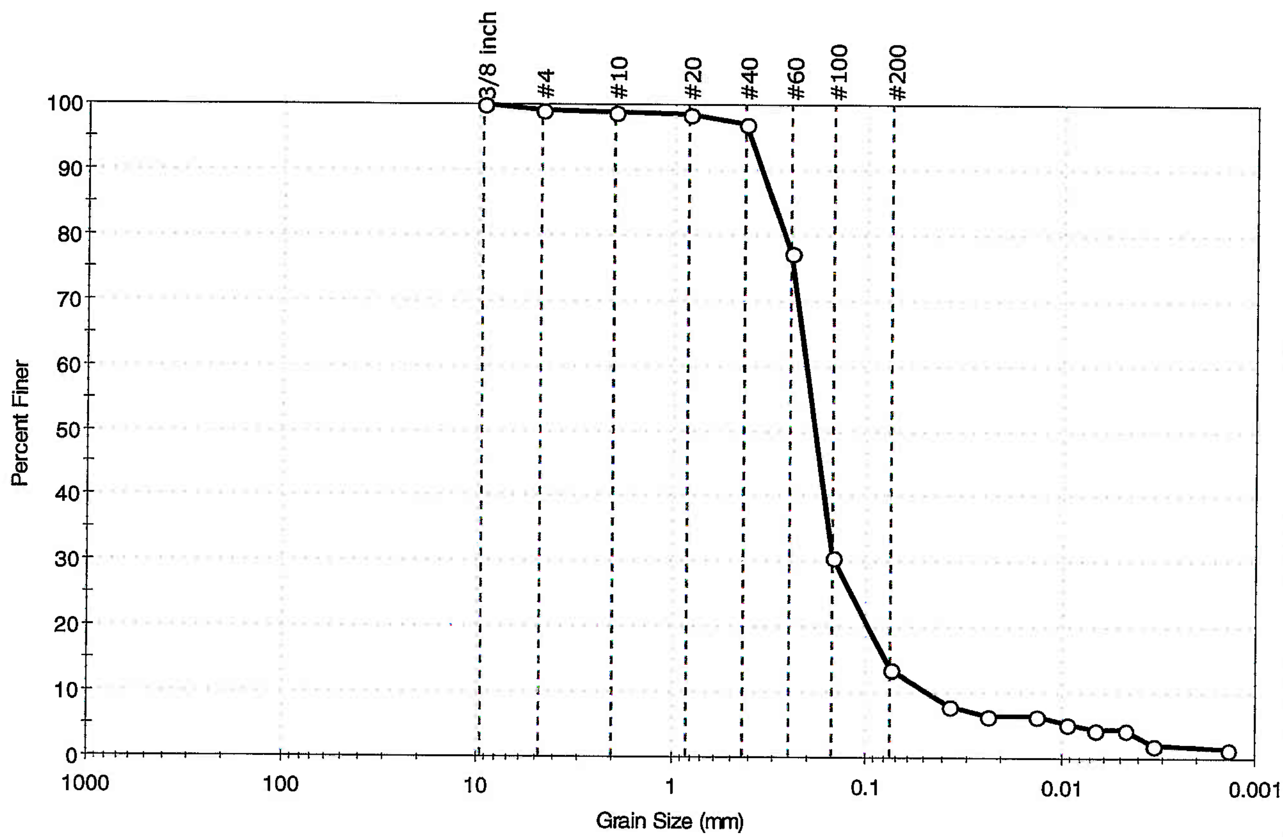
Client:	Sanborn, Head & Associates		
Project:	Routine Soil Vapor/Monitoring/Consulting		
Location:	Endicott, NY	Project No:	GTX-7530
Boring ID: EN-387B	Sample Type: bag	Tested By:	mll
Sample ID:S-5	Test Date: 06/14/07	Checked By:	jdt
Depth : 8-8.7 ft	Test Id: 113847		
Test Comment:	---		
Sample Description:	Moist, dark brown silty sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.9	85.4	13.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	99		
#10	2.00	99		
#20	0.84	99		
#40	0.42	97		
#60	0.25	77		
#100	0.15	31		
#200	0.075	14		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0380	8		
---	0.0236	7		
---	0.0135	6		
---	0.0094	5		
---	0.0067	4		
---	0.0047	4		
---	0.0034	2		
---	0.0014	1		

Coefficients

D_{85} =0.3069 mm	D_{30} =0.1456 mm
D_{60} =0.2064 mm	D_{15} =0.0791 mm
D_{50} =0.1848 mm	D_{10} =0.0479 mm
C_u =N/A	C_c =N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

printed 6/19/2007 10:01:01 AM

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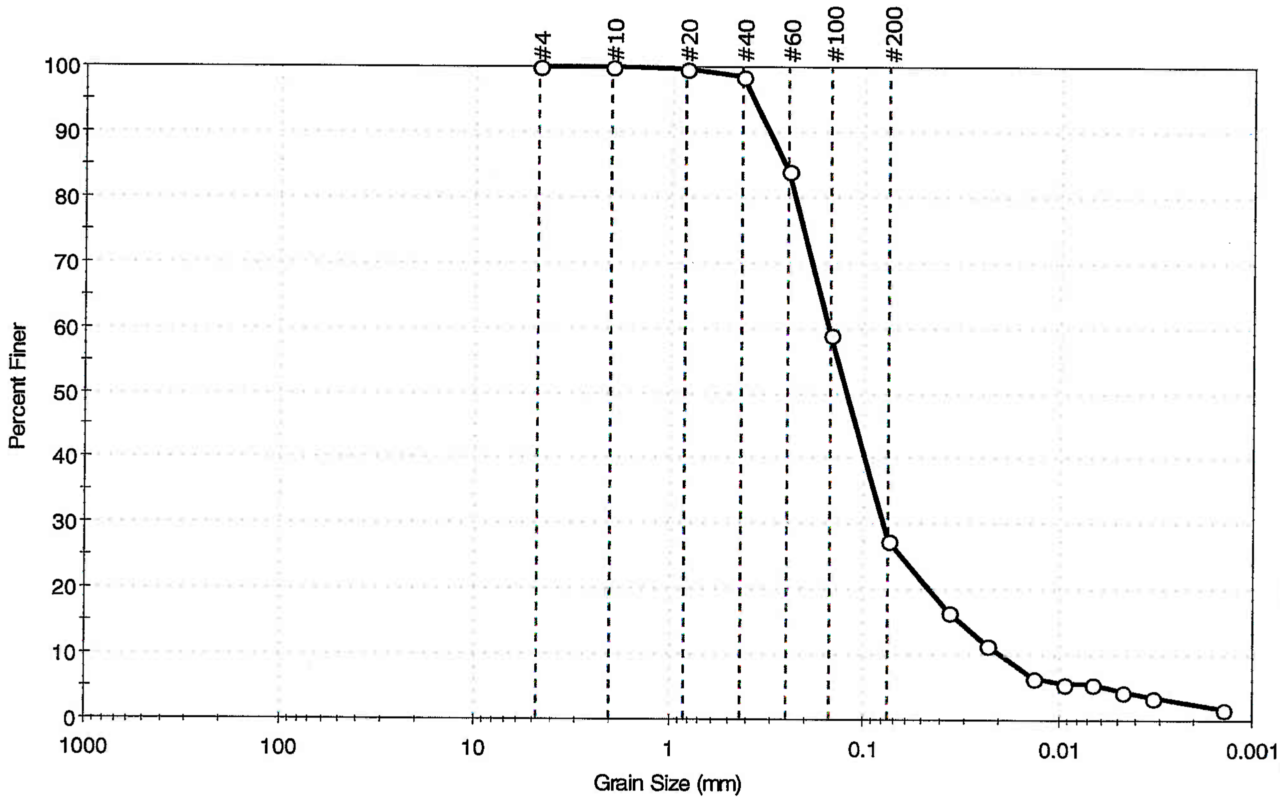
Client:	Sanborn, Head & Associates		
Project:	Routine Soil Vapor/Monitoring/Consulting		
Location:	Endicott, NY	Project No:	GTX-7530
Boring ID: EN-387B	Sample Type: bag	Tested By:	mll
Sample ID: S-5B	Test Date: 06/14/07	Checked By:	jdt
Depth : 8.7-8.9 ft	Test Id: 113848		
Test Comment:	---		
Sample Description:	Moist, brown silty sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	72.5	27.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.84	100		
#40	0.42	98		
#60	0.25	84		
#100	0.15	59		
#200	0.075	28		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0368	17		
---	0.0232	12		
---	0.0134	7		
---	0.0095	6		
---	0.0067	6		
---	0.0047	5		
---	0.0033	4		
---	0.0014	2		

Coefficients

D_{85} =0.2576 mm D_{30} =0.0792 mm
D_{60} =0.1522 mm D_{15} =0.0319 mm
D_{50} =0.1225 mm D_{10} =0.0196 mm
C_u =N/A C_c =N/A

Classification

ASTM   N/A

AASHTO   Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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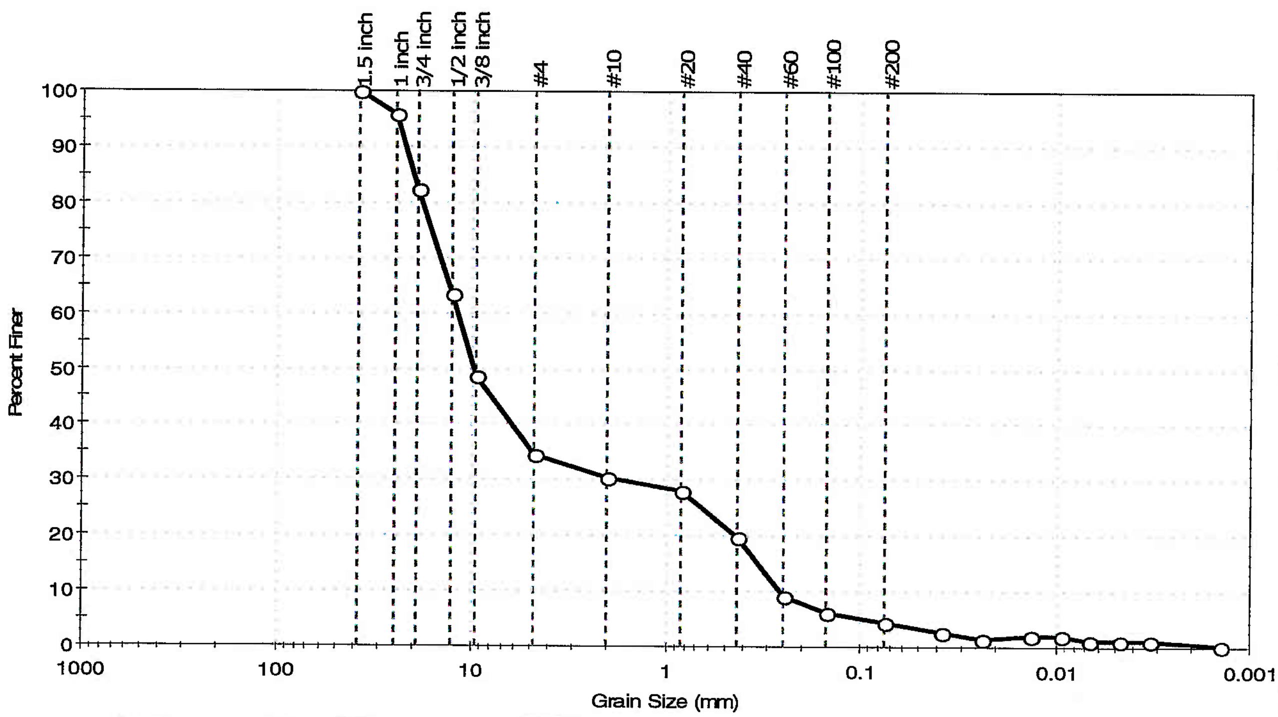
Client:	Sanborn, Head & Associates		
Project:	Routine Soil Vapor/Monitoring/Consulting		
Location:	Endicott, NY	Project No:	GTX-7530
Boring ID: EN-387B	Sample Type: bag	Tested By:	mll
Sample ID:S-7	Test Date: 06/13/07	Checked By:	jdt
Depth : 12-14 ft	Test Id: 113849		
Test Comment:	---		
Sample Description:	Dry, very dark brown gravel with sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	65.5	30.0	4.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 inch	38.10	100		
1 inch	25.00	96		
3/4 inch	19.00	82		
1/2 inch	12.70	63		
3/8 inch	9.50	49		
#4	4.75	34		
#10	2.00	30		
#20	0.84	28		
#40	0.42	20		
#60	0.25	9		
#100	0.15	6		
#200	0.075	4		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0384	3		
---	0.0240	1		
---	0.0135	2		
---	0.0095	2		
---	0.0068	1		
---	0.0047	1		
---	0.0033	1		
---	0.0014	0		

Coefficients

D_{85} =20.0574 mm D_{30} =1.7663 mm

D_{60} =11.8627 mm D_{15} =0.3349 mm

D_{50} =9.7533 mm D_{10} =0.2617 mm

C_u =45.329 C_c =1.005

Classification

ASTM Well-graded gravel with sand (GW)

AASHTO Stone Fragments, Gravel and Sand (A-1-a (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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GeoTesting express
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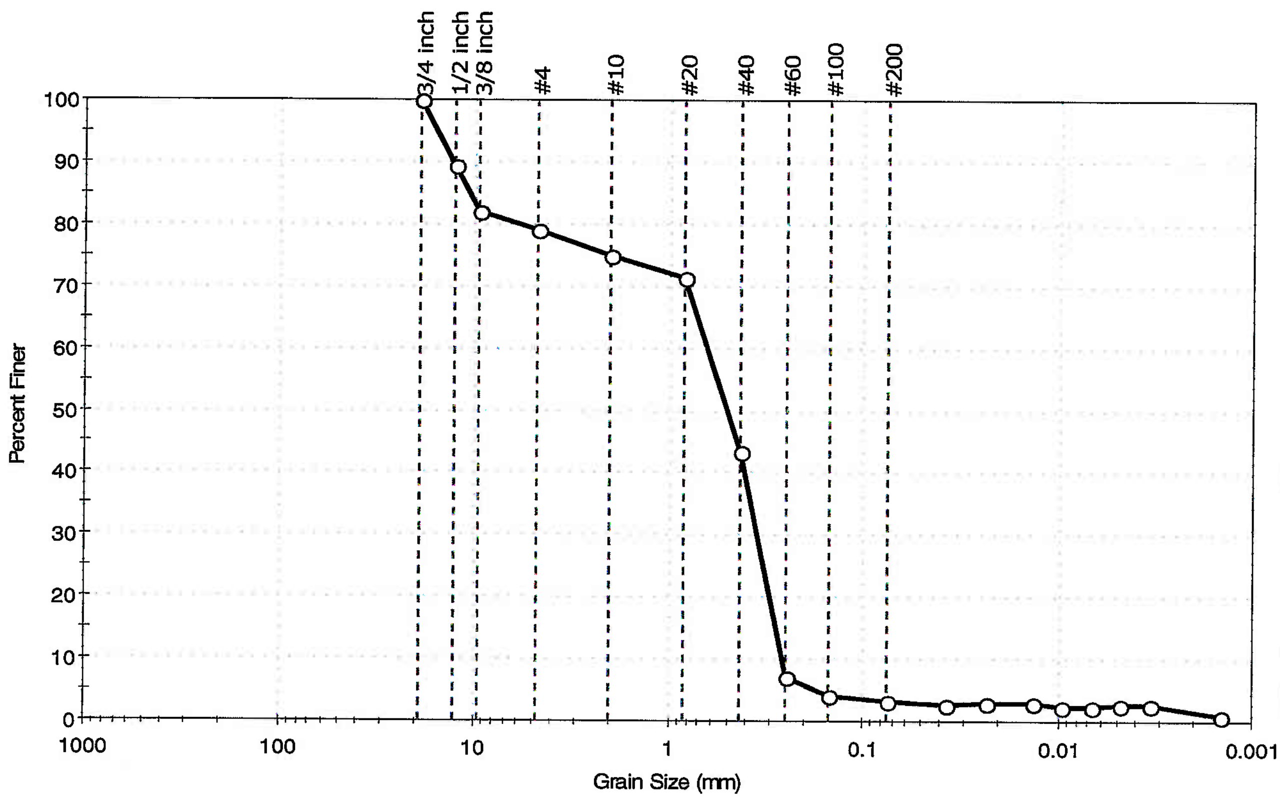
Client: Sanborn, Head & Associates			
Project: Routine Soil Vapor/Monitoring/Consulting			
Location: Endicott, NY		Project No:	GTX-7530
Boring ID: EN-387B	Sample Type: bag	Tested By:	mll
Sample ID:S-9	Test Date: 06/14/07	Checked By:	jdt
Depth : 16-18 ft	Test Id: 113850		
Test Comment: ---			
Sample Description: Dry, very dark brown sand with gravel			
Sample Comment: ---			

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	21.0	75.7	3.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/4 inch	19.00	100		
1/2 inch	12.70	89		
3/8 inch	9.50	82		
#4	4.75	79		
#10	2.00	75		
#20	0.84	71		
#40	0.42	43		
#60	0.25	7		
#100	0.15	4		
#200	0.075	3		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0373	3		
---	0.0235	3		
---	0.0136	3		
---	0.0096	2		
---	0.0068	2		
---	0.0048	3		
---	0.0034	3		
---	0.0015	1		

Coefficients

D_{85} =10.7036 mm
D_{30} =0.3495 mm
D_{60} =0.6376 mm
D_{15} =0.2805 mm
D_{50} =0.4998 mm
D_{10} =0.2607 mm
C_u =2.446
C_c =0.735

Classification

ASTM Poorly graded sand with gravel (SP)

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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GeoTesting express
a subsidiary of Geocomp Corporation

SOIL CHAIN OF CUSTODY & TEST REQUEST

CLIENT	
Company: SHA	
Address: 95 HIGH STREET	
City, State, Zip: PORTLAND ME 04101	
Contact: ERICA BRADSTREET	E-mail: ebradstreet@sanborn-head.com
Phone: 207-761-9300	Fax: 207-761-9339

PROJECT	
Project Name: ROUTINE SOIL VAPOR MONITORING/CONSULTING	
Address:	Client Project #: 2755.00
City, State, Zip: ENDICOTT NY	
On-site Contact:	E-mail:
Phone:	Fax:

GeoTesting Express, Inc.
1145 Massachusetts Avenue
Boxborough, MA 01719
800 434 1062 Toll Free
978 635 0266 Fax

2662 Holcomb Bridge Road, Suite 310
Alpharetta, GA 30022
770 645 6575 Tel
770 645 6570 Fax

www.geotesting.com

INVOICE (complete if different from client)	
Company:	
Address:	
City, State, Zip:	
Contact:	E-mail:
Phone:	Fax:

GENERAL			
Purchase Order #:		GTX Sales Order #:	
Shipped By:		Date Shipped:	
Mode of Shipment:		Requested Turnaround:	
Send Results To:	☒ CLIENT OFFICE	☐ PROJECT OFFICE	
Send Results Via:	☒ E-MAIL ☐ FAX	☐ VERBAL	☐ HARD COPY

SOIL *please include boring # and depth if known	Sample ID	Atterberg Limits (ASTM D 4318)	California Bearing Ratio (ASTM D 1883) *specify conditions below	USCS – Classification (ASTM D 2487)	Density (ASTM D 2937)	Direct Shear (ASTM D 3080) *specify conditions below	Direct Simple Shear (ASTM D 6528) *specify conditions below	Electrical Resistivity (ASTM G 57)	Grain Size (ASTM D 422) Sieve Only / Sieve & Hydrometer please circle one	Incremental Consolidation (ASTM D 2435)	Moisture Content (ASTM D 2216)	Organic Content (ASTM D 2974)	Permeability/ Hydraulic Conductivity (Fixed Wall - ASTM D 2434) (Flexible Wall – ASTM D 5084) please circle one	Ph (ASTM D 4972)	Proctor Compaction (Standard – ASTM D 698) (Modified – ASTM D 1557) please circle one	Specific Gravity (ASTM D 854)	Triaxial Shear (UU – ASTM D 2850) (CU – ASTM D 4767) (CD – US COE EM1110) *specify conditions below please circle one	Unconfined Compression (ASTM D 2166)	Other:	Other:
1	EN-387B/S-3A/4-5'								X		X									
2	EN-387B/S-3/6'								X		X									
3	EN-387B/S-5/8-8.7'								X		X									
4	EN-387B/S-5B/8.7-8.9'								X		X									
5	EN-387B/S-7/12-14'								X		X									
6	EN-387B/S-9/16-18'								X		X									
7																				

*Specify Test Conditions (Undisturbed or Remolded, Density and moisture, Test Normal Loads, Test Confining Stresses, etc.):

return remaining sample to us.

AUTHORIZE BY SIGNING AND DATING:

SIGNATURE: [signature] PRINT NAME: Samuel Warner DATE: 6/8/07

Incoming Sample Inspection Performed ☐
Adverse conditions:

Relinquished By:	DATE: TIME:	Received By: [signature]	DATE: TIME:
Relinquished By:	DATE: TIME:	Received By:	DATE: TIME:

GeoTesting express
a subsidiary of Geocomp Corporation

WARRANTY and LIABILITY

GeoTesting Express (GTX) warrants that all tests it performs are run in general accordance with the specified test procedures and accepted industry practice. GTX will correct or repeat any test that does not comply with this warranty. GTX has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

GTX may report engineering parameters that require us to interpret the test data. Such parameters are determined using accepted engineering procedures. However, GTX does not warrant that these parameters accurately reflect the true engineering properties of the *in situ* material. Responsibility for interpretation and use of the test data and these parameters for engineering and/or construction purposes rests solely with the user and not with GTX or any of its employees.

GTX's liability will be limited to correcting or repeating a test which fails our warranty. GTX's liability for damages to the Purchaser of testing services for any cause whatsoever shall be limited to the amount GTX received for the testing services. GTX will not be liable for any damages, or for any lost benefits or other consequential damages resulting from the use of these test results, even if GTX has been advised of the possibility of such damages. GTX will not be responsible for any liability of the Purchaser to any third party.

Commonly Used Symbols

A	pore pressure parameter for $\Delta\sigma_1 - \Delta\sigma_3$
B	pore pressure parameter for $\Delta\sigma_3$
CIU	isotropically consolidated undrained triaxial shear test
CR	compression ratio for one dimensional consolidation
C_c	coefficient of curvature, $(D_{30})^2 / (D_{10} \times D_{60})$
C_u	coefficient of uniformity, D_{60}/D_{10}
C_c	compression index for one dimensional consolidation
C_α	coefficient of secondary compression
c_v	coefficient of consolidation
c	cohesion intercept for total stresses
c'	cohesion intercept for effective stresses
D	diameter of specimen
D_{10}	diameter at which 10% of soil is finer
D_{15}	diameter at which 15% of soil is finer
D_{30}	diameter at which 30% of soil is finer
D_{50}	diameter at which 50% of soil is finer
D_{60}	diameter at which 60% of soil is finer
D_{85}	diameter at which 85% of soil is finer
d_{50}	displacement for 50% consolidation
d_{90}	displacement for 90% consolidation
d_{100}	displacement for 100% consolidation
E	Young's modulus
e	void ratio
e_c	void ratio after consolidation
e_o	initial void ratio
G	shear modulus
G_s	specific gravity of soil particles
H	height of specimen
PI	plasticity index
i	gradient
K_o	lateral stress ratio for one dimensional strain
k	permeability
LI	Liquidity Index
m_v	coefficient of volume change
n	porosity
PI	plasticity index
P_c	preconsolidation pressure
p	$(\sigma_1 + \sigma_3) / 2$, $(\sigma_v + \sigma_h) / 2$
p'	$(\sigma'_1 + \sigma'_3) / 2$, $(\sigma'_v + \sigma'_h) / 2$
p'_c	p' at consolidation
Q	quantity of flow
q	$(\sigma_1 - \sigma_3) / 2$
q_f	q at failure
q_o, q_i	initial q
q_c	q at consolidation
S	degree of saturation
SL	shrinkage limit
s_u	undrained shear strength
T	time factor for consolidation
T	temperature
t	time
U, UC	unconfined compression test
UU, Q	unconsolidated undrained triaxial test
u_a	pore gas pressure
u_e	excess pore water pressure
u, u_w	pore water pressure
V	total volume
V_g	volume of gas
V_s	volume of solids
V_v	volume of voids
V_w	volume of water
V_o	initial volume
v	velocity
W	total weight
W_s	weight of solids
W_w	weight of water
w	water content
w_c	water content at consolidation
w_f	final water content
w_l	liquid limit
w_n	natural water content
w_p	plastic limit
w_s	shrinkage limit
w_o, w_i	initial water content
α	slope of q_f versus p_f
α'	slope of q_f versus p_f'
γ_t	total unit weight
γ_d	dry unit weight
γ_s	unit weight of solids
γ_w	unit weight of water
ε	strain
ε_{vol}	volume strain
ε_h, ε_v	horizontal strain, vertical strain
μ	Poisson's ratio, also viscosity
σ	normal stress
σ'	effective normal stress
σ_c, σ'_c	consolidation stress in isotropic stress system
σ_h, σ'_h	horizontal normal stress
σ_v, σ'_v	vertical normal stress
σ_1	major principal stress
σ_2	intermediate principal stress
σ_3	minor principal stress
τ	shear stress
φ	friction angle based on total stresses
φ'	friction angle based on effective stresses
φ'_r	residual friction angle
φ_{ult}	φ for ultimate strength

APPENDIX C

BACKGROUND DEFINITIONS, EQUATIONS AND CONCEPTS

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APPENDIX C
BACKGROUND DEFINITIONS, EQUATIONS AND CONCEPTS

This Appendix is intended to provide some additional detail regarding certain terminology, equations, and concepts, used or referred to in the report text and on certain report figures. The terminology and concepts are titled in **emboldened** text and arranged in alphabetical order as follows.

Apparent Groundwater to Indoor Air Attenuation: The term attenuation factor α, or attenuation ratio has been used to broadly describe assumed/default attenuation in screening of sites for relative vapor intrusion potential (α_a) or empirical data derived from field measurements of groundwater and indoor air or soil vapor and indoor air quality (α_m).

United States EPA Guidance[1] defines the "attenuation factor as the ratio of indoor air concentration measured in a residence to vapor concentration measured in subsurface materials underlying or adjacent to the residence". The EPA Guidance presented default attenuation factors for initial screening of sites for vapor intrusion potential, including a groundwater to indoor air default of 10^{-3} to be applied to soil vapor concentrations estimated based on groundwater data assuming equilibrium partitioning, referred to as a "groundwater to indoor air attenuation factor (α_a-GW)".

The indoor air to soil vapor attenuation coefficient α has been used as a measure of the predicted ratio of indoor air and soil vapor concentrations from vapor intrusion modeling (α_p**)**.

Capillary Fringe: The capillary fringe is the increment of porous media immediately above the water table that exists at a near water saturated condition under negative capillary pressure. The thickness of the capillary fringe or height of capillary rise will vary inversely with the pore size of a soil.

Effective Diffusion: Diffusion is the process by which a mass moves from an area of higher concentration to lower concentration as a result of the concentration gradient. Diffusion can be defined as the movement of atoms or molecules from one part of a medium to another caused by their random thermal motion. The result of diffusion is mass transfer from an area of higher concentration to an area of lower concentration. Fick's law states that the mass flux, or mass transfer rate per unit area, is proportional to the concentration gradient. The term "Effective Diffusion" is used to denote diffusion through a porous media is influenced by the presence of solid, liquid, and gas phases.

[1] U.S. EPA, October 23, 2001, Supplemental Guidance for Evaluation the Vapor Intrusion to Indoor Air Pathway, Draft Issued for Comment., *Appendix F- Empirical Attenuation Factors and Reliability Assessment.*

A modified form of Fick's law a first order partial differential equation as follows can be used to describe diffusion of VOCs through a porous media, an environment partially filled with soil solids, water, and air[2].

$$J = -\rho_b D_e \frac{\partial C_t}{\partial x} \quad (1)$$

Where,

J = Diffusive mass flux $\left[\frac{M}{tL^2}\right]$; ρ_b = bulk density of soil $\left[\frac{M}{L^3}\right]$;

D_e = effective diffusion coefficient $\left[\frac{L^2}{t}\right]$; and

$\frac{\partial C_t}{\partial x}$ = the gradient of total concentration across the segment of vadose zone.

This "diffusion" equation is a direct analog to Darcy's law, the equation governing water flow through porous media. The effective diffusion coefficient, or effective diffusivity (D_e), is a constant of proportionality similar to hydraulic conductivity. The effective diffusion coefficient for a VOC in a porous media containing both air and water can be estimated using what has been referred to as the Millington relationship which is equation developed to rationally account for the relative proportion of soil volume filled with solids, water, and air, and the resultant tortuous path for diffusion:

$$D_e = D_{air}\left(\frac{\theta_a^{3.33}}{\phi^2}\right) + \frac{D_w}{K_H}{}_w\left(\frac{\theta_w^{3.33}}{\phi^2}\right) \quad (2)$$

Where,

D_a = free air diffusion coefficient [L^2/t]
θ_a = volumetric air-content [unitless fraction]
ϕ = soil porosity [unitless fraction]
D_w = free water diffusion coefficient [L^2/t]
θ_W = volumetric water content [unitless fraction]
K_H Henry's Constant [unitless ratio].

Review of the above relationship indicates that as the water content of the porous media increases (and the air content decreases), the diffusion coefficient is more heavily dependent on the water-phase diffusion coefficient, D_w.

Diffusion in the gas phase is much more effective than diffusion through water as evidenced from values for TCE (D_a of 8×10^{-2} square centimeters per second (cm^2/sec) and D_w of 9×10^{-6} cm^2/sec. D_a is 8,700 times higher than $D_{w)}$. Assuming steady diffusive transport the steep concentrations gradients found in soil vapor profiles are inferred to reflect reductions in D_e related to higher soil moisture contents.

[2] McWhorter, David, B., 1993, *Vadose Zone Processes*, Course Notes, Lecture No. 12, diagnosis and Remediation of DNAPL Sites. Waterloo center for Groundwater Research.

Mass per Unit Area: Estimates of VOC mass per unit area are outlined in the report Section 2.1.3 in units of gram per square meter (g/m^2) or microgram per square meter ($\mu g/m^2$). These estimates were developed as a generally indicator of the possible magnitude of total mass present in the subsurface profile based on available data. The estimates can be compared to estimated mass flux due to diffusion, advection, and infiltration transport mechanisms.

The estimates were calculated based on analytical laboratory data for soil samples reported by the laboratory in units of "mass VOC per mass of dry soil", typically in grams per kilogram (g/kg) or micrograms per kilogram (µg/kg). The lab values are assumed to represent the total mass of VOC present in a soil sample in vapor and dissolved phases and sorbed to the soil solids. The lab data are converted into estimates of mass per unit area using estimated or assumed dry bulk density of soils in mass per unit bulk volume. By multiplying the values of mass of VOC per unit volume by the sample depth interval, we obtain units of mass per unit area, in this case g/m^2 for each soil sample increment. An estimate of total mass per unit area across the soil column is derived by summing the incremental estimates. The actual mass present in the subsurface will vary with spatial variations in concentration and may be greater or less.

Vadose Zone: The term vadose zone as used in the report text is meant to describe the interval of porous media (soil) between the ground surface and the water table. In the vadose zone, the soil the pore space is only partly filled with water which typically exists at pressures below atmospheric. Tthe remaining void space is occupied by air or other gases. The capillary fringe as defined above is part of the vadose zone. The capillary fringe is saturated, but the pressure is less than atmospheric.

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APPENDIX D

COMPACT DISC OF DATA AND DATA USABILITY ASSESSMENT

APPENDIX D.1: **TABLE D.1 – SUMMARY OF ANALYTICAL LABORATORY DATA OCTOBER 2006 through OCTOBER 2007**

APPENDIX D.2: **DATA USABILITY REPORTS**

APPENDIX D.3: **ANALYTICAL LABORATORY REPORTS**

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