201 Charles Street, Maybrook
Orange County, New York

Remedial Investigation Report

Brownfield Cleanup Application
NYSDEC Spill Number: 1601483

Prepared for:

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Division of Environmental Remediation
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1. Introduction

This Remedial Investigation Report presents the results and findings of the Remedial Investigation (RI) conducted at and near the commercial building identified as 201 Charles Street, LLC in Maybrook, Orange County, NY. The site location is shown on the USGS 7.5 Minute Maybrook, NY Quadrangle (Figure 101) and on an air photo (Figure 102). A spill was discovered at the site and reported on May 12, 2016, when a potential buyer for the building hired a consultant to review site conditions. During ASTM E1527-13 Phase I and Phase II Environmental Site Investigations, tetrachlorethylene (also known as tetrachlorethene or PCE) was detected in soil and groundwater samples by LCS Inc. William L. Going & Associates conducted investigative and remedial work on the site from 2016 until 2019. At that time NYS DEC requested that the site make application for the Brownfield Cleanup Program. This report is prepared as part of that application prepared by Mid-Hudson Geosciences and Anaerobix under the supervision of Jolanda G. Jansen, P.E of Jansen Engineering, PLLC.

1.1. Purpose of Report

This Remedial Investigation Report is prepared for the purpose of summarizing and interpreting the field and laboratory work to

- Delineate the area and vertical extent and mass of contaminants in all media at or emanating from the site;
- Determine the surface and subsurface characteristics of the site, including topography, stratigraphy, and depth to groundwater;
- Identify and characterize the source(s) of contamination from chlorinated solvent chemicals, the migration paths, and actual or potential receptors of contaminants on or through air soil bedrock, sediment, groundwater, surface water, utilities and structures at the site, without regard to property boundaries;
- Describe the concentrations, fate and transport, material phase and state(s), locations, and other significant properties of the contamination present from metal working manufacturing activities;
- Define hydrogeological factors and conditions on the site and potential transport pathways;
- Evaluate actual and potential threats to public health and the environment, including potential public health exposure pathways and potential impacts to fish and wildlife;
- Collect field data needed for selection and design of remedial alternatives; and
- Identify remedial action objectives.

By documenting the nature and extent of contamination at 201 Charles Street, this RI Report will provide a basis to develop an effective and reliable remediation strategy.

1.2. Report Organization

This Report is organized as follows:

- Section 1: Introduction – Discusses the Site setting and history.
- Section 2: Summary of Previous Investigations – Summarizes the results and findings of the Phase I and Phase II Site Characterization Studies (SC).
- Section 3: Investigation Activities – Describes the investigation activities, sampling locations, and sampling and analytical methods of the RI.
- Section 4: Field Observations and Findings – Discusses the Site hydrogeology and

the distribution of observed Site contamination and environmental impacts.

- Section 5: Analytical Results – Presents and interprets the results of the soil, groundwater, indoor air, and soil vapor testing conducted as part of the RI and the observed distribution of volatile organic compounds detected on and off site.
- Section 6. Conceptual Site Model – Discusses the nature and extent of volatile organic compounds in air, vapors, soil and groundwater across the site and on neighboring properties.
- Section 7. Qualitative Human Health Exposure Assessment- Identifies the Compounds of Potential Concern (COPCs) encountered during the RI, potential receptors on and near the site, and potential exposure pathways.
- Section 8. Conclusions and Recommendations – Presents a summary of the findings and conclusions drawn, and identifies potential data gaps and recommendations to address potential data gaps.
- Section 9. References – Lists the references used in preparing the RI Report.

This Report also includes a significant number of attached tables, figures, boring logs and appendices. The compact disk (in pdf format) included with this Report contains additional documentation, including previous investigation reports, laboratory data reports, and data usability reports. A complete list of these items can be found in the Table of Contents.

1.3. Site Description

The 201 Charles Street business warehouse is located in the southeastern corner of the Village of Maybrook bounded on the east by railroad tracks of Middletown and New Jersey Railroad, LLC. The northern boundary of the property is Charles Street which continues to the east and enters through a gate into a parking lot bounded on the east with a fence and the railroad track (Middletown & NJ Railroad LLC).

Location. A land survey of the site was conducted by T.M. Depuy dated April 14, 2016 (Figure 131). The 201 Charles Street LLC property is located in the Village of Maybrook two blocks east of the main north-south NYS Route 208 within two miles of the interchange of Interstate-84 to the north. The Middletown & New Jersey Railroad tracks are immediately to the east of the site. Maybrook was a historical railroad hub for many years as shown by the network of railroad sidings and tracks east and north of the site on the USGS 7.5 Minute Maybrook NY Quadrangle. One block of single and multiple family residential housing is located between Route 208 and the site and also to the north. The Village of Maybrook Fire Department and Public Works Department are located within a block northwest and north of the site, respectively.

201 Charles Street LLC owns three lots as shown on the survey prepared by T.M. Depuy April 14, 2018 at a scale of 1 inch equals 40 feet. The property includes three parcels:

I	Section Block Lot:	114-1-1.2	5.6 acres
III	Section Block Lot	112-5-5.22	3.093 acres
IV	Abandoned section of Creamery Road		0.28 acres

Parcel II is the Decker historical home located on the southeast corner of Route 208 (Homestead Avenue) and the remaining one block segment of Creamery Road. Apparently all four parcels were the location of a creamery at one time. Three parcels (I, III, and IV) are owned by 210 Charles Street LLC. As shown on tax maps (Figures 132 and 133), all of the

201 Charles Street, LLC holdings are within the Village of Maybrook, parcels I and IV are within the Town of Hamptonburgh, and parcel III lies in both the Town of Montgomery and the Town of Hamptonburgh. About two thirds of the approximate 2 acres lot including the 53,000 square foot building lie in the Town of Montgomery and the southern third lies in the Town of Hamptonburgh. The Tax Maps for sections 112 and 114 (Figures 133, 134, and 135) seem to have some errors, since a section of the residential lots west of the site property and east of NYS Route 208 do not seem to be shown on either map. It may be possible that section 113 which is primarily located west of Route 208 may cover a small area east of Route 208 and west of Wallace Avenue. Since it will not change any information about the site, the tax map for section 113 was not studied.

The southern portions of the site are very flat and predominantly parking lots which were filled with buses until the bus company recently left the premises. Along Florence Street, which becomes Charles Street when crossing Wallace Avenue from west to east. The property gently slopes down to the east from Route 208 toward the railroad tracks with a slope of about 40 feet drop over a horizontal distance of 1000 feet.

Land Use and Zoning The property with the tetrachloroethylene aka tetrachloroethene or PCE contamination is in soil vapor and groundwater in the subsurface of the lot with the large building on it. The remainder of the property to the south is paved and was used for school bus parking on the south side of the former Creamery Road. All of the land is within the Village of Maybrook and the zoning district is “Village Industry” (Figure 136).

1.4. 201 Charles Street Site History

The historical use of the subject property has been researched through review of historic maps, historic aerial photographs, municipal records, city directories and/or other reasonably obtainable documents, as detailed below (Phase I and recent investigations by LCS, Inc.).

Date Range	Apparent Use	Source
At least 1935	Undeveloped land	Historic Topographic Map
At least 1957 through at least 1981	Developed with the northern-most portion of the existing subject structure between 1957 and 1975	Arial [sic] photographs and historic topographic map
At least 1994 through present	Developed with the existing 53,000 sq ft structure used by a light bulb manufacturer in at least 2003 and as a bus sales and service facility since at least 2008.	Arial [sic] photographs, city directories, municipal info, historic topo map, site contacts, and site inspection.

The following conditions indicative of releases or threatened releases of hazardous substances on, at, in, or to the subject property were identified based on LCS’ historical research:

• The subject structure has been utilized as a bus service facility since at least 2008.
• The subject structure was historically utilized as a light bulb manufacturing facility in at least 2003. Based on a Facility Clearance Report dated November 2003, air samples and metal dust samples were obtained and analyzed in conjunction with the closure of the former light bulb manufacturing facility. Analytical results indicated that all air samples and metal wipe samples were below established regulatory guidelines.

The presence of high voltage power supply (480 volts) and the separation of the northeastern part of the building from the rest of the structure (which the high voltage feeds) left us with questions about the history of the building. A title search was ordered for the property parcels. That 54-page document provided us with information about property transfers and ownership from early to mid-1900s to the present. The following table summarizes that documentation as well as research on the nature of manufacture of surgical instruments that took place on site (likely source of PCE contamination).

Dates	Owner/Title Transfer	Notes
Prior to 7 November 1956	Frederick L. Hackenburg, Jr.	Owner of current industrial property prior to development.
7 November 1956	3460 Jerome Ave. Realty Corp.	Real estate company owned by John Sklar of J. Sklar Mfg. Co., Inc. Historical aerial photographs indicate “old” section of industrial building was built between 1953-1957.
Date?	Balke Products, Inc. (*from 3460 Jerome Ave Realty Corp.*)	Both Balke Products and J. Sklar Mfg. produced surgical steel tools by the drop-forging process. Finishing operations were known or suspected to include vapor degreasing (using PCE) and possibly plating.
31 October 1962	3460 Jerome Ave Realty Corp. (*from Balke Products, Inc.*)	
15 July 1976	Balke Products, Inc. (*from 3460 Jerome Ave Realty Corp.*)	
11 December 1981	J. Sklar Mfg. Co., Inc. (*from Balke Products, Inc.*)	
August 1984	Osram Corp. (*from J. Sklar Mfg. Co., Inc.*)	Osram and its successor—Osram Sylvania— manufactured light bulbs in the north (“old”) portion of the building; they were/are one of the largest U.S. producers of light bulbs. The southern half of the building was constructed in 1990 by Osram.
31 January 1999	Osram Sylvania, Inc. / Osram Sylvania Products, Inc.	Transaction consistent with merger of Osram with Sylvania.
12 September 2005	Westport Management LLC (*from Osram Sylvania Products, Inc.*)	Cessation of manufacturing operations in north “old” section of building. Ownership transitioned property management to leasing. Commercial bus companies have occupied office, training and maintenance space in the north
17 October 2019	210 Charles Street, LLC (*from Westport Management LLC*) 201 Charles Street, LLC	

	(from Nonexistent corporation 210 Charles Street LLC)	("old") portion of the building. A wood product finishing and distribution company leases the south ("new") section of the building. No PCE-related impacts have been found in and around the "new" (south) building section.

1.4.1 1984 – 2005: Osram Corporation / Osram Sylvania

Osram purchased the property from J. Sklar Mfg. Co., Inc. in 1984. Osram, and later Osram-Sylvania (following the merger of these companies) was a leading U.S. manufacturer of light bulbs. According to interviews with local (Maybrook) authorities, Osram-Sylvania manufactured, warehoused and distributed light bulbs from the Site. Osram-Sylvania's operations reportedly involved soldering / welding of light-bulb components. Reportedly, Osram-Sylvania did not conduct vapor degreasing or otherwise use large quantities of solvents such as PCE. Based on all available information, it is unlikely that Osram-Sylvania's operations were responsible for the documented PCE contamination. However, fluorescent bulbs typically contained mercury during the time period of their historical operations at the site. Accordingly, mercury, cadmium and lead will be added as analytical parameters for future sampling activities.

1.4.2 1956 – 1984: J. Sklar Mfg. Co., Inc. / Balke Products, Inc. / 3460 Jerome Ave. Realty Corp.

From 1956 to 1984, the property was owned interchangeably by three corporate entities: 3460 Jerome Ave. Realty Corp., Balke Products Inc. and J. Sklar Mfg. Co., Inc. 3460 Jerome Ave. Realty Corp. appears to have been a real-estate holding company owned by John Sklar. The operating "entity" at the site dating to the 1950s appears to have been Balke Products, Inc. The nature of the relationship between J. Sklar Mfg. and Balke Products is unclear; however it is likely that they were formally connected, e.g., either via joint ownership or a joint venture.

Historical records document that J. Sklar Mfg. Co., Inc. and Balke Products, Inc. both manufactured surgical-steel tools and instruments. Historical operations included hammerboard drop-forging of steel tools and metal-finishing operations. Excerpts from historical records obtained on-line concerning these companies are included in **Appendix E**. As documented in **Appendix E**, J. Sklar Mfg. was originally based in Brooklyn, NY dating to the late 1800s and later re-located to Long Island City, NY. J. Sklar Mfg. operations were self-reported as including "…*a plating and polishing department, a brass machine shop and a spinning and stamping department*…." (**Appendix E**). The Long Island City location was on a rail line, so it is likely the railroad was used to move materials and products between the two plants.

Limited historical information was found on-line concerning Balke Products, Inc. Nonetheless, a joint-military-service report produced by officers on the subject of the domestic production of medical/surgical supplies (Col. John J. Cuddy, USA et al.; 1987), lists Balke Products as a major producer of "*forged surgical/dental instrument(s)*" (**Appendix E**). (Noteworthy is that J. Sklar Mfg. is also listed in this report.) Apparently unknown to the officers at the time of their report (1987), both Balke and J. Sklar Mfg. had ceased business operations and no longer manufactured surgical/dental tools in the United States (**Appendix E**). In addition, a job announcement placed in Chester, PA newspaper by Balke in 1960 states "*FORGER — Must have experience In drop hammerboard forging — good working conditions*…." (**Appendix E**).

Our research concerning historical drop-forging of steel tools indicates that vapor degreasing was a standard procedure following the forging process. PCE would have been the ideal solvent for vapor degreasing of forged surgical-steel instruments, given that (i) PCE is noninflammable, (ii) PCE has no known auto-ignition temperature and (iii) PCE has the highest boiling point of the common (historical) solvents used in vapor degreasing. According to the industry reference "ASTM Manual on Vapor Degreasing, Third Edition," published in 1989, the above-referenced properties of PCE enable the deposition of a higher amount of vaporized solvent on forged steel instruments at higher temperatures, enhancing the removal of cutting / stamping oils from the forging process.

1.4.3 Discussion: Historical Site Operations and Associated Environmental Concerns

Based on all available information collected to date, the PCE contamination of soil and groundwater documented at the subject site almost certainly resulted from historical operations of Balke Products, Inc. / J. Sklar Mfg. Co. prior to 1980, when Balke Products ceased operations. **Figure 143** illustrates the identified areas of concern (AOCs) associated with the historical site operations associated with Balke Products, Inc. / J. Sklar Mfg. Co.

The northeast section of the overall building complex is itself a discrete structure built with an exceptionally thick concrete foundation (**Figure 143**). According to local officials (e.g., Matt Thorpe, DPW Supervisor), this building was the '*forging / stamping building*' and these operations '*could be heard throughout the village (of Maybrook)*.' The forging building was clearly built to withstand and isolate the vibration stresses from metal forging/stamping consistent with "industry" publications indicating that a separate / distinct manufacturing area was common for drop-forging operations.

Interviews with local residents and Maybrook officials indicate that the raised concrete platform illustrated in **Figure 143** was used for solvent storage. The face of the "old" (Balke) building adjacent to the former solvent-storage area has a long row of cantilevered windows, ostensibly for ventilation of the vapor-degreasing operations area. An asphalt patch indicative of a former excavation (date unknown) was discovered this past year and appears to be the source-area of the PCE release as inferred from PCE isopleth maps prepared by Mid-Hudson Geosciences (**Appendix E**). A recent GPR survey confirmed the presence of an old excavation beneath the asphalt patch with an estimated depth of 7-8 feet below grade. No indications of piping leading to the excavation were identified. It is unclear as to whether the excavation area formerly contained a waste-solvent tank or dry well. It is possible that there was piping and that it was removed; alternatively, waste solvents may have been transferred to such a structure manually.

The deeds and property transfer history indicate that there was a continuous relationship between these two companies. The records do indicate that Balke Products, Inc. was dissolved on December 11, 1981 with all assets going to J. Sklar Manufacturing Co., Inc. Sklar Surgical Instruments still exists at 1333 Lenape Road, West Chester, PA 19382 with telephone (610) 430-3200. Their website states the company was founded in 1969. That company purchases instruments from all over the world and sells them all over the world.

In October of 2020, the tenant in the northern end of the building left and we had an opportunity to observe the interior of the building. The vapor degreasing room was found to be on the east side of the building north of the loading dock where the blacktop was cut and replaced. The vapor degreasing room is a long narrow room inside the east wall with a fire door on the south end and another on the north end. Near the roof there are large windows which could be opened to ventilate the PCE vapors from the workspace below. The area for storage of drums of the PCE is outside the building on the opposite side of the wall from the vapor degreasing room (Figures 144 and 145).

1.5. Building Construction and Site Plan

The northern half of the building may have been built in 1956 because that was the year of property transfer from Frederick L. Hackenberg, Jr. to the 5460 Jerome Avenue Reality Corp., the holding company for J. Sklar. On the 1:24,000 USGS Maybrook, NY Topographic map published in 1957, the northern half of the building is shown. Immediately after 1984 when Osram bought the property from J. Sklar. Osram acquired the southernmost lot (where the buses have been parked for several years) at that time from a previous owner who apparently purchased it on speculation from a long time owner. The date of construction of the southern half of the building was 1990. The northeast corner of the old building is a discrete structure. There are actually a few feet of vertical space between the northeast corner and the loading dock area to the south. It was built to withstand and isolate the vibrations and stresses from metal forging and stamping. The front along Charles Street is a facade.

The construction of the building (Figure 151) and use for the past 28 years has involved the following elements:

- Underground water supply line installed from Charles Street and additional water supply line under the back parking lot to supply the southern part of the building in 1990 and a fire hydrant close to the railroad track.
- Underground sewer line also installed from Charles Street.
- Electric wires are overhead from poles at the street to transformers on the lawn between Charles Street and the separate NE corner building and electric line installed under the back parking lot to supply the southern part of the building in 1990.
- Natural gas line from Charles Street underground and enters the eastern side of the northeast part of the building, which was the metal stamping facility.
- Small parking lot on Charles Street for cars to park perpendicular to the side of the building near the entrance.
- Offices are located along the north side of the building with windows looking out onto Charles Street.
- Two bathrooms are located near the entrance and the offices on north side.
- Stormwater drainage grates and lines are on the eastern and northern edges of the property near the building, draining off of the property toward the railroad track and to the northeast.

2. Summary of Previous Investigations

This remedial investigation report is based on previous work documented in the following reports:

• ASTM E1527-13 All Appropriate Inquiries Phase I
Environmental Site Assessment Report For The Property Identified As: Commercial Property 201 Charles Street, 116 Wallace Avenue, and Two Unaddressed Parcels on Old Creamery Road (Parcel Nos. 112-5-5.2, 112-5-1, 114-1-1, and 114-1-2) Maybrook, New York 12543
LCS Project No.. 14N5457.39. January 6, 2015
Prepared for Mr. Arthur Cecchini, Valad Electric Heating Corporation,
160 Wildey Street, Tarrytown, New York 10591,
Prepared By: LCS, Inc, 40 La Riviere Drive, Suite 120, Buffalo, New York 14202
(716) 845-6145, (800) 474-6802

• Supplemental Limited and Focused Subsurface Soil and Groundwater Investigation and Vapor Intrusion Assessment Report for the Property Identified as: 201 Charles Street, 116 Wallace Avenue, and Two Unaddressed Parcels on Old Creamery Road
(Parcel Nos. 112-5-5.2, 112-5-1, 114-1-1, and 114-1-2) Maybrook, New York
LCS Project No.15N6714.22, February 5, 2016
Prepared for Ms. Geryl Vitagliano, West Port Management, LLC
33 South Park Road, Newburgh, New York 12550
Prepared By: LCS, Inc, 40 La Riviere Drive, Suite 120, Buffalo, New York 14202
(716) 845-6145, (800) 474-6802

• Letter Report: William L. Going & Associates to NYSDEC Region III: Site Investigation Report and Proposed Remediation Plan Spill No. 1601483 at 201 Charles Street, Maybrook, NY, May 12, 2016

• Letter Report: William L. Going & Associates to NYSDEC Region III: Status Report: Remediation of PCE Contamination Plume Spill No. 1601483 at 201 Charles Street, Maybrook, NY, March 3, 2017

The majority of the work proposed in the May 12, 2016 report prepared by William L. Going & Associates, Inc. was completed by William L. Going & Associates, Inc. and reported in the March 3, 2017 report. Under the supervision of the same Professional Engineer, Jolanda G. Jansen, in early 2020, the project has taken on a new consulting team with Project Manager Katherine Beinkafner of Mid-Hudson Geosciences and Principal Scientist Eric Hince of Anaerobix. The group is preparing the application for 201 Charles Street LLC to enter into the Brownfields Program. This report is part of the application.

A recommendation of the initial Phase 1 Report was to sample soil, groundwater, ambient air, and sub-slab vapor. The Phase 2 Focused Study resulted in findings of chlorinated solvent (tetrachloroethylene) in all four media (soil, groundwater, ambient air, and sub-slab soil vapors.

In retrospect, the investigative and remedial work conducted by William L. Going and Associates, Inc. was an Interim Remedial Investigation (IRI) and Interim Remedial Measure (IRM). Hence, in this report Going's work will be identified as IRI and IRM. To date, the investigative work has consisted of collection of soil samples, groundwater samples and soil gas samples around the building and in the parking lots at 201 Charles Street. Ambient air samples and sub-slab gas samples were taken in the northern half of the building. A primitive passive sub-slab vapor extraction system was installed in the northern part of the warehouse building. A series of 18 injection wells were installed parallel to the east side of the northern half of the building in two rows in the parking lot. A Regenesis product known as Persulf/Ox/ISCO was injected to clean up the PCE in groundwater. This report provides summaries and interpretations of that data for use in conducting more effective remedial actions for onsite groundwater and sub-slab vapors. A separate Remedial Action Work Plan is being written for submission with the Brownfield Application and this RIR.

3. Remedial Investigation Activities

Specific RI activities are generally defined as underground utility clearance, soil investigation, groundwater investigation, soil vapor and air sampling, data usability assessment, and survey elevations of monitoring wells. Because remedial activities have also been conducted and the PCE is still present, groundwater sampling and soil vapor sampling will be presented and evaluated to prepare a new Remedial Action Work Plan.

All work conducted during the remedial investigation was completed in general conformance with the following documents:

- Draft DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002)
- Draft Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH, 2002)
- Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH, 2006)
- Low Stess (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells (US EPA, Region 1, July 30, 1996 Revision 2)
- Health and Safety Plan for 201 Charles Street field activities will be prepared for future work
- Quality Assurance/Quality Control Project Plan will be prepared for future work

3.1. Underground Utility Clearance

Prior to initiation of intrusive investigation activities, utility markouts were requested from the NY “call before you dig service” also know as “Dig Safely New York.” Underground utility lines for water, sewer, natural gas, and stormwater drainage were marked out around the 201 Charles Street building in parking lots and along the eastern end block of Charles Street.

3.2. Phase I and II Soil Investigations (November 17, 2015 and January 14, 2016)

LCS collected soil samples on November 17, 2015 and January 14, 2016, with a percussion and hydraulically driven drive system equipped with an approximate 2-inch diameter, approximate 48-inch long macro-core sampler. Soil samples were collected within each of 13 boreholes continuously from the ground surface until refusal, a depth of between approximately 3 and 11.5 feet below the ground surface (ft. bgs). Any downhole equipment was decontaminated with an Alconox and tap water wash and tap water rinse between boreholes. The cutting shoes were decontaminated in a similar manner between collections of each sample.

The physical characteristics of all soil samples were classified using the Unified Soil Classification System (USCS) (Visual-Manual Method) and placed in separate sealable containers to allow any vapors to accumulate in the headspace. After several minutes, the container was opened slightly and total volatile organic compound (VOC) concentrations in air within the sample container were measured using a photoionization detector (PID). (The PID is designed to detect VOCs, such as those associated with petroleum and some solvents.) Based on the field observations and/or screening results, soils were selected for analysis (see below). The soil sample lithologic logs are included in Appendix A.

The Phase I soil samples were collected and sent to the laboratory for VOC analysis:

SB1 (2-4 ft bgs) SB2 (2-4 ft bgs) SB4 (4-6 ft bgs)
SB5 (6-8 ft bgs) SB6 (6-8 ft bgs)

The following soil samples were collected and sent to the laboratory for VOC analysis:

BH8 (4-6 ft. bgs) BH9 (4-6 ft. bgs) BH10 (4-6 ft. bgs) BH10 (11.5 ft. bgs)
BH11 (6-8 ft. bgs) BH12 (1-3 ft. bgs) BH13 (6-8 ft. bgs)

The soil samples were sent to the laboratory under chain of custody for VOC analyses by US EPA Method 8260.

3.3 Phase I & II Groundwater Investigations

During the Phase I work, three temporary monitoring wells were constructed in soil borings TPMW1, -2, and -3 along the southeastern side of the building. After well development, on November 17, 2015; groundwater samples were collected and sent to the laboratory under chain of custody for VOC analyses by US EPA Method 8260.

Temporary groundwater monitoring wells TW4 and TW5 were installed within boreholes BH9 and BH10, respectively. Generally, the bottoms of the wells were set to approximately 11.5 ft. bgs. Each of the wells was constructed with one-inch diameter PVC screen and riser with a silica filter pack placed around the well screen. A bentonite seal was placed above the sand and the wells were covered with plastic caps, to prevent surface water from entering the wells prior to sampling. Refer to the attached subsurface logs/well construction details for well specific well construction details (Appendix A). Two groundwater samples from temporary groundwater monitoring wells TW4 and TW5 were collected on January 14, 2016. Prior to sample collection, each well was developed by removing at least three well volumes from the well. New disposable dedicated PVC bailers were used for well development and sample collection activities. The groundwater samples were sent to the laboratory under chain of custody for VOC analyses by US EPA Method 8260.

3.4 Phase II Air and Sub-Slab Soil Vapor Investigation

Prior to sampling the sub-slab soil vapor, an electric hammer drill equipped with an approximate ¾ inch masonry bit was used to penetrate the concrete slab within the building. Following advancement of the hole through the concrete slab, the area was cleaned to remove concrete dust. An approximate ¼ inch (inside diameter) polyethylene tube (sample probe) was then inserted in the hole created in the concrete foundation by the drill and sealed using modeling clay. On January 14, 2016 LCS collected three sub-slab soil vapor sample, one outdoor sample, and one indoor air sample from the subject structure

PID measurements were above total ambient air background VOC measurements (i.e., 0.0 parts per million, ppm) in one of the 26 soil samples collected. The elevated concentration measured 41.5 ppm (BH10, ~4-6 ft. bgs). No petroleum or solvent-type odors were detected in soil samples collected from test borings. In LCS' experience, the PID measurements and field observations do not suggest the obvious presence of VOC impact proximate to areas investigated.

The sub-slab vapor samples and indoor and outdoor air samples were collected on January 14, 2016, with laboratory-provided pre-cleaned evacuated Summa Canisters each equipped with an eight-hour flow regulator. Each regulator was opened and the vacuum in each Summa Canister was monitored for proper function throughout the eight-hour sampling period. After sampling, the Summa canisters were returned to the laboratory with chain of custody for analysis by US EPA Method TO-15 for VOCs and Tentative Identified Compounds (TICs).

3.5 IRI and IRM Soil Investigation

In March 2016, William L. Going & Associates, Inc. (WLG) installed 13 soil borings in the overburden with Geoprobe® equipment. Soil borings were advanced to refusal using a Geoprobe®. Refusal was identified as bedrock at depths ranging from 4 feet in SB-1 upgradient of the commercial building to a maximum depth of 12 feet in SB-12 downgradient of the commercial building. Soil from the entire depth of each of the borings was scanned onsite with a MiniRAE Model PGM-7300 (PID) for VOC upon opening each sampling tube. The only significant evidence of VOC was observed in SB-7 downgradient of the commercial building at 10' below ground surface [bgs] (58.4 ppm) and in SB-10 also downgradient of the commercial building at 10'bgs (535 ppm). Soil samples were collected from near the bottom of each boring and placed in a cooler and transported to Envirotest Laboratories under chain of custody where they were analyzed for VOCs by US EPA Method 8260.

3.6 IRI and IRM Groundwater Investigation

Piezometers were installed in all thirteen soil borings. Six monitoring wells were installed in bedrock with truck-mounted augers and air rotary equipment.

The piezometers in soil borings (GP) were constructed of 1-inch inner diameter schedule 40 PVC materials and #1 sand installed within the 2-inch diameter Geoprobe® boring. Each well was constructed with five- or ten-foot lengths of 0.010-inch slotted screen. The deep monitoring wells (DMW 1, 2, 2S, 3, 4 and 5) were drilled to auger refusal and then drilled with an air rotary drill bit into the bedrock. A 4-inch steel casing was grouted into the bedrock socket in DMWs 1, 2, 2S and 3 to prevent groundwater contaminant migrating from overburden down into bedrock. The following day, the rotary rig pierced the grout seal and advanced the well from top of grout into the bedrock. Specific dimensions measured in feet below ground surface are as follows:

Construction Dimensions for WLG Monitoring Wells at 201 Charles Street
Monitoring Wells were constructed on March 9, 10, 11, and 31, 2016.
All measurements are depth measured in feet from ground surface.

Monitoring Well	Auger Refusal	Total Depth of Boring	Screened Interval	Sand in Annulus	Bentonite Seal	Backfill
DMW4	14	14	9-14	8-14	6-8	0-6
DMW5	14	18	8-18	7-14	5-7	0-5

Monitoring wells were advanced into the top of bedrock (depth of penetration of bedrock ranging from 3-10 feet) with truck-mounted auger and air rotary equipment.

Construction of Deep Monitoring Wells
Depth of Auger Refusal
Depth of Rotary Drilling & Setting Casing
Total Depth of Bedrock Borehole (Well)
All Depths are in Feet from Surface
Depth Total
WLG Steel Depth

Monitoring Well Identification	Auger Refusal	Casing Set	Bedrock Borehole
DMW1	7	11	14
DMW2	13	19	23
DMW2S	13	15	17
DMW3	13	19	23

Each monitoring well was installed and constructed in conformance with the following specifications:

- Wells were constructed with 2-inch-inside-diameter (ID), threaded, flush-joint, schedule 40 PVC casing and screen;
- Screens were 5 feet long with 10-slot (0.01-inch) openings;
- The annulus around the screens was backfilled with appropriately sized clean silica sand (e.g., Morie No. 1) to a minimum height of 2 feet above the top of the screen
- A bentonite pellet seal with a minimum thickness of 2 feet was placed above the sand pack. The bentonite seal was allowed to hydrate before placement of grout above the seal;
- The remainder of the annular space was filled with a cement-bentonite grout up to near the ground surface. The grout was allowed to set for a minimum of 24 hours before well development;
- Each monitoring well had a sealed cap (J-plug) and was contained in a flush-mount drive-over vault. The J-plug keeps surface water from infiltrating into the well during rain events and high water conditions;
- The concrete seal or pad was sloped slightly to channel water away from the well, and was deep enough to remain stable during freezing and thawing of the ground;
- The vaults and concrete pads were completed so that they would not pose a trip hazard.

The monitoring wells were developed and samples of groundwater were collected using dedicated disposable bailers on March 4, 11, and 31, 2016. Samples were placed in a cooler and transported to Envirotest Laboratories under chain-of custody where they were analyzed for VOCs by US EPA Method 8260. The NYSDEC ASP Category B data package was requested. Once the complete data valuation package is received from the lab, a data usability study was conducted and is included as an Appendix to this report. Water levels were measured at the completion of sampling.

3.7 IRI and IRM Air and Sub-Slab Vapor Investigation

In March 2016, the commercial building and the entire property was completely vacant and empty. The commercial building was closed but very well maintained and heated.

The address and vicinity of the commercial building and the area that LCS found to be contaminated are identified on the attached locator map (Figure 132 aerial photo). All of the LCS and WLG sampling locations are identified on the attached site survey, which was prepared by T.M. DePuy Engineering & Land Surveying, P.C.

Summa canisters were used to collect the air and sub-slab vapor sample on March 3, 2016. Three (8 hr.) air samples were collected from the workspace breathing zone inside the commercial building, along with 18 (8 hr.) sub-slab soil vapor samples from beneath the commercial building, and 1 (8 hr.) air sample from outside the commercial building (using SUMMA canisters and flow controllers).

The slabs of the building are two separate slabs, for the original northern part of the building constructed in 1957 and the southern half of the building constructed in 1990. Sub-slab samples were collected through a PVC tube that was inserted through the concrete slab and cemented in place. The building was empty at the time, although it was heated and all windows and doors were closed. Samples were transported to Envirotest Laboratories under chain of custody and were shipped to Alpha Analytical where they were analyzed for VOCs by US EPA Method TO-15 for the full analyte list plus tentative identified compounds.

3.8 Surface Water and Sediment Sampling

There are no surface waters or sediments on the 201 Charles Street property; hence, no sampling is required.

3.9. Data Usability Assessment

Once the NYSDEC ASP Category B Data Package was received from the laboratory, it was sent to ZDataReports in Syracuse for review and preparation of a Data Usability Summary Report. The data usability reports are summarized in section 5.7 and the actual summary reports are provided in extensive PDF files in Appendix D.

3.10. Survey of Monitoring Well Elevations

A survey of the site was prepared by T.M. DePuy Engineering & Land Surveying, P.C. of Midddletown and the elevations were determined for the top of the casing for each of the monitoring wells and for the land surface at each boring location. All elevations are relative to mean sea level. T.M. DePuy is now part of Lanc and Tully Engineering and Surveying, P.C.

4. Field Observations and Findings

Soils, fill material, unconsolidated sedimentary surficial deposits, and bedrock comprise the subsurface setting beneath the 201 Charles Street site. Surface water from stormwater and snowmelt provides recharge to the water-bearing zones in these geologic materials along with the downgradient groundwater flow from higher elevations on the west. These elements provide the physical framework to investigate the nature and extent of contamination, to trace the fate and transport of contaminants, and to select and implement remedial measures to cleanup the remnants of PCE spillage.

4.1. Regional Geological Setting

On the Geologic Map of New York (1970) a golden–color swath extends from Kingston and Newburgh southwest to the northern New Jersey border representing sedimentary rocks deposited in the time interval of 470 to 460 million years ago. The eastern unit of this band of the Trenton Group is the Normanskill Formation extending from Schunemunk Mountain on the east to Montgomery on the west.

Stratigraphic strike of the Ordovician and Silurian rocks in southeastern New York is generally North 30 degrees East. This strike is shown in the hills known as Hussey Hill, Shaupeneak, Illinois, and Marlboro Mountains extending from Kingston to Newburgh on the western side of the Hudson River. The characteristic strike is represented by the trend of the Shawangunk Ridge extending from Port Jervis to Kingston.

The Normanskill Formation is composed of shale, argillite, and siltstone. These sedimentary rocks represent deposition of sediments from active erosion of metamorphic and igneous mountains from the east (western Connecticut). The shale and argillite represent quiet times of deposition of fine grain sediments such as mud, clay, organic carbon, and limestone in shallow marine waters known as an epeiric sea.

The sedimentary Trenton Group has been folded and faulted at least three times in geologic history, so that groundwater within the bedrock is found in fractures, joints, and cracks associated with times of compressional and tensional deformation. Drillers tend to refer to these linear openings in rock as “seams.”

The bedrock surface of New York State has been sculptured by advancing glaciers. Overburden deposits or unconsolidated sediments have been formed by glacial grinding and melting, aeolian (wind) transport, and flowing water. Stream deposition can take place on the land surface or on top of, within, or beneath glaciers.

Much of glacial deposition is till consisting of unsorted mixtures of gravel, rock fragments, sand, silt, and clay. There are two types of till, the gray sticky dense clay till and the yellow-brown compacted silt. Both types have varying proportions of gravel, rock fragments, sand, silt, and clay.

Deposits, which are primarily silt, are most likely windblown “loess” sediments associated with thermal winds on the edge of glaciers. Silt grains are more easily entrained and carried by wind than other size particles.

The Soil Survey of Orange County New York (USDA, 1981) shows that the area in Maybrook between Route 208 on the west and the railroad track immediately east of the 201 Charles Street site is Bath-Nassau Shaly Silt Loam (map symbol BnB). The general description of the BnB soil type is as follows:

“This soil complex consists of deep, well drained soils and shallow, somewhat excessively drained soils that formed in glacial till deposits derived from shale and slate. These gently sloping soils are on hilltops and ridges in uplands. Because of the underlying folded and tilted bedrock the topography is often irregular and sloping in many directions. Areas are mostly long and oval and 5 to 30 acres.”

"The complex is about 50 percent Bath soil, 30 percent Nassau soil, and 20 percent other soils. Areas of Bath and Nassau soils occur in such an intricate pattern that they are not mapped separately."

"Typically the Bath soil has a dark brown shaly silt loam surface layer 9 inches thick. The subsoil is 44 inches thick. The upper 17 inches is yellowish brown shaly silt loam; the middle 3 inches is mottled olive brown shaly silt loam; and the lower part is an olive brown very shaly silt loam fragipan. Dark gray shale bedrock is at a depth of 53 inches."

"Typically the Nassau soil has a dark grayish brown shaly silt loam surface layer 10 inches thick. The subsoil is yellowish brown very shaly silt loam 9 inches thick. Hard dark gray shale bedrock is at a depth of 19 inches."

"In the Bath soil a perched water table is above the fragipan for very brief periods early in spring. In the Nassau soil there is no seasonal high water table above the bedrock. Permeability in the Bath soil is moderate in the subsoil above the fragipan and is slow or very slow in the fragipan. In the Nassau soil permeability is moderate throughout. Runoff is low to medium in both soils. Available water capacity is moderate in the Bath soil and low to very low in the Nassau soil. Depth to bedrock is 40 to 60 inches in the Bath soil, and 10 to 20 inches in the Nassau soil. Roots are restricted by the fragipan in the Bath soil and by bedrock in the Nassau soil. Natural organic matter content is low in both soils. The surface layer of both soils is 15 to 35 percent gravel fragments, dominantly shale."

4.2. Site Geology and Hydrogeology

Depth to groundwater was measured in each of the monitoring wells and piezometers with an electronic tape on April 15, 2016. Water level measurements in the piezometers and monitoring wells on subject property were converted to feet of elevation relative to sea level. A contour map of the water table elevations (Figure 421) shows the southeast sloping water table or hydraulic gradient under the site. The direction of groundwater flow is southeast as shown by the arrows on the drawing. There do not appear to be any sensitive receptors downgradient of the contaminated area.

Water Levels in WLG Monitoring Wells April 15, 2016
201 Charles Street, Maybrook, NY
Converted to Elevations Above Mean Sea Level
Based on Survey by T.M. DePuy of April 14, 2016
All measurements are in feet.

Monitoring Well	Elevation Top Casing	Depth to Groundwater	Elevation of Water Table
DMW1	416.08	8.60	407.48
DMW2	410.71	10.21	400.50
DMW2S	412.08	11.50	400.58
DMW3	410.98	10.02	400.96
DMW4	416.71	10.91	405.08
DMW5	412.04	12.71	399.34

Detailed examination and description of the soil boring material leads to a three dimensional conceptual model of the strata within the unconsolidated overburden and its relation to the underlying bedrock and groundwater occurrence. Overburden thickness ranges from a minimum thickness of 4 feet on the upgradient northwestern edge of the subject property to a maximum observed thickness of 14 feet on the downgradient southeastern side of subject property. The parking lot around the commercial building is generally flat. As the overburden thickness increases to the south-southeast, the surface of bedrock dips in elevation.

Overburden stratigraphy in the upper zone consists of yellow-brown silt layers. Various percentages of fine to medium gravel size rock fragments occur in the silt layers, although many layers are pure silt. Many of the silt strata contain fine to medium sand grains. The silt layers are wind-blown loess deposits as shown by the yellow brown iron staining indicative of a sub-aerial oxidizing environment of deposition.

Overburden stratigraphy in the lower zone is comprised of loose, highly porous fractured rock fragments. This unit is derived from the underlying bedrock. The bedrock consists of laminated siltstone, greywacke sandstone, and gray to dark gray mudstone and shale, identified as the Normanskill Formation. The rock fragments are likely the result of grinding and compression by glacial action on the underlying bedrock surface.

A foot by foot analysis of the soil boring logs superimposed on a map of the boring locations was drawn to illustrate the three dimensional subsurface conditions on the southeast side of the building where the majority of soil borings and monitoring wells are located. In Figure 422, a stratigraphic section is drawn foot by foot for each soil boring and monitoring well where cores were obtained from 4-ft. intervals. There are three strata from top to bottom: 1) packed silt (*orange*), 2) porous fractured, weathered shale rock (*green and cyan*), and 3) shale bedrock (*purple*). The water levels are shown by triangles on the right side of the logs. The depths down from surface are shown in 4-ft. intervals. (Some of the soil borings were completed as piezometers with 1-in. schedule 40 PVC. The monitoring wells were installed deeper into bedrock with a roller bit mounted on a drill rig.) The fence diagram is constructed by drawing fence panels showing the correlation of strata from boring to boring. Close to the building, the boring logs (SB13, MW3, GP12, GP9, GP8) show that the silt contains a layer of porous fractured shale. That stratum appears to pinch out to the northeast where the bedrock surface rises to within 5 feet or less from ground surface (near the eastern corner of the building (SB5, SB6). Figure 422 indicates that the water bearing zone is found in the shale fragments and in the (fractured) top of bedrock.

In Figure 423, the top of bedrock is contoured on the southeast side of the building, in the area between the building and the railroad track. The contours are depth to bedrock measured from the ground surface downward. The contours depict a trough that is closed at the southwest end and open to the northeast. In the southwest portion of the trough the water table is nearly flat (at about 10 ft. bgs) within saturated sediments that continue down to top of bedrock (at approximately 13 ft. bgs). The water in the trough is fed by groundwater flowing southeast under the building. Water in the trough then flows to the northeast.

4.3. Hydrogeologic Parameters

Hydraulic Gradient- Based on a difference in water table elevation (407.48 minus 399,34 feet) in monitoring wells WMGMW-1 and WMGMW-5 and the distance between them (about 380 feet), the ***hydraulic gradient is about 0.0214***.

Hydraulic Conductivity- To accurately measure hydraulic conductivity, a series of slug tests will be performed on each of the wells to have a quantitative measure of permeability of the saturated water-bearing shale fragment hydrostratigraphic unit shown in aqua on the fence diagram (Figure 422). The overlying silt unit does not seem to be saturated in the area of concern. No slug tests have been conducted to estimate hydraulic conductivity. Hence, hydraulic conductivity has been estimated from a Table 4.5 Page 80 in Fetter, 1978, second edition. The table provides an average hydraulic conductivity value for well sorted gravel of 0.1 cm/sec.

Estimated Permeability and Effective Porosity- For the saturated shale fragment zone overlying bedrock (the transmissive unit) estimate of permeability is about 10 cm/sec using an average value range for clean gravel presented in Freeze & Cherry (1979, Table 2.3, page 29). Effective porosity for gravelly sand or fine gravel is selected from a table of Specific Yields (Fetter, 1988, second edition, Table 4-3, page 74) averaged at 0.22 from a reported range of 20 to 35 percent. Specific yield is actual water given up by a unit pore volume of sediments, so it is a better approximation than actual porosity because porosity is measured by heating the sediment and driving all water out of the sample.

Average Linear Groundwater Flow Velocity- The average linear velocity of groundwater flow is the actual rate at which one could observe a tracer moving in the groundwater from one point to another. As Freeze and Cherry (1979, page 71) state average linear velocity (V_X) "does not represent the average velocity of water particles traveling through pore spaces. These true, microscopic velocities are generally larger than V_X, because the water particles must travel along irregular paths that are longer than the linearized path represented by V_X." The average linear velocity is found by multiplying the hydraulic conductivity (0.1 cm/sec) times the hydraulic gradient (0.02) and dividing by the effective porosity (0.22). Using those values, V_X is found to be 0.009 cm/sec, which is equivalent to an average linear groundwater flow of 7.77 meters per day or 25.5 ft/day. If these estimates are correct, the water is moving moderately rapidly through the thin transmissive fractured shale zone because of the high porosity, high permeability, but a low hydraulic gradient.

Physical-Chemical Properties of Groundwater- With the low flow sampling method, several water quality parameters are measured while pumping to obtain stabilization. However, since we have not been sampling recently. We have been monitoring the water quality parameters with a YSI meter for the following parameters: pH, Conductivity, Turbidity, Dissolves Oxygen, Temperature, and Oxidation Reduction Potential. A recent set of reading is reported in Table 43. These readings indicate that the environment is nearly anaerobic, which is necessary tor the proposed enhanced bioremediation groundwater cleanup of chlorinated solvents.

4.4. Field Observations of Tetrachloroethylene Impacts

At the 201 Charles Street site, there do not seem to be any actual field observations that one could make on a daily basis, such as stains on the ground or chemical buildups on solid surfaces or persistent odor in the air. The contamination that has been detected requires digging to depth in the soils, sampling groundwater at depth, and sampling air for 24 hours.

As will be described in great detail in Section 5, low levels of VOCs at background levels of 2-3 parts per million were detected from soil samples using a Photoionization Detector. Low levels of tetrachloroethylene have been found in soils where the molecules apparently are sorbed onto soil particles. Dissolved product has been detected in groundwater. Gaseous tetraethylene has been detected in soil gas and air samples collected from subsurface soils, sub-slab locations under the northern part of the building, indoor air, and outdoor air samples.

4.5. Land Use & Database Search

On December 30, 2014, a three-part database search was obtained from Environmental Data Resouces, Inc. of 4340 Wheelers Farms Road, Milford, CT 06461 (phone 800-352-0050, www.edrnet.com). The entire EDR Environmental Database Search within 0.5 miles of 201 Charles Street, Maybrook is contained in Appendix B of this report. The search within a half mile radius around 201 Charles Street included a Certified Sanborn Map search (no maps found), Aerial Photo Package and ERD Radius Map™ Report (Figures 451 and 452) with GeoCheck®. Most relevant information is as follows:

4.5.1 Subject Property

According to the EDR report, the subject property, listed as Village of Maybrook Department of Public Works/Quality Bus Sales and Service/Quality Bus and Truck Center/Matthews Buses Inc./Osram Sylvania Products Inc./Osram Corporation, addressed at 201 Charles Street, was identified as a RCRA Small Quantity Generator of hazardous waste (with no unresolved violations reported) and on the Manifest database as a result of the RCRA listing. Osram Sylvania Products was identified as a historical generator in 1985, 1992, 1999, 2004, 2006, and 2007. Worthy to note, a facility clearance report reviewed by LCS (above) indicates that the Osram facility ceased operations in 2003. In addition, the subject property was identified as an ICIS facility. According to the USEPA website, the ICIS listing is associated with a formal enforcement action. The subject property was also identified in the AIRS, TRIS, National Compliance database (NCDB), and FIS databases. As a result of the above listings, the subject property was identified in the FINDS database.

Furthermore, the subject property was identified as a NY Spill site. Spill No. 9601687 involved the release of propylene glycol and allyl ether into a storm drain and is classified as “inactive.” Spill No. 9202499 involved a drum that was tipped over in a parking lot and is classified as “closed.” In addition, the subject property was identified as a registered UST facility (Facility ID No. 3-600086) with two 4,000-gallon No. 6 fuel oil USTs listed as installed on December 1, 1957 and “closed-removed” on July 1, 1991.

4.5.2 Adjacent Sites

The following adjacent properties were also identified in the EDR report:
- Village of Maybrook DPW Garage, addressed at 202 Charles Street, was identified as a NY registered AST facility with active tanks.

• Montgomery Overall Service Inc./Mont Overall, addressed at 110 Homestead Avenue/110-112 Homestead Avenue/Route 208/Route 208 and Volunteer Place, was identified on the following databases:

- o CERCLIS-NFRAP listed hazardous waste site.
- o RCRA Small Quantity Generator of hazardous waste (with no unresolved violations reported) and in the Manifest database as a result of the RCRA listing.
- o AIRS database.
- o Registered AST facility with no active tanks.
- o Registered UST facility with an active tank.
- o NY LTANKS site and Spill site: Spill No. 8604154 involved a tank test failure and is classified as “closed.” Spill No. 1308798 involved No. 2 fuel oil identified in soil samples taken after a tank removal and is classified as “inactive.”
- o NY Spill site: Spill No. 1205249 involved petroleum spill that was due to a blown hose and is classified as “inactive.”

In addition to the adjacent listings, there are four NYSDEC listed spill sites attributed to LTANKs and six additional spill sites located within a one-half mile radius of the subject property. Each of these spill sites is classified as either “inactive” or “closed” by the NYSDEC. [A status of “closed” indicates the spill was remediated and the NYSDEC file closed with no further remediation required. A status of “inactive” indicates the contamination may remain but no further remediation is required.] This information is not a recognized environmental ondition at the subject property based on the listed spill sites due to the “closed” or “inactive” status of the listed spills and/or the distance to the subject property.

LCS (Section 5.4 of the Phase I Report) was provided with and reviewed “Facility Clearance Report, Osram Sylvania Products Inc., 201 Charles Street, Maybrook, New York,” prepared by GZA GeoEnvironmental Inc. (GZA) for Osram Sylvania Products Inc. and dated November 2003. Based on this report, GZA performed post-closure indoor air quality, industrial hygiene, and facility clearance sampling In October 2003. The purpose of this sampling was to conduct a screening level evaluation throughout the facility for the potential presence of a specific list of environmental contaminants associated with previous fluorescent lamp manufacturing operations (specifically, mercury,cadmium, and lead).

At the time of the sampling, all manufacturing equipment and process lines had been removed. GZA collected air samples throughout the facility. The samples were analyzed in accordance with a modified National Institute for Occupational Safety and Health Method 6009. In addition, GZA collected metal dust samples and submitted them for analysis according to OSHA standards for cadmium, lead, and mercury. Analytical laboratory results indicated that all air samples and metal wipe samples were below established regulatory guidelines.

5. Analytical Results Define Nature and Extent of Contamination

This section presents the environmental conditions present in soil, groundwater, soil gas (vapor), and air (sub-slab, indoor, and outdoor) samples and field observations collected during two investigation. Analytical results are provided in tabular form for each environmental medium. Where appropriate applicable analytical data for each medium are compared to cleanup objectives and/or screening criteria to identify *constituents of potential concern* (COPCs). COPCs are defined as any constituent that is detected at a concentration greater than a cleanup objective or screening value. The environmental conditions in each sample medium are also illustrated in figures as an aid to evaluate the vertical and horizontal distribution of the target compound at the site.

Based on the data validation as provided in data usability reports (Appendix D) by independent contractors it is concluded that the data quality is usable for the purposes of satisfying the project objectives.

5.1. Screening Criteria

PCE concentrations in soil samples were compared to Recommended Soil Cleanup Objective (RSCO) of 700 ug/L listed in NYSDEC TAGM 4046. That RSCO represents a conservative value for protection of human health, groundwater, and ecological systems. Specifically, the human-health based RSCOs were developed in consideration of exposure of a child resident and an adult resident to soils via ingestion, inhalation, dermal contact, and through consumption of homegrown vegetable and animal products. The groundwater RSCOs are protective of groundwater via the soil to groundwater migration pathway (i.e., soil leaching and groundwater transport). The ecological RSCOs are protective of ecological resources (i.e., wildlife).

For groundwater, standards and/or guidance values from the NYSDEC (1998) Technical and Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations were used to identify constituents of potential concern. Specifically, Class GA standards and guidance values of 5 ug/L wereused to screen groundwater data. That standard and guidance value is considered protective of drinking water sources.

Air samples were collected as part of the field investigation to determine if there is a complete transport pathway of PCE from soil gas and/or sub-slab vapor to indoor air. If a complete transport pathway occurs for PCE in indoor air then both of the following environmental conditions must be present:

- PCE must be present in indoor air and ambient air or soil vapor.
- PCE concentration in ambient air or soil vapor must be greater than the concentration in indoor air.

Note the second condition assumes there is no indoor source of PCE present. Indoor air sample results were compared to ambient air, soil gas and sub-slab vapor results as well as the NYSDOH Guideline for PCE in air (100 ug/m^3 = 15 ppbv, NYSDOH, 2006).

5.2. Soils in the Vadose Zone

The original soil sampling occurred in the Phase I and II Investigations following within a month by William L. Going and Associates work.

5.2.1 LCS Phase I & II Soil Sampling

Phase 1 soil sampling (SB1 to SB6) was advanced in various areas around the building to get a general survey of the soil in November 1915. During Phase II soil sampling, seven boreholes (BH7 to BH13) were completed in accessible areas of the subject property on the southeastern side of the building in the parking area near the loading dock and three samples from beneath the slab inside the building near the loading doc. Refer to the attached subsurface logs for soil classification for each sample interval, field observations and PID measurements (Appendix A). A total of 26 soil samples were collected for geologic description. Fill material consisting of asphalt, gravel, and silt was noted within test borings BH8 through BH13 ranging in depth of refusal from 3 ft to 11.5 ft. bgs. Generally, the native soils encountered consisted of varying mixtures of sand, silt, and clay to the bottom of the test borings. Equipment refusal was encountered within all test borings between approximately 3 and 11.5 ft bgs. The cause of the equipment refusal could not be determined; however, is suspected to be due to shallow bedrock underlying the property.

PID measurements were above total ambient air background VOC measurements (i.e., 0.0 parts per million, ppm) in one of the 26 soil samples collected. The elevated concentration measured 41.5 ppm (BH10, ~4-6 ft. bgs). No petroleum or solvent-type odors were detected in soil samples collected from test borings. In LCS' experience, the PID measurements and field observations do not suggest the obvious presence of VOC impact proximate to areas investigated.
.
The 12 soil samples collected and analyzed VOCs detected are shown on Table 521 (November 14-17, 2015 and January 2016). If analytes were not detected, they are not listed. The respective concentrations as well as applicable regulatory guidance values are also listed for comparison. The detected VOCs include carbon tetrachloride, tetrachloroethylene (PCE), 1,1,1-trichloroethane, and trichloroethylene (TCE). The concentrations of PCE were the highest and most prevalent in the soils. Hence, PCE concentrations of PCE in mg/kg are plotted and contoured on Figure 521. The spatial distribution of the PCE in soil samples is a north-south trending oval centered around BH10 with a concentration of 9.43 mg/kg.

5.2.2 W.L. Going Soil Sampling (March 2, 2016)

William L. Going & Associates conducted soil boring work onsite on March 2, 2016. Installing 13 soil borings in front of the loading dock area *WLGP-4 to 13) and near the northern corner of the building (WLGP1 to 3). PCE detection is summarized in Table 522 and mapped on Figure 5. The contour maps of PCE concentrations for the March 2016 data (Figure 522) shows a very similar spatial distribution to that of Figure 521 for Phase I & II soil sampling (November 2015 and January 2016). Maps of both soil sampling events show a similar spatial distribution in near circular plumes under the pavement between the southeast side of the building and the railroad track (Figure 521 and Figure 522). However, the concentrations reported for the March 2016 sampling event are at least one order of magnitude higher than the previous events. Also some low detections of PCE were reported on the northwestern (upgradient) side of the building. In any event, PCE in soil is not of great concern at this site because the concentrations measured are all below the Part 375 Soil Cleanup Objective for Industrial sites.

Degradation products of PCE were detected in most of the soil samples, where the entire list of analytes is available. Such degradation products of PCE are from the reaction series

PCE → TCE → DCE → VC → Carbon Dioxide

Where PCE is tetrachloroethylene (aka perchloroethylene or "perc"), TCE is tricholorethene, DCE is 1,2-Dichloroethylene, and VC is vinyl chloride.

5.3. Groundwater

5.3.1 LCS Phase I & II Groundwater Sampling

Three temporary monitoring wells (TPMW1 to 3) were sampled as part of the Phase I investigation on November 17, 2015. Two additional temporary monitoring wells (TW4 and TW5) were sample as part of the Phase II study on January 14, 2016. After sampling, each set of samples was sent to the laboratory under chain of custody for VOC analyses by US EPA Method 8260. The results are reported in Table 531 and PCE concentrations plotted on Figure 531. The contoured spatial distribution of the PCE concentrations is a north-south oriented oval with the highest concentration of 2240 µg/L in the center at TW5.

5.3.2 W.L. Going Groundwater Sampling (March 3, 11, 31, 2016)

Groundwater samples from 6 piezometers, 6 monitoring wells, and the old well in the parking lot on the southeastern side of the building were collected in March 2016. The laboratory results of VOC analysis are reported in Table 532 and the PCE concentrations mapped on Figure 532. The spatial distribution of the Going concentrations is similar to the Phase 1 & II sample results except that the highest concentration at WLGDMW2 is 24,000 compared to 2240 µg/L at TW5. The Going sampling shows a higher magnitude of PCE concentration and also covers a larger area approaching the fence between the subject property and the railroad track.

In the Remediation Plan, WLG proposed to utilize Regenesis products “PersulOx/ISCO” and “PlumeStop” to eliminate PCE in soil and groundwater immediately south of the old original portion of the commercial building. The proposed treatment area was accurately delineated.

In June 2016, WLG/Soil Testing Inc. installed 18 injection wells directly into the contaminated area. Each well extended down into the top of the fractured bedrock with truck-mounted roller bit; end of boring (auger refusal) ranged from 14-15 feet bgs (3-7 ft. into top of fractured bedrock surface). Each injection well was constructed of 2-inch schedule 40 PVC, coarse sand and coarse bentonite. Each well was constructed with 8 feet of 0.020-inch slotted screen and 8 feet of solid riser. Injection wells were spaced 15 feet apart along the approximate centerline of the PCE plume to allow for maximum coverage and distribution of the PersulfOx. A new survey of the treatment area was prepared by T.M. DePuy Engineering & Land Surveying, P.C.; the exact location of each injection well is presented in Figure 533.

PersulfOx was injected into each well in June 2016 and again in July 2016. Specifically, 3,400 pounds of powdered PersulfOx mixed with approximately 1,800 gallons of water was injected under pressure evenly across the contaminated groundwater trough during each treatment. Frequent field colorimetric analyses using a CHEMets kit and laboratory measurements of oxygen reduction potential in groundwater samples from selected injection wells indicate that PersulfOx concentrations have remained high since the initial treatment..

Three other groundwater sampling events were conducted at the site and documented as follows:

September 18, 2016	Table 534	Figure 534
January 26, 2017	Table 535	Figure 535
August 30, 2019	Table 536	Figure 536

Considering the fact that PCE concentrations in the contaminated area southeast of the building ranged as high as 24,000 µg/l (*DMW 2*) when the PCE plume was first discovered in March 2106, it is clear that PersulfOx is having the desired effect on the groundwater plume. PCE concentrations continue to decrease in monitoring wells along the south and east sides of the plume, while a rebound of PCE concentration has recently been observed in injection wells inside the plume and at the northeast end of the plume

The rebound could be attributed to a movement of aqueous-phase PCE out of fractures in the top of bedrock and back into the groundwater in the trough, but it could possibly also be attributed (in part?) to a migration of PCE from an upgradient source...and we know that there has been no industrial activity at subject property in several years that could have released any PCE.

Figure 534 presents the spatial distribution and concentration of PCE in selected wells on September 18, 2016. The plume had greatly decreased in size and in concentration.

Figure 535 presents the spatial distribution and concentration of PCE in selected wells on January 26, 2017. The plume is roughly the same shape, although exhibiting a rebound in PCE concentration at center and to the northeast (in the direction of groundwater movement within the trough). Also TCE and cis-1,2DCE concentrations increased somewhat. A rebound in chlorinated solvent concentrations within the plume can be attributed to the release of some material bound to sediments, especially if the water table rises as could be the case in winter from infiltration of snow melt. Also the highest concentration of PCE at 1600 µg/L was detected in Injection Well 17 at the far end of the plume.

Figure 536 presents the spatial distribution and concentration of PCE in selected wells on August 30, 2019. The PCE concentrations are characterized by three high PCE concentration areas within the plume at INJ8 by 760, INJ13 by 750 and INJ16 by 420 µg/L.

PCE and minor amounts of its associated breakdown products are observed in the groundwater where groundwater is found at about 10 feet below the pavement surface in a trough subparallel to the southeast side of the building and the railroad track. The groundwater plume is similar in shape to the area of PCE contamination in soil, except that the groundwater flows northeast under the pavement. After chemical oxidation treatment there are very few degradation products, such as TCE, cis-1,2DEC, 1,1,-TCA, and vinyl chloride. In fact no vinyl chloride was detected in groundwater sampling for VOCs. It is possible the volume of liquid oxidation treatment has driven the plume farther to the northeast. Currently (May 2020), the water quality parameters of the groundwater in the plume area have been changed to anaerobic conditions with the introduction of Sodium Lactate. Dissolved oxygen, pH, and redox conditions are within optimal ranges for the introduction of the bacterial inoculum (Table 537).

At that time, Dr. Katherine Beinkafner and Eric Hince became involved in the project and enhanced bioremediation was selected as a better remedy than chemical oxidation because PCE is not flammable. Dr. Beinkafner is managing two Brownfield sites, one in Kingston and one in Middletown with Jolanda G. Jansen, P.E. with enhanced bioremediation. Eric Hince has been helping with formulating the dosing of sodium lactate to create anaerobic conditions required for the work of the bacteria strains which degrade the chlorinated solvents at the other sites and 201 Charles Street.

5.4 Sub-Slab Soil Vapor and Air Sampling

Sub-slab vapor and air testing was conducted by LCS as part of the Phase II study and by William L. Going & Associates, Inc in 2016. PCE was detected in many samples.

5.4.1 LCS Phase II Sub-Slab and Air Sampling

On January 14, 2016, LCS collected five samples: indoor air, outdoor air, and three sub-slab samples inside the building on the southeast side of the building near the loading dock. Table 541 shows the full suite of VOCs detected in the samples. The analyte with the highest concentrations is PCE ranging from 23 to 114 $\mu g/m^3$ in the sub-slab samples and 5.08 and 3.71 $\mu g/m^3$ in indoor and outdoor air respectively. Locations of the samples are shown on Figure 541 with the later sampling.

5.4.2 W,L. Going Sub-Slab and Air Sampling

On March 3, 2016 William L. Going collected 22 samples including one outdoor ambient air, 3 indoor ambient air, 8 samples from the new southern building and 9 from the old northern building. All samples were collected with Summa canisters and sent to Alpha Laboratories by Envirotest Laboratories in Newburgh for VOC analysis and tentative identified compounds by US EPA Method TO-15. PCE was detected in the highest concentrations. The results are listed in Table 542 and plotted on Figure 542.

In May of 2016, 18 passive vents were installed in the sub-slab of the northern part of the building (Figure 543). Two locations are shown on the figure where a vacuum test was conducted to determine if there is any permeability beneath the slab. Because there was nearly zero permeability beneath the slab, a passive vapor extraction system consisting of five vents with outdoor wind-blown turbines was installed, as shown in the generalized Figure 544.

Another round of sub-slab vapor and ambient air testing was conducted on November 23, 2019 (Table 545 and Figure 545). PCE in nine indoor air samples ranged from 16.1 to 67.5 $\mu g/m^3$, the outdoor air had 0.387 $\mu g/m^3$, and the sub-slab PCE vapor content ranged from 29.6 to 10,400 $\mu g/m^3$. Comparison of the March 2016 and November 2019 (figure 2 and 2) indicate that the eastern half of the sub-slab PCE vapor has greatly diminished in over the course of three years. There are still two areas greater than10,000 $\mu g/m^3$ in the eastern corner and western corners of the northern old building.

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5.5 Data Validation

The three data sets (soil, groundwater, air and sub-slab vapor) collected in March of 2016 were analyzed for VOCs. The DEC B data package was requested from the labs. The data packages were sent to ZDataReports in Syracuse, NY for data validation. A Data Usability Summary Report (Appendix D) dated April 2016 was received and declared that all of the data was in compliance with US EPA Methods and all of the data was valid for use in assessing the environmental quality conditions in soil, groundwater, air, and soil vapor for the 201 Charles Street site.

6. Conceptual Site Model Reveals Contaminant Fate and Transport

This section of the RI presents the conceptual site model, which pertains to the nature, extent, and transport of PCE in subsurface soil and groundwater.

6.1. Sources, Nature, and Movement of PCE

Based on information obtained during the remedial investigation, it is not clear if there is one source of contamination or a series of spills leading to current site conditions.

6.1.1. Primary Sources

The groundwater plume shown in Figure 532 (March 2016) seems to originate from a area where there is a patch in the black top near the building near WLGP-9 and TMW1. If Tetrrachloroethylne was spilled there, it would go down through the old blacktop and about 4 feet of silt, 2 feet of shale fragments, 2 more feet of silt, 2 more feet of shale fragments and into saturated shale fragments at about 12 feet below ground surface as shown in the soil boring located at GP-9 on the fence diagram (Figure 422). At that location, groundwater flow is to the east (Figure 421), but the plume shows lateral flow to the northeast and south east. The PCE concentration in the soil shows essentially the same plume area in the silt that is found below in the saturated shale fragments. Within the silt, the PCE apparently spread out in a southeastern direction as well as south and east.

In November 2015 LCS took sub-slab soil samples (LCSBH-11, LCSBH-12, and LCS-BH-13, Figure 521); which indicates that PCE was discovered in the soil under the northern half of the building floor (slab). In January 2016 LCS took sub-slab soil vapor samples and detected PCE vapors. Since the silt material under the parking lot like extends to the west under the building, there is no barrier to stop PCE vapors from moving under the building.

6.1.2. Vertical and Horizontal Extent of Contamination

The PCE-contaminated groundwater is of limited extent because only a small area and thickness of shale fragments is located on the site. The bedrock trough under the parking lot on the eastern side of the building is shown in Figure 423. The trough is about 200 feet long, ranging in width from about 20 feet in the northeast to about 40 feet in the wider section to the southwest. The trough is fed by groundwater flow under the building from the northwest, but is probably limited to times of rain storms and snow melt. The depth to groundwater in WLGMW-1 at the top of the hill is 8.6 feet, which is 1.6 feet below refusal at 7 feet encountered when drilling. A roller bit was used to deepen the well into the bedrock. It is likely all of the water table beneath the building is within the top two feet of bedrock. Contour lines of the top of bedrock are likely parallel to the contours of the water table.

From our historical research, we are quite certain that PCE was used as a degreaser for the surgical steel products produced in the northern part of the building from 1957 through 1984. The stamping facility was set up in the northeastern corner of the building, which is actually a building isolated from the rest of the building. PCE contamination could have gotten into the sub-slab area by penetrating cracks in the floor from spills on the floor or by migration as a gas from the spill area in the parking lot outside the loading dock.

Although PCE vapor is heavier than air, it can still migrate through pore spaces in the silt and soil and become trapped under the building slab. If it does sink down to groundwater, it can be entrained in the groundwater in a dissolved state. The limits of PCE-contaminated soil vapor is likely confined to under the building and possibly in the entire thickness of unconsolidated soil and silt down to the top of fractured bedrock.

Because the concentrations of PCE in sub-slab vapors ranged from 1510 to 39,500 µg/m^3, sub-slab vapor conditions require mitigation. A passive sub-slab vapor extraction system was installed and the concentrations are coming down, but the most recent sampling (November 2019) laboratory results are not in compliance with NYS DOH CEH BEEI Soil Vapor Intrusion Guidance.

6.3. Fate and Transport of Contaminants

The following table lists the processes or mechanisms involved in the fate and transport of PCE contaminants:

Contaminant Fate and Transport Processes		
Medium	**Process**	**Result**
Ground surface	Volatilization	Liquid to gas and dispersal in atmosphere
Air	Wind	Moves and disperses gases in atmosphere
Soil	Gravity	Moves liquid into soil
Soil	Dissolution	Contaminants dissolved in rainfall or snowmelt and infiltrate deeper into the soil
Soil	Sorption	Temporary adhesion of PCE molecules to soil
Soil	Leaching	Desorption of PCE and movement into groundwater
Groundwater	Hydrodynamic Dispersion	Mixes dissolved PCE with cleaner water and spreads out the plume
Groundwater	Hydrodynamic Flow Advection, Dispersion	Moves PCE plume downgradient through preferrential pathways of porous & permeable media in the Water-Bearing Sand Unit
Groundwater	Volatilization	At water table, releases PCE as a gas beck into soils in the vadose zone.
Soil & Groundwater	Biodegradation	Breakdown of PCE into series of products PCE → TCE → DCE → VC
Soil & Groundwater	Biodegradation as Type 2 Behavior anaerobic conditions	in the presence of biologically available native organic Carbon, microbes use the carbon as a source and they metabolize the ethene solvents by reductive dechlorination.
Soil & Groundwater	Biodegradation under aerobic conditions	In the presence of dissolved oxygen, VC can be oxidized rapidly.

6.4. Potential Exposure Pathways and Receptors

The water table is 7 to 12 feet below the ground surface and the ground surface is covered by the building and blacktop except for a small area of grass when Charles Street enters the back parking area. For those reasons, it is unlikely that a person or animal will come in contact with or drink the groundwater at the 201 Charles Street site.

Likewise the soil and overburden is also covered by blacktop and the building, so exposure to soil is not likely unless someone were digging in the grassy area beside Charles Street and the area behind the building. The PCE concentrations in soil are below cleanup levels.

In the northern half of the building at 201 Charles Street, Sub-slab PCE soil vapor is the serious contaminant of concern because of the high levels detected under the slab. Poor air flow conditions under the slab create difficult conditions to mitigate. The passive vapor extraction system is reducing contamination but slower than an active blower system. PCE concentrations in the ambient air are low enough that mitigation is not required, so the area can be used for work space.

7. Qualitative Human Health Exposure Assessment

This section of the RI presents a qualitative human health exposure assessment, which evaluates the potential for human exposure to PCE released at the 201 Charles Street in Maybrook, NY site. This assessment is prepared consistent with the NYSDOH guidance as presented in *Draft DER-10 Technical Guidance for Site Investigation and Remediation* (NYSDOH, 2002) and uses information regarding current and foreseeable land uses and available site data to evaluate the potential for exposure of human receptors. The assessment includes an evaluation of contaminant fate and transport for PCE and the identification and characterization of complete exposure pathways. The results of this qualitative exposure evaluation will be used, in part, to help evaluate proposed remedial actions for the site.

7.1. Site-Specific COPC

PCE is the site-specific COPC for soil, groundwater, and sub-slab soil vapor. Other VOCs such as the BTEX compounds may be present in neighboring properties, but they have not come from a source on the 201 Charles Street site.

As mentioned above, degradation products of PCE were detected in most of the soil samples, where the entire list of analytes is available. Such degradation products of PCE are from the reaction series

PCE → TCE → DCE → VC → Carbon Dioxide

Where PCE is tetrachloroethylene (aka perchloroethylene or “perc”), TCE is tricholorethene, DCE is 1,2-Dichloroethylene, and VC is vinyl chloride.

7.2. Contaminant Fate and Transport

PCE has a high vapor pressure and will partition into the atmosphere from surface soil and surface water. Rates of volatilization from soils depend on temperature, humidity and soil type. Subsurface soil infiltration will also occur. This chemical has a relatively high mobility in soils because sorption is not significant enough to prevent migration. PCE will leach into the groundwater particularly in soils with low organic carbon. In surface water, PCE can be transformed via photooxidation and biodegradation. In soils, anaerobic soil microbes are responsible for biodegradation.

7.3. Exposure Assessment (potential exposure points, receptors and route of exposure)

An initial step in evaluating potential human exposure is the identification of potentially complete exposure pathways. "For an exposure pathway to be complete, the following five elements must exist: 1) a contaminant source; 2) contaminant release and transport mechanisms; 3) a point of exposure; 4) a route of exposure; and 5) a receptor population." If all five elements exist, then that exposure pathway is considered to be complete (NYSDOH, 2002).

7.3.1. Potential Direct Contact with Soil

Potential direct contact with soil is not a concern because the PCE concentrations measured in all of the soil samples were below the Recommended Soil Cleanup Objective.

7.3.2. Potential Inhalation of Vapors from Surface Soil

Potential inhalation of vapors from soil is not a concern because the PCE concentrations measured in all of the soil samples were below the Recommended Soil Cleanup Objective.

7.3.3. Direct Contact with Groundwater and Surface Waters

The groundwater Table beneath the site ranges from approximately 7 to 12 feet below grade. Groundwater is not used as a potable source at the site, and depth to groundwater precludes potential direct exposures of human receptors to this medium. There are no surface water bodies at the site.
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7.3.4 Inhalation of Indoor Air

Since concentrations of PCE detected in air samples were below the NYSDOH air guidance value of 40 $\mu g/m^3$ (4.4 ppbv), an exposure pathway is not considered.

7.4. Impact on Fish and Wildlife Summary

PCE at the 201 Charles Street site and surrounding properties does not impact fish or wildlife because the groundwater is the only contaminated medium to exceed NYS guidance values. The groundwater is buried 7 to 12 feet below grade making wildlife exposure unlikely.

7.5. Summary

Analytical data indicate that PCE concentrations measured in indoor air quality samples are within NYS guidelines. Groundwater beneath the site is not used as a potable source and therefore exposure via ingestion of groundwater is unlikely.

8. Summary and Conclusions

8.1. Summary

The horizontal and vertical extent of PCE contamination at 201 Charles Street, Maybrook has been outlined on maps of soil samples, groundwater samples, sub-slab soil vapor samples and indoor and outdoor ambient air.

There are no significant exposure pathways because contaminated soil and groundwater are not exposed at the land surface. Soil contamination does not exceed the cleanup standard. Groundwater is 7 to 12 feet below grade, so it is not likely to be in contact with receptors except possibly during construction activities.

8.2. Conclusions

- The RI objectives have been achieved.
- Sources of Contamination—Two likely sources of PCE contamination (spills} were identified
  - A spill on the blacktop outside the loading doc
  - Spills within the northern half of the building during degreasing operations, likely the vapor degreasing room.
- Soil--PCE seeped into soils beneath the blacktop.
- Groundwater PCE is dissolved within infiltrating precipitation in the soils and migrates downward to transmissive zones in the fractured bedrock.
- The transmissive water bearing zones are characterized by shale fragments.
- PCE breakdown products (TCE and cisDCE) have been detected in many soil and groundwater samples indicating a natural degradation process is occurring in both soil and groundwater.
- PCE was detected in soil samples and soil gas samples obtained from beneath the floor of the building. PCE in soil vapor was detected at several times the NYSDOH guideline of 30 $\mu g/m^3$.
- No outdoor exposure pathways were identified for humans, fish or wildlife with respect to soil, soil gas or groundwater.

8.3 Recommendations for Future Work

Some data gaps which may prove useful for the Remedial Action Selection Report may include:

- Measurement of hydraulic conductivity (permeability) of the Water-bearing Transmissive Units in the screened interval of monitoring wells. Slug tests can be conducted prior to preparing the remedial design.
- Obtain information on location, depth, and construction details for stormwater drainage system for Parking Lot and Drainage Basin
- Continue sampling Indoor and Sub-Slab Air Samples in the northern part of the building
- Redesign the sub-slab vapor extraction system from passive to active possibly using a variable frequency drive blower with capability of drawing from specific sub-slab vents
- Continue sampling monitoring wells.
- Change the groundwater environment to anaerobic and commence enhanced bioremediation to clean up the PCE contamination.

• Sampling parameters in soil and groundwater shall also include cadmium, mercury, and lead based on historical light bulb manufacturing by Osram-Sylvania (1984-2005).

8.4. Recommended Remedial Action Objectives

Appropriate remedial action objectives are selected to attain the goal of restoring the site to pre-contaminant conditions to the extent feasible. At a minimum, the remedy shall eliminate or mitigate all significant threats to public health and the environment presented by the contamination identified at the site through the proper application of scientific and engineering principles. The following protective remedial objectives may be appropriate, if significant threats to public health can be substantiated:

Remedial Action Objective #1 - Public Health Protection of Groundwater

§ Prevent people from drinking groundwater with contaminant levels exceeding drinking water standards.
§ Prevent contact with contaminated groundwater.
§ Prevent inhalation of contaminants from groundwater.

Remedial Action Objective #2 - Environmental Protection of Groundwater

§ Restore the groundwater aquifer to meet ambient groundwater quality criteria, to the extent feasible.
§ Prevent discharge of contaminated groundwater to surface water.

For each of the preventive objectives for groundwater, mitigating measures already exist because the groundwater is at a depth of 3 to 12 feet below grade.

At this time, it is not known if groundwater from the site discharges to surface water

Remedial Action Objective #3 - Public Health Protection of Soil

§ Prevent ingestion/ direct contact with contaminated soil
§ Prevent inhalation of contaminants from soil.

Soil contamination was found to be limited to the northern and western areas of the site beneath blacktop and under the building. Historical sampling has indicated that degradation products of PCE were present in all soil samples where PCE detected. Some form of natural degradation of PCE has been occurring in sub-slab soils in the northern part of the building. Recent soil samples have not exhibited any concentrations of PCE above the NYSDEC soil cleanup objective of 1400 ug/kg. Direct contact in any of these locations is impossible except for construction workers. Such exposure could be mitigated with the use of personal protective equipment.

Recent soil samples have not detected any concentrations of PCE above the NYSDEC soil cleanup objective of 1400 µg/kg.

Remedial Action Objective #4 - Environmental Protection of Soil

§ Prevent migration of contaminants that would result in groundwater or surface water contamination.
§ Prevent impacts to biota from ingestion/ direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.

As shown in this report, PCE contamination has migrated to groundwater. However, degradation of soil and groundwater has been documented as occurring naturally. Soil contamination was found to be limited to the parking lot on the southeastern side of the building on the site. Recent soil samples have not exhibited any concentrations of PCE above the NYSDEC soil cleanup objective of 1400 ug/kg.

Because the contaminated soil is beneath blacktop, biota are not likely to ingest or contact the soil at this site.

Remedial Action Objective #5 - Public Health of Soil Vapor Intrusion

§ Mitigate impacts to public health resulting from existing, or potential for, soil vapor intrusion into the indoor air of buildings at or near the site.

Additional sub-slab air samples shall be collected and analyses compared with the previous level of PCE trapped under the 201 Charles Street building. Sampling shall continue after installation of an active soil vapor extraction system.

9. References

Environmental Data Resouces, Inc (December 30, 2014) ***EDR Environmental Database Search within 0.5 miles of 201 Charles Street, Maybrook, NY,*** prepared by EDR of 4340 Wheelers Farms Road, Milford, CT 06461 (phone 800-352-0050, www.edrnet.com).

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US Department of Agriculture (1981) ***Soil Survey of Orange County, New York*** Map 64 and pages 63-64.

TABLES

201 Charles Street, Maybrook
Orange County, New York

Remedial Investigation Report

Brownfield Cleanup Application
NYSDEC Spill Number: 1601483

Prepared for:

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NOVEMBER 2020

LIST OF TABLES

Table 43

Groundwater Field Measurement Log: WLG - Maybrook NY (YSI DSS)

201 Charles Street LLC Date: 2 April 2020

MW/TW ID:	**I-18**	**I-17**	**I-16**	**I-15**	**I-14**	**I-13**	**I-12**	**I-11**	**I-10**
Time	13:45								
DTW (ft. below TOC)	8.26	7.79	7.44	7.76	NR	6.19	8.1	7.63	8.04
Parameter - Measured in-situ with YSI Pro DSS									
Baro. P. (mm Hg)	765.7								
Turbidity (ntu)	13.37	16.28	9.2	36	26.23	87.47	38.7	11.1	21.0
Temp. (°C)	10.1	9.6	9.5	9.5	9.9	10.1	10.6	101.4	10.8
DO (mg/L)	1.31	0.96	0.88	0.79	0.72	0.84	0.77	0.8	0.73
Sp. Cond. (mS/cm)	8.17	4.74	3.99	27.28	23.79	8.05	13.37	15.35	47.36
TDS (ppm)	5,425	3,074	3,200	17,720	15,468	5,674	8,730	10,130	30,780
Salinity (ppt)	4.74	2.48	2.66	16.8	14.44	4.94	7.80	9.3	30.69
pH (s.u.)	10.22	6.75	7.04	6.56	6.62	7.74	6.51	7.42	7.03
ORP (mV)	-45	-46	-16	67	-21	-221	-12	-61	147
Odors (Key)	F	SL/F	SL/F	SL	SL/F	F/S	SL/F	SL/F	SL/F
Color (Key)	T-G, cloudy	T-G, cloudy	T-G, cloudy	T-Y, semi tr.	Y, semi tr.	T-G, cloudy	Y-T, cloudy	Y-T, clear	Y, semi tr.

MW/TW ID:	**I-9**	**I-8**	**I-7**	**I-6**	**I-5**	**I-4**	**I-3**	**I-2**	**I-1**
Time									15:40
DTW (ft. below TOC)	7.81	7.76	7.93	8.09	6.66	7.87	7.64	7.78	7.67
Parameter - Measured in-situ with YSI Pro DSS									
Baro. P. (mm Hg)									
Turbidity (ntu)	35	15	95	39	17	120	32	32	28
Temp. (°C)	11	11.2	11.2	111.4	11.6	11.8	12	12	12.6
DO (mg/L)	0.94	0.88	0.75	0.74	0.93	0.91	0.77	0.74	0.83
Sp. Cond. (mS/cm)	46.9	9.53	5.71	6.67	46.4	31.23	11.17	11.07	3.71
TDS (ppm)	30,520	6,240	3,735	4,330	30,250	20,250	7,265	7,220	2,400
Salinity (ppt)	30.46	5.52	3.13	3.64	30.28	19.27	6.38	6.36	1.96
pH (s.u.)	6.69	6.28	6.01	5.91	6.47	6.4	6.85	5.63	6.11
ORP (mV)	-4	-96	-204	-69	160	109	-108	76	-188
Odors (Key)	F/SL	F/S	S/F	F/SL	SL	SL/F	F/S	SL/F	S
Color	Y, sl. cloudy	G, cloudy	G, sl. cloudy	Y-T, cloudy	O, semi tr.	Y, semi tr.	T-G, cloudy	Y, clear	G, cloudy

Personnel/Weather	E.C. Hince, T. Kincade. Low-mid. 50s F, partly sunny, windy
Equipment/Materials	Water level indicator. YSI Pro DSS, Sonde, 10M cable with optical DO, ORP/pH, temp/salinity. Decon kit.
*Notes:	Optical DO sensor "sluggish" as readings decreased below 1 mg/L.
Odor Key:	SL=sodium lactate; F=fermentation; S=sulfide; first letter in mixed key is the predominant odor
Odor Key:	Y=yellow; T=tan; G=gray; O=orange; semi tran=semi transparent; sl.=slightly

Table 521

Phase I and: Phase II Soil Sampling
Date of Sampling: November 14-17, 2015 and January 14, 2016
Site: 201 Charles Street, Maybrook, NY
Laboratory Analyses by US EPA SW-846 Method 8260
All Volatile Organic Compound Concentrations are reported in pg/kg
ESC Lab Sciences 12065 Lebanon Road, Mount Juliet, TN 37122
Sampling Reported in Phase II Study Prepared by
LCS, Inc. 40 La Riviere Drive, Suite 120, Buffalo, NY 14202

Sample ID	SB1	SB2	SB4	SB5	SB6	BH8	BH9	BH10	BH10	BH11	BH12	BH13	Part 375 (Unrestricted) Soil Cleanup Objectives	Part 375 (Residential) Soil Cleanup Objectives	Part 375 (Residential Restricted) Soil Cleanup Objectives	Part 375 (Commercial) Soil Cleanup Objectives	Part 375 (Industrial) Soil Cleanup Objectives
Date Sampled	11/17/15	11/17/15	11/17/15	11/17/15	11/17/15	1/14/16	1/14/16	1/14/16	1/14/16	1/14/16	1/14/16	1/14/16					
Sample Depth	2-4 ft. bgs	2-4 ft. bgs	4-6 ft. bgs	6-8 ft. bgs	6-8 ft. bgs	4-6 ft. bgs	4-6 ft. bgs	4-6 ft. bgs	9.5-11.5 ft. bgs	6-8 ft. bgs	1-3 ft. bgs	6-8 ft. bgs					
Units	pg/kg	pg/kg	pg/kg	pg/kg	pg/kg	pg/kg	pg/kg	pg/kg	pg/kg	pg/kg	pg/kg	pg/kg	pg/kg	pg/kg	pg/kg	pg/kg	pg/kg
Acetone	87.0	60.7	36.2 J	19.5 J	<10	28.7J	<10	<10	14.5 J	<10	20.3 J	<142	50	100,000	100,000	500,000	1,000,000
Carbon Disulfide	0.512 J	<0.221	<0.221	<0.221	<0.221	<0.221	<0.221	<0.221	<0.221	0.278 J	0.414 J	<3.15	NL	NL	NL	NL	NL
2- Butanone	8.40 J	9.44 J	<4.68	<4.68	<4.68	<4.68	<4.68	<4.68	<4.68	<4.68	<4.68	<4.68	120	100,000	100,000	500,000	1,000,000
Cis-1,2- Dichloroethene	<0.235	3.74	<0.235	<0.235	<0.235	0.358 J	0.357	11.0	10.1	<0.235	2.30	<3.315	250	59,000	100,000	500,000	1,000,000
Trichloroethene	<0.279	0.940 J	<0.279	<0.279	<0.279	1.29	1.17	4.92	4.34	<0.279	1.24	<3.98	470	10,000	21,000	200,000	400,000
Tetrachloroethene	81.4	37.5	1.12 J	<0.276	<0.276	123	100	6,270	9,420	3.32	7.23	209	1,300	5,500	19,000	150,000	300,000
Trans-1,2-Dichloroethene	<0.264	<0.264	<0.264	<0.264	<0.264	<0.264	<0.264	0.305 J	<0.264	<0.264	<0.264	<3.76	190	100,000	100,000	500,000	1,000,000

pg/kg = micrograms per kilogram
ft. bgs = feet below ground surface
NL = Not Listed
J = Indicates an estimated value
Part 375 Soil Cleanup Objectives = New York State Department of Environmental Conservation 6 NYCRR Part 375 Environmental Remediation Programs, December 14, 2006 (375-6.8, Soil Cleanup Objective Tables)
= Analyte detected above the Part 375 (Unrestricted) Soil Cleanup Objectives and Part 375 (Unrestricted) Soil Cleanup Objectives.

Table 522

PCE (Tetrachloroethylene) Concentrations Detected in Soil Borings

All other volatile organic compounds were not detected (ND)

Date of Sampling: March 2, 2016

Site: 201 Charles Sreet, Maybrook, NY NYSDEC Spill No. 1601483

Laboratory Analyses by US EPA Method 8260

EnviroTest Laboratories, Inc., 315 Fullerton Avenue, Newburgh, NY 12550

Sampling Conducted by William L. Going & Associates, Inc.

Soil Boring Location	Depth (feet)	End of Boring	Concentration (mg/kg)
SB1	3-4	Refusal	ND
SB2	10-11	Refusal	0.0003
SB3	5-6	Refusal	0.0009
SB4	6-7	Refusal	0.001
SB5	3-4	Refusal	0.12
SB6	7-8	Refusal	4.00
SB7	10-11	Refusal	6.00
SB8	9-10	Refusal	0.11
SB9	9-10	Refusal	0.67
SB10	9-10	Refusal	77.00
SB11	6-7	Refusal	0.24
SB12	11-12	Refusal	0.16
SB13	7-8	Refusal	0.59

Table 531

Phase I and II Groundwater Sampling
Dates of Sampling January 14, 2016 and November 17, 2016
Site: 201 Charles Street, Maybrook, NY
Laboratory Analyses by-US EPA Method 8260
All Volatile Organic Compounds are reported in pg/L
ESC Lab Sciences 12065 Lebanon Road, Mount Juliet, TN 37122
Sampling Reported in Phase II Study Prepared by
LCS, Inc. 40 La Riviere Drive, Suite 120, Buffalo, NY 14202

Sample ID Date Sampled Units	TPMW1 11/17/15 Mk	TPMW2 11/17/15 pg/L	TPMW3 11/17/15 pg/L	TW4 1/14/16 pg/L	TW5 1/14/16 pg/L	NYSDEC Groundwater Criteria (Class GA) MOii
Cis-1,2- Dichloroethene	3.16	<0.260	0.394 J	1.16	24.1	5
Trichloroethene	4.81	<0.398	<0.398	3.73	12.6	5
Tetrachloroethene	614	4.69	<0.372	458	2,240	5
Naphthalene	<10	<1	**<1**	<1	3.82 J	10
Trans-1,2-Dichloroethene	<0.396	<0.396	<0.396	<0.396	0.444 J	5
n-Propylbenzene	<0.349	<0.349	<0.349	<0.349	0.54 J	5
1,2,4-Trimethylbenzene	<0.373	<0.373	<0.373	<0.373	2.23	5
1,3,5-Trimethylbenzene	<0.387	<0.387	<0.387	<0.387	0.534 J	5
Ethylbenzene	<0.384	<0.384	<0.384	<0.384	0.793 J	5
m,p- Xylene	<0.719	<0.719	<0.719	<0.719	0.88 J	5

pg/L = micrograms per liter
J = Indicates an estimated value.
NYSDEC Groundwater Criteria (Class GA) = 6 NYCRR Part 703 (June 1998 and April 2000 Addendum)
= Analyte detected above the NYSDEC Groundwater Criteria.

Table 532
Chlorinated Solvent Concentrations Detected in Groundwater
Dates of Sampling March 3, 11, & 31, 2016
Site: 201 Charles Street,Maybrook, NY NYSDEC Spill No. 1601483
Laboratory Analyses by US EPA Method 8260
EnviroTest Laboratories, Inc., 315 Fullerton Avenue, Newburgh, NY 12550
"-" indicates analyte was not detected (ND)
"J" indicates concentration is estimated
Sampling by William L. Going & Associates, Inc.

Well or Piezometer	PCE µg/L	TCE µg/L	1,2DCE µg/L	1,1,1TCA µg/L
SB2	2.8	-	-	-
SB7	**870**	**9.4**	0.78J	0.76J
SB8	**120**	3.4	2.5	-
SB9	**160**	2.1	0.37J	-
SB10	**10,000**	**36**	2	0.54J
SB12	**14**	**-**	-	-
DMW1	**-**	**-**	-	-
DMW2	**24,000**	**3,100**	**710**	**7.9**
DMW2S	**6,300**	**200**	**12**	1.7
DMW3	**66**	1.4	-	0.31J
DMW4	**-**	-	-	-
DMW5	**230**	1.6	1.1	1.1
ORM	1.1	-	-	-

Table 534
Chlorinated Solvent Concentrations Detected in Groundwater
Dates of Sampling September 19, 2016
Site: 201 Charles Street,Maybrook, NY NYSDEC Spill No. 1601483
Laboratory Analyses by US EPA Method 8260
EnviroTest Laboratories, Inc., 315 Fullerton Avenue, Newburgh, NY 12550
"-" indicates analyte was not detected (ND)
Sampling by William L. Going & Associates, Inc.

Well or Piezometer	PCE µg/L	TCE µg/L	1,2DCE µg/L	1,1,1TCA µg/L
DMW1				
DMW2	**35**	**2**	**0.83**	**ND**
DMW2S	**28**	**0.78**	**ND**	ND
DMW3	**22**	0.26	ND	ND
DMW4				
DMW5	**140**	932	ND	1.1
ORM				
INJ 2	**150**	0.26	ND	0.53
INJ 4	**85**	0.53	ND	0.79
INJ 7	**8.2**	ND	ND	1.1
INJ 11	**350**	1.2	1.3	1.3
INJ15	**99**	ND	ND	0.49

Table 535
Chlorinated Solvent Concentrations Detected in Groundwater
Dates of Sampling January 26, 2017
Site: 201 Charles Street,Maybrook, NY NYSDEC Spill No. 1601483
Laboratory Analyses by US EPA Method 8260
EnviroTest Laboratories, Inc., 315 Fullerton Avenue, Newburgh, NY 12550
"-" indicates analyte was not detected (ND)
"J" indicates concentration is estimated
Sampling by William L. Going & Associates, Inc.

Well or Piezometer	PCE µg/L	TCE µg/L	1,2DCE µg/L	1,1,1TCA µg/L
DMW1				
DMW2	**9.1**	**0.22 J**	**ND**	**ND**
DMW2S	**2.8**	**ND**	**ND**	ND
DMW3	**5.1**	ND	ND	ND
DMW4				
DMW5	**160**	2.3	0.71	ND
ORM				
INJ 2	330	1.9	ND	0.38
INJ 4	580	5.2	0.96	0.8
INJ 7	390	4	3.7	ND
INJ 11	890	6.2	3.4	0.96
INJ15	740	4.1	2.9	0.62
INJ 17	1600	9.3	3.7	1.2

Table 536
Chlorinated Solvent Concentrations Detected in Groundwater
Dates of Sampling August 30, 2019
Site: 201 Charles Street,Maybrook, NY NYSDEC Spill No. 1601483
Laboratory Analyses by US EPA Method 8260
EnviroTest Laboratories, Inc., 315 Fullerton Avenue, Newburgh, NY 12550
"-" indicates analyte was not detected (ND)
"J" indictes estimated concentration
Sampling by William L. Going & Associates, Inc.

Well or Piezometer	PCE µg/L	TCE µg/L	1,2DCE µg/L	1,1,1TCA µg/L
DMW1				
DMW2	**ND**	**ND**	**ND**	**ND**
DMW2S				
DMW3				
DMW4	**0.24 J**	ND	ND	ND
DMW5				
ORM				
INJ1	82	ND	ND	ND
INJ2	220	ND	ND	ND
INJ3	570	ND	ND	ND
INJ4	6.2	ND	ND	ND
INJ5	11	ND	ND	ND
INJ6	130	ND	12	ND
INJ7	150	ND	6.2	ND
INJ8	780	0.2	42	ND
INJ9	110	ND	ND	ND
INJ10	25	ND	ND	ND
INJ11	57	ND	ND	ND
INJ12	76	16	24	ND
INJ13	50	16	24	ND
INJ14	630	ND	ND	ND
INJ15	ND	ND	ND	ND
INJ16	420	ND	ND	ND
INJ17	56	ND	ND	ND

Table 541
Indoor and Outdoor Air and Sub-Slab Soil Vapor Sampling
Date of Sampling: January 14, 2016
Site: 201 Charles Street, Maybrook, NY
Laboratory Analyses by US EPA Method TO-15
All Volatile Organic Compound Concentrations are reported in μg/m^3
ESC Lab Sciences 12065 Lebanon Road, Mount Juliet, TN 37122
Sampling Reported In Phase II Study Prepared by
LCS, Inc. 40 La Riviere Drive Suite 120, Buffalo, NY 14202
Sub-slab sampling locations shown on Figure 5, Indoor Air was sampled
Near SS2 and Outdoor Air was sampled near TMW-1

Sample ID	**INDOOR**	**OUTDOOR**	**SS1**	**SS2**	**SS3**
Date Collected	**1/14/2016**	**1/14/2016**	**1/14/2016**	**1/14/2016**	**1/14/2016**
Units	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**
Acetone	5.08	3.71	39.6	114	23.0
Benzene	1.60	0.97	2.50	3.82	3.07
1,3-Butadiene	0.285 J	<0.125	<0.125	3.24 J	<0.125
Carbon disulfide	<0.169	<0.169	1.84	0.193 J	0.411 J
Carbon tetrachloride	0.597 J	0.55 J	0.422 J	0.49 J	0.479 J
Chloroform	<0.279	<0.279	<0.279	<0.279	1.77
Chloromethane	1.43	1.45	0.744	1.53	0.857
Cyclohexane	<0.184	<0.184	0.712	1.87	0.858
Ethanol	31.8	5.76	60.1	112	24.9
Ethylbenzene	0.509 J	<0.219	1.79	1.05	0.875
4-Ethyltoluene	<0.327	<0.237	0.52 J	0.554 J	<0.327
Trichlorofluoromethane	1.73	1.57	14.5	1.46	1.84
Dichlorodifluoromethane	2.20	2.03	320	1.72	2.19
1,1,2-Trichlorotrifluoroethane	0.669 J	0.695 J	0.67 J	0.612 J	0.679 J
Heptane	0.384 J	<0.256	1.02	1.26	1.21
n-Hexane	0.673 J	0.534 J	1.98	3.72	1.49
Naphthalene	<0.806	<0.806	<0.806	0.823 J	<0.806
2-Butanone (MEK)	<0.145	<0.145	3.04 J	1.83 J	2.70 J
4-Methyl-2-Pentone (MIBK)	<0.266	<0.266	8.85	0.772 J	2.54 J
2-Propanol	2.22 J	0.591 J	8.53	96.4	1.33 J
Toluene	1.35	0.618 J	8.27	3.26	4.65
Styrene	<0.198	<0.198	0.873	0.475 J	0.364 J
Tetrachloroethene	**42.6**	<0.337	**618**	**18.9**	**2,360**
Tetrahydrofuran	<0.15	<0.15	0.525 J	<0.15	<0.15
Trichloroethane	<0.292	<0.292	7.49	<0.292	0.725 J
1,1,1-Trichloroethane	<0.362	<0.362	1.82	<0.362	1.57
1,2,4-Trimethylbenzene	0.53 J	<0.237	1.81	1.89	0.82 J
1,3,5-Trimethylbenzene	<0.31	<0.31	0.485 J	0.583 J	<0.31
2,2,4-Trimethylpentane	0.649 J	0.645 J	3.25	1.82	0.59
m&p-Xylene	1.24 J	<0.41	6.44	3.09	2.76
o-Xylene	0.52 J	<0.274	2.22	1.28	0.957

SS = Sub slab vapor sample
μg/m^3 = micrograms per cubic meter
J = Estimated value

Table 542
Ambient Air and Sub-Slab Soil Vapor Sampling Laboratory Results
Date of Sampling: March 3, 2016
Site: 201 Charles Street, Maybrook, NY NYSDEC Spill No. 1601483
Laboratory Analysis by US EPA MethodTO15Full List, 6 Liter Summa Canisters
All Concentrations of Volatile Organic Compounds are measrued in $\mu g/m^3$
EnviroTest Laboratories, 315 Fullerton Avenue, Newburgh, NY 12550
"-" indicates compound not detected (ND)
Sampling conducted by Willim L. Going & Associates, Inc.

Sampling Location	Carbon Tetrachloride	1,1,1-TCA	TCE	PCE	Two Parts of Building
Summa 1	-	-	-	35.9	New Building
Summa 2	-	-	-	13.5	New Building
Summa 3	-	-	-	4.83	New Building
Summa 4	-	-	-	64.2	New Building
Summa 5	-	-	-	22	New Building
Summa 6	-	4.29	-	86.1	New Building
Summa 7	-	63.8	-	-	New Building
Summa 8	-	29.7	-	41.5	New Building
Summa 9	-	-	-	119	New Building
Summa 10	-	-	-	9.97	Old Building
Summa 11	-	-	-	3,040	Old Building
Summa 12	-	-	48.3	13,100	Old Building
Summa 13	-	-	35.4	9,490	Old Building
Summa 14	-	-	92.4	30,700	Old Building
Summa 15	-	-	-	39,500	Old Building
Summa 16	-	-	23.5	10,500	Old Building
Summa 17	-	-	-	1,510	Old Building
Summa 18	-	-	160	37,400	Old Building
Ambient 1	0.484	-	-	16.300	Old Building
Ambient 2	0.491	-	0.113	30.400	Old Building
Ambient 3	0.516	-	-	7.260	Old Building
Ambient Outdoor	0.503	-	-	0.502	Outdoors

Table 545
Ambient Air and Sub-Soil Vapor Sampling
Date of Sampling: November 23, 2019
Site: 201 Charles Street, Maybrook, NY; NYSDEC Spill No. 1601483
Laboratory Analyses by US EPA Method TO15 Full List, 6 Liter Canisters
All Concentrations of Volatile Organic Compounds are measured in $\mu g/m^3$
EnviroTest Laboratories, 315 Fullerton Avenue, Newburgh, NY 12550
"-" indicates compound not detected (ND)
Sampling conducted by William L. Going & Associates, Inc.

	VOC*	VOC*	VOC*	VOC*
Sampling Location	**Carbon Tetrachloride**	**1,1,1 TCA**	**TCE**	**PCE**
Summa I 1	-	-	-	40.3
Summa I 2	-	-	-	36.1
Summa I 3	-	-	-	14.4
Summa I 4	-	-	-	43.7
Summa I 5	-	-	-	48.4
Summa I 6	-	-	-	33.8
Summa I 7	-	-	-	41.8
Summa I 8	-	-	-	49.2
Summa I 9	-	-	-	67.5
Summa SS 1	-	8.18	97.8	10200
Summa SS 3	0.465	0.306	13.3	225
Summa SS 7	0.390	0.327	0.134	29.0
Summa SS 9	-	1.98	-	3360
Summa SS 13	0.395	0.600	0.683	269
Summa SS 14	0.377	-	0.709	608
Summa SS 15	-	-	112	10400
Summa SS 16	0.415	0.382	6.29	412
Summa SS 18	0.550	0.557	1.14	530
Ambient Out	0.409	-	0.145	0.387
Action Required	**NFA**	**Monitor**	**Monitor**	**Mitigate**

*=Volatile Organics TO-15 (ug/cu.m.)
- = Not Detected

FIGURES
201 Charles Street, Maybrook
Orange County, New York

Remedial Investigation Report

Brownfield Cleanup Application
NYSDEC Spill Number: 1601483

Prepared for:
201 CHARLES STREET LLC, 33 SOUTH PLANK ROAD, NEWBURGH, NEW RK, 12550

Prepared by:

Jansen Engineering, PLLC
72 Coburn Drive
Poughkeepsie, NY 12603
(845) 505-0324 ;

Mid-Hudson Geosciences
1003 Route 44/55,
POBox 32
Clintondale, NY 12615
(845) 883-5726

and Anaerobix
P.O. Box 13
Washingtonville, NY 10992
(207) 280-1913

Figure 101
USGS 7.5Minute Quadrangle: Maybrook, NY
Scale: 1:6000
Brownfield Site: 201 CharlesStreet LLC
Village of Maybrook
NYS DEC Spill No: 1601483

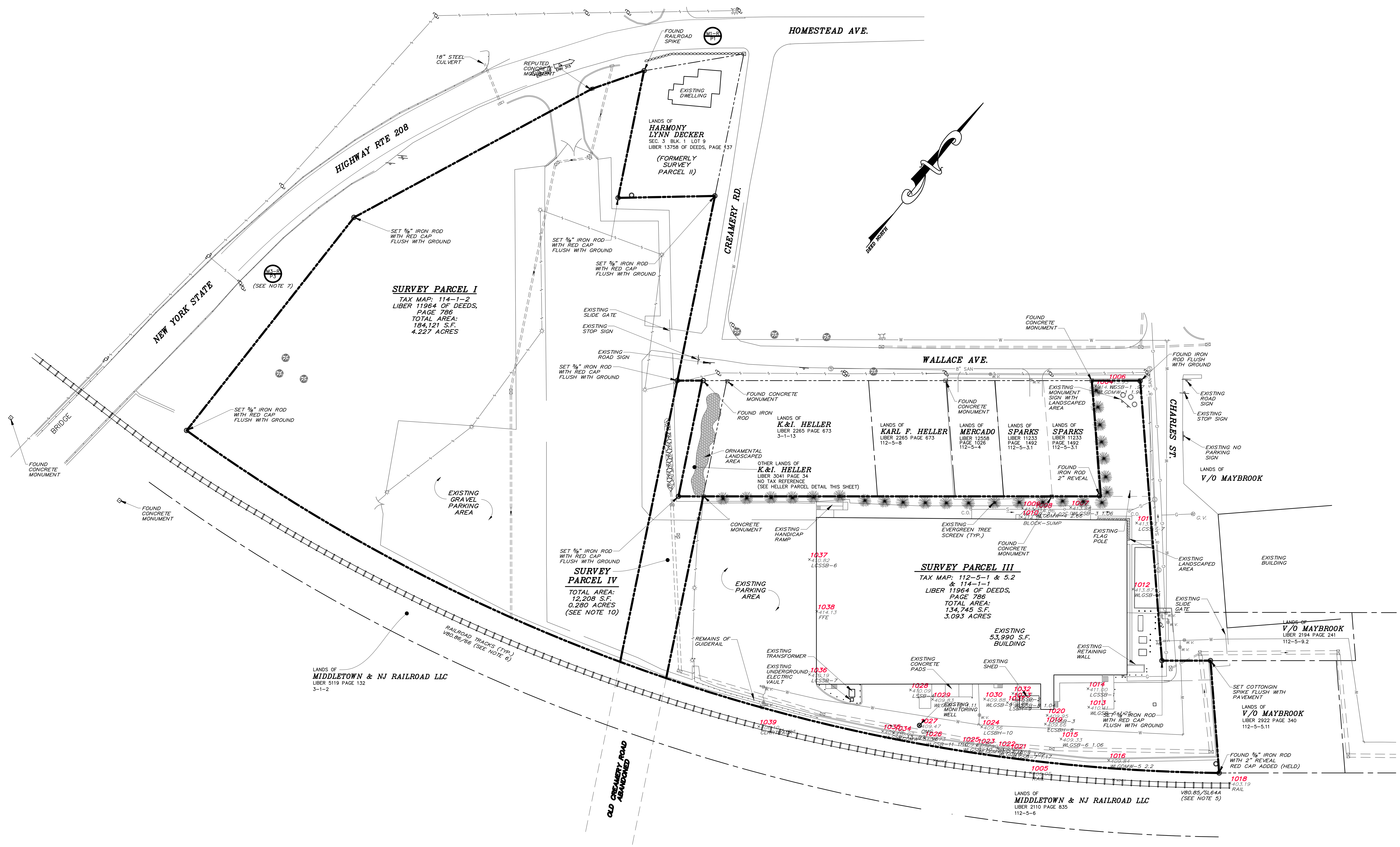


Figure 131

APRIL 14, 2016
SCALE: 1" = 40'

T.M DEPUY
ENGINEERING & LAND SURVEYING, P.C.
2656 ROUTE 302, MIDDLETOWN, NY 10941
PHONE: (845) 361-5421 FAX: (845) 361-5229

Figure 132 **Locator Map; 201 Charles Street, Maybrook, New York**

Figure 133

LEGEND

STATE OR COUNTY LINE		FILED PLAN LOT LINE		TAX MAP BLOCK NO.	(4)	FILED PLAN BLOCK NO.	(2) (4)
CITY TOWN OR VILLAGE		EASEMENT LINE		TAX MAP PARCEL NO.	32	FILED PLAN LOT NO.	(3) or (P/o 2)
BLOCK OR SECTION LIMIT		MATCH LINE		AREAS (DEED) 11.1A or (CALCULATED) 11.6A(C)		STATE HIGHWAYS	N Y STATE HWY NO 17
SPECIAL DISTRICT LINE	FIRE WATER LIGHT SCHOOL	WATER FEATURES		DIMENSIONS (DEED) 66 or (CALCULATED) 75S		COUNTY HIGHWAYS	COUNTY ROAD NO 4
PROPERTY LINE		GRID COORDINATE/CENTROID	•	PORTION OF TAX LOT	P/o 1-1-1	TOWN ROADS	TOWN ROAD 1

ORANGE COUNTY—NEW YORK

Prepared by
Orange County Tax Map Department
124 Main Street, Goshen, N.Y. 10924
Phone 845.291.2498 Fax 845.291.2499

NOTICE
MAINTENANCE, ALTERATION, SALE OR DISTRIBUTION OF ANY PORTION OF THE ORANGE COUNTY TAX MAP IS PROHIBITED WITHOUT WRITTEN PERMISSION OF THE O.C. REAL PROPERTY TAX SERVICE AGENCY

NOT TO BE REPRODUCED FOR COMMERCIAL PURPOSES FOR TAX PURPOSES ONLY NOT TO BE USED FOR CONVEYANCE ©

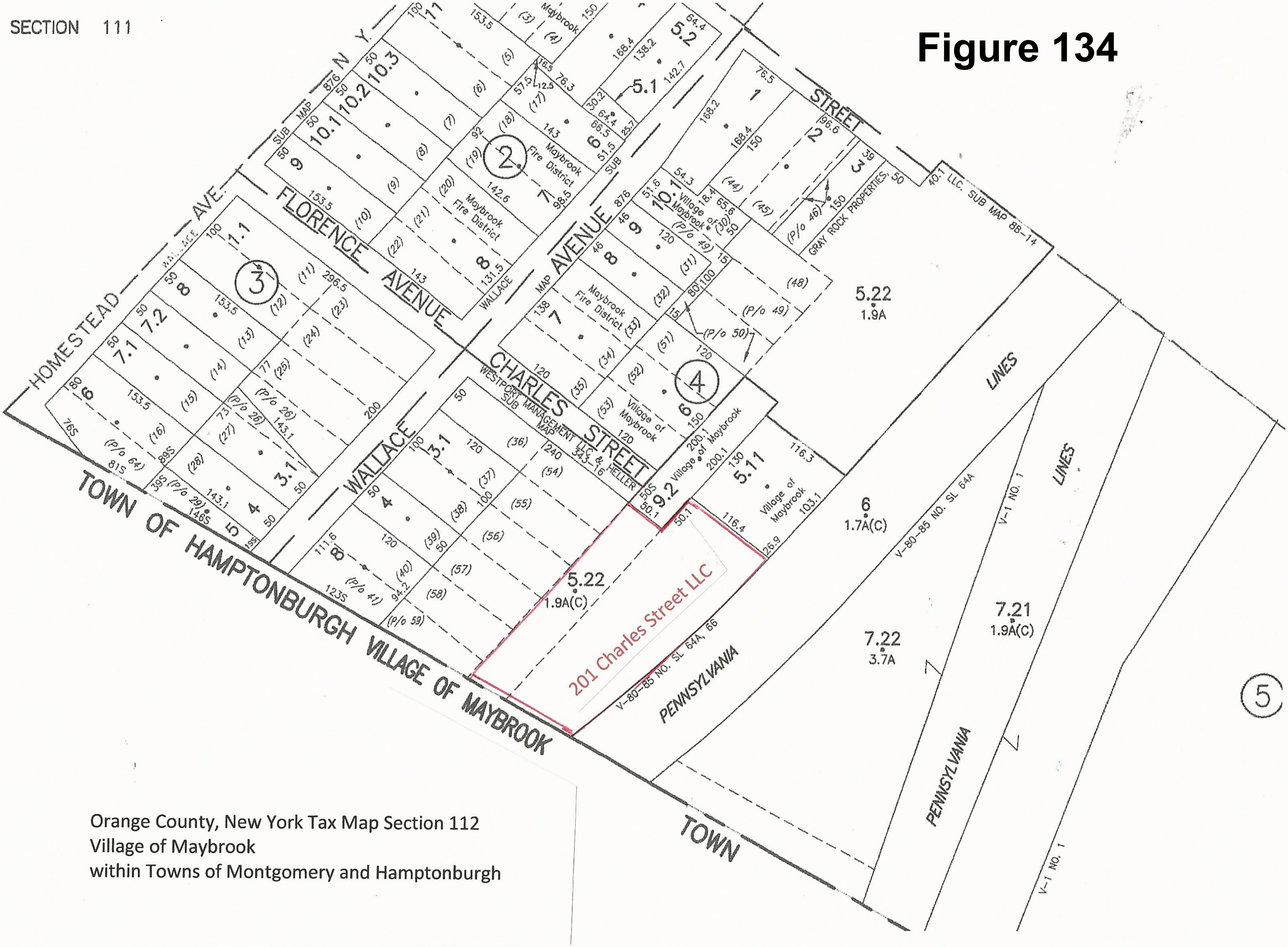
ADJOINING REFERENCE

334201
VILLAGE OF MAYBROOK

Scale 1" = 100' Section No. 112

TAX YEAR 2019

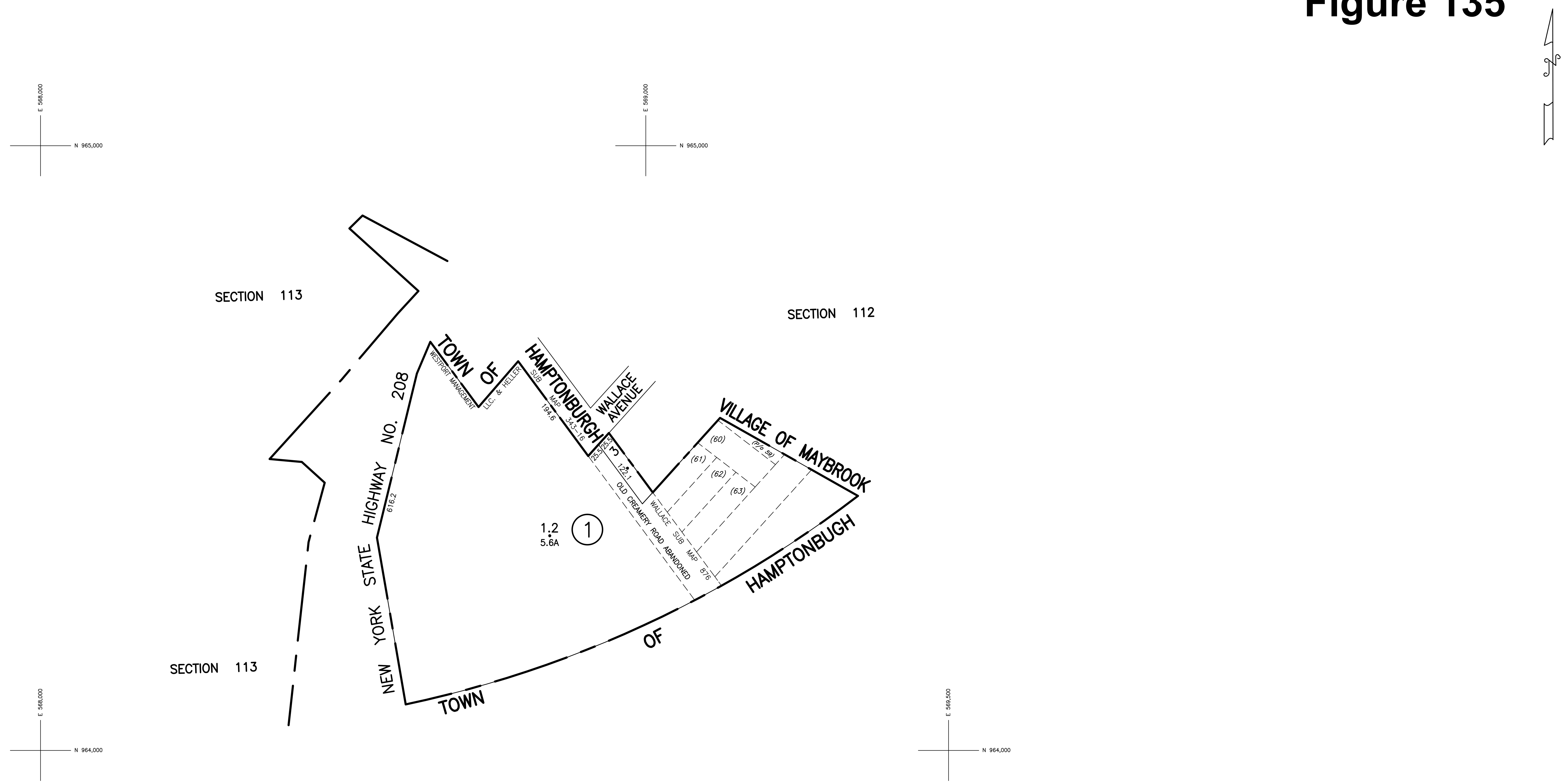
Figure 134



Orange County, New York Tax Map Section 112
Village of Maybrook
within Towns of Montgomery and Hamptonburgh

REVISION
03/01/03
11/03/03
10/11/16 LR

Figure 135



LEGEND

STATE OR COUNTY LINE	▬ ▬ ▬	FILED PLAN LOT LINE	– – – – – –	TAX MAP BLOCK NO.	④	FILED PLAN BLOCK NO.	㉓ ④
CITY TOWN OR VILLAGE	▬ — ▬	EASEMENT LINE	— · · — · · —	TAX MAP PARCEL NO.	32	FILED PLAN LOT NO.	(3) or (P/o 2)
BLOCK OR SECTION LIMIT	▬ — — ▬	MATCH LINE	——— ? ———	AREAS	(DEED) 11.1A or (CALCULATED) 11.6A(C)	STATE HIGHWAYS	N Y STATE HWY NO 17
SPECIAL DISTRICT LINE	FIRE WATER — — LIGHT SCHOOL	WATER FEATURES		DIMENSIONS	(DEED) 66 or (CALCULATED) 75S	COUNTY HIGHWAYS	COUNTY ROAD NO 4
PROPERTY LINE	———	GRID COORDINATE/CENTROID	•	PORTION OF TAX LOT	P/o 1-1-1	TOWN ROADS	TOWN ROAD 1

ORANGE COUNTY—NEW YORK

Prepared by
Orange County Tax Map Department
124 Main Street, Goshen, N.Y. 10924
Phone 845.291.2498 Fax 845.291.2499

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NOT TO BE REPRODUCED FOR COMMERCIAL PURPOSES FOR TAX PURPOSES ONLY NOT TO BE USED FOR CONVEYANCE ©

ADJOINING REFERENCE

333401
VILLAGE OF MAYBROOK
IN THE TOWN OF HAMPTONBURGH
Scale 1" = 100'   Section No. 114

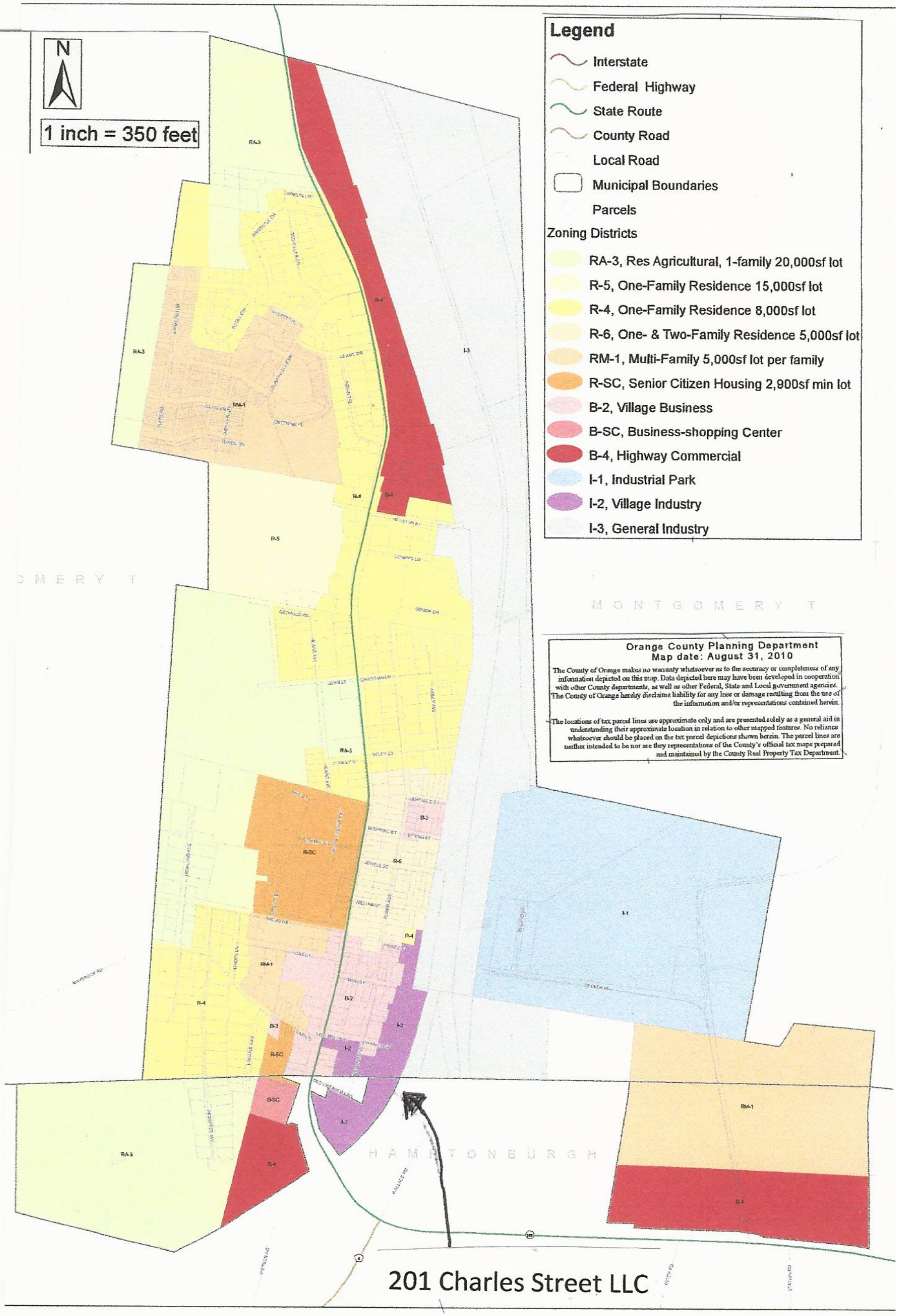
TAX YEAR 2019

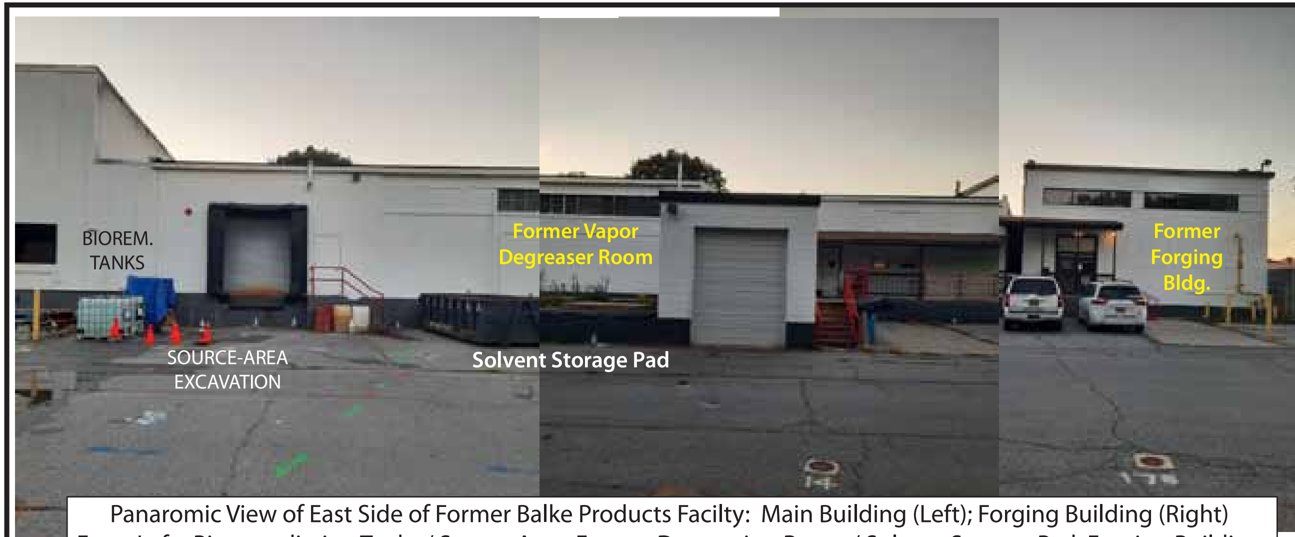
Figure 136

Village of Maybrook, New York

Zoning Map

Last Amended :





Panaromic View of East Side of Former Balke Products Facilty: Main Building (Left); Forging Building (Right)
From Left: Bioremediation Tanks / Source Area; Former Degreasing Room / Solvent Storage Pad; Forging Building

Bioremediation Tanks (Left);
Source-Area Well (Cone/Right)

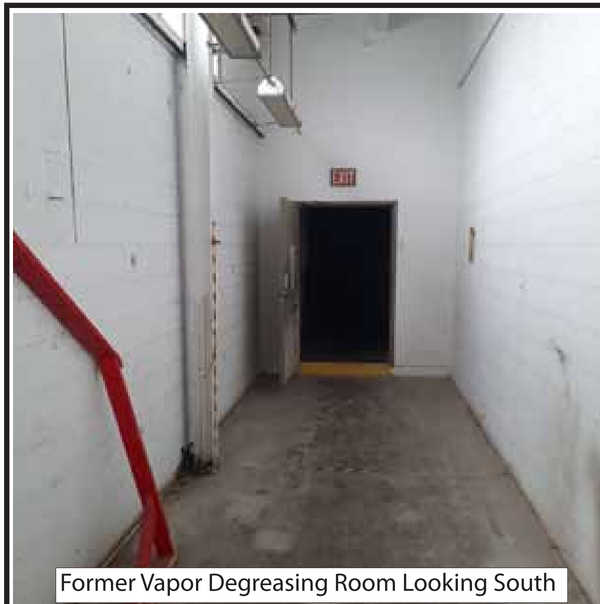
Former Solvent Storage Adjacent to Vapor Degreasing

East Side of Former Balke Forging Building

Bioremediation Tanks, Source-Area (foreground)

FIGURE 144

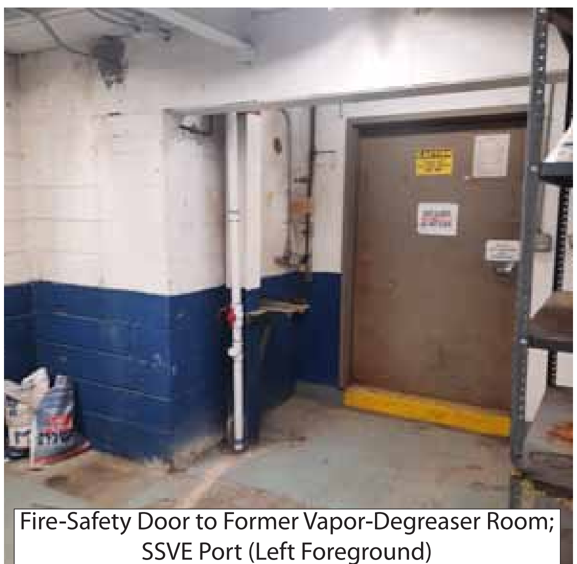
Former Vapor-Degreasing Room Looking N



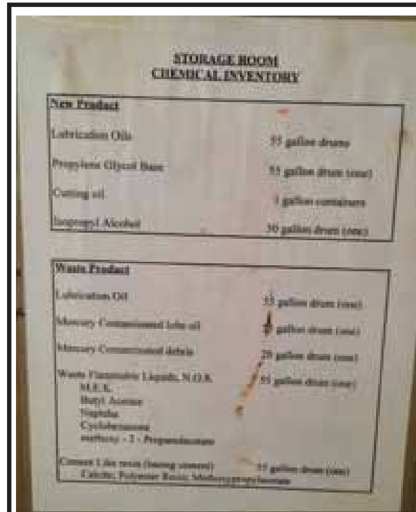
Former Vapor Degreasing Room Looking South


Venting Windows along top of East/Exterior Wall of Former Vapor Degreasing Room


Fire-Safety Switch
Former Degreaser Room

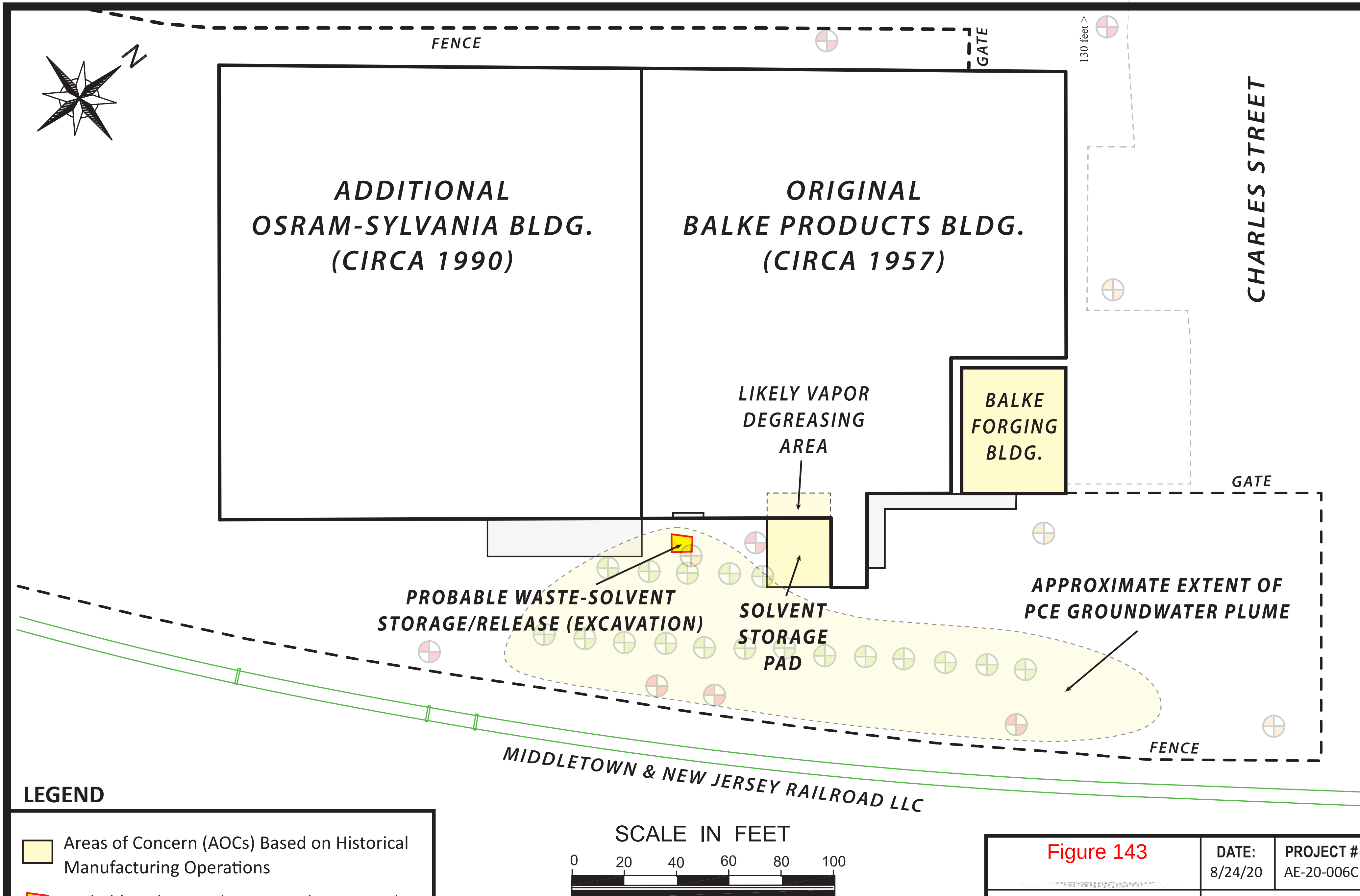

Fire-Safety Door to Former Vapor-Degreaser Room; SSVE Port (Left Foreground)

Fire Door to Vapor Degreaser Room



Osram-Sylvania Haz-Mat. Inventory posted on Fire Door

FIGURE 145



LEGEND

- Areas of Concern (AOCs) Based on Historical Manufacturing Operations
- Probable Solvent Release Area (Excavation)
- Groundwater Remediation Well (2")
- Overburden Monitoring Well (MW; 2")
- Proposed Add. Boring / Overburden MW (2")

MAP REFERENCES (See Appendix 1):

1. Sample location, isopleth and remediation figures prepared by Mid-Hudson Geosciences (Katherine J. Beinkafner, Ph.D)
2. Site surveys / CAD maps prepared by T.M. Dupuy Engineering & Land Surveying P.C.

Figure 143	DATE: 8/24/20	PROJECT # AE-20-006C
ANAEROBIX ENVIRONMENTAL LLC P.O. BOX 13 WASHINGTONVILLE, NY 10992	DRAWN BY: ECH CHECKED BY: KJB	

HISTORICAL AREA OF CONCERN (AOC) PLAN

Former Manufacturing Site
201 Charles Street
Maybrook, NY 12543

FIGURE #
AOC

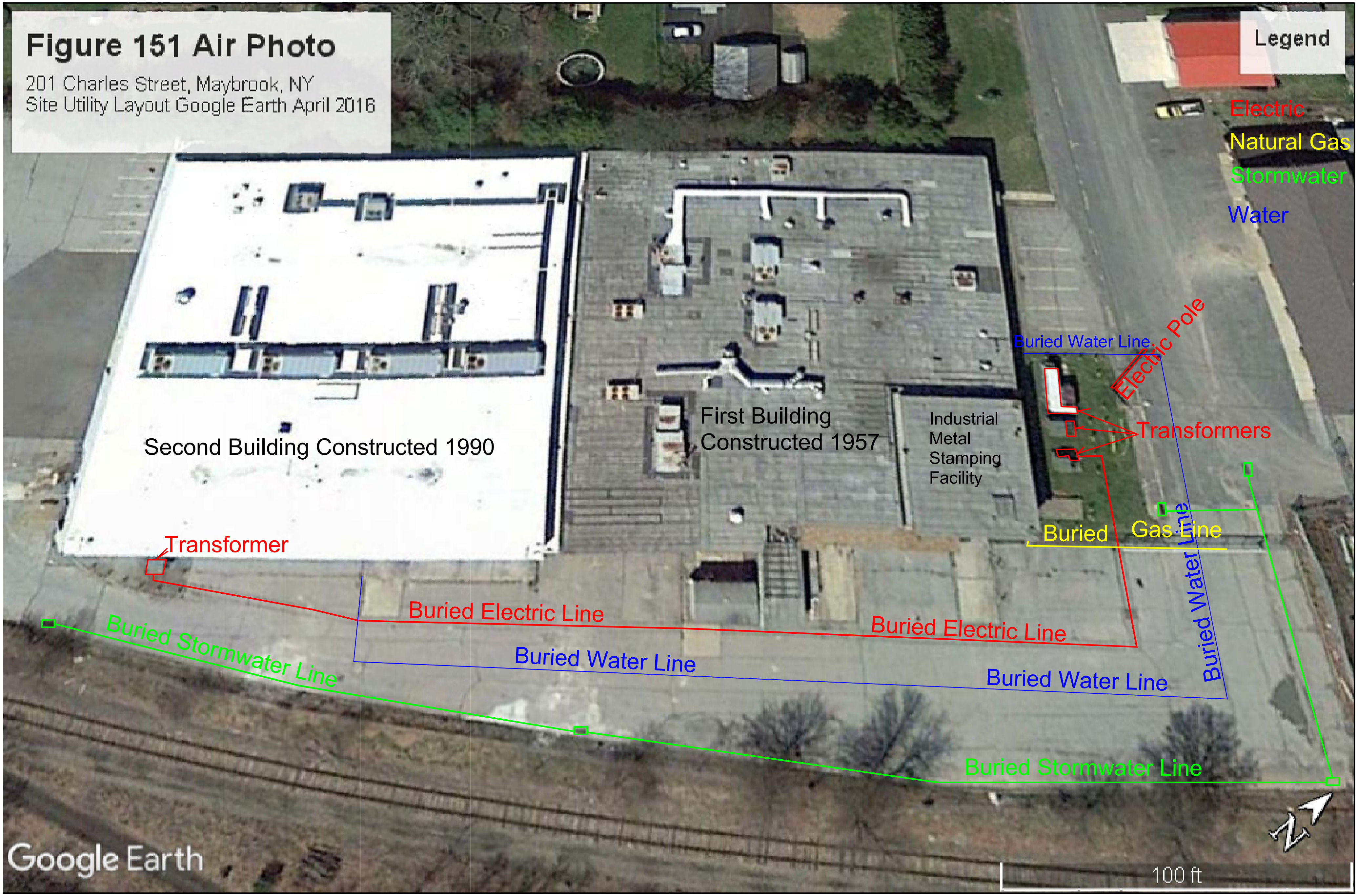


Figure 151 Air Photo
201 Charles Street, Maybrook, NY
Site Utility Layout Google Earth April 2016
Legend
Electric
Natural Gas
Stormwater
Water
Second Building Constructed 1990
First Building Constructed 1957
Industrial Metal Stamping Facility
Buried Water Line
Electric Pole
Transformers
Transformer
Buried Gas Line
Buried Electric Line
Buried Electric Line
Buried Water Line
Buried Water Line
Buried Water Line
Buried Stormwater Line
Buried Stormwater Line
N
100 ft
Google Earth

Figure 421

Contour Map of Water Table Elevations showing Hydraulic Gradient and Direction of Groundwater Flow. Measurments taken April 5, 2016 adjusted to elevations relative to sea level based on Survey by T.M. Depuy April 5, 2016.

Location: 201 Charles Street, Maybrook, NY.

William L. Going & Associates, Inc.
5 Stella Drive, Gardiner, NY 12525 (845) 895-1744 budgoing@gmail.com

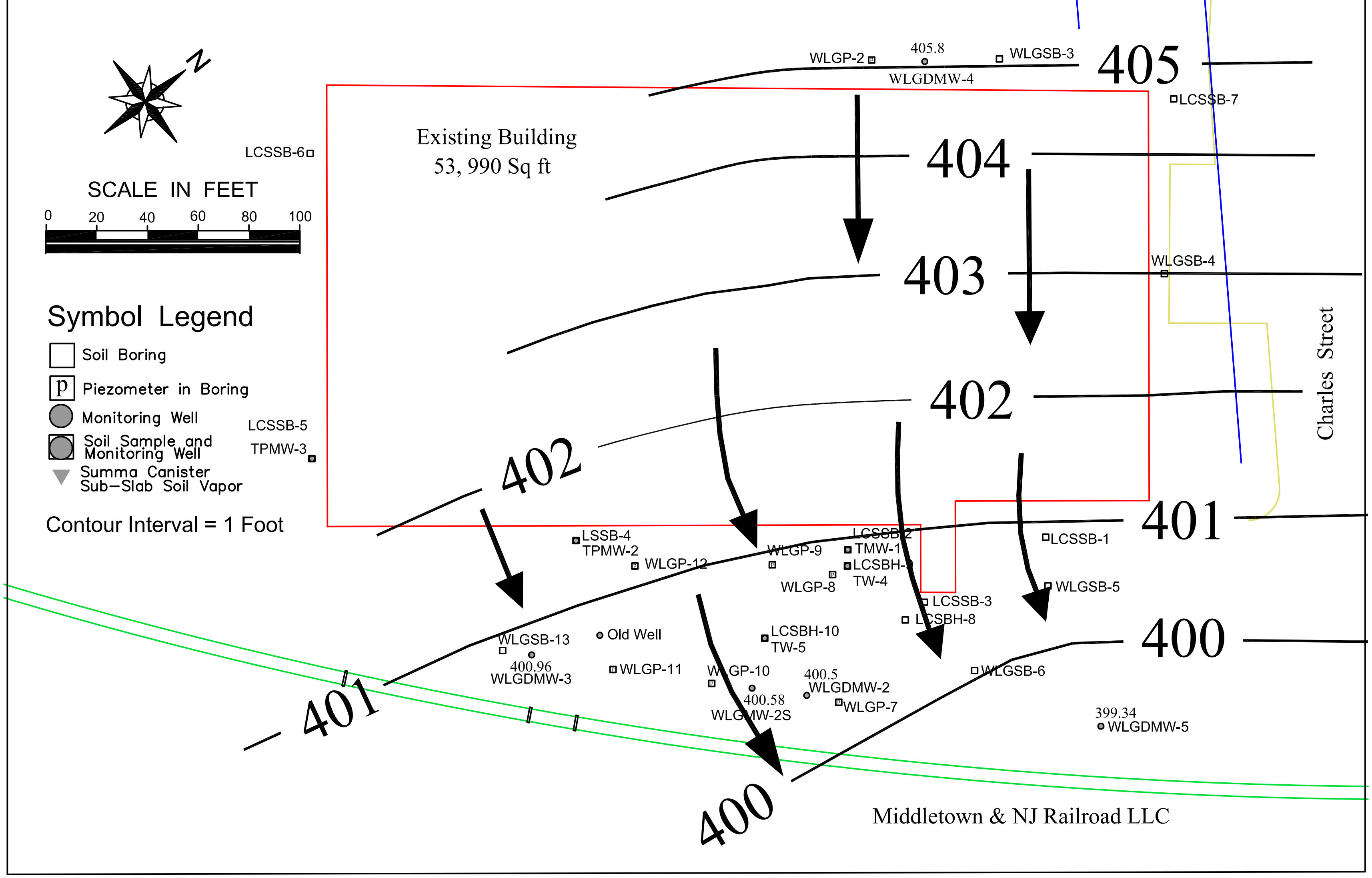


Figure 422

Fence Diagram showing 3D distribution of overburden and bedrock within and forming underground Bedrock trough. Zones of firmly packed silt and porous gray shale rock fragments are shown above the gray shale bedrock trough on the southeast side of the 201 Charles Street Building, Maybrook, NY.

Prepared by William L. Going & Associates, Inc.
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(845) 895-1744 budgoing@gmail.com

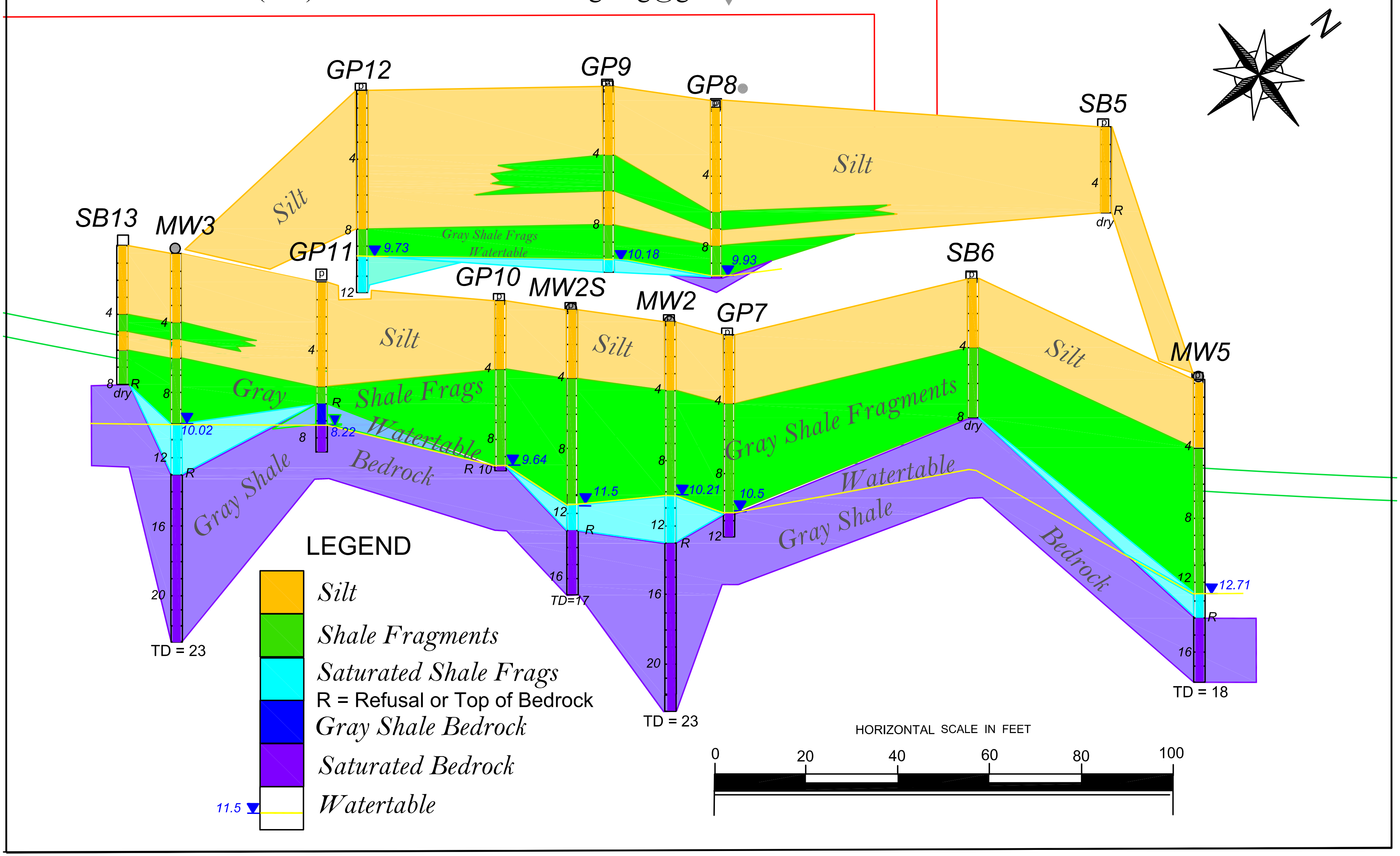

Figure 423

Contour Map of Top of Gray Shale Bedrock Surface measured down from ground surface showing underground trough on southeast side of 201 Charles Street Building, Maybrook, NY. In the yellow area, soil materials (silt and shale fragments) are saturated within the trough.

Prepared by William L. Going & Associates, Inc.
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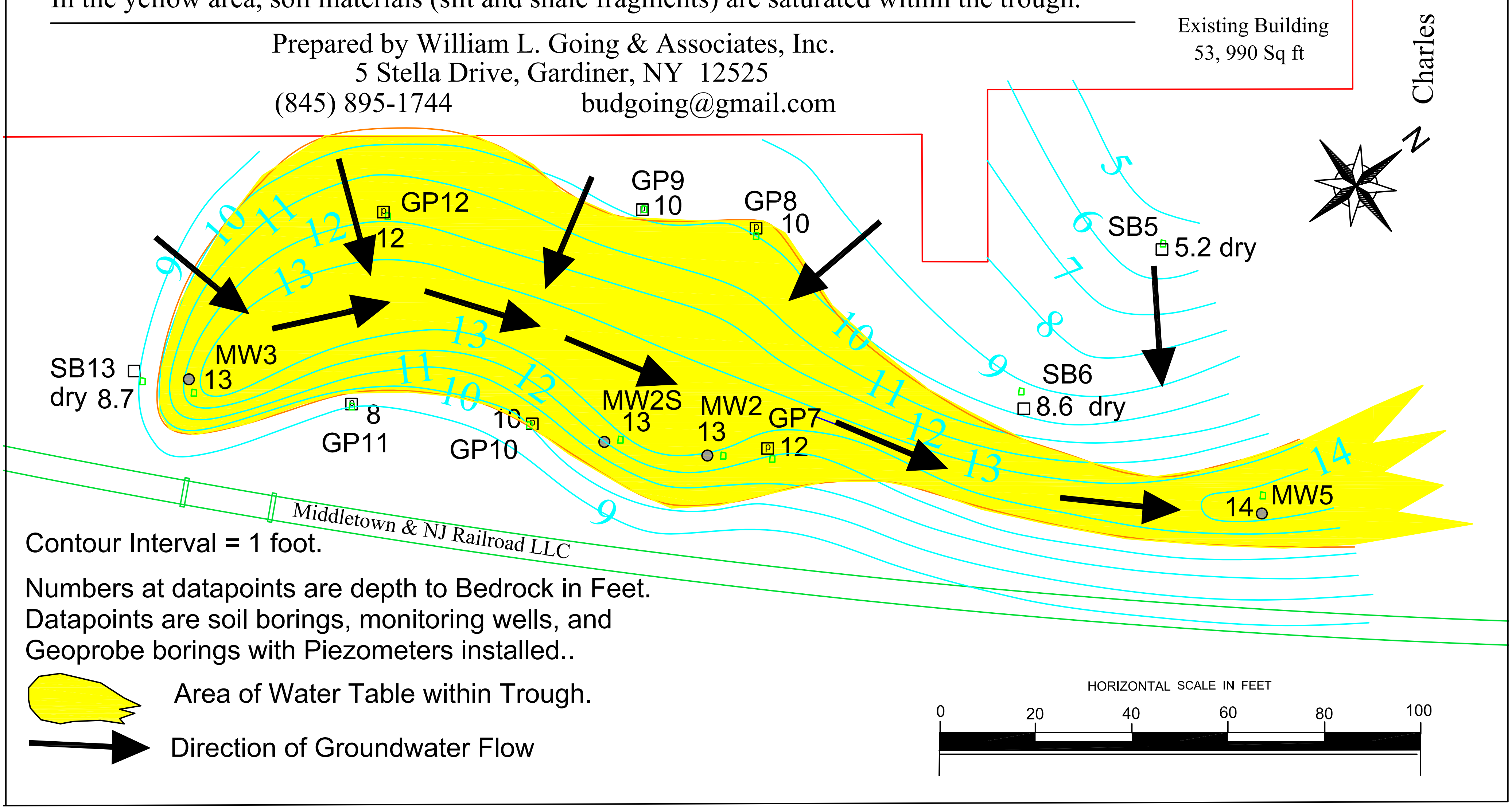


Contour Interval = 1 foot.

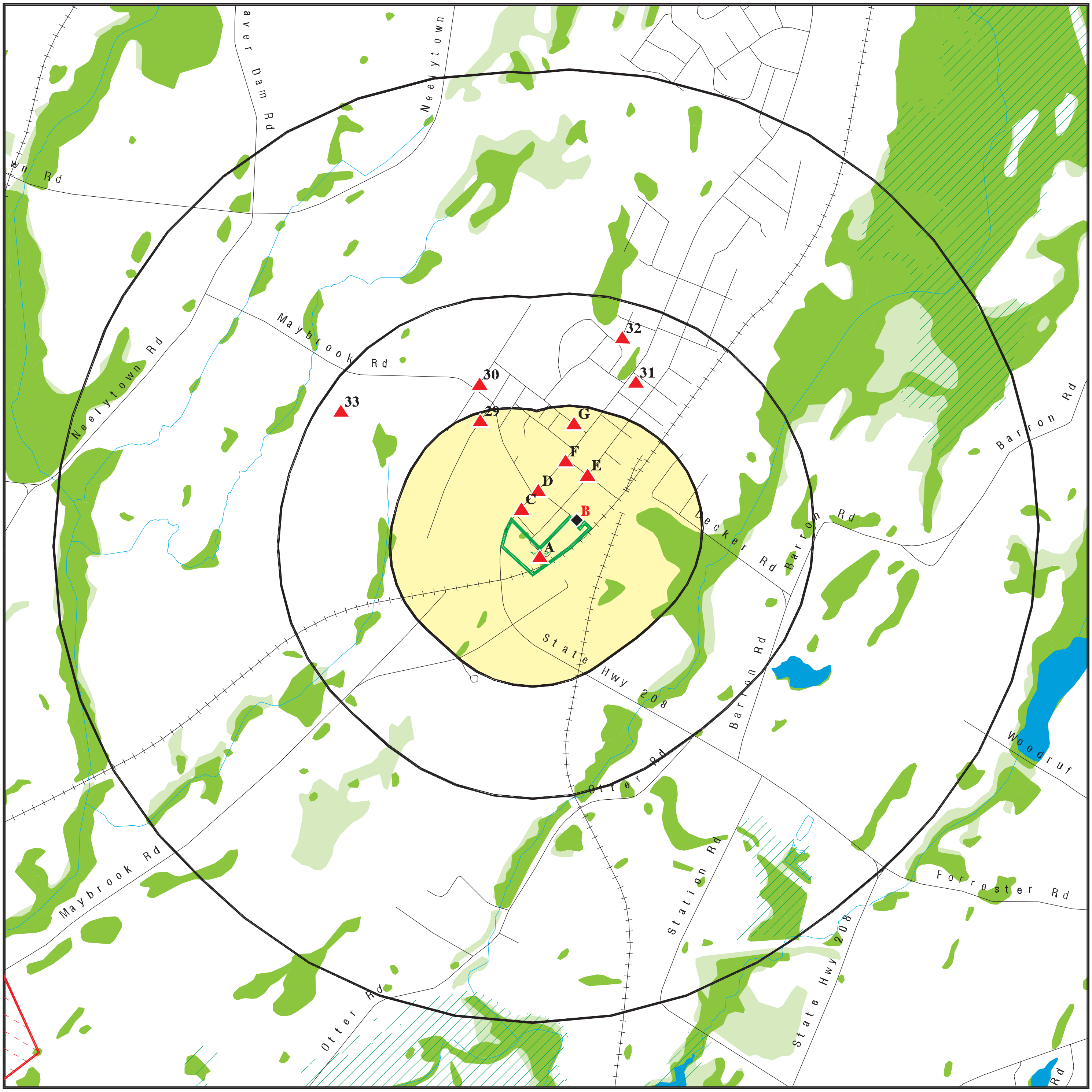
Numbers at datapoints are depth to Bedrock in Feet.
Datapoints are soil borings, monitoring wells, and Geoprobe borings with Piezometers installed..

Area of Water Table within Trough.

Direction of Groundwater Flow

OVERVIEW MAP - 4170740.2S

Figure 451



Target Property

Sites at elevations higher than or equal to the target property

Sites at elevations lower than the target property

Manufactured Gas Plants

National Priority List Sites

Dept. Defense Sites

0 1/4 1/2 1 Miles

Indian Reservations BIA

Oil & Gas pipelines from USGS

100-year flood zone

500-year flood zone

National Wetland Inventory

State Wetlands

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME:	201 Charles St	CLIENT:	LCS, Inc
ADDRESS:	201 Charles St Maybrook NY 12543	CONTACT:	Stephanie Laplaca
		INQUIRY #:	4170740.2s
LAT/LONG:	41.4803 / 74.2195	DATE:	December 30, 2014 10:58 am

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Figure 452

DETAIL MAP - 4170740.2S

- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines from USGS
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: 201 Charles St	CLIENT: LCS, Inc
ADDRESS: 201 Charles St Maybrook NY 12543	CONTACT: Stephanie Laplaca INQUIRY #: 4170740.2s
LAT/LONG: 41.4803 / 74.2195	DATE: December 30, 2014 10:59 am

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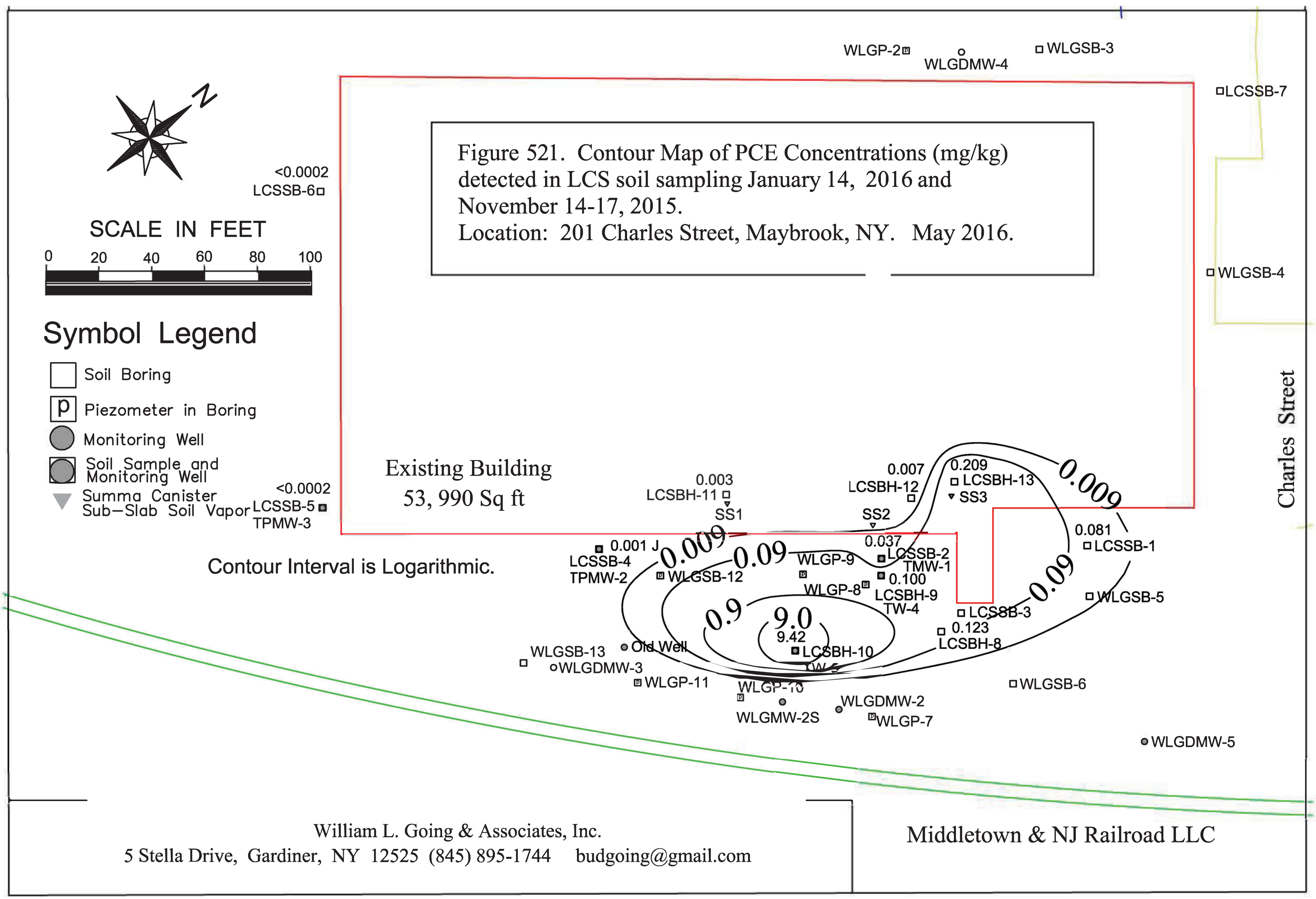

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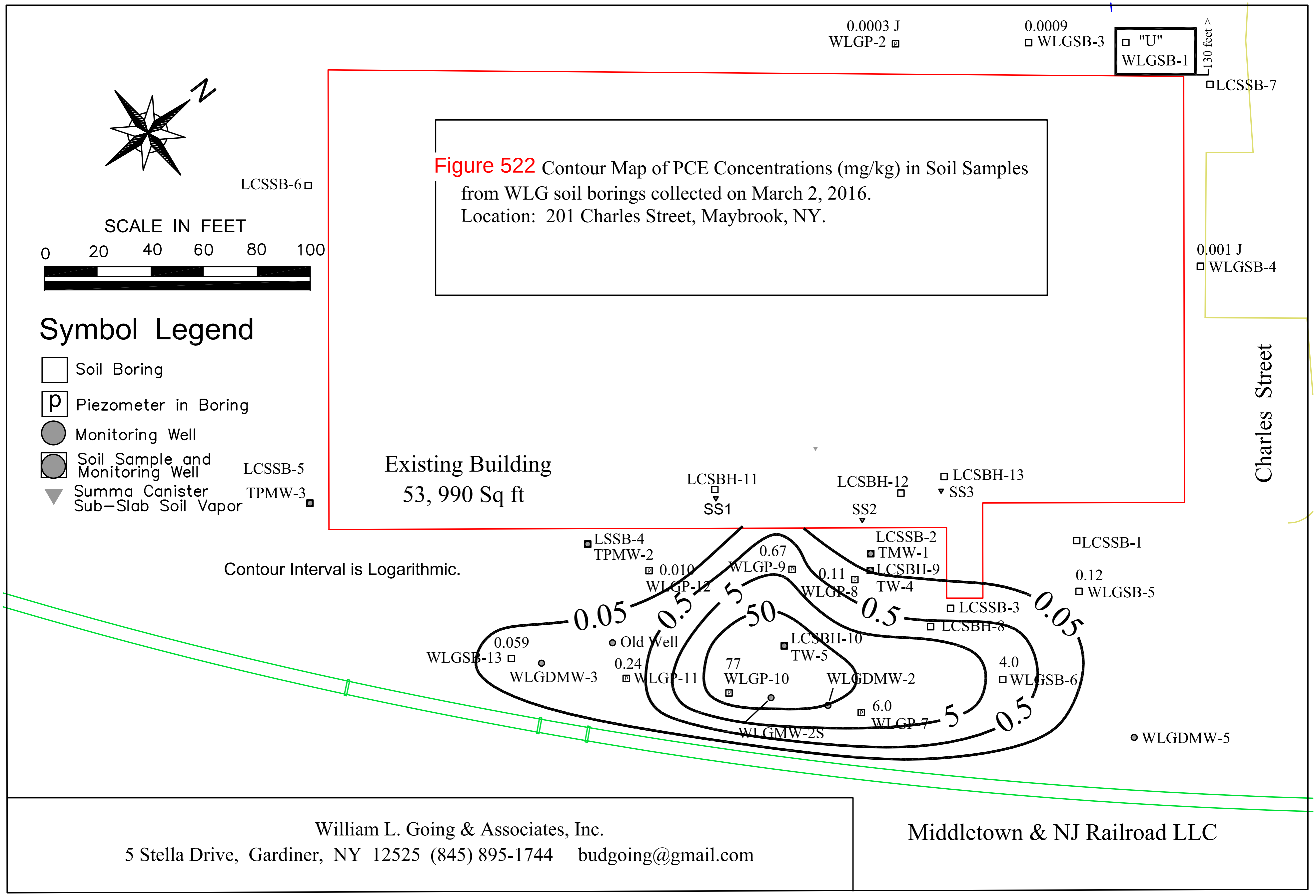
Figure 522 Contour Map of PCE Concentrations (mg/kg) in Soil Samples
from WLG soil borings collected on March 2, 2016.
Location: 201 Charles Street, Maybrook, NY.
SCALE IN FEET
0 20 40 60 80 100
Symbol Legend
Soil Boring
Piezometer in Boring
Monitoring Well
Soil Sample and Monitoring Well
Summa Canister Sub-Slab Soil Vapor
LCSSB-5
TPMW-3
LCSSB-6
Existing Building
53, 990 Sq ft
Contour Interval is Logarithmic.
0.0003 J
WLGP-2
0.0009
WLGSB-3
"U"
WLGSB-1
130 feet >
LCSSB-7
0.001 J
WLGSB-4
Charles Street
LCSBH-11
SS1
LCSBH-12
SS2
LCSBH-13
SS3
LCSSB-1
0.12
WLGSB-5
LSSB-4
TPMW-2
0.010
WLGP-12
0.67
WLGP-9
0.11
WLGP-8
LCSSB-2
TMW-1
LCSBH-9
TW-4
LCSSB-3
LCSBH-8
0.059
WLGSB-13
WLGDMW-3
Old Well
0.24
WLGP-11
LCSBH-10
TW-5
77
WLGP-10
WLGDMW-2
WLGMW-2S
6.0
WLGP-7
4.0
WLGSB-6
WLGDMW-5
0.05
0.5
5
50
William L. Going & Associates, Inc.
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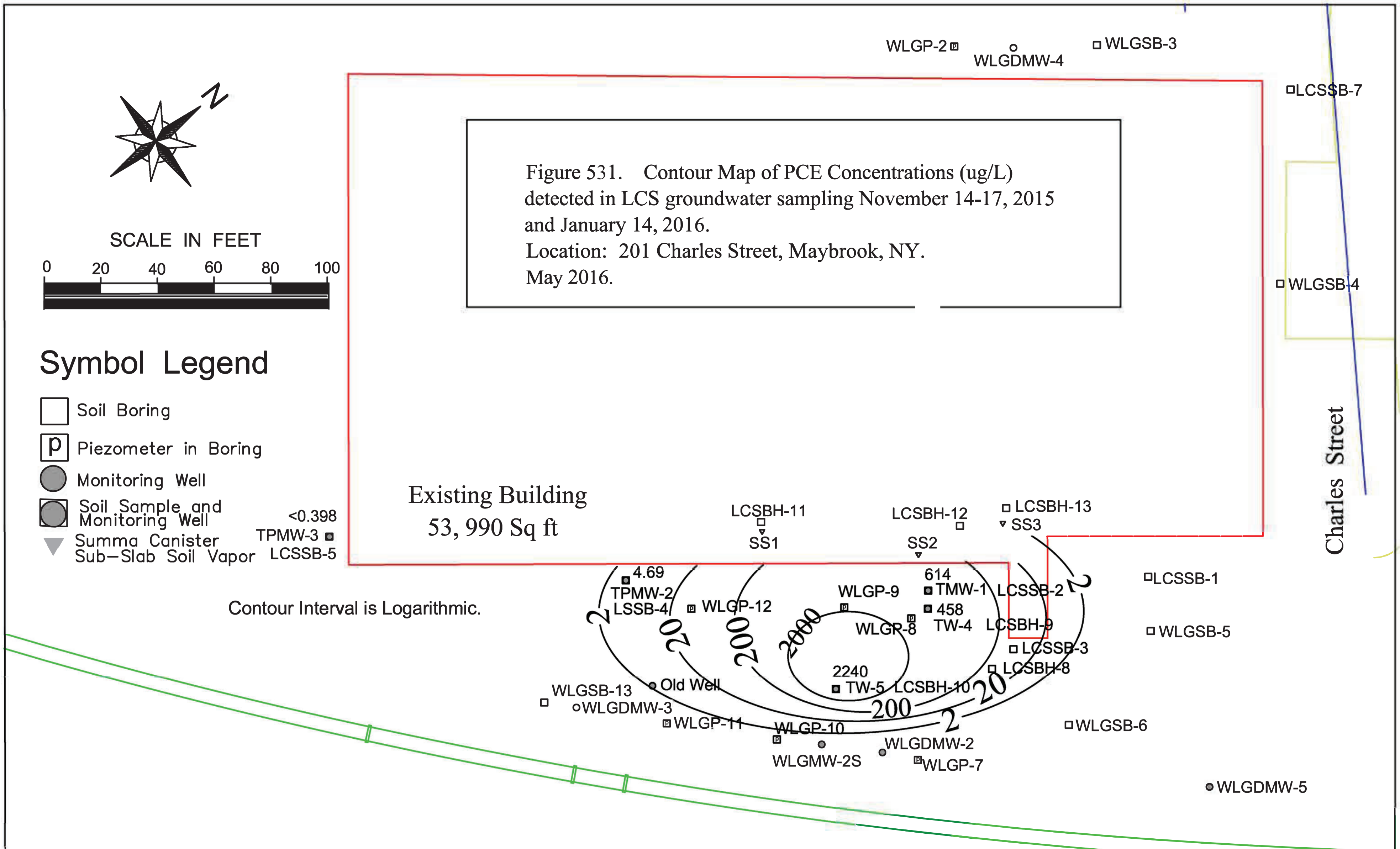
Middletown & NJ Railroad LLC

Figure 531. Contour Map of PCE Concentrations (ug/L) detected in LCS groundwater sampling November 14-17, 2015 and January 14, 2016.
Location: 201 Charles Street, Maybrook, NY.
May 2016.



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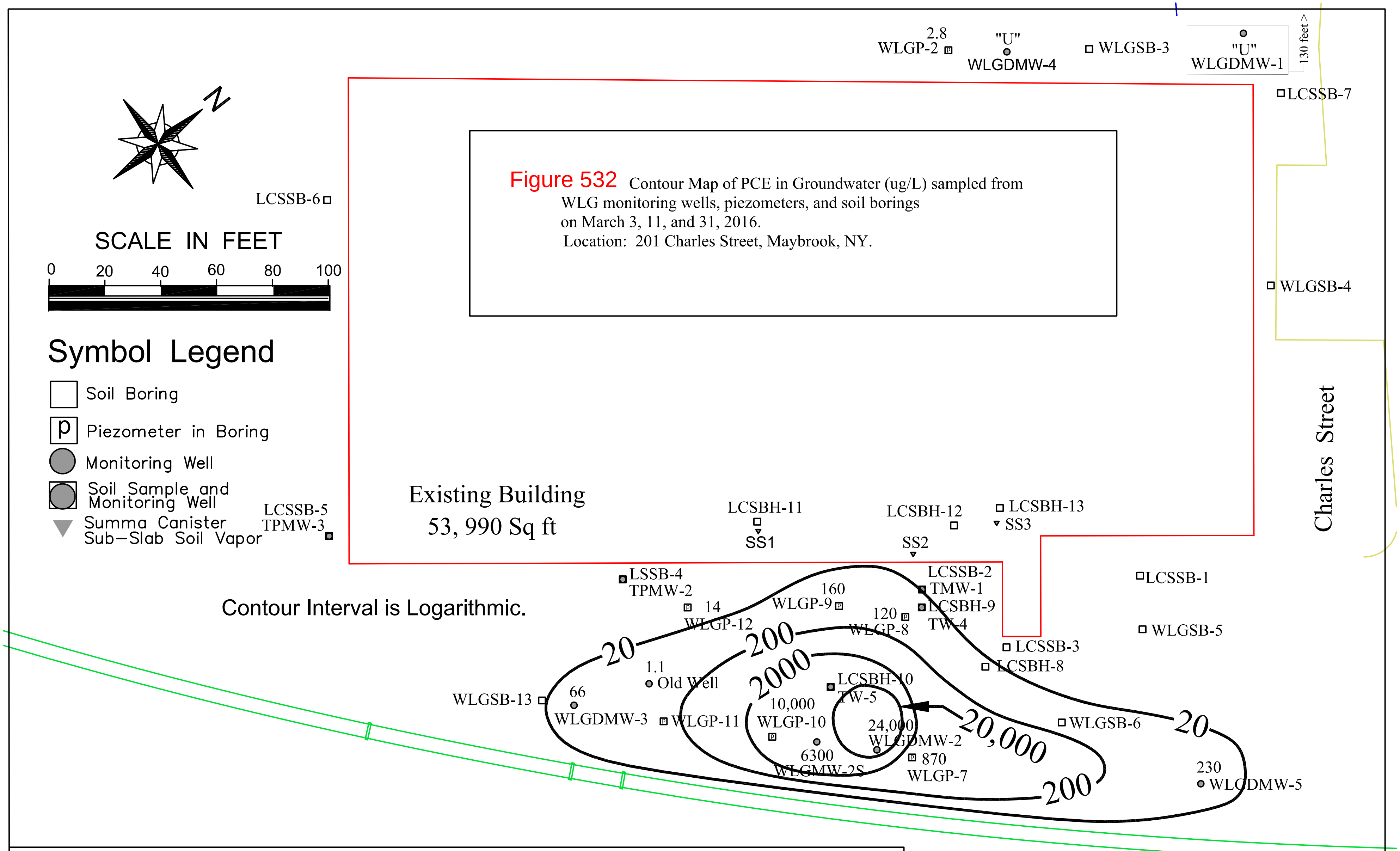

Figure 532 Contour Map of PCE in Groundwater (ug/L) sampled from WLG monitoring wells, piezometers, and soil borings on March 3, 11, and 31, 2016.
Location: 201 Charles Street, Maybrook, NY.

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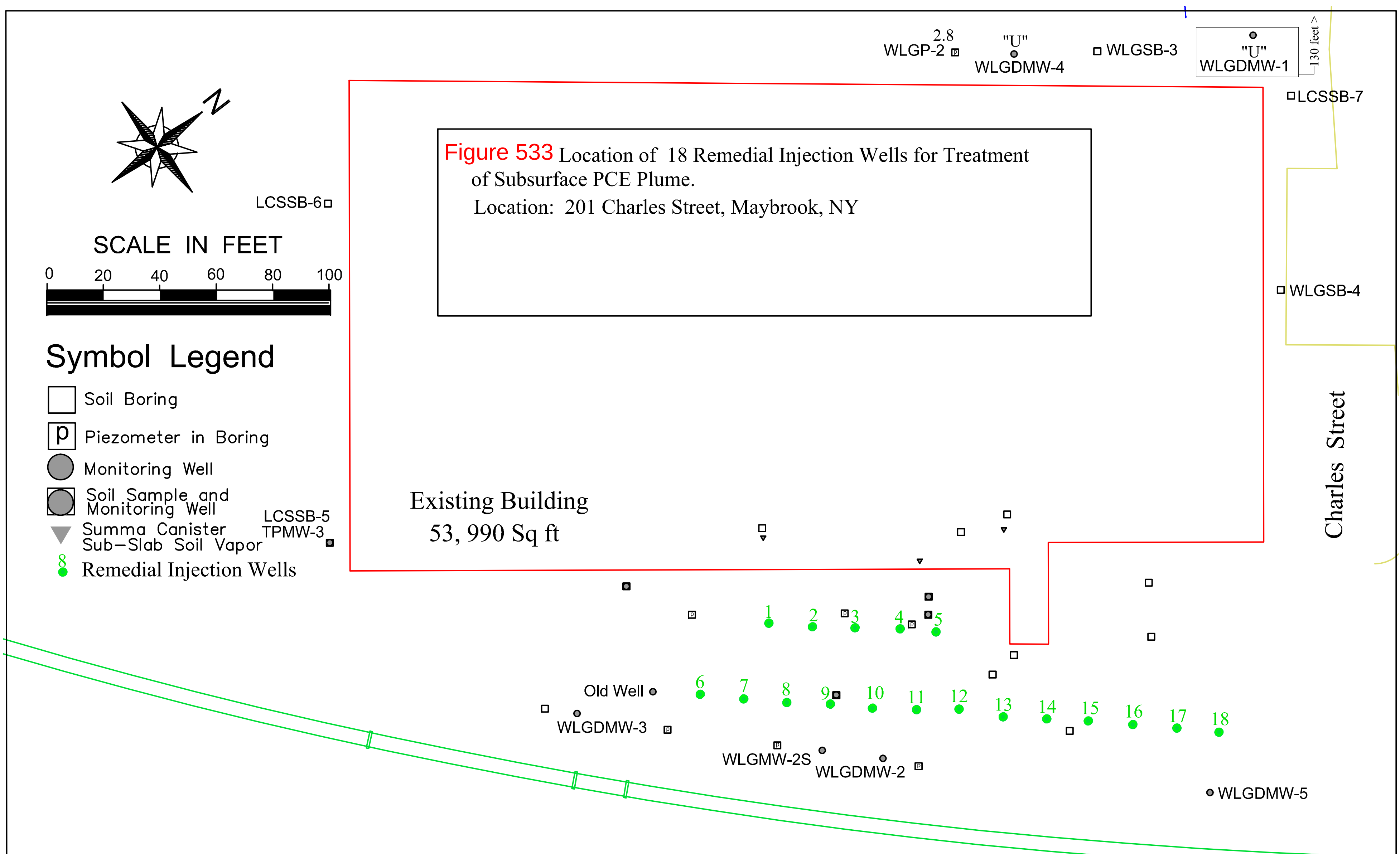

Figure 533 Location of 18 Remedial Injection Wells for Treatment of Subsurface PCE Plume.
Location: 201 Charles Street, Maybrook, NY

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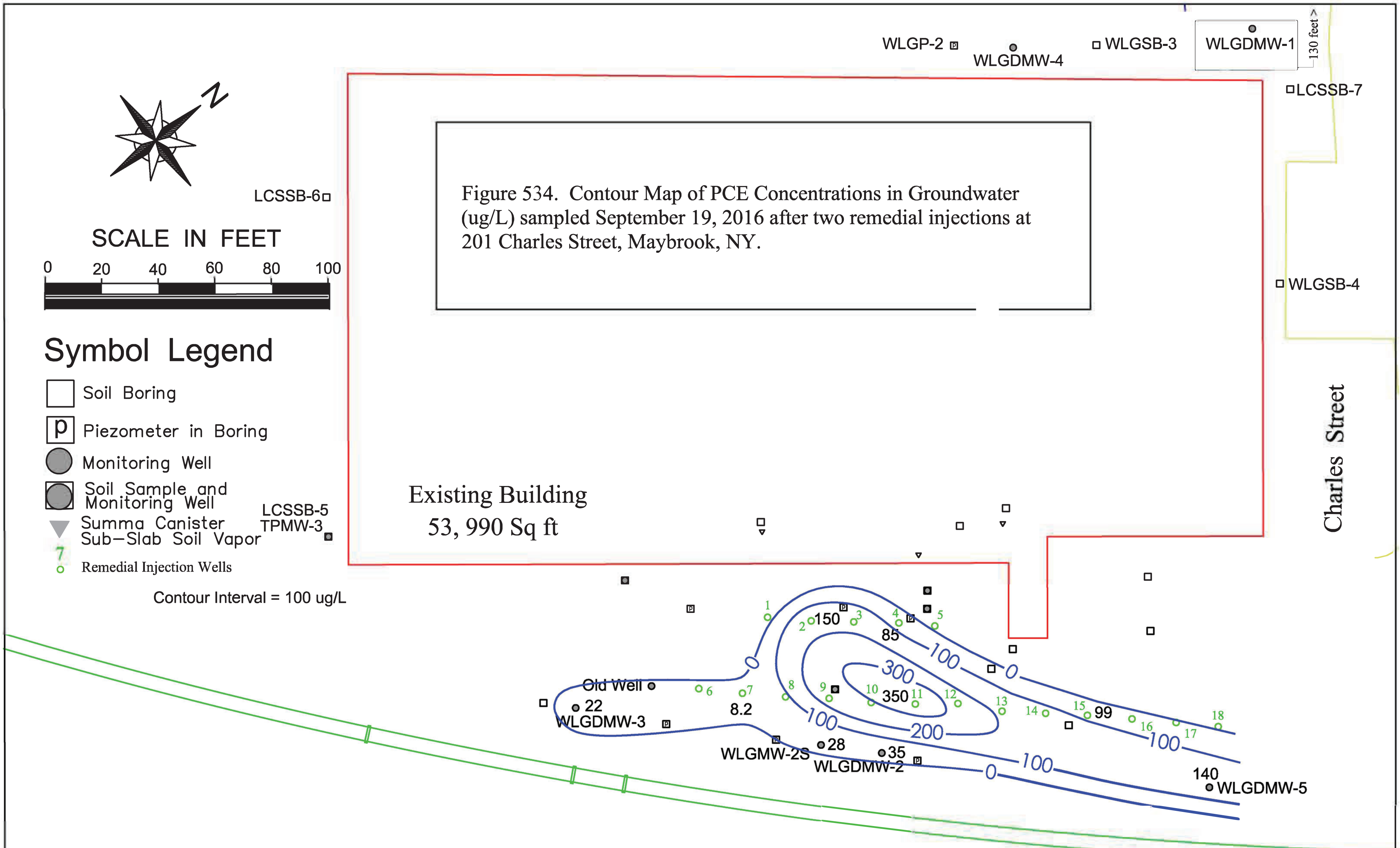

Figure 534. Contour Map of PCE Concentrations in Groundwater (ug/L) sampled September 19, 2016 after two remedial injections at 201 Charles Street, Maybrook, NY.

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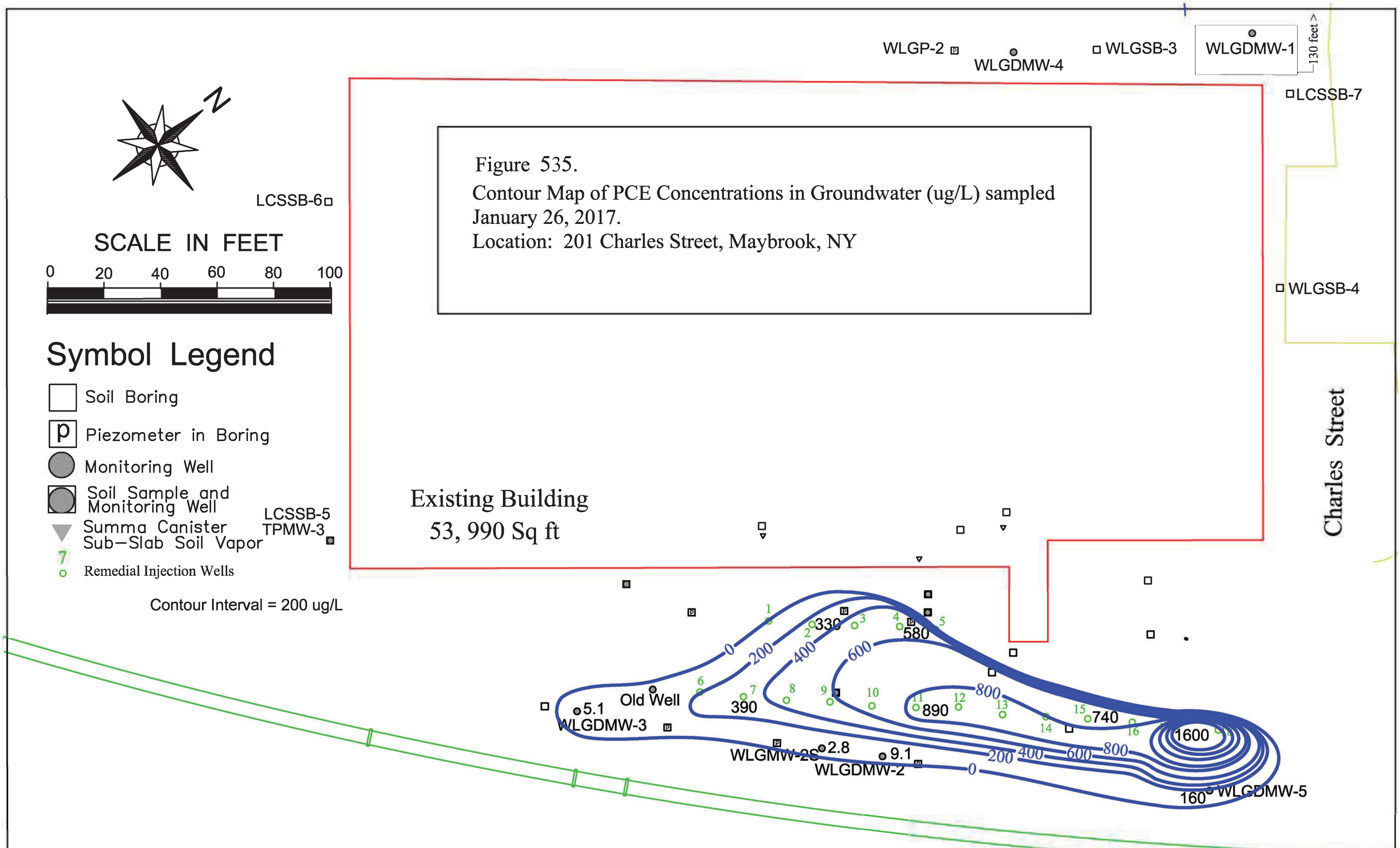

Figure 535.
Contour Map of PCE Concentrations in Groundwater (ug/L) sampled January 26, 2017.
Location: 201 Charles Street, Maybrook, NY

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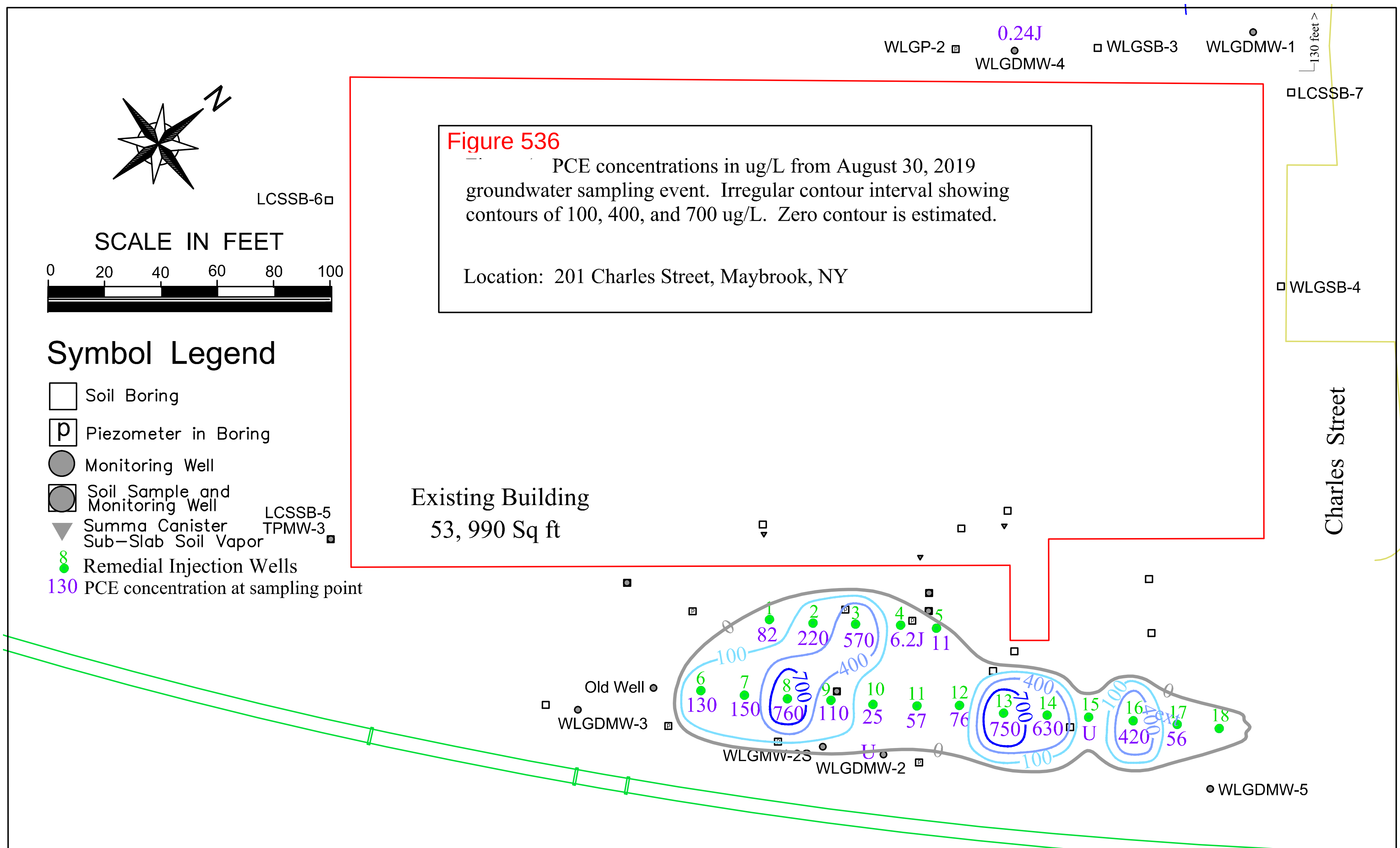

Figure 536

PCE concentrations in ug/L from August 30, 2019 groundwater sampling event. Irregular contour interval showing contours of 100, 400, and 700 ug/L. Zero contour is estimated.

Location: 201 Charles Street, Maybrook, NY

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Figure 542 Map of Sub-Slab PCE Concentrations (ug/m^3) in soil vapor sampled on March 3, 2016. Concentrations are contoured on right (old building). On the left side (new building) concentrations are two orders of magnitude lower. Basemap from Survey by T.M. Depuy (April 5, 2016). Location: 201 Charles Street, Maybrook, NY.

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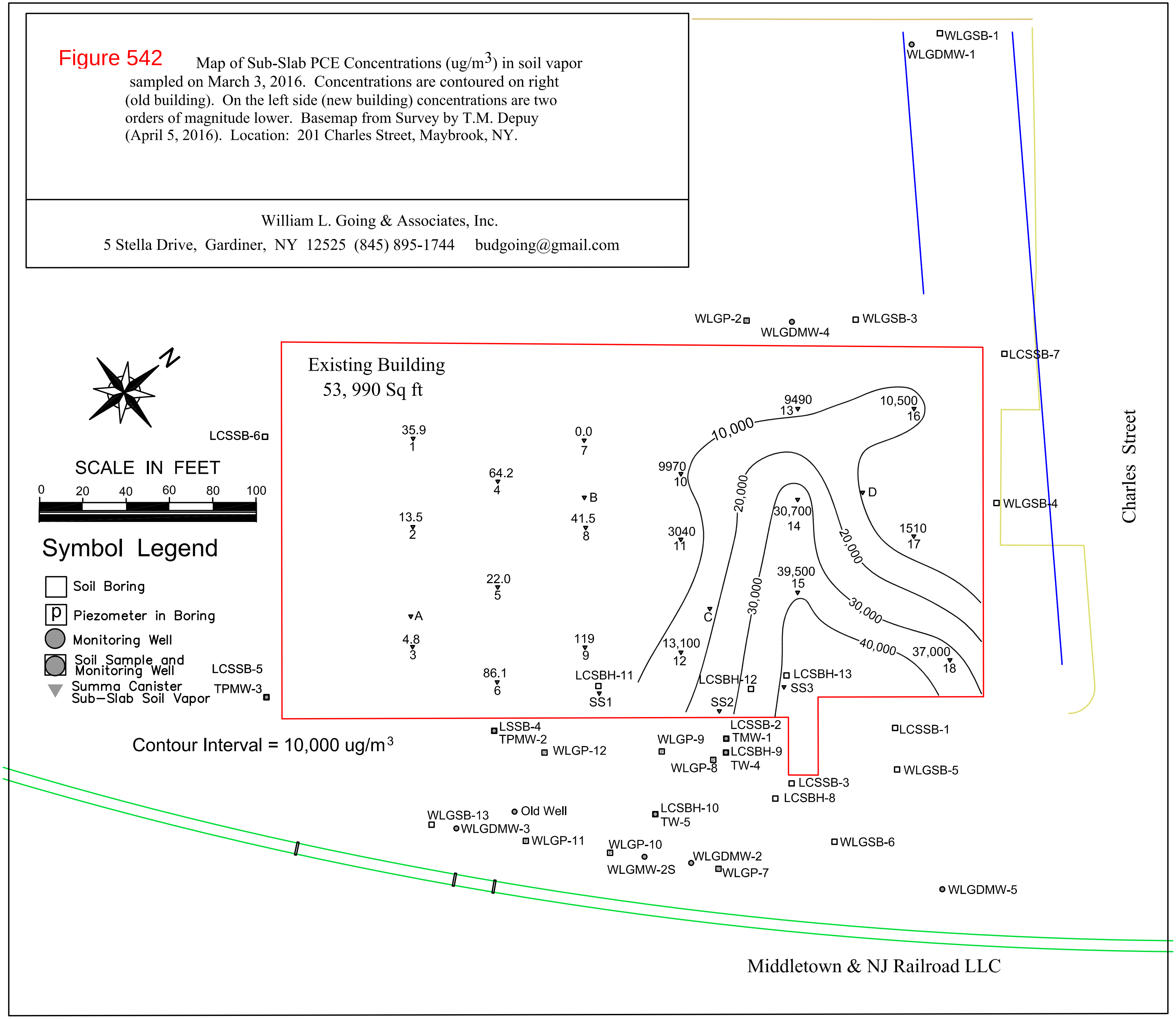

Figure 543 Proposed Locations for Passive Vents for Sub-Slab Soil Vapor Remediation. 11 vertical vents are planned to vent the vapor from beneath the slab to above the roof on the northeastern side of the building where sampling results are shown. Location: 201 Charles Street, Maybrook, NY. May 2016.

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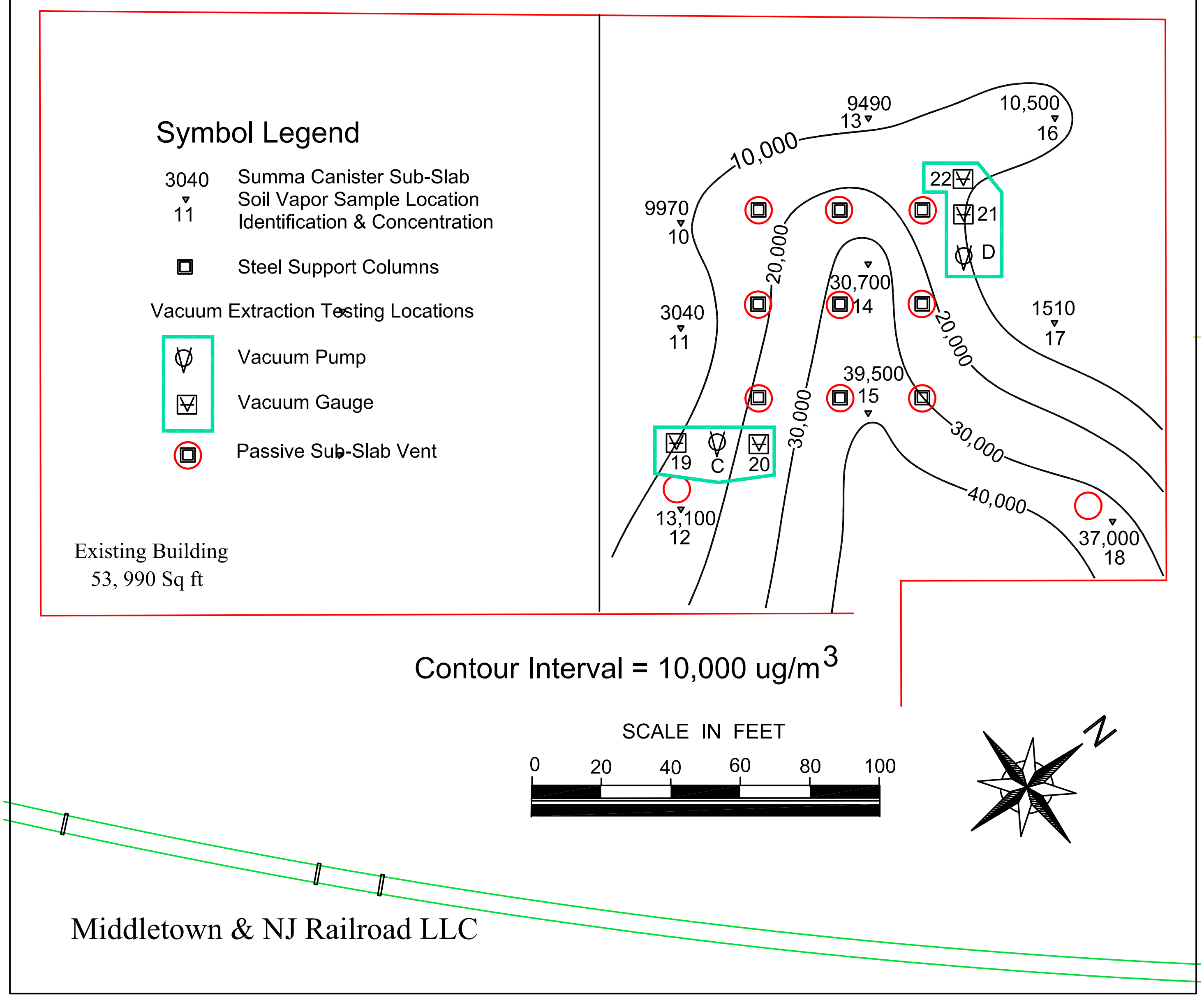

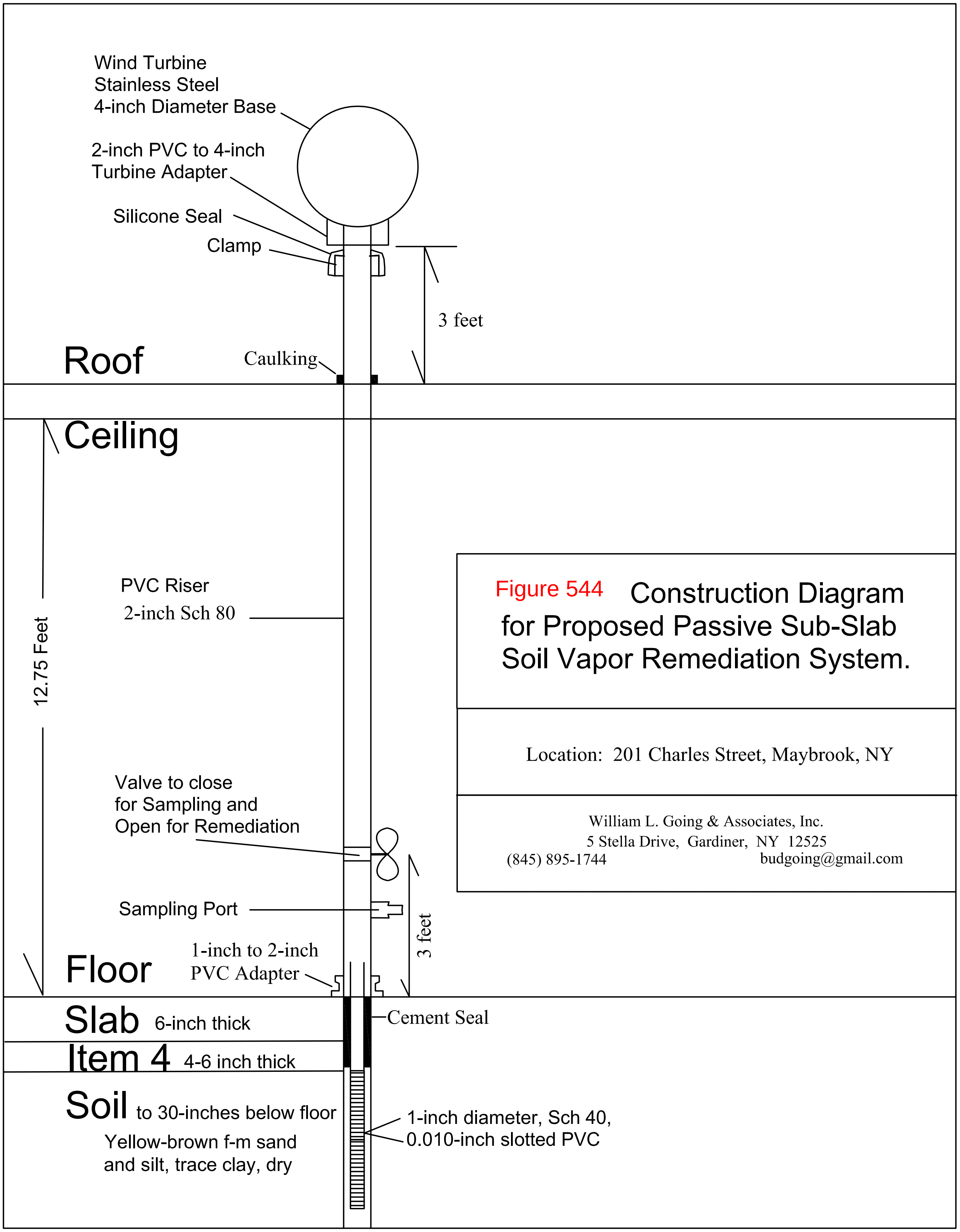

Figure 544 Construction Diagram for Proposed Passive Sub-Slab Soil Vapor Remediation System.

Location: 201 Charles Street, Maybrook, NY

William L. Going & Associates, Inc.
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Figure 545 Concentrations of Tetrachloroethylene (PCE) in sub-slab vents. Summa Canister samples collected for US EPA Method TO-15 November 23, 2019. Measurement units are ug/m^3.

Basemap from Survey by T. M. Depuy (April 5, 2016).
Location: 201 Charles Street, Maybrook, NY.

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