114 SNEDIKER AVENUE SITE

221-224 GLENMORE AVENUE
BROOKLYN, NEW YORK

Draft Interim Remedial Measures Work Plan

AKRF Project Number: 220249
NYSDEC BCP Site Number: TBD

Prepared for:

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CERTIFICATION

I, Rebecca Kinal, P.E., certify that I am currently a NYS registered Professional Engineer as defined in 6 NYCRR Part 375 and that this Interim Remedial Measures Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

Rebecca Kinal, P.E.	DRAFT	
Name	Signature	Date

1.0 INTRODUCTION

This Interim Remedial Measures (IRM) Work Plan has been prepared by AKRF, Inc. (AKRF) on behalf of Glenmore Owner, LLC (the Applicant) for the property identified as the 114 Snediker Avenue Site (Site) located at 221-224 Glenmore Avenue, Brooklyn, New York. The legal definition of the Site is Brooklyn Tax Block 3697, Lots 1 and 33. The Site is located within a mixed-use neighborhood on the northern side of Glenmore Avenue between Van Sinderen Avenue and Snediker Avenue, in the New Lots sub-section of the East New York neighborhood in Brooklyn, New York. A Site Location Plan is included as Figure 1.

This IRM Work Plan is being submitted by the Volunteer in conjunction with an application to enter the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP). The Volunteer wishes to enter the BCP to investigate and remediate the Site under oversight of the NYSDEC. Prior to submitting the BCP application, the Volunteer coordinated a series of investigations at the Site, including a Phase II subsurface investigation and a Remedial Investigation (RI). The investigations identified exceedances of chlorinated solvent-related volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), pesticides, metals, perfluorooctanoic acid (PFOA), and perfluorooctanesulfonic acid (PFOS) in soil, chlorinated solvent-related VOCs, metals, PFOS, and PFOA in groundwater, and chlorinated solvent-related VOCs in soil vapor above applicable standards and/or guidance values. Notably, the solvent-related VOCs present in shallow soil (up to six feet below grade) were detected at concentrations that exceeded NYSDEC cleanup objectives for restricted residential use and/or groundwater protection, with hot spot locations containing solvent concentrations consistent with gross contamination. The investigation data indicates the soil contamination is an active, ongoing source of contamination to multiple environmental media, and the IRM described in this Work Plan is being proposed as a proactive measure to address the ongoing source of solvent contamination in soil prior to completing the remedy phase of the BCP.

To complete the IRM, additional subsurface investigation is proposed to be completed prior to the excavation efforts to define the limits of the IRM excavation and identify the soil handling requirements. This IRM investigation effort will also be expanded to include the collection of data needed to properly design the groundwater and soil vapor treatment programs of the full site remedy. The complete scope of work for the proposed subsurface investigation is included in this IRMWP as a Preliminary Design Investigation (PDI).

2.0 SITE DESCRIPTION AND HISTORY

A complete review of the Site description, surrounding land use, and local geology is included in the BCP Application and Remedial Investigation Report (RIR). For the purpose of this IRM Work Plan, this section includes a summary of the Site details.

2.1 Site History

The Site comprises two tax lots (Lots 1 and 33). The following known or suspected sources of contamination were identified at the Site during previous investigations:

- Historic lighting manufacturing activities on Lots 1 and 33 (221 and 241 Glenmore Avenue) from 1966 through 2022, with the confirmed former use and off-site disposal of spent halogenated solvents used in degreasing, including tetrachloroethene (PCE), trichloroethene (TCE), and methylene chloride, and non-halogenated solvents.
- Previous historical on-site uses including auto repair and junkyard activities, plumbing manufacturing, and a nail polish bottling facility.
- Historic underground storage tanks (USTs) were identified on the southwestern portion of Lot 1 and southeastern portion of Lot 33 in the 1928 Sanborn Fire Insurance Map. Neither tank appears on the following 1950 Sanborn Map or more recent Sanborn images. No documentation regarding the UST removal was identified and it is not known whether the tanks were removed properly or abandoned in place properly.

2.2 Previous Investigations

Phase I Environmental Site Assessment, 221 & 241 Glenmore Ave, Brooklyn, New York, Impact Environmental Closures, Inc., May 28, 2021

A Phase I Environmental Site Assessment (ESA) of the Site was completed by IEC in May 2021. At the time of IEC's assessment, the Site was developed with three adjoining buildings consisting of: a two-story building on Lot 33 utilized as storage and workshop spaces on the first floor and management offices on the second floor (southeastern portion of the Site, 241 Glenmore Avenue), a single-story manufacturing building on the northeastern portion of Lot 1 (northeastern portion of Site, 221 Glenmore Avenue), and a single-story manufacturing building on the western portion of Lot 1 which operated as the light manufacturing area (western portion of the Site, 221 Glenmore Avenue). The three buildings located within the Site were occupied by Legion Lighting Co. Inc., which operated as an industrial light manufacturer until May 2022. A small sub-grade cellar was located in the southwestern corner of Lot 1 (221 Glenmore Avenue) and contained a concrete encased 1,000-gallon No. 2 fuel oil tank and two fuel-oil fired boilers. The Phase I ESA was conducted in conformance with the scope and limitations of American Society for Testing & Materials (ASTM) Practice E1527-13 and included a visual inspection of the Site and a review of regulatory database records and historical records. Based on the findings of the Phase I ESA, the following Recognized Environmental Conditions (RECs) were identified:

- Historic site operations have included a lumber yard (circa 1908), auto repair activities (circa 1928 and 1966-1996), a factory for metal stamping (circa 1947), plumbing manufacturing (circa 1950), and a nail polish bottling facility (circa 1950). Legion Lighting was identified as a RCRA Large Quantity Generator (LQG) in 1982 for the generation of halogenated solvents (F-listed wastes) and was registered under the USEPA ID: 110001602169 within USEPA's Enforcement and Compliance History Online (ECHO) database with multiple "Action

Numbers" that correspond to "Pollutant Codes", one of which states "PCE on-Site". Other types of chemicals listed on the USEPA database which may be used currently and/or were used for historic operations include, but are not limited to, petroleum and solvent-related compounds. Based on past uses of identified for the Site dating back to at least 1947, the potential for releases or discharges resultant of use, storage and handling of the chemical compounds associated with these types of operations is considered a REC.

- On the 1928 Sanborn Fire Insurance Map, two gasoline tanks are identified at the Site. One tank is located on the 221 Glenmore Avenue portion of the Site (Lot 1), in the southern section of the warehouse, and the other is located at 243 Glenmore Avenue (Lot 33), within what was the former auto repair building. Neither tank appears on the following 1950 Sanborn Map or more recent Sanborn images. No documentation was obtained with respect to the referenced tanks. It is not known whether the tanks were removed or abandoned in-placed properly, and if contamination resultant from the tanks is present in surrounding soil.

Based on the findings of the Phase I ESA, IEC recommended a subsurface investigation to investigate the identified RECs.

Subsurface Investigation Report, 221 and 241 Glenmore Avenue, Brooklyn, New York, Impact Environmental Closures, Inc, July 1, 2022

IEC conducted a subsurface investigation in April and May 2022 on behalf of Camber Property Group, LLC. The scope of work was based on the findings of the May 2021 Phase I ESA prepared by IEC. The subsurface investigation included a private utility survey; the advancement of ten soil borings across the Site and collection of two soil samples from each boring; the installation of three semi-permanent groundwater monitoring wells and collection of three groundwater samples; and the installation of eight soil vapor points with collection of eight soil vapor samples.

Two soil samples were collected from each soil boring for laboratory analysis. One sample was collected from each boring from the 0 to 2-foot interval. A second sample was collected from each boring from the 12 to 14 below grade interval within the proposed cellar footprint and from the 2 to 4-feet below grade interval outside the proposed cellar footprint. Three small diameter semi-permanent polyvinyl chloride (PVC) groundwater monitoring wells were installed within three borings across the Site. Monitoring well MW-3 was installed using 1-inch inner diameter (ID) flush joint schedule 40 PVC, while monitoring wells MW-2 and MW-5 were installed using 2-inch ID flush-joint schedule 40 PVC.

The soil samples were analyzed for the NYSDEC Part 375 List VOCs by USEPA methods 8260C/5035, semi-volatile organic compounds (SVOCs) by USEPA method 8270D, pesticides and herbicides by USEPA methods 8081B and 8151A, polychlorinated biphenyls (PCBs) by USEPA method 8082A, Metals by USEPA Methods 6010C. Nine soil samples and one duplicate sample were also analyzed for Per- and Polyfluoroalkyl Substances (PFAS) by USEPA Method 537 and 1,4-dioxane by USEPA method 8270 SIM isotope dilution.

Groundwater Samples were analyzed for the TCL VOCs by USEPA methods 8260C/5035, TCL SVOCs by USEPA method 8270D, Pesticides by USEPA method 8081B, PCBs by USEPA method 8082A, Target Analyte List (TAL) Metals by USEPA Method 6010C. Two groundwater samples and one duplicate sample were also analyzed for PFAS/PFOA by USEPA Method 537 and 1,4-dioxane by USEPA method 8270 SIM isotope dilution.

Eight temporary soil vapor points were installed approximately two feet below the building slab, at points SV-3 through SV-8 and 12-feet below grade at points SV-1 and SV-2. Eight soil vapor samples and one duplicate soil vapor sample were analyzed for VOCs by EPA Method TO-15.

The results of the Phase II ESA are included in Section 3.0 as a comprehensive summary of data compiled from both the Phase II ESA and the Remedial Investigation (RI).

Geotechnical Evaluation Report, 221 Glenmore Avenue, Brooklyn, New York, GEODesign, Inc. P.C., July 2022

GEODesign, Inc. (GDI) performed a geotechnical investigation in April and May 2022 on behalf of Camber Property Group, LLC. The objective of the investigation was to evaluate the subsurface conditions at the Site and provide geotechnical recommendations for the design and construction of the proposed building. The scope of work was based on the April 4, 2022 architectural drawings which included proposed demolition of the existing buildings and construction of a new 5-story building with one cellar level ("Cellar Option #2") with an assumed cellar height of 10 feet. The geotechnical investigation included advancement of six test borings (B-1 through B-6) using a track mounted Fordia 300 drilling rig and a track mounted Geoprobe 7822DT drilling rig. Borings were advanced using mud rotary drilling techniques. Subsurface conditions generally consisted of approximately 5 to 10 feet of uncontrolled sandy fill (Stratum 1), 15 to 25 feet of very dense sand and gravel (Stratum 2), and very dense sand that extends to a depth of at least 100 feet (Stratum 3).

One groundwater observation well was installed at Boring B-3 and constructed with 2-inch diameter schedule 25 PVC pipe with a 20-foot-long screen between depths of approximately 20 and 40 feet, and 20 feet of riser pipe. Two environmental wells were installed in Borings B-1B and PT-1B and were constructed with a 10-foot-long screen between the depths of 40 to 50 feet, and 40 feet of rise pipe. The groundwater observation well was dry on May 18, 2022 and groundwater is estimated to be deeper than 40 feet. Groundwater measurements were not taken over an extended period of time; therefore, the measurements likely do not adequately reflect seasonal or other time dependent variations that may occur.

Remedial Investigation Report, 221 and 241 Glenmore Avenue, Brooklyn, New York, AKRF, Inc., December 2022

An RI was conducted at the Site by AKRF from September 29, 2022 to October 20, 2022. The soil, groundwater, and soil vapor data documented in IEC's May 2022 Phase II SIR (described above) was used as a foundation to identify data gaps and direct the rationale for the RI sampling plan. The RI included the following scope of work: a geophysical survey, the advancement of 20 soil borings with continuous soil sampling, the installation and development of six two-inch-diameter permanent groundwater monitoring wells, the installation of 12 temporary soil vapor points, and the laboratory analysis of 81 soil samples, six groundwater samples, and 12 soil vapor samples. The sample collection and laboratory analysis included NYSDEC's requirements for quality assurance/quality control (QA/QC), including Category B Reporting.

Soil from each continuous sampling interval was observed for evidence (i.e., staining, odors) of contamination, field screened using a photoionization detector (PID), and logged using the modified Burmister soil classification system. Field evidence of contamination, including petroleum-like odors and solvent-like odors, staining, and/or elevated PID readings, were observed at various depths within the top 7 feet below grade in all but one soil boring. No evidence of free phase product [non-aqueous phase liquid (NAPL)] was identified in any of the borings installed during the RI.

Soil from each of the continuous sampling intervals was placed into laboratory supplied containers and was either placed on hold or designated for analysis using a varying set of parameters based on location, depth, initial laboratory results, what contaminants were present, and delineation needs. The first round of analysis included surface soil [0-2 feet below grade (bg)]; a second sample was collected for analysis from the 2 to 4 feet bg interval; a third grab sample was collected for analysis from borings on the eastern portion of the Site from either 8 to 10 feet bg, 12 to 14 feet bg, or 14 to 16 feet bg; and, a fourth grab soil sample was collected for analysis at locations where groundwater monitoring wells were installed from the two-foot interval directly above the apparent groundwater interface, which varied between approximately 38 and 42 feet bg depending on the location. The first, third, and fourth soil samples were analyzed for Target Compound List (TCL) VOCs by EPA Method 8260D, TCL SVOCs by EPA Method 8270E, PCBs by EPA Method 8082A, TCL pesticides by EPA Method 8081B, herbicides by EPA Method 8151A, TAL metals by EPA Method 6000/7000 series, cyanide by EPA Method 9012B, trivalent and hexavalent chromium by EPA Method 7196A, PFAS by EPA Method 537 (modified), and 1,4-dioxane by EPA Method 8270E SIM. The second soil sample was analyzed for chlorinated VOCs (CVOCs) only.

Additional grab samples were collected from all soil borings in two-foot increments from two feet bg to the terminus of the boring to vertically delineate the extent of CVOC contamination. These samples were initially placed on hold pending analysis of the sample from the previous interval. Additionally, a sample was collected at RI-SB-02 from 12 to 14 feet bg, which was analyzed for CVOCs and TAL metals only, corresponding to a hotspot identified during IEC’s April and May 2022 subsurface investigation. The soil samples collected also coincided with depth intervals where the highest levels of field contamination were observed (staining, odors, and/or PID readings).

The RI results are included in a comprehensive summary of environmental conditions included below in Section 3.0.

3.0 SUMMARY OF ENVIRONMENTAL CONDITIONS

This Section includes a comprehensive summary of the data compiled during both the Phase II ESA completed by IEC, and the RI completed by AKRF. The soil analytical results were compared to the NYSDEC Unrestricted Use Soil Cleanup Objectives (UUSCOs), Restricted Residential Soil Cleanup Objectives (RRSCOs), and Protection of Groundwater Soil Cleanup Objectives (PGWSCOs). PGWSCOs were compared against CVOCs only. Analytical results for the groundwater samples were compared to NYSDEC's Ambient Water Quality Guidance Values (AWQSGVs). No standards currently exist for soil vapor. A Site plan showing the sampling locations for the Phase II ESA and the RIR is included as Figure 2.

Summary of Hydrogeological Findings

The Site was underlain by an unconsolidated fill comprised of a mixture of sand, gravel, silt, clay, brick, concrete, metal, and plastic to depths down to approximately 10.5 feet bg. The fill was underlain by a dense sand and silt with varying amounts of gravel and cobbles down to the maximum boring terminus of 50 feet below grade. Bedrock was not encountered during the RI.

Groundwater beneath the Site was measured from surveyed monitoring wells to be at elevations ranging from 8.73 to elevation 8.91 feet above sea level [North American Vertical Datum 1988 (NAVD88)], or approximately 40 to 42 feet below grade surface. Groundwater was calculated to flow in a south-southeasterly direction toward the Jamaica Bay, approximately 2.5 miles southeast of the Site. A groundwater contour map is depicted on Figure 3.

Soil Quality

Soil contamination was documented between 0 to 4 feet below grade, with isolated zones of CVOC contamination extending to six feet below grade, and an isolated area of metals contamination within the observed fill zone extending to nine feet below grade.

- Chlorinated VOCs were detected at concentrations above the UUSCOs, RRSCOs, and/or PGWSCOs, including PCE (max. 98 ppm), TCE (max. 8.0 ppm), cis-1,2-dichloroethene (max. 0.47 ppm), and methylene chloride (max. 0.069 ppm). The highest concentrations of VOCs were detected in soil samples along the central and northern portions of the Site.
- SVOCs were detected in shallow samples above the UUSCOs and/or RRSCOs including benzo(a)anthrancene (max. 3.1 ppm), benzo(a)pyrene (max. 14 ppm), benzo(b)fluoranthene (max. 3.4 ppm), benzo(k)fluoranthene (max. 5.6 ppm), chrysene (max. 14 ppm), dibenz(a,h)anthracene (max. 2.0 ppm), indeno(1,2,3-cd)pyrene (max. 9.2 ppm), and naphthalene (max. 13 ppm). SVOC exceedances were detected in isolated areas of the Site between 0 to 4 feet below grade.
- Total PCBs (max. 0.48 ppm) were detected in one sample (RI-SB-01_0-2) and its associated blind duplicate at concentrations above the UUSCO but below the RRSCO.
- Up to four pesticides were detected in shallow samples at concentrations above the UUSCOs but below RRSCOs including 4,4'-DDD (max. 0.17 ppm), 4,4'-DDE (max. 0.04 ppm), 4,4'-DDT (max. 0.28 ppm), and dieldrin (max. 0.033 ppm). Pesticide exceedances were located in isolated areas between 0 to 4 feet below grade.

- Between one and 13 metals compounds were detected above their respective UUSCOs and/or RRSCOs, including arsenic (max. 18.0 ppm), barium (max. 814 ppm), cadmium (max. 11.1 ppm), trivalent chromium (max. 214 ppm), hexavalent chromium (max. 3.72 ppm), copper (max. 936 ppm), cyanide (max. 36.9 ppm), lead (max. 1,360 ppm), manganese (2,140 ppm), mercury (max. 3.71 ppm), nickel (max. 318 ppm), silver (max. 4.55 ppm), and zinc (max. 1,110 ppm). The highest concentrations of metals were detected on the central portion of the Site. The metals exceedances were located between 0 to 4 feet below grade, with one location extending to 14 feet below grade.

- PFOS [max. 10.8 parts per billion (ppb)] was detected above its NYSDEC Guidance Value for Unrestricted Use of 0.88 ppb in 13 samples. All PFOS detections remained below the NYSDEC Guidance Value for Restricted Residential Use. PFOA (max. 3.08 ppb) was detected above its NYSDEC Guidance Value for Unrestricted Use of 0.66 ppb in three soil samples. PFOA was not detected above its NYSDEC Guidance Value for Restricted Residential use.

Exceedances of UUSCOs, RRSCOs and/or PGWSCOs in soil samples are shown on Figures 4A and 4B, with PCE and TCE concentration isocontour maps included as Figures 5A and 5B (0 to 2 ft bg) and Figures 6A and 6B (2 to 4 ft bg).

Groundwater Quality

- Three chlorinated VOCs (PCE, TCE, and chloroform) were detected in groundwater samples at concentrations above the AWQSGVs. PCE was detected at concentrations ranging from 400 ppb (RI-MW-04) to 19,000 ppb (RI-MW-DUP), above its AWQSGV of 5 ppb. TCE was detected at concentrations ranging from 3.8 ppb (RI-MW-04) to 30 ppb (RI-MW-03), with all but one concentration above its AWQSGV of 5 ppb. Chloroform was detected in seven of the nine groundwater samples at concentrations ranging from an estimated concentration of 0.92 ppb (RI-MW-04) to an estimated concentration of 18 ppb (RI-MW-03), with one well exceeding its AWQSGV of 7 ppb. All remaining VOCs remained below their respective AWQSGVs.

- Up to eight metals compounds, including antimony (max. 0.005 ppb), arsenic (max. 0.03 ppb), chromium (max. 0.167 ppb), iron (max. 1,700 ppb), lead (max. 0.077 ppb), manganese (max. 2,000 ppb), nickel (max. 0.275 ppb), and sodium (max. 88,900 ppb), were detected in the total metals (unfiltered) groundwater samples at concentrations above their respective AWQSGVs. Three metals including iron (max. 1,600 ppb), manganese (max. 1,940 ppb), and sodium (max. 81,500 ppb) were detected in the multiple dissolved (filtered) groundwater samples at concentrations above their respective AWQSGVs.

- PFOA was detected in groundwater throughout the Site at concentrations ranging from 16.8 nanograms per liter (ng/L) to 89.5 ng/L, above the NYSDEC screening level of 10 ng/L. PFOS was detected in groundwater throughout the Site at concentrations ranging from 1.30 ng/L to 105 ng/L, with three of the four samples detecting PFOS above the NYSDEC screening level of 10 ng/L.

Figure 7 includes a review of compounds detected in groundwater samples that exceed either the NYSDEC AWQSGVs and/or the NYSDEC Screening Levels. Figures 8A and 8B include isocontour maps depicting PCE and TCE concentrations in groundwater, respectively.

Soil Vapor Quality

Eight sub-slab soil vapor samples were collected during the May 2022 Phase II Investigation and 12 sub-slab soil vapor samples were collected during the October 2022 RI. All sub-slab soil vapor samples were analyzed for VOCs using EPA Method TO-15.

Petroleum-related VOCs, including, among others, 1,2,4-trimethylbenzene, benzene, ethanol, ethylbenzene, hexane, isopropanol, xylenes, and toluene were detected in the sub-slab soil vapor samples.

Solvent-related VOCs in sub-slab soil vapor samples, including PCE, TCE, 1,1-dichloroethene (DCE), cis-1,2-DCE, 1,1,1-trichloroethane (TCA), 1,1,2-TCA, acetone, chloroform, and methyl ethyl ketone (MEK) were detected across the Site, with PCE and TCE being detected at concentrations up to 980,000 micrograms per cubic meter ($\mu g/m^3$) and 250,000 $\mu g/m^3$, respectively. The highest concentrations were detected on the central and eastern portions of the Site.

Sub-slab soil vapor sample results are shown on Figures 9A and 9B, and isocontour maps for PCE and TCE in soil vapor are included on Figures 10A and 10B.

4.0 INTERIM REMEDIAL MEASURE OBJECTIVES

Previous investigations at the project site have identified CVOCs, SVOCs, pesticides, metals, and PFAS contamination in shallow soil. The contamination was documented in the top two feet of soil across the Site, with several areas extending to 6 to 9 feet bg. In addition, all soil exceeding RRSCOs and PGWSCOs (CVOCs only) will be removed extending to approximately 15 feet bg within the proposed cellar footprint of the new building. Notably, the CVOC concentrations in shallow soil, along with the contamination documented in groundwater and soil vapor, are indicative of gross contamination. The objective of the IRM is to complete an action that is protective of public health and the environment by removing an ongoing source of contamination affecting groundwater and soil vapor beneath the Site, and, in the process, collect targeted analytical, hydrogeological, and geological data to design the anticipated Site remedy. The actions proposed during the IRM to achieve the objectives include a PDI, and excavation and removal of the contamination source area in soil. These objectives are consistent with guidance for Brownfield Cleanup Program sites in NYSDEC DER-10. For excavation of soil, endpoint sampling will confirm attainment of the lower of the RRSCOs and the PGWSCOs (CVOCs only) listed in 6 NYCRR Part 375-6.8.

5.0 PRELIMINARY DESIGN INVESTIGATION (PDI)

The PDI field program is proposed to include the collection of soil, soil vapor, and groundwater samples for analytical testing, and the completion of hydrogeological tests to determine aquifer parameters. This data will be used to prepare detailed plans for implementation of the full site remedy, including soil vapor extraction (SVE) and in-situ groundwater treatment.

5.1 Field Program Summary

The field sampling scope of work includes the advancement of soil borings, installation of nested soil vapor points and monitoring wells, collection and laboratory analysis of soil, soil vapor, and groundwater samples, and the hydrogeological testing. Soil boring locations PDI-SB-01 to PDI-SB-33 have been located to delineate the nature and extent of the soil hot spot areas documented in the RIR for waste characterization/disposal purposes. Proposed soil boring locations PDI-SB-34 to PDI-SB-36 include deeper borings for the installation of intermediate and deep monitoring wells. The nested soil vapor points (PDI-SV-01 to PDI-SV-25) are set up in a site-wide grid based on approximately 40-foot centers to aid in the design of the SVE system and identify target SVE well screen intervals. At each location, nested soil vapor sampling probes will be installed every 10 feet bg in the same boring until reaching two feet above the groundwater table. Monitoring wells PDI-MW-07, PDI-MW-08, PDI-MW-10 through PDI-MW-15, and PDI-MW-17 are intended to be two-inch diameter wells screened across the water table to complete shallow groundwater delineation to aid in designing a groundwater treatment program. Monitoring wells PDI-MW-01M/01D, PDI-MW-02M/2D, PDI-MW-03M/3D, and PDI-MW-06M/06D are nested two-inch diameter intermediate and deep wells to be co-located with the existing shallow wells installed during the RI. Monitoring wells PDI-MW-09S/09M/09D and PDI-MW-16S/16M/16D are nested two- or four-inch diameter shallow, intermediate and deep wells to complete vertical groundwater delineation and hydrogeological testing. The proposed sample locations are shown on Figure 11A through 11C. The rationale for the proposed sample locations is included in In-Text Tables 1 through 3:

In-Text Table 1
PDI Soil Sampling Locations and Rationale

Sample ID	Location	Rationale
PDI-SB-01	Northeastern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-02	Northeastern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-03	Northeastern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-04	Northeastern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-05	Northeastern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-06	Northeastern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-07	North-central soil hotspot	Delineation of shallow soil hotspot for waste characterization

Sample ID	**Location**	**Rationale**
PDI-SB-08	North-central soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-09	North-central soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-10	North-central soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-11	Northwestern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-12	Northwestern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-13	Northwestern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-14	Northwestern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-15	North-central soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-16	North-central soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-17	North-central soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-18	Central/southern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-19	Central/southern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-20	Central/southern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-21	Southern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-22	Southern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-23	Southwestern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-24	Southwestern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-25	Southwestern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-26	Central/southern soil hotspot	Delineation of shallow soil hotspot for waste characterization

Sample ID	**Location**	**Rationale**
PDI-SB-27	Central/southern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-28	Central/southern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-29	Southeastern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-30	Southeastern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-31	Southeastern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-32	Southeastern soil hotspot	Delineation of shallow soil hotspot for waste characterization
PDI-SB-33	Southeastern and downgradient portion of the Site	Installation of intermediate and deep monitoring wells (PDI-MW-01M/D) and sieve analysis
PDI-SB-34	Northeastern and upgradient corner of the Site / Northeastern soil hotspot	Installation of intermediate and deep monitoring wells (PDI-MW-03M/D), sieve analysis, and delineation of shallow soil hotspot for waste characterization
PDI-SB-35	Central portion of the Site	Installation of intermediate and deep monitoring wells (PDI-MW-02M/D) and sieve analysis
PDI-SB-36	Southern and downgradient corner of the Site / Southern soil hotspot	Installation of intermediate and deep monitoring wells (PDI-MW-06M/D), sieve analysis and delineation of soil hotspot for waste characterization

In-Text Table 2
PDI Soil Vapor Sampling Locations and Rationale

Sample ID	**Location**	**Rationale**
PDI-SV-01	Northern property boundary	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-02	Northeastern property boundary	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-03	Northeastern property boundary	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table

Sample ID	**Location**	**Rationale**
PDI-SV-04	Northwestern property boundary	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-05	Northern portion of the Site	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-06	Northern portion of the Site	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-07	Northern portion of the Site	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-08	Northeastern property boundary	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-09	Western side of the Site	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-10	Central portion of the Site	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-11	Central portion of the Site, and northwestern boundary to Lot 36	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-12	Central portion of the Site, and northeastern boundary to Lot 36	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-13	Central portion of the Site	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-14	Western side of the Site	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-15	Central portion of the Site	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-16	Central portion of the Site, and western boundary to Lot 36	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table

Sample ID	**Location**	**Rationale**
PDI-SV-17	Central portion of the Site, and eastern boundary to Lot 36	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-18	Central portion of the Site	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-19	Southeastern property boundary	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-20	Western side of the Site	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-21	Southern side of the Site	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-22	Southern side of the Site, and southwestern boundary to Lot 36	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-23	Southern side of the Site, and southeastern boundary to Lot 36	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-24	Southern side of the Site	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table
PDI-SV-25	Southeastern property boundary	Soil vapor sampling at 10 feet bg, 20 feet bg, 30 feet bg, and two feet above the GW table

In-Text Table 3
PDI Groundwater Sampling Locations and Rationale

Sample ID	**Location**	**Rationale**
PDI-MW-07	Southern and downgradient corner of the Site and southwestern boundary to Lot 36	Shallow groundwater quality to aid in design of a groundwater remedy
PDI-MW-08	Southwestern and downgradient side of the Site	Shallow groundwater quality to aid in design of a groundwater remedy
PDI-MW-09S/09M/09D	Central-eastern and upgradient portion of the Site	Shallow, intermediate, and deep groundwater quality and hydrogeologic testing of saturated zone

Sample ID	Location	Rationale
PDI-MW-10	Northwestern and upgradient corner of the Site	Shallow groundwater quality to aid in design of a groundwater remedy
PDI-MW-11	North-central and upgradient portion of the Site	Shallow groundwater quality to aid in design of a groundwater remedy
PDI-MW-12	Central portion of the Site and northern boundary to Lot 36	Shallow groundwater quality to aid in design of a groundwater remedy
PDI-MW-13	Northeastern and upgradient portion of the Site	Shallow groundwater quality to aid in design of a groundwater remedy
PDI-MW-14	Northeastern and upgradient portion of the Site	Shallow groundwater quality to aid in design of a groundwater remedy
PDI-MW-15	Northeast and upgradient corner of the Site	Shallow groundwater quality to aid in design of a groundwater remedy
PDI-MW-16S/16M/16D	Eastern-central and downgradient portion of the Site	Shallow, intermediate, and deep groundwater quality and hydrogeologic testing of saturated zone to aid in design of a groundwater remedy
PDI-MW-17	Southern end and downgradient side of the Site and southeastern boundary to Lot 36	Shallow groundwater quality to aid in design of a groundwater remedy
PDI-MW-01M	Southeastern and downgradient corner of the Site	Intermediate well nested with shallow well RI-MW-01 to aid in design of a groundwater remedy
PDI-MW-01D	Southeastern and downgradient corner of the Site	Deep well nested with shallow well RI-MW-01 to aid in design of a groundwater remedy
PDI-MW-02M	Northern and upgradient side of the Site	Intermediate well nested with shallow well RI-MW-02 to aid in design of a groundwater remedy
PDI-MW-02D	Northern and upgradient side of Site	Deep well nested with shallow well RI-MW-02 to aid in design of a groundwater remedy
PDI-MW-03M	Northeastern and upgradient corner of the Site	Intermediate well nested with shallow well RI-MW-03 to aid in design of a groundwater remedy
PDI-MW-03D	Northeastern and upgradient corner of the Site	Deep well nested with shallow well RI-MW-03 to aid in design of a groundwater remedy

Sample ID	Location	Rationale
PDI-MW-06M	Southwestern and downgradient side of the Site	Intermediate well nested with shallow well RI-MW-06 to aid in design of a groundwater remedy
PDI-MW-06D	Southwestern and downgradient side of the Site	Deep well nested with shallow well RI-MW-06 to aid in design of a groundwater remedy

A Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP) will be implemented during all subsurface disturbance activities included in the field program to be performed at the Site. CAMP data will be provided to the NYSDEC and NYSDOH on a weekly basis. Any exceedances of CAMP action levels as well as correction measures taken will be reported to the Departments immediately (within 24 hours). The HASP and CAMP are included as Appendix A and Appendix B, respectively.

5.2 Sample Handling and Laboratory Reporting

The procedures and guidelines for sample collection are included in the Quality Assurance Project Plan (QAPP) provided in Appendix C. Each sample slated for analysis will be labeled and placed in laboratory-supplied containers and shipped to the laboratory via courier with appropriate chain of custody documentation in accordance with appropriate EPA protocols to Eurofins TestAmerica in South Burlington, Vermont, a NYSDOH Environmental Laboratory Approval Program (ELAP)-certified laboratory. Each laboratory report will be prepared using Category B deliverables with electronic data deliverables (EDDs) in the latest NYSDEC format. A standard turnaround time will be requested from the laboratory.

5.3 Soil Sampling

A sonic drill rig will be used to advance soil borings PDI-SB-01 through PDI-SB-32 to 15 feet below grade, as shown on Figure 11A. Continuous soil samples will be collected using stainless steel samplers fitted with five-foot-long dedicated plastic bags. Soil samples will be inspected by AKRF field personnel for evidence of contamination (e.g., odors, staining), screened for the presence of volatile organics with a photoionization detector (PID) equipped with a 11.7 electron volt (eV) lamp, and logged using the Modified Burmister soil classification system. AKRF field personnel will record and document subsurface conditions. The PID will be calibrated in accordance with manufacturer’s recommendations prior to sampling. The RIR documented that CVOC-contaminated soil hot spots are present in shallow soil (0 to 4 feet bg). Soil samples will be collected from plastic bags in 1 to 2-foot intervals from 4 to 15 feet bg (i.e., 4 to 6 feet, 6 to 8 feet, 8 to 10 feet, 10 to 12 feet, 12 to 14 feet, and 14 to 15 feet bg). All samples will be submitted for laboratory analysis of CVOCs via EPA Method 8260D, samples collected from soil borings PDI-SB-02 to PDI-SB-05 and PDI-SB-30 through PDI-SB-33 will be additionally analyzed for PAHs via EPA Method 8270E, and samples collected from soil borings PDI-SB-02 to PDI-SB-05 will be additionally analyzed for TAL metals EPA Method 6000/7000. Additional analysis (e.g., TCLP VOCs) will be conducted as required to satisfy disposal facility requirements and in support of a “contained-in determination” request.

A sonic drilling rig will be utilized to advance soil borings PDI-SB-33 to PDI-SB-36 to a depth of approximately 75 feet below grade to facilitate installation of deep monitoring wells at these locations. Soil samples will be collected every 10 feet starting at approximately 10 feet below grade until the boring terminal depth (approximately 70 ft below grade) and will be set aside for laboratory analysis of CVOCs by EPA Method 8260D. Once below the water table, additional soil sample volume will be collected from within the saturated zone at locations between approximately 40 and 70 feet below grade for parameters to assist with remedial design, including soil pH, clay content, total organic carbon (TOC) and grain size distribution (sieve analysis).

Additional soil samples may be collected for laboratory analysis at borings advanced for installation of the soil vapor points and/or other monitoring wells based on field observations.

All investigation derived waste (IDW) associated with drilling soil borings will be managed as described in Section 5.11.

5.4 Soil Vapor Point Installation and Sampling

A sonic drilling rig will be used to drill the soil borings designated for installation of the nested soil vapor sampling points. A total of 25 multi-point locations have been proposed to be installed in a grid pattern across the Site with approximately 40 foot centers. Each boring will be drilled to a depth of approximately 38 to 42 feet below grade to reach the terminal soil vapor point installation depth (two feet above the anticipated groundwater interface).

Dedicated 6-inch stainless steel mesh sample points connected to polyethylene tubing to grade will be installed at each of the targeted sampling depths (10, 20, 30, and approximately 40 feet below grade) within the respective boring for each location. Each sample point will be backfilled with No. 2 filter sand to 1-foot above the screened interval, followed by hydrated bentonite until the start of the next sampling point interval. The tubing will be marked at the surface with colored tape after each sample point installation, with red tape (approximate 40-foot point), white tape (approximate 30-foot point), blue tape (approximate 20-foot point) and yellow tape (approximate 10-foot point). Hydrated bentonite will be used to seal the gap between the ground surface and the tubing. One soil vapor sample will be collected simultaneously from each of the four sample points at each of the 25 nested point locations.

Samples will be collected using six-liter stainless steel Summa canisters. A flow meter will be affixed to each Summa canister and calibrated for sample collection over a 2-hour period of time. All Summa canisters will be analyzed by a NYSDOH-certified laboratory for VOCs by EPA Method TO-15.

5.5 Monitoring Well Installation and Well Development

Up to eight shallow 2-inch diameter monitoring wells (PDI-MW-07, PDI-MW-08, PDI-MW-10 through PDI-MW-15, and PDI-MW-17), four nested 2-inch diameter intermediate and deep wells (PDI-MW-01M/01D, PDI-MW-02M/2D, PDI-MW-03M/3D, and PDI-MW-06M/06D), and two nested 2- or 4-inch diameter shallow, intermediate, and deep wells (PDI-MW-09S/09M/09D and PDI-MW-16S/16M/16D) are proposed to be installed to provide for additional groundwater plume delineation and hydrogeological testing at the Site to aid in the design of a groundwater treatment program. The two nested shallow, intermediate, and deep wells (PDI-MW-09S/09M/09D and PDI-MW-16S/16M/16D) may be installed with a larger diameter (4-inch) casing depending on volume requirements for hydrogeological testing (slug test) equipment.

Monitoring well installation will include the use of sonic drilling equipment to reach the targeted depths, with installation of 15 feet of well screen for the shallow water table wells (anticipated 35 to 50 ft bg), and 5 to 10 feet of well screen for the intermediate wells (anticipated 55 to 60 ft bg) and deep wells (anticipated 70 to 75 ft bg). A 1-foot sump will be provided below the well screen at the bottom of each well. Final well screen intervals will be based on the observed groundwater table at each well location. Morie sand will be backfilled around each well screen to a depth of 2 feet above the screen. A bentonite seal will be placed above the sand pack for each well, and the remaining borehole will be filled with bentonite grout.

Each monitoring well will be completed using locking gate boxes, flush with grade, and will be developed by pumping until clear, if practicable or in accordance with the QAPP. The location and elevation of each new monitoring well will be surveyed by a licensed surveyor.

5.6 Groundwater Sampling

Groundwater samples will be collected from all existing RI monitoring wells (RI-MW-01 through RI-MW-06) and all newly installed monitoring wells. All newly installed PDI monitoring wells will be sampled a minimum of 7 days after of completion of well development. The existing RI wells will not be redeveloped prior to sampling as they were adequately developed during the RI field activities in October 2022. Prior to sampling, a synoptic round of water level measurements will be collected by gauging the depth to water at each location with a multi-phase interface meter. Water measurements from surveyed monitoring wells will be used to prepare a groundwater elevation contour map. Groundwater samples will be collected from each of the existing and newly installed monitoring wells using low-flow sampling techniques. The purge water will be monitored for turbidity and water quality indicators (i.e., pH, dissolved oxygen, oxidation-reduction potential, temperature, and specific conductivity) with measurements collected approximately every five minutes. The criteria for stabilization will be three successive readings within ±10% for pH, temperature, and specific conductivity. Each sample will be analyzed for VOCs using EPA Method 8260D.

5.7 Soil Sampling for Bench Scale Treatability Testing

In addition to the soil and groundwater sampling described in Sections 5.3 and 5.6, bulk soil and groundwater samples will be collected for submission to a vendor for bench-scale groundwater treatability testing. The soil samples will be collected across the saturated zone; and the groundwater samples will be collected from shallow, intermediate, and deep groundwater zones. The samples will be collected from select soil borings and monitoring wells based on field screening and other observations during the field work. The sample volumes and sampling containers will be determined based on the requirements of the selected testing vendor. The bench scale testing will include testing of up to three in situ chemical oxidation (ISCO), reductive dichlorination, and/or enhanced bioremediation reagents/additives.

5.8 Rising and Falling Head Aquifer Testing

Aquifer testing will be conducted to assess the aquifer’s hydraulic conductivity for remediation design purposes. To estimate hydraulic conductivity for groundwater treatment, AKRF will perform rising and/or falling head slug tests in designated shallow, intermediate, and deep monitoring wells. The slug tests will be performed utilizing an approximate 1.5-inch diameter mechanical slug (or a 3-inch diameter slug if 4-inch diameter monitoring wells are installed). Prior to the slug tests, AKRF will install an In-Situ™ Level TROLL 700 pressure transducer at the bottom of each well to monitor the depth to water over a specific time interval before, during, and after each test.

After the data logger is set and activated using the surface connected In-Situ™ Rugged Reader (or equivalent) and the static water level will be confirmed, the falling head slug test will be initiated by placing the mechanical slug in the well to a depth where the top of the slug is below the static water level. AKRF will periodically monitor the depth to water by checking the logging data with the Rugged Reader until the water level returns to within 0.05 feet of the measured static water level.

Following completion of the falling head slug test, AKRF will perform a rising head slug test by removing the mechanical slug from the well. After the slug is removed, AKRF will monitor the depth to water with the Rugged Reader until the water level recovers to within 0.05 feet of the static water level. The slug testing data will be downloaded from the Rugged Reader for desktop analysis. The Bouwer and Rice analysis method will be used to analyze the slug test data and determine a hydraulic conductivity (K) value.

5.9 Quality Assurance / Quality Control (QA/QC)

Additional analysis will be included for quality control measures, as required by the Category B sampling techniques. The QA/QC samples for soil and groundwater will include one field blank, one MS/MSD, and one blind duplicate sample at a frequency of one sample per 20 field samples per media. The field blank, blind duplicate, and MS/MSD samples will be analyzed for VOCs using EPA Method 8260D. MS/MSD and duplicate samples will be collected at locations for each media where VOCs, PAHs, and TAL metals are slated for analysis (as indicated in the QAPP). The field blank samples will be obtained by using laboratory provided water and passing the water over or through the sampling device and into laboratory provided sample containers. The QAPP describes the QA/QC protocols and procedures that will be followed during implementation of the PDI. The QAPP is included as Appendix C. The data will be reviewed by a third-party validator and a Data Usability Summary Report (DUSR) will be prepared to document the usability and validity of the data.

5.10 Decontamination Procedures

All non-dedicated sampling equipment (e.g., stainless steel sampling equipment, submersible/peristaltic pumps and oil/water interface probe) will be decontaminated between sampling locations using the following procedure:

1. Scrub equipment with a bristle brush using a tap water/Simple Green® solution.
2. Rinse with tap water.
3. Scrub again with a bristle brush using a tap water/Simple Green® solution.
4. Rinse with tap water.
5. Rinse with distilled water.
6. Air-dry the equipment.

5.11 Management of Investigation-Derived Waste (IDW)

Soil cuttings generated by the drilling of soil vapor points, soil borings and installation of monitoring wells, and drilling fluids and purge water generated by monitoring well installation, development, and low flow sampling will be containerized in properly labeled Department of Transportation (DOT)-approved 55-gallon drums for future off-site disposal at a permitted facility. The drums will be sealed at the end of each work day and labeled with the date, the well or boring number(s), the type of waste (i.e., drill cuttings, decontamination fluids, or purge water) and the name of an AKRF point-of-contact. All drums will be labeled "pending analysis" until laboratory data is available. All IDW will be disposed of or treated according to applicable local, state, and federal regulations following completion of the PDI. All boreholes will be filled with bentonite chips (hydrated) and restored to its original surface condition. Disposable sampling equipment, including spoons, gloves, bags, paper towels, etc. that come in contact with environmental media will be double bagged and disposed of as municipal trash in a facility trash dumpster as non-hazardous refuse.

6.0 INTERIM REMEDIAL MEASURES - EXCAVATION

The IRM will include excavation and removal of the zone of soil contamination and source of contamination for environmental media that was documented during the Phase II and RI.

6.1 Site Preparation

Prior to conducting any intrusive IRM activities, the work zone(s), designated entry points, soil stockpile staging areas, decontamination zones, and truck routes will be established on a site plan, as applicable. The site plan will be updated as necessary to reflect any changes in operations during the intrusive work. Dust control measures, if necessary, will be implemented as outlined in Section 6.7. Additional details of site preparation activities are provided in the following sections.

6.1.1 Mobilization

Site mobilization involving site security setup, installation of fencing and barriers, erosion control measures, construction of decontamination and materials staging areas, equipment mobilization, utility mark outs and marking and staking excavation areas will be performed prior to undertaking any IRM excavation work.

6.1.2 Building Demolition and Asbestos Abatement

The selected contractor will complete abatement of the building prior to demolition. Abatement will include, but is not limited to: asbestos, lead based paint, and universal waste. Demolition and abatement will be completed in accordance with local, state, and federal regulations. Construction and demolition (C&D) debris will not be utilized on-Site for fill but will be disposed of at an appropriate C&D facility.

6.1.3 Erosion and Sedimentation Controls

Erosion and sediment control measures will be installed at the Site prior to conducting any ground-intrusive work in accordance with the presented in NYS Guidelines for Urban and Erosion Sediment Controls. The control measures will include procedures for perimeter Site/stockpile controls, stabilized construction entrance pads, equipment decontamination, drainage inlet protection, and dust suppression, as applicable.

6.1.4 Stabilized Construction Entrance(s)

A crushed stone path will be constructed at all truck entrances and exits. All trucks will drive over the path prior to leaving so that they do not get re-contaminated prior to departure from the Site. A laborer will check the trucks as they leave, and will use a hose, shovel, and/or broom to clean the truck tires and body as it leaves the Site, as necessary.

6.1.5 Utility Marker and Easements Layout

The Volunteer and its contractors are solely responsible for the identification of utilities that might be affected by work under the IRM and implementation of all required, appropriate, or necessary health and safety measures during performance of work under this IRM. The Volunteer and its contractors are solely responsible for safe execution of all invasive and other work performed under this IRM. The Volunteer and its contractors must obtain any local, State or Federal permits or approvals pertinent to such work that may be required to perform work under this IRM. Approval of this IRMWP by NYSDEC does not constitute satisfaction of these requirements.

6.1.6 Sheeting and Shoring (If Necessary)

Appropriate management of structural stability of on-site or off-site structures during on-site excavation activities is the sole responsibility of the Volunteer and its contractors. The Volunteer and its contractors are solely responsible for safe execution of all invasive and other work performed under this Plan. The Volunteer and its contractors must obtain any local, State or Federal permits or approvals that may be required to perform work under this Plan and/or where permit equivalency cannot be granted. Further, the Volunteer and its contractors are solely responsible for the implementation of all required, appropriate, or necessary health and safety measures during performance of work under the approved Plan.

6.1.7 Equipment and Material Staging

Staging and storage of equipment and materials will be contained within the secured site. By the nature of the work involved in this project, equipment and materials will be moved to different areas within the secured site as work progresses.

6.1.8 Decontamination Area

A decontamination area will be established in accordance with the HASP. All equipment in direct contact with known or potentially contaminated material will be either dedicated or decontaminated prior to handling less contaminated material or removal from the Site. All liquids used in the decontamination procedure will be collected, stored and disposed of in accordance with federal, state and local regulations. Personnel performing this task will wear the proper personal protective equipment as prescribed in the HASP.

6.1.9 Demobilization

After completing the scope of the IRM, it is anticipated that excavation work will continue as part of Site redevelopment and general construction work. Equipment will be decontaminated prior to removal. Upon completion of the remedial excavation work, any waste materials (i.e., plastic sheet, absorbent pads, refuse) and the decontamination pad will be removed from the Site and properly disposed of. Areas that have been disturbed to accommodate support and temporary access areas will be restored or prepared for general construction work.

6.2 IRM Excavation

The proposed IRM includes excavation of contaminated soil to two feet below grade across the entire site, plus removal of additional source material extending to depths ranging from 6 to 9 feet below grade in hotspot areas identified during the Phase II and RI and to approximately 15 feet below grade within the cellar footprint of the proposed new building. Figure 12 depicts the anticipated depth of soil excavation across the Site. All excavations will be considered open excavations and will be managed according to applicable local, State, and Federal regulations. The Owner and its contractors will be responsible for safe execution of all invasive and other work performed under this Plan. The presence of utilities and easements on the Site will be investigated by the Remedial Engineer. It will be determined whether a risk or impediment to the planned work under this IRMWP is posed by utilities or easements on the Site.

The 2-foot deep excavation sidewalls will be expanded to the perimeter boundary of the Site. The excavation depth will be extended in the hot spot area as indicated on Figure 12, and will be expanded based on field screening of the sidewalls and bottom of the excavation until visual/olfactory observations demonstrate that the contaminated soil has been removed.

Endpoint samples will be collected from the bottom and sidewalls of the sitewide excavation and from all hotspot removal areas in accordance with DER-10 sampling frequency requirements. The samples will be submitted for laboratory analysis to confirm that CVOCs meet the lower of the PGWSCOs and RRSCOs and that the PAHs and metals hotspots have been removed. All intrusive excavation work will be conducted in accordance with the procedures defined in the HASP (Appendix A) and CAMP (Appendix B).

6.3 Soil Screening Methods

Visual, olfactory, and instrument-based soil screening will be performed by a qualified environmental professional during all soil excavation work. Monitoring will include inspecting soil for heavy staining, sheen, odors, or other evidence of gross contamination, and field screening for the presence of VOCs with a PID. All soil exhibiting evidence of contamination will be separated and stockpiled in accordance with Section 6.4.

In addition to screening excavated material for the presence of contamination, work zone air monitoring for VOCs will be performed according to the HASP, and perimeter monitoring will be conducted in accordance with the CAMP.

Visual, olfactory, and PID soil screening and assessment will be performed under the direction of a qualified environmental professional during all IRM excavations into known or potentially contaminated material.

Visual, olfactory and instrument-based soil screening will be performed during the excavation to confirm the depth of excavation, and to confirm that there is no evidence of contamination remaining in soil at the limits of the excavation. Field screening will include inspecting soil for heavy staining, sheen, odors, or other evidence of gross contamination, and field screening for the presence of VOCs with a PID. The final excavation limits and amount of excavated soil will be measured and documented by field personnel.

6.4 Stockpile Methods

Soil excavated from the Site will either be live loaded or placed in separate designated stockpiles based on the results of field screening, as described in Section 6.3 and/or pre-characterization sampling. Soil that exhibits evidence (i.e., PID readings, staining, odors) of contamination will be placed in an isolated stockpile designated for off-site disposal. Soil that does not exhibit evidence of contamination will be placed in separate stockpiles based on the intended use, which include on-site reuse, or off-site disposal. Although not anticipated, if any excavated soil is reused on-site, it will be managed in accordance with Section 6.13. Each soil stockpile will be located based on security, ease of loading onto haul trucks, or ease of reuse as backfill on-site, and will be placed on sheeting and kept fully covered whenever excavation and/or loading operations are not occurring with an appropriately anchored tarp or min 6-mil poly sheeting. Each stockpile cover will be routinely inspected to ensure adequate cover. If a damaged tarp/poly sheeting cover is observed, it will be promptly replaced. Soil stockpiles will be continuously encircled with a berm and/or silt fence as necessary to prevent runoff off-site or to uncontaminated locations on-site. Hay bales and/or other erosion and sediment controls will be used as needed near any catch basins or other discharge points.

The location and classification of each stockpile location will be tracked on site drawings and updated, if necessary, at the end of each workday. Copies of site drawings will be kept in the field log book.

6.5 Fluids Management

Due to the depth to water at the Site (approximately 40 feet below grade), dewatering is not anticipated during the IRM. All liquids removed from the excavation will be handled, transported and disposed of at Clean Water of New York in accordance with applicable local, State, and Federal regulations. NYSDEC and NYSDOH will be notified if an alternative disposal facility is proposed.

6.6 Air Monitoring

Work zone and community air monitoring will be conducted during all work identified in this IRM. The work zone air monitoring will be completed in accordance with the site-specific HASP and CAMP, which are provided in Appendix A and Appendix B, respectively.

6.7 Site Control Measures

The potential off-site transport of sediment, dust, and organic vapors potentially generated during soil excavation activities will be controlled by: placing stockpiles on and covering soil stockpiles and/or open excavations with 6-mil polyethylene sheeting; decontaminating equipment used for soil excavation/sampling; providing drainage inlet protection for catch basins; and/or the use of odor-controlling spray foam, as warranted. In addition to the site control measures listed above, a CAMP will be implemented during all intrusive activities. The CAMP is located in Appendix B and includes perimeter monitoring of dust and organic vapors. The CAMP includes screening levels, and a response plan that is consistent with the NYSDOH CAMP requirements. These measures will be employed according to the requirements of all applicable or relevant and appropriate Federal, State and local laws.

6.8 Remedial Performance Evaluation

Post-excavation endpoint soil samples will be collected to evaluate the effectiveness of excavation as the chosen soil remedial method. This Section includes the methods to be implemented for soil sample collection.

6.8.1 End-Point Sampling Frequency

Per NYSDEC DER-10 Section 5.4, side-wall samples will be collected a minimum one sample for every 30 linear feet and bottom samples will be collected at a frequency of one every 900 SF.

6.8.2 Methodology

Each endpoint sample collected from the excavation will be analyzed for Target Compound List (TCL) VOCs by EPA Method 8260D, TCL SVOCs by EPA Method 8270E, PCBs by EPA Method 8082A, TCL pesticides by EPA Method 8081B, herbicides by EPA Method 8151A, TAL metals by EPA Method 6000/7000 series. Samples will be shipped to the laboratory with appropriate chain of custody documentation. The samples will be analyzed in a laboratory following NYSDOH ASP Category B deliverables.

6.8.3 Quality Assurance/Quality Control (QA/QC)

Measures will be taken to provide for QA and maintain QC of environmental sampling and remedial activities conducted under the IRMWP. A QAPP that describes the QA/QC protocols and procedures that will be followed during implementation of the IRM is included in Appendix C. Adherence to the QAPP will ensure that defensible data will be obtained during the implementation of the IRM.

6.8.4 Data Usability Summary Reports

A DUSR will be prepared for all laboratory analytical results, which will be prepared by a third-party validator.

6.9 Decontamination

Sampling equipment (hand auger, shovels, etc.) will be either dedicated or decontaminated between sampling locations. The decontamination procedure will be as follows:

1. Scrub using tap water/Simple Green® mixture and bristle brush.
2. Rinse with tap water.
3. Scrub again with tap water/ Simple Green® and bristle brush.
4. Rinse with tap water.
5. Rinse with distilled water.
6. Air-dry the equipment, if possible.

Excavation equipment including the excavator bucket will be decontaminated prior to being mobilized off-site by steam cleaning using a tap water/Simple Green® solution. Decontamination of all equipment will be conducted on plastic sheeting (or equivalent) that is bermed to prevent discharge to the ground.

6.10 Materials Load Out

A qualified environmental professional or person under his/her supervision will oversee all load-out of all contaminated excavated material for off-site disposal. The owner of the property and its contractors are solely responsible for safe execution of all invasive and other work performed under this Plan. Loaded vehicles leaving the Site will be appropriately lined, hard-tarped, manifested, and placarded in accordance with appropriate Federal, State, local, and NYSDOT requirements (and all other applicable transportation requirements). The qualified environmental professional will be responsible for ensuring that all egress points for vehicle and equipment transport from the site are clean of dirt and other materials derived from the Site during intrusive excavation activities.

6.11 Materials Transport Off-Site

All transport of materials will be performed by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers will be appropriately licensed and trucks properly placarded. Material transported by trucks exiting the Site will be covered with a tight fitting tarp. Loose-fitting canvas-type truck covers will be prohibited. Proposed in-bound and out-bound truck will travel the most appropriate route and take into account: (a) limiting transport through residential areas and past sensitive sites; (b) use of mapped truck routes; (c) limiting total distance to major highways; (d) promoting safety in access to highways; and (e) overall safety in transport. Trucks will be prohibited from stopping and idling in the residential neighborhoods outside of the project site. To the extent possible, queuing of trucks will be performed on-site to minimize off-site disturbance.

6.12 Materials Disposal Off-Site

Disposal locations will be established at a later date and will be reported to the NYSDEC Project Manager prior to removal of material from the Site. Each stockpile or in-situ soil will be sampled for waste characterization purposes in accordance with the disposal facility requirements.

1. All excavated soil and fill material that is removed from the Site will be treated as regulated material and will be disposed in accordance with all local, State (including 6NYCRR Part 360) and Federal regulations. Material that does not meet Track 1 unrestricted SCOs is prohibited from being taken to a New York State recycling facility (6NYCRR Part 360-16 Registration Facility). Non-hazardous historic fill and contaminated soil taken off-site will be handled, at minimum, as a Municipal Solid Waste per 6NYCRR Part 360-1.2.
2. Non-hazardous and hazardous soil/fill determination will be decided upon completion of sampling performed during the PDI and waste characterization activities and in discussion with NYSDEC.

The following documentation will be obtained by the QEP (under supervision of the Remedial Engineer) for each disposal location used in this project to fully demonstrate and document that the disposal of material derived from the site conforms with all applicable laws: (1) a letter from the QEP or BCP Applicant to the receiving facility describing the material to be disposed of and requesting formal written acceptance of the material. This letter will state that material to be disposed of is contaminated material generated at an environmental remediation site in New York State. The letter will provide the project identity and the name and phone number of the QEP. The letter will include as an attachment a summary of all chemical data for the material being transported; and (2) a letter from the receiving facility stating it is in receipt of the correspondence (above) and is approved to accept the material.

6.13 Materials Reuse On-Site

It is anticipated that all soil excavated as part of the IRM will be disposed of off-site. In the event that non-hazardous material is proposed for potential on-site reuse, it will be managed in accordance with protocols in this section.

Contaminated soil, or any material in direct contact with the contaminated soil, may not be separated for reuse on-site and will be disposed of as described in Section 6.12. Organic matter (wood, roots, stumps, etc.) or other solid is prohibited for reuse on-site. Any demolished material from the existing vacant buildings, including the concrete slabs, and the existing asphalt, will be disposed of in accordance with all prevailing Federal, State, and local regulations. Soil that does not exhibit evidence of contamination during field screening, as described in Section 6.3 and is free of debris will be stockpiled and tested at a frequency of one sample per 500 cubic yards and characterized for reuse below the site cap. Each sample will be tested for TCL VOCs by EPA Method 8260, TCL SVOCs by EPA Method 8270, PCBs by EPA Method 8082, pesticides by EPA Method 8081, TAL metals by EPA Method 6000/7000 series, and PFAS by EPA Method 1633. Samples will be shipped to the laboratory with appropriate chain of custody documentation. The samples will be analyzed in a laboratory following NYSDOH ASP Category B deliverables. Soil from representative samples that meet the lower or RRSCOs and PGWSCOs (CVOCs only) can be reused on-site and below the site cap as backfill. Soil designated for reuse as part of the site cap will be tested in accordance with the sampling protocol described in Section 6.14. All sampling of materials for potential reuse will be conducted in accordance with the QAPP included in Appendix C.

6.14 Backfill from Off-Site Sources

Material from industrial sites, spill sites, or other environmental remediation sites or potentially contaminated properties will not be imported to the Site. All imported soil will meet the backfill and cover soil quality standards established in 6 NYCRR 375-6.7(d). Approval will also be based on an evaluation of the land use, protection of groundwater, and protection of ecological resources criteria. Soil will be considered appropriate for use as on-site imported backfill if contaminant concentrations are below the lesser of the 6 NYCRR Part 375 Restricted Residential and Protection of Groundwater SCOs. Soil that meet 'exempt' fill requirements under 6 NYCRR Part 360, but do not meet backfill or cover soil objectives for this Site, will not be imported onto the site without prior approval by NYSDEC. Solid waste will not be imported onto the Site.

Native material from a New York State Department of Transportation (NYSDOT) designated virgin quarry source will not be sampled prior to use as backfill on the site. Non-DOT designated virgin quarry sources, or non-virgin imported material that does not have an approved NYSDEC Beneficial Use Determination will be tested at the originating facility in accordance with Section 5.4(e) 10 of NYSDEC DER 10, and at a frequency indicated by the following table:

NYSDEC DER-10 Table 5.4(e) 10 Recommended Number of Soil Samples for Soil Imported To or Exported From a Site			
	VOCs (EPA Method 8260)	SVOCs (EPA Method 8270), Inorganics (EPA Method 600/7000 Series & PCBs/Pesticides (EPA Methods 8082/8081)	
Soil Quantity (cubic yards)	Discrete Samples	Composite Samples	Composite Sample Protocol
0-50	1	1	3-5 discrete samples from different locations in the fill being provided will comprise a composite sample for analysis
50-100	2	1	
100-200	3	1	
200-300	4	1	
300-400	4	2	
400-500	5	2	
500-800	6	2	
800-1,000	7	2	
>1,000	Add an additional 2 VOC and 1 composite for each additional 1,000 cubic yards or consult with NYSDEC		

After compliance with the above import criteria is established for a specific source, adjustment of the sampling frequency may be requested by the NYSDEC.

Samples will be analyzed for VOCs using EPA Method 8260, SVOCs using EPA Method 8270, TAL metals using EPA Method 6000/7000 series, PCBs using EPA Method 8082, pesticides using EPA Method 8081, and PFAS using EPA Method 1633. All sampling of imported backfill will be conducted in accordance with the QAPP included in Appendix C.

6.15 Odor, Particulate, and Nuisance Controls

Odor Controls

Specific odor control methods to be used during implementation of the IRM will include the use of a PID to screen for VOCs and olfactory observations by a field technician. If nuisance odors are identified, work will be halted and the source of odors will be identified and corrected. Work will not resume until all nuisance odors have been abated. The NYSDEC and NYSDOH project managers will be notified of all odor events and of any other complaints about the project.

All necessary means will be employed to prevent on- and off-site nuisances. At a minimum, procedures will include: (a) limiting the area of open excavations; (b) shrouding open excavations with tarps or covers; and (c) using foams to cover exposed odorous soil. If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: (d) direct load-out of soils to trucks for off-site disposal; (e) use of chemical odorants in spray or misting systems; and, (f) use of staff to monitor odors in surrounding neighborhoods.

Where odor nuisances have developed during remedial work and cannot be corrected, or where the release of nuisance odors cannot otherwise be avoided due to on-site conditions or close proximity to sensitive receptors, odor control will be achieved by sheltering excavation and handling areas under tented containment structures equipped with appropriate air venting/filtering systems.

Particulate Controls

Particulate management during invasive on-site work will include, at a minimum, the items listed below and is further detailed in the Site-specific CAMP, included in Appendix B:

- Site fencing will be adequately constructed of plywood and/or chain-link fencing with a mesh fabric fence screen as an engineering control to help contain dust and debris during remedial activities.
- Particulate suppression will be achieved through the use of a dedicated hose connected to a fire hydrant. The hose will be equipped with a nozzle capable of spraying water directly onto off-road areas including excavations and stockpiles.
- Clearing and grubbing of the Sites will be done in stages to limit the area of exposed, non-vegetated soils vulnerable to airborne particulate production.
- Crushed stone will be used on on-site roadways to provide a clean and dust-free road surface.
- On-site roads will be limited in total area to minimize the area required for water spraying.

Other Nuisances

A plan for rodent control will be developed and utilized by the contractor prior to and during Site clearing and Site grubbing, and during all remedial work.

6.16 Site Restoration

The IRM is being conducted as the initial phase of Site remediation. After the IRM has been completed, excavation may continue for construction of foundation elements and surrounding Site cap. Any additional excavation, backfilling and site restoration work will be conducted in accordance with the NYSDEC-approved BCP Remedial Action Work Plan (RAWP). Complete details for Site restoration and final construction layout will be included in the RAWP.

7.0 REPORTING REQUIREMENTS

7.1 Interim Remedial Measures Construction Completion Report (CCR)

Upon completion of all field work and receipt of laboratory analytical results, a CCR will be prepared that will: document field activities, present field and laboratory data, and discuss conclusions and recommendations drawn from the results of the investigation in accordance with DER-10. Soil boring logs, monitoring well construction logs, well development logs, and DUSRs will be included in the final report. Electronic Data Deliverables (EDDs) will be submitted to NYSDEC. The CCR will include a Preliminary Design Report (PDR) that will detail the design parameters for completing the full site remedy.

7.1.1 PDI and IRM Field Activities

This section of the CCR will describe the field methods used to characterize the Site conditions during the PDI, and monitor/document the soil removal activities during the IRM excavation. The methods will include, but not be limited to oversight and sampling techniques; field screening equipment and screening methods; drilling equipment; monitoring well installation procedures; and management of IDW.

7.1.2 PDI Soil Boring Assessment

The CCR will include a section that presents field and laboratory data for soil results. The section will include a description of soil characteristics and figures will be provided that illustrate soil boring locations. Field and laboratory analytical results will be presented in the body of the report, summarized in tables and figures, and the detected concentrations will be compared to regulatory standards and/or guidance values. Soil boring logs and laboratory analytical reports will be provided as attachments.

7.1.3 PDI Soil Vapor Assessment

The CCR will include a section that presents field and laboratory data for the soil vapor samples. The section will include a description of the nested soil vapor sampling points that includes the results for specific sampling depths at each sampling location. Figures will be provided that illustrate the sampling locations and the results with depth. Field and laboratory analytical results will be presented and compared with regulatory standards and/or guidance values, where applicable. Soil vapor sampling logs and laboratory analytical reports will be provided as attachments.

7.1.4 PDI Groundwater Assessment

The CCR will include a section that presents field and laboratory data from the groundwater sampling. The section will include a description of groundwater characteristics, including water table elevation contours and estimation of inferred groundwater flow direction, and figures will be provided that illustrate the monitoring well locations. Field and laboratory analytical results will be presented and compared with regulatory standards and/or guidance values. Low-flow groundwater sampling logs and laboratory analytical reports will be provided as attachments.

7.1.5 IRM Excavation Activities

This section of the CCR will describe the field methods used to oversee and direct the IRM excavation. The methods will include, but not be limited to oversight, field screening, equipment and screening methods; excavation equipment; all soil handling activities, soil import and export, and soil endpoint sampling.

7.1.6 IRM Excavation Soil Endpoint Assessment

This section will include a description of field and laboratory data for soil screening and laboratory analysis results, which will be supported by tabulated data in the form of attached tables, and Site figures that will illustrate soil boring locations and laboratory results (spider maps). Field and laboratory analytical results will be compared to regulatory standards and/or guidance values. Soil boring logs and laboratory analytical reports will be provided as attachments. The endpoint sample tables and figures included in the CCR also will be presented in the Final Engineer Report for the project to demonstrate achievement of the SCOs established in the RAWP.

7.1.7 Preliminary Design Report

The CCR will include a remediation PDR that documents the technical specifications for the intended full site remedy. The PDR will include an updated conceptual site model that depicts the release mechanism, migration pathway, and all affected environmental media, and the documented nature and extent of contamination will be the baseline for applying a site-wide remedy as part of the RAWP. The data presented in the PDR, including the compiled aquifer and geological characteristics, will be used to finalize the specifics for the remedial approach to address remaining soil, groundwater, and soil vapor contamination.

7.1.8 Results and Conclusions

The CCR will include an analysis of the collected data in combination with the information compiled during the PDI and IRM excavation. The full spectrum of data will be concluded as the baseline for remedy preparation.

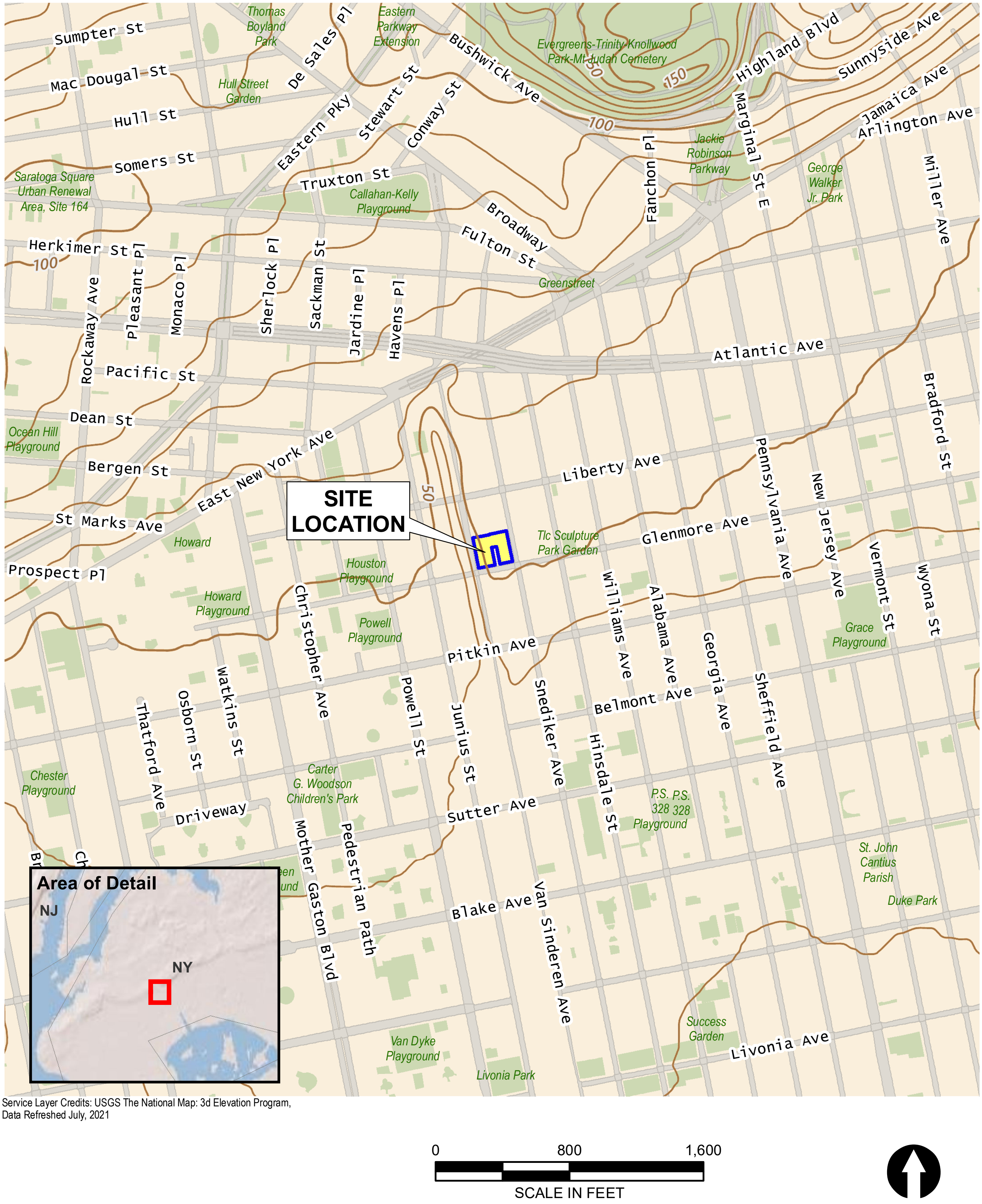
8.0 SCHEDULE OF WORK

The following tentative schedule has been developed for the project:

In-Text Table 4
Proposed IRM Schedule

Task	Date
Submission of IRM Work Plan to NYSDEC along with the BCP Application	December 2022
Execution of the Brownfield Cleanup Agreement	April/May 2023
NYSDEC Approval of updated IRM Work Plan	May 2023
Initiate Site Work – Preliminary Design Investigation	May 2023
Initiate Site Work – Excavation	June 2023
Submit IRM Construction Completion Report	December 2023

FIGURES



Service Layer Credits: USGS The National Map: 3d Elevation Program, Data Refreshed July, 2021

©2022 AKRF Q:\Projects\220249 - 221 GLENMORE AVENUE\Technical\GIS and Graphics\SAR\RMWP\220249 Fig 1 Site Location.mxd12/28/2022 6:42:08 PM mveilleux

AKRF
440 Park Avenue South, New York, NY 10016

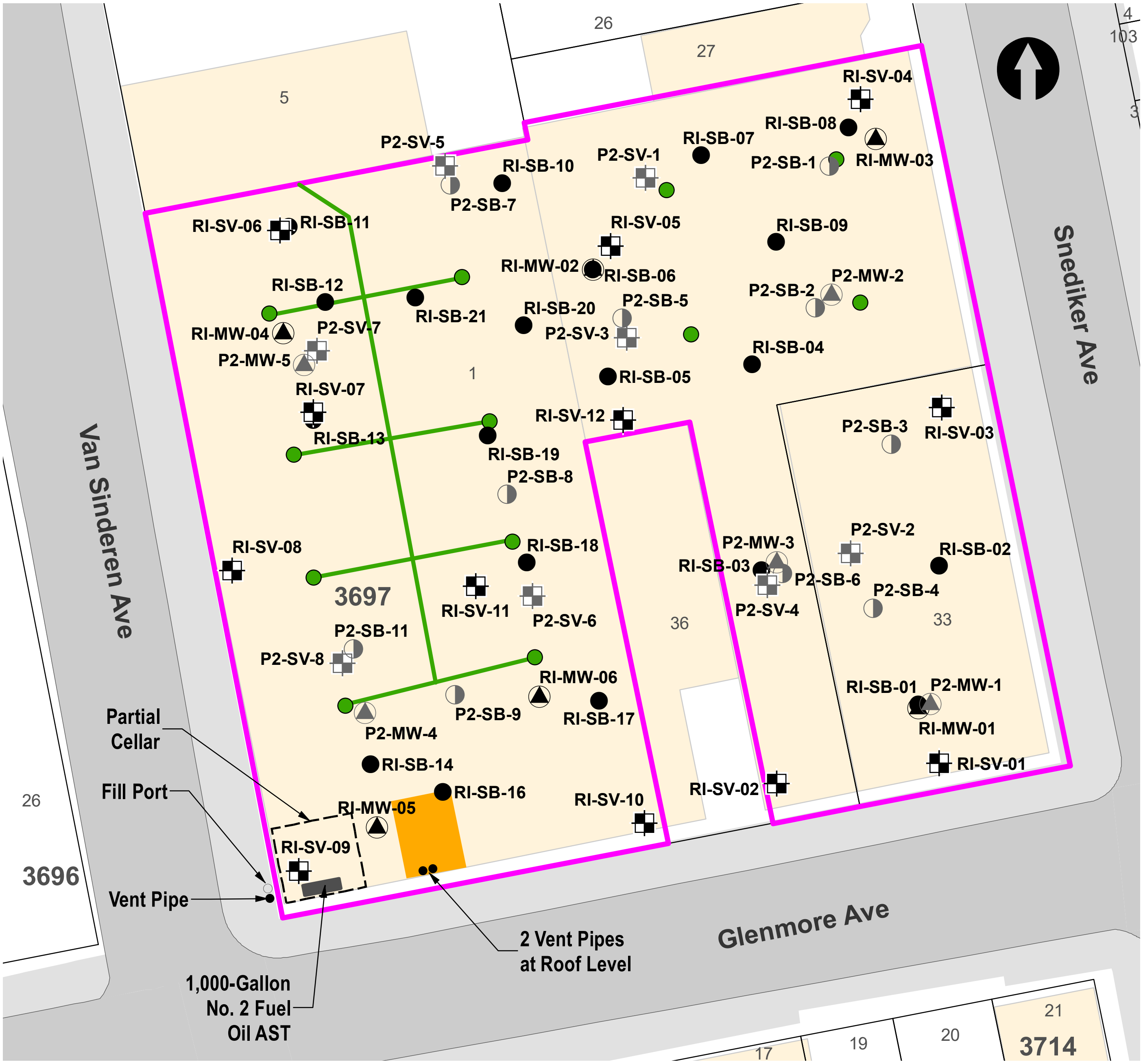
114 Snediker Avenue Site
221-241 Glenmore Avenue
Brooklyn, New York

SITE LOCATION

DATE
12/28/2022

PROJECT NO.
220249

FIGURE
1



Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

▲ PHASE II GROUNDWATER MONITORING WELL LOCATION (MAY 2022)

◐ PHASE II SOIL BORING LOCATION (MAY 2022)

▨ PHASE II SOIL VAPOR EXTRACTION POINT LOCATION (MAY 2022)

▲ REMEDIAL INVESTIGATION GROUNDWATER MONITORING WELL LOCATION (OCTOBER 2022)

● REMEDIAL INVESTIGATION SOIL BORING LOCATION (OCTOBER 2022)

▨ REMEDIAL INVESTIGATION SOIL VAPOR EXTRACTION POINT LOCATION (OCTOBER 2022)

🟧 GEOPHYSICAL RADAR ANOMALY (POTENTIAL UST AREA)

🟪 PROJECT SITE BOUNDARY

1 LOT BOUNDARY AND TAX LOT NUMBER

3697 BLOCK NUMBER

🟨 BUILDING

— UNDERGROUND PLUMBING

🟢 FLOOR DRAIN

0 40 80

SCALE IN FEET

AST = ABOVEGROUND STORAGE TANK
UST = UNDERGROUND STORAGE TANK

AKRF
440 Park Avenue South, New York, NY 10016

114 Snediker Avenue Site
221-241 Glenmore Avenue
Brooklyn, New York

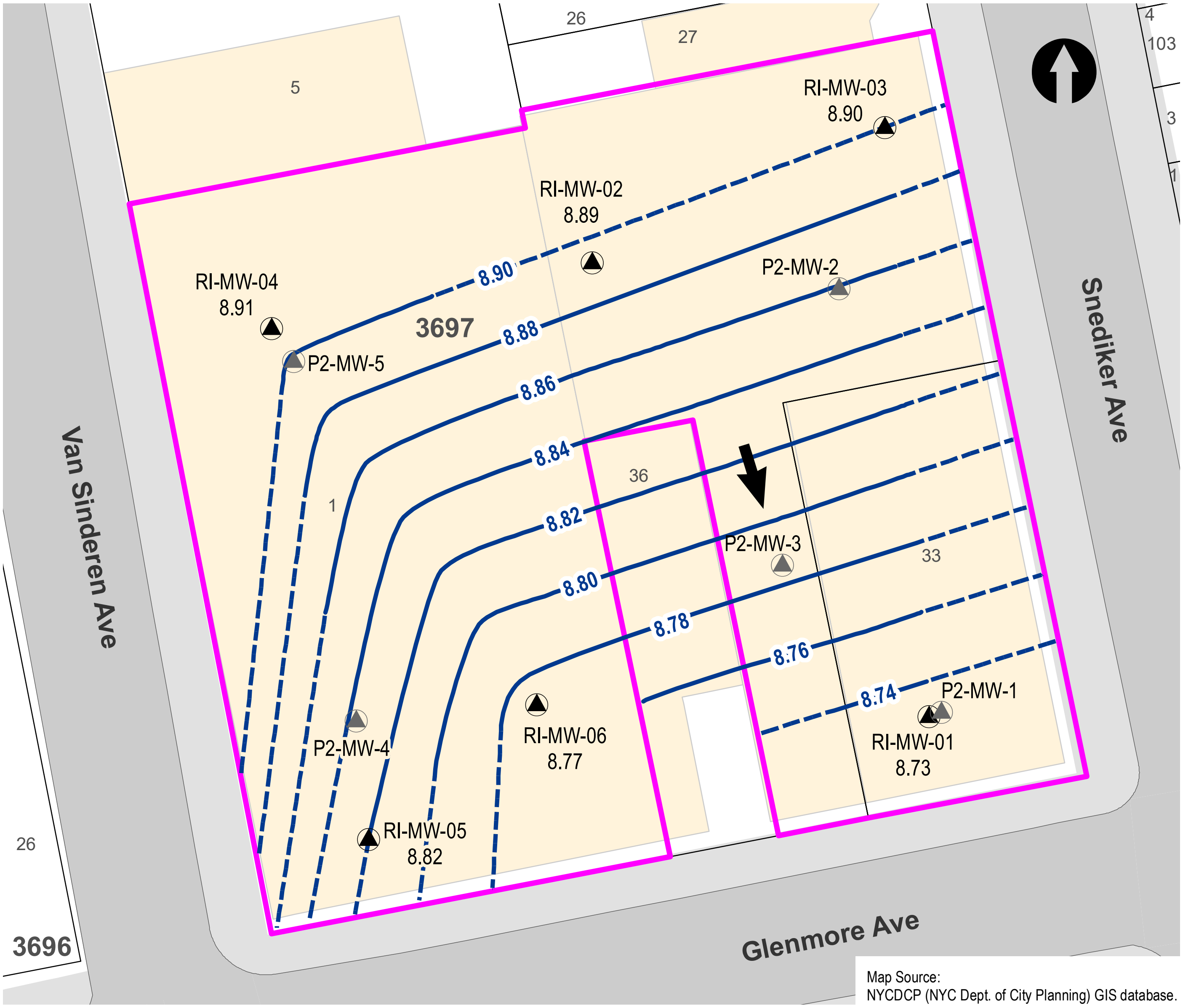
SITE PLAN AND SAMPLE LOCATIONS

DATE
12/28/2022

PROJECT NO.
220249

FIGURE
2

©2022 AKRF Q:\Projects\220249 - 221 GLENMORE AVENUE\Technical\GIS and Graphics\SAR\RMWP\220249 Fig 2 Site Plan and Sample Locations.mxd12/28/2022 6:45:44 PM mveilleux



Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

▭	PROJECT SITE BOUNDARY
1	LOT BOUNDARY AND TAX LOT NUMBER
3697	BLOCK NUMBER
▨	BUILDING
▲	PHASE II GROUNDWATER MONITORING WELL LOCATION (MAY 2022)
▲	REMEDIAL INVESTIGATION GROUNDWATER MONITORING WELL LOCATION (OCTOBER 2022)
—	GROUNDWATER ELEVATION CONTOUR LINE (DASHED WHERE INFERRED)
↓	GROUNDWATER FLOW DIRECTION

Monitor Well ID	Top of Casing (TOC) (feet elevation)	Water Table (feet below TOC) *10/19/2022*	Groundwater Elevation (feet elevation) *10/19/2022*
RI-MW-01	49.68	40.95	8.73
RI-MW-02	51.35	42.46	8.89
RI-MW-03	51.33	42.43	8.90
RI-MW-04	51.67	42.76	8.91
RI-MW-05	51.14	42.32	8.82
RI-MW-06	50.83	42.06	8.77
P2-MW-1	49.72	41.02	8.70
P2-MW-3	51.26	42.48	8.78
P2-MW-4	51.39	42.58	8.81
P2-MW-5	51.74	42.86	8.88

Notes:
Surveyed elevations refer to NAVD 1988.
TOC - Top of Casing

Note: Phase II monitoring well elevations were not utilized in the groundwater contour due to varying well construction details and well diameters

0 40 80
SCALE IN FEET

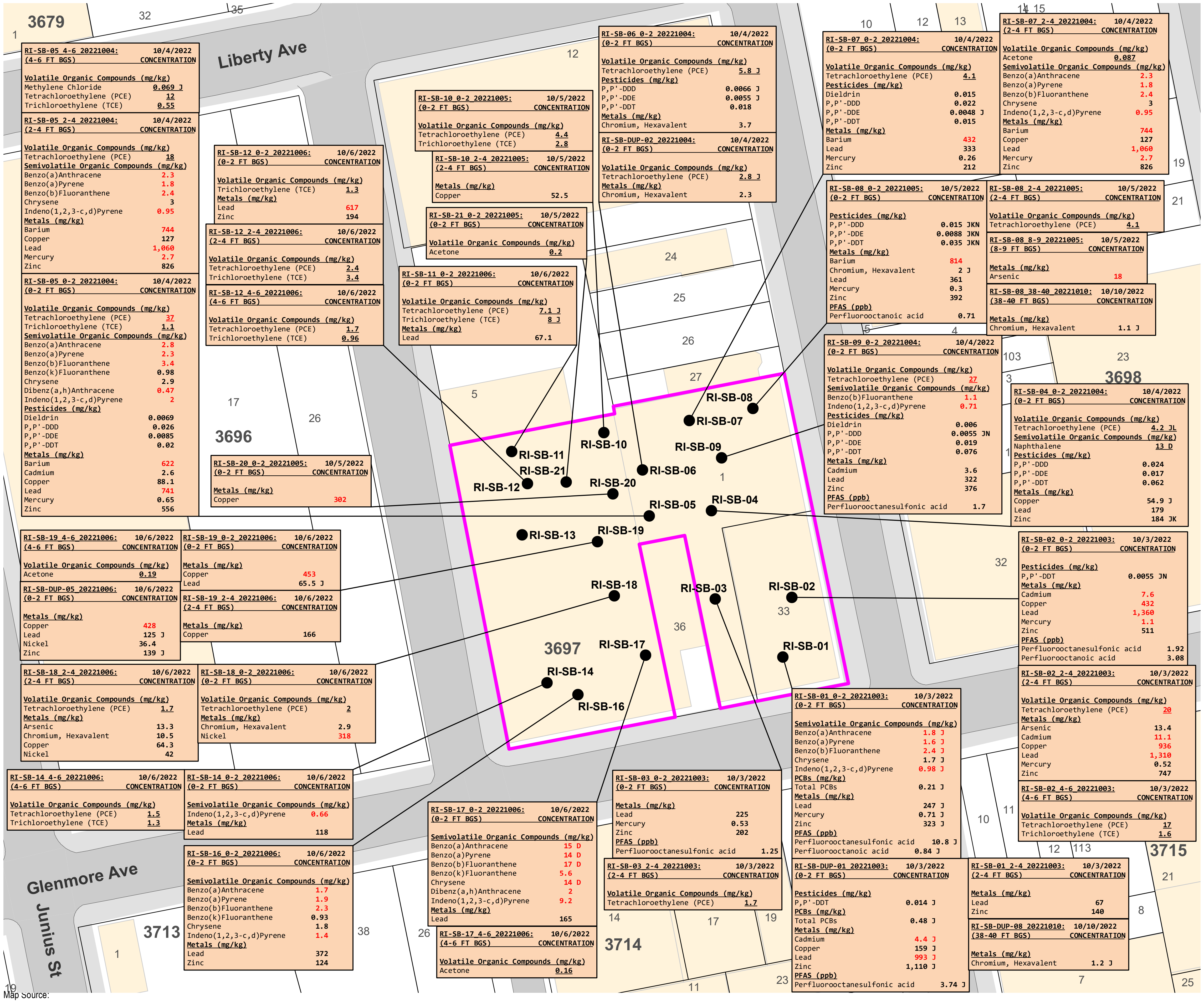
AKRF
440 Park Avenue South, New York, NY 10016

114 Snediker Avenue Site
221-241 Glenmore Avenue
Brooklyn, New York

GROUNDWATER ELEVATION CONTOUR MAP
OCTOBER 19, 2022

DATE
12/29/2022
PROJECT NO.
220249
FIGURE
3

©2022 AKRF Q:\Projects\220249 - 221 GLENMORE AVENUE\Technical\GIS and Graphics\SAR\IRMWP\220249 Fig 3 GW Elevation Contour Map Oct 2022.mxd12/29/2022 12:45:47 PM mveilleux



RI-SB-05_4-6_20221004: (4-6 FT BGS)	10/4/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Methylene Chloride	0.069 J
Tetrachloroethylene (PCE)	12
Trichloroethylene (TCE)	0.55

RI-SB-05_2-4_20221004: (2-4 FT BGS)	10/4/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	18
Semivolatile Organic Compounds (mg/kg)	
Benzo(a)Anthracene	2.3
Benzo(a)Pyrene	1.8
Benzo(b)Fluoranthene	2.4
Chrysene	3
Indeno(1,2,3-c,d)Pyrene	0.95
Metals (mg/kg)	
Barium	744
Copper	127
Lead	1,060
Mercury	2.7
Zinc	826

RI-SB-05_0-2_20221004: (0-2 FT BGS)	10/4/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	37
Trichloroethylene (TCE)	1.1
Semivolatile Organic Compounds (mg/kg)	
Benzo(a)Anthracene	2.8
Benzo(a)Pyrene	2.3
Benzo(b)Fluoranthene	3.4
Benzo(k)Fluoranthene	0.98
Chrysene	2.9
Dibenz(a,h)Anthracene	0.47
Indeno(1,2,3-c,d)Pyrene	2
Pesticides (mg/kg)	
Dieldrin	0.0069
P,P'-DDD	0.026
P,P'-DDE	0.0085
P,P'-DDT	0.02
Metals (mg/kg)	
Barium	622
Cadmium	2.6
Copper	88.1
Lead	741
Mercury	0.65
Zinc	556

RI-SB-12_0-2_20221006: (0-2 FT BGS)	10/6/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Trichloroethylene (TCE)	1.3
Metals (mg/kg)	
Lead	617
Zinc	194

RI-SB-12_2-4_20221006: (2-4 FT BGS)	10/6/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	2.4
Trichloroethylene (TCE)	3.4

RI-SB-12_4-6_20221006: (4-6 FT BGS)	10/6/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	1.7
Trichloroethylene (TCE)	0.96

RI-SB-20_0-2_20221005: (0-2 FT BGS)	10/5/2022 CONCENTRATION
Metals (mg/kg)	
Copper	302

RI-SB-10_0-2_20221005: (0-2 FT BGS)	10/5/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	4.4
Trichloroethylene (TCE)	2.8

RI-SB-10_2-4_20221005: (2-4 FT BGS)	10/5/2022 CONCENTRATION
Metals (mg/kg)	
Copper	52.5

RI-SB-21_0-2_20221005: (0-2 FT BGS)	10/5/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Acetone	0.2

RI-SB-11_0-2_20221006: (0-2 FT BGS)	10/6/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	7.1 J
Trichloroethylene (TCE)	8 J
Metals (mg/kg)	
Lead	67.1

RI-SB-06_0-2_20221004: (0-2 FT BGS)	10/4/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	5.8 J
Pesticides (mg/kg)	
P,P'-DDD	0.0066 J
P,P'-DDE	0.0055 J
P,P'-DDT	0.018
Metals (mg/kg)	
Chromium, Hexavalent	3.7

RI-SB-DUP-02_20221004: (0-2 FT BGS)	10/4/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	2.8 J
Metals (mg/kg)	
Chromium, Hexavalent	2.3

RI-SB-07_0-2_20221004: (0-2 FT BGS)	10/4/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	4.1
Pesticides (mg/kg)	
Dieldrin	0.015
P,P'-DDD	0.022
P,P'-DDE	0.0048 J
P,P'-DDT	0.015
Metals (mg/kg)	
Barium	432
Lead	333
Mercury	0.26
Zinc	212

RI-SB-07_2-4_20221004: (2-4 FT BGS)	10/4/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Acetone	0.087
Semivolatile Organic Compounds (mg/kg)	
Benzo(a)Anthracene	2.3
Benzo(a)Pyrene	1.8
Benzo(b)Fluoranthene	2.4
Chrysene	3
Indeno(1,2,3-c,d)Pyrene	0.95
Metals (mg/kg)	
Barium	744
Copper	127
Lead	1,060
Mercury	2.7
Zinc	826

RI-SB-08_0-2_20221005: (0-2 FT BGS)	10/5/2022 CONCENTRATION
Pesticides (mg/kg)	
P,P'-DDD	0.015 JKN
P,P'-DDE	0.0088 JKN
P,P'-DDT	0.035 JKN
Metals (mg/kg)	
Barium	814
Chromium, Hexavalent	2 J
Lead	361
Mercury	0.3
Zinc	392
PFAS (ppb)	
Perfluorooctanoic acid	0.71

RI-SB-08_2-4_20221005: (2-4 FT BGS)	10/5/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	4.1

RI-SB-08_8-9_20221005: (8-9 FT BGS)	10/5/2022 CONCENTRATION
Metals (mg/kg)	
Arsenic	18

RI-SB-08_38-40_20221010: (38-40 FT BGS)	10/10/2022 CONCENTRATION
Metals (mg/kg)	
Chromium, Hexavalent	1.1 J

RI-SB-09_0-2_20221004: (0-2 FT BGS)	10/4/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	27
Semivolatile Organic Compounds (mg/kg)	
Benzo(b)Fluoranthene	1.1
Indeno(1,2,3-c,d)Pyrene	0.71
Pesticides (mg/kg)	
Dieldrin	0.006
P,P'-DDD	0.0055 JN
P,P'-DDE	0.019
P,P'-DDT	0.076
Metals (mg/kg)	
Cadmium	3.6
Lead	322
Zinc	376
PFAS (ppb)	
Perfluorooctanesulfonic acid	1.7

RI-SB-04_0-2_20221004: (0-2 FT BGS)	10/4/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	4.2 JL
Semivolatile Organic Compounds (mg/kg)	
Naphthalene	13 D
Pesticides (mg/kg)	
P,P'-DDD	0.024
P,P'-DDE	0.017
P,P'-DDT	0.062
Metals (mg/kg)	
Copper	54.9 J
Lead	179
Zinc	184 JK

RI-SB-19_4-6_20221006: (4-6 FT BGS)	10/6/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Acetone	0.19

RI-SB-19_0-2_20221006: (0-2 FT BGS)	10/6/2022 CONCENTRATION
Metals (mg/kg)	
Copper	453
Lead	65.5 J

RI-SB-DUP-05_20221006: (0-2 FT BGS)	10/6/2022 CONCENTRATION
Metals (mg/kg)	
Copper	428
Lead	125 J
Nickel	36.4
Zinc	139 J

RI-SB-19_2-4_20221006: (2-4 FT BGS)	10/6/2022 CONCENTRATION
Metals (mg/kg)	
Copper	166

RI-SB-18_2-4_20221006: (2-4 FT BGS)	10/6/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	1.7
Metals (mg/kg)	
Arsenic	13.3
Chromium, Hexavalent	10.5
Copper	64.3
Nickel	42

RI-SB-18_0-2_20221006: (0-2 FT BGS)	10/6/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	2
Metals (mg/kg)	
Chromium, Hexavalent	2.9
Nickel	318

RI-SB-14_4-6_20221006: (4-6 FT BGS)	10/6/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	1.5
Trichloroethylene (TCE)	1.3

RI-SB-14_0-2_20221006: (0-2 FT BGS)	10/6/2022 CONCENTRATION
Semivolatile Organic Compounds (mg/kg)	
Indeno(1,2,3-c,d)Pyrene	0.66
Metals (mg/kg)	
Lead	118

RI-SB-16_0-2_20221006: (0-2 FT BGS)	10/6/2022 CONCENTRATION
Semivolatile Organic Compounds (mg/kg)	
Benzo(a)Anthracene	1.7
Benzo(a)Pyrene	1.9
Benzo(b)Fluoranthene	2.3
Benzo(k)Fluoranthene	0.93
Chrysene	1.8
Indeno(1,2,3-c,d)Pyrene	1.4
Metals (mg/kg)	
Lead	372
Zinc	124

RI-SB-17_0-2_20221006: (0-2 FT BGS)	10/6/2022 CONCENTRATION
Semivolatile Organic Compounds (mg/kg)	
Benzo(a)Anthracene	15 D
Benzo(a)Pyrene	14 D
Benzo(b)Fluoranthene	17 D
Benzo(k)Fluoranthene	5.6
Chrysene	14 D
Dibenz(a,h)Anthracene	2
Indeno(1,2,3-c,d)Pyrene	9.2
Metals (mg/kg)	
Lead	165

RI-SB-17_4-6_20221006: (4-6 FT BGS)	10/6/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Acetone	0.16

RI-SB-03_0-2_20221003: (0-2 FT BGS)	10/3/2022 CONCENTRATION
Metals (mg/kg)	
Lead	225
Mercury	0.53
Zinc	202
PFAS (ppb)	
Perfluorooctanesulfonic acid	1.25

RI-SB-03_2-4_20221003: (2-4 FT BGS)	10/3/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	1.7

RI-SB-01_0-2_20221003: (0-2 FT BGS)	10/3/2022 CONCENTRATION
Semivolatile Organic Compounds (mg/kg)	
Benzo(a)Anthracene	1.8 J
Benzo(a)Pyrene	1.6 J
Benzo(b)Fluoranthene	2.4 J
Chrysene	1.7 J
Indeno(1,2,3-c,d)Pyrene	0.98 J
PCBs (mg/kg)	
Total PCBs	0.21 J
Metals (mg/kg)	
Lead	247 J
Mercury	0.71 J
Zinc	323 J
PFAS (ppb)	
Perfluorooctanesulfonic acid	10.8 J
Perfluorooctanoic acid	0.84 J

RI-SB-DUP-01_20221003: (0-2 FT BGS)	10/3/2022 CONCENTRATION
Pesticides (mg/kg)	
P,P'-DDT	0.014 J
PCBs (mg/kg)	
Total PCBs	0.48 J
Metals (mg/kg)	
Cadmium	4.4 J
Copper	159 J
Lead	993 J
Zinc	1,110 J
PFAS (ppb)	
Perfluorooctanesulfonic acid	3.74 J

RI-SB-02_0-2_20221003: (0-2 FT BGS)	10/3/2022 CONCENTRATION
Pesticides (mg/kg)	
P,P'-DDT	0.0055 JN
Metals (mg/kg)	
Cadmium	7.6
Copper	432
Lead	1,360
Mercury	1.1
Zinc	511
PFAS (ppb)	
Perfluorooctanesulfonic acid	1.92
Perfluorooctanoic acid	3.08

RI-SB-02_2-4_20221003: (2-4 FT BGS)	10/3/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	20
Metals (mg/kg)	
Arsenic	13.4
Cadmium	11.1
Copper	936
Lead	1,310
Mercury	0.52
Zinc	747

RI-SB-02_4-6_20221003: (4-6 FT BGS)	10/3/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	17
Trichloroethylene (TCE)	1.6

RI-SB-01_2-4_20221003: (2-4 FT BGS)	10/3/2022 CONCENTRATION
Metals (mg/kg)	
Lead	67
Zinc	140

RI-SB-DUP-08_20221010: (38-40 FT BGS)	10/10/2022 CONCENTRATION
Metals (mg/kg)	
Chromium, Hexavalent	1.2 J

Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

- PROJECT SITE BOUNDARY
- 1 LOT BOUNDARY AND TAX LOT NUMBER
- 3697 BLOCK NUMBER
- BUILDING
- ● REMEDIAL INVESTIGATION SOIL BORING LOCATION (OCTOBER 2022)

Part 375 Soil Cleanup Objectives (SCOs): SCOs listed in the New York State Department of Environmental Conservation (NYSDEC) "Part 375" Regulations (6 NYCRR Part 375).

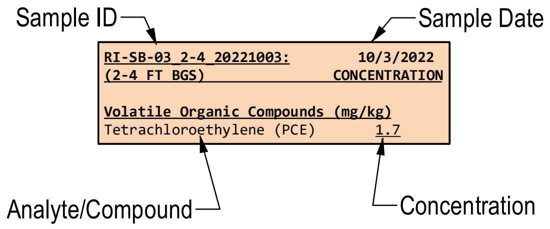
Exceedances of NYSDEC Unrestricted Use Soil Cleanup Objectives (UUSCOs) are presented in bold font.

Exceedances of NYSDEC Restricted Residential Soil Cleanup Objectives (RRSCOs) are presented in red.

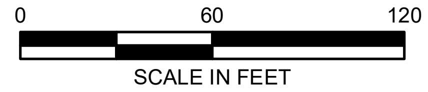
Exceedances of NYSDEC Protected Groundwater Soil Cleanup Objectives (PGWSCOs) are presented in underline.
*Note: PGWSCO comparison was performed for chlorinated VOCs only

mg/kg:milligrams per kilogram = parts per million (ppm)
µg/kg: micrograms per kilogram = parts per billion (ppb)
J: The concentration given is an estimated value.
N: Indicates presumptive evidence of a compound
D: Indicates an identified compound in an analysis that has been diluted
NS: No Standard

	PGWGV ppb	RRGV ppb	UUSCO mg/kg	PGWSCO mg/kg	RRSCO mg/kg
Volatile Organic Compounds					
Acetone	NS	NS	0.05	100	0.05
Methylene Chloride	NS	NS	0.05	100	0.05
Tetrachloroethylene (PCE)	NS	NS	1.3	19	1.3
Trichloroethylene (TCE)	NS	NS	0.47	21	0.47
Semivolatile Organic Compounds					
Benzo(a)Anthracene	NS	NS	1	(Not Compared)	1
Benzo(a)Pyrene	NS	NS	22	(Not Compared)	1
Benzo(b)Fluoranthene	NS	NS	1.7	(Not Compared)	1
Benzo(k)Fluoranthene	NS	NS	1.7	(Not Compared)	0.8
Chrysene	NS	NS	1	(Not Compared)	1
Dibenz(a,h)Anthracene	NS	NS	1000	(Not Compared)	0.33
Indeno(1,2,3-c,d)Pyrene	NS	NS	8.2	(Not Compared)	0.5
Naphthalene	NS	NS	12	(Not Compared)	12
PCBs					
Total PCBs	NS	NS	3.2	(Not Compared)	0.1
Pesticides					
Dieldrin	NS	NS	0.1	(Not Compared)	0.005
P,P'-DDD	NS	NS	14	(Not Compared)	0.0033
P,P'-DDE	NS	NS	17	(Not Compared)	0.0033
P,P'-DDT	NS	NS	136	(Not Compared)	0.0033
Metals					
Arsenic	NS	NS	16	(Not Compared)	13
Barium	NS	NS	820	(Not Compared)	350
Cadmium	NS	NS	7.5	(Not Compared)	2.5
Chromium, Hexavalent	NS	NS	19	(Not Compared)	1
Copper	NS	NS	1720	(Not Compared)	50
Lead	NS	NS	450	(Not Compared)	63
Mercury	NS	NS	0.73	(Not Compared)	0.18
Zinc	NS	NS	2480	(Not Compared)	109
PFAS					
Perfluorooctanesulfonic acid (PFOS)	3.7	44	NS	NS	NS
Perfluorooctanoic acid (PFOA)	1.1	33	NS	NS	NS



RI-SB-03_2-4_20221003: (2-4 FT BGS)	10/3/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	1.7



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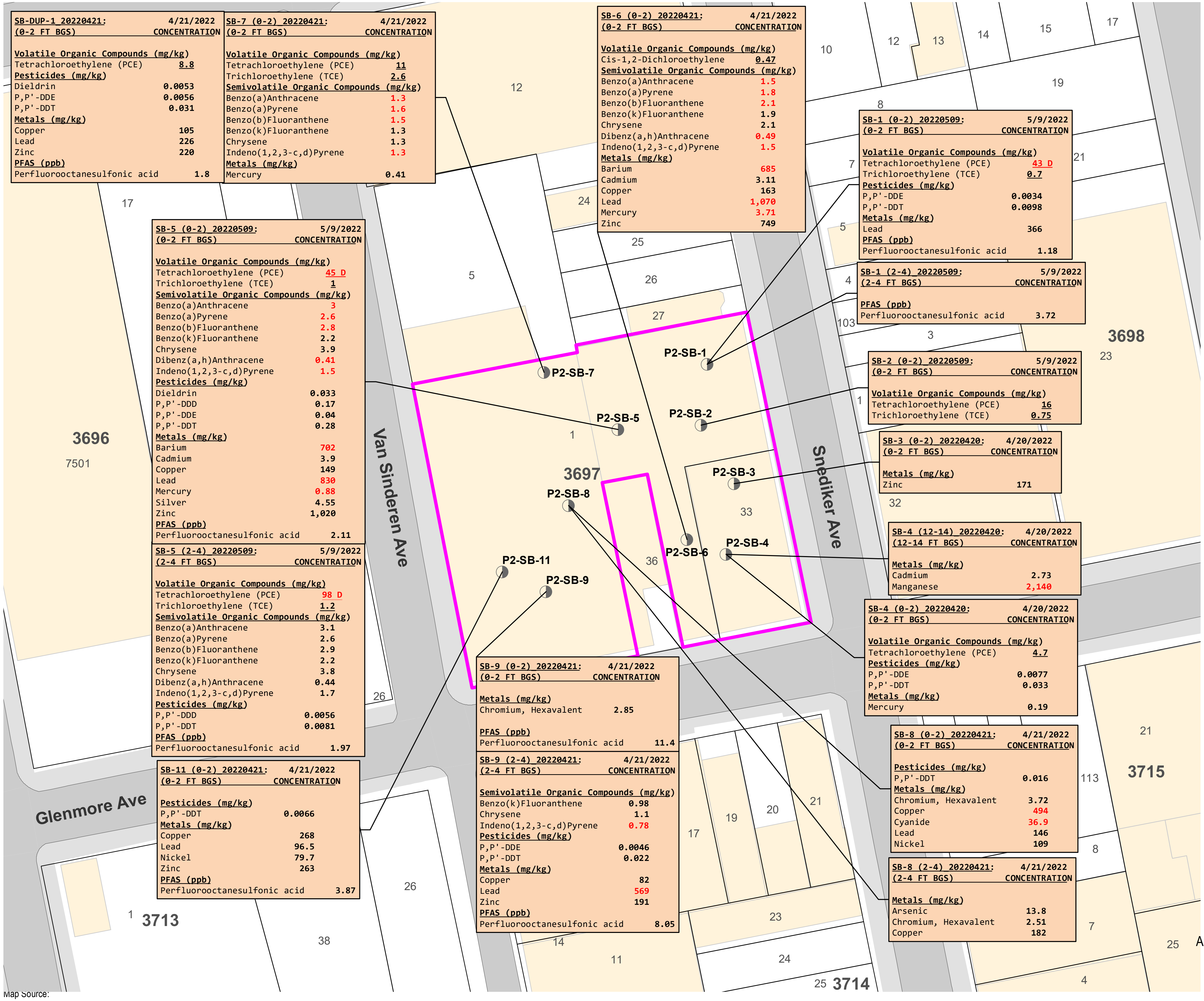
REMEDIAL INVESTIGATION SOIL CONCENTRATIONS ABOVE NYSDEC UUSCOs, RRSCOs, AND/OR PGWSCOs

DATE
12/16/2022
PROJECT NO.
220249
FIGURE
4A



SB-DUP-1_20220421: (0-2 FT BGS)	4/21/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	8.8
Pesticides (mg/kg)	
Dieldrin	0.0053
P,P'-DDE	0.0056
P,P'-DDT	0.031
Metals (mg/kg)	
Copper	105
Lead	226
Zinc	220
PFAS (ppb)	
Perfluorooctanesulfonic acid	1.8

SB-7 (0-2)_20220421: (0-2 FT BGS)	4/21/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	11
Trichloroethylene (TCE)	2.6
Semivolatile Organic Compounds (mg/kg)	
Benzo(a)Anthracene	1.3
Benzo(a)Pyrene	1.6
Benzo(b)Fluoranthene	1.5
Benzo(k)Fluoranthene	1.3
Chrysene	1.3
Indeno(1,2,3-c,d)Pyrene	1.3
Metals (mg/kg)	
Mercury	0.41

SB-6 (0-2)_20220421: (0-2 FT BGS)	4/21/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Cis-1,2-Dichloroethylene	0.47
Semivolatile Organic Compounds (mg/kg)	
Benzo(a)Anthracene	1.5
Benzo(a)Pyrene	1.8
Benzo(b)Fluoranthene	2.1
Benzo(k)Fluoranthene	1.9
Chrysene	2.1
Dibenz(a,h)Anthracene	0.49
Indeno(1,2,3-c,d)Pyrene	1.5
Metals (mg/kg)	
Barium	685
Cadmium	3.11
Copper	163
Lead	1,070
Mercury	3.71
Zinc	749

SB-1 (0-2)_20220509: (0-2 FT BGS)	5/9/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	43 D
Trichloroethylene (TCE)	0.7
Pesticides (mg/kg)	
P,P'-DDE	0.0034
P,P'-DDT	0.0098
Metals (mg/kg)	
Lead	366
PFAS (ppb)	
Perfluorooctanesulfonic acid	1.18

SB-1 (2-4)_20220509: (2-4 FT BGS)	5/9/2022 CONCENTRATION
PFAS (ppb)	
Perfluorooctanesulfonic acid	3.72

SB-5 (0-2)_20220509: (0-2 FT BGS)	5/9/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	45 D
Trichloroethylene (TCE)	1
Semivolatile Organic Compounds (mg/kg)	
Benzo(a)Anthracene	3
Benzo(a)Pyrene	2.6
Benzo(b)Fluoranthene	2.8
Benzo(k)Fluoranthene	2.2
Chrysene	3.9
Dibenz(a,h)Anthracene	0.41
Indeno(1,2,3-c,d)Pyrene	1.5
Pesticides (mg/kg)	
Dieldrin	0.033
P,P'-DDD	0.17
P,P'-DDE	0.04
P,P'-DDT	0.28
Metals (mg/kg)	
Barium	702
Cadmium	3.9
Copper	149
Lead	830
Mercury	0.88
Silver	4.55
Zinc	1,020
PFAS (ppb)	
Perfluorooctanesulfonic acid	2.11

SB-5 (2-4)_20220509: (2-4 FT BGS)	5/9/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	98 D
Trichloroethylene (TCE)	1.2
Semivolatile Organic Compounds (mg/kg)	
Benzo(a)Anthracene	3.1
Benzo(a)Pyrene	2.6
Benzo(b)Fluoranthene	2.9
Benzo(k)Fluoranthene	2.2
Chrysene	3.8
Dibenz(a,h)Anthracene	0.44
Indeno(1,2,3-c,d)Pyrene	1.7
Pesticides (mg/kg)	
P,P'-DDD	0.0056
P,P'-DDT	0.0081
PFAS (ppb)	
Perfluorooctanesulfonic acid	1.97

SB-2 (0-2)_20220509: (0-2 FT BGS)	5/9/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	16
Trichloroethylene (TCE)	0.75

SB-3 (0-2)_20220420: (0-2 FT BGS)	4/20/2022 CONCENTRATION
Metals (mg/kg)	
Zinc	171

SB-4 (12-14)_20220420: (12-14 FT BGS)	4/20/2022 CONCENTRATION
Metals (mg/kg)	
Cadmium	2.73
Manganese	2,140

SB-4 (0-2)_20220420: (0-2 FT BGS)	4/20/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	4.7
Pesticides (mg/kg)	
P,P'-DDE	0.0077
P,P'-DDT	0.033
Metals (mg/kg)	
Mercury	0.19

SB-9 (0-2)_20220421: (0-2 FT BGS)	4/21/2022 CONCENTRATION
Metals (mg/kg)	
Chromium, Hexavalent	2.85
PFAS (ppb)	
Perfluorooctanesulfonic acid	11.4

SB-9 (2-4)_20220421: (2-4 FT BGS)	4/21/2022 CONCENTRATION
Semivolatile Organic Compounds (mg/kg)	
Benzo(k)Fluoranthene	0.98
Chrysene	1.1
Indeno(1,2,3-c,d)Pyrene	0.78
Pesticides (mg/kg)	
P,P'-DDE	0.0046
P,P'-DDT	0.022
Metals (mg/kg)	
Copper	82
Lead	569
Zinc	191
PFAS (ppb)	
Perfluorooctanesulfonic acid	8.05

SB-11 (0-2)_20220421: (0-2 FT BGS)	4/21/2022 CONCENTRATION
Pesticides (mg/kg)	
P,P'-DDT	0.0066
Metals (mg/kg)	
Copper	268
Lead	96.5
Nickel	79.7
Zinc	263
PFAS (ppb)	
Perfluorooctanesulfonic acid	3.87

SB-8 (0-2)_20220421: (0-2 FT BGS)	4/21/2022 CONCENTRATION
Pesticides (mg/kg)	
P,P'-DDT	0.016
Metals (mg/kg)	
Chromium, Hexavalent	3.72
Copper	494
Cyanide	36.9
Lead	146
Nickel	109

SB-8 (2-4)_20220421: (2-4 FT BGS)	4/21/2022 CONCENTRATION
Metals (mg/kg)	
Arsenic	13.8
Chromium, Hexavalent	2.51
Copper	182

Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

▭	PROJECT SITE BOUNDARY
1	LOT BOUNDARY AND TAX LOT NUMBER
3697	BLOCK NUMBER
▭	BUILDING
◑	PHASE II SOIL BORING LOCATION (MAY 2022)

Part 375 Soil Cleanup Objectives (SCOs): SCOs listed in the New York State Department of Environmental Conservation (NYSDEC) "Part 375" Regulations (6 NYCRR Part 375).

Exceedances of NYSDEC Unrestricted Use Soil Cleanup Objectives (UUSCOs) are presented in bold font.

Exceedances of NYSDEC Restricted Residential Soil Cleanup Objectives (RRSCOs) are presented in red.

Exceedances of NYSDEC Protected Groundwater Soil Cleanup Objectives (PGWSCOs) are presented in underline.
*Note: PGWSCO comparison was performed for chlorinated VOCs only

mg/kg:milligrams per kilogram = parts per million (ppm)
µg/kg: micrograms per kilogram = parts per billion (ppb)

D: Indicates an identified compound in an analysis that has been diluted
NS: No Standard

	UUGV ppb	RRGV ppb	PGWSCO mg/kg	RRSCO mg/kg	UUSCO mg/kg
Volatile Organic Compounds					
Cis-1,2-Dichloroethylene	NS	NS	0.25	100	0.25
Tetrachloroethylene (PCE)	NS	NS	1.3	19	1.3
Trichloroethylene (TCE)	NS	NS	0.47	21	0.47
Semivolatile Organic Compounds					
Benzo(a)Anthracene	NS	NS	(No Comparison)	1	1
Benzo(a)Pyrene	NS	NS	(No Comparison)	1	1
Benzo(b)Fluoranthene	NS	NS	(No Comparison)	1	1
Benzo(k)Fluoranthene	NS	NS	(No Comparison)	3.9	0.8
Chrysene	NS	NS	(No Comparison)	3.9	1
Dibenz(a,h)Anthracene	NS	NS	(No Comparison)	0.33	0.33
Indeno(1,2,3-c,d)Pyrene	NS	NS	(No Comparison)	0.5	0.5
Pesticides					
Dieldrin	NS	NS	(No Comparison)	0.2	0.005
P,P'-DDD	NS	NS	(No Comparison)	13	0.0033
P,P'-DDE	NS	NS	(No Comparison)	8.9	0.0033
P,P'-DDT	NS	NS	(No Comparison)	7.9	0.0033
Metals					
Arsenic	NS	NS	(No Comparison)	16	13
Barium	NS	NS	(No Comparison)	400	350
Cadmium	NS	NS	(No Comparison)	4.3	2.5
Chromium, Hexavalent	NS	NS	(No Comparison)	110	1
Copper	NS	NS	(No Comparison)	270	50
Cyanide	NS	NS	(No Comparison)	27	27
Lead	NS	NS	(No Comparison)	400	63
Manganese	NS	NS	(No Comparison)	2000	1600
Mercury	NS	NS	(No Comparison)	0.81	0.18
Nickel	NS	NS	(No Comparison)	310	30
Silver	NS	NS	(No Comparison)	180	2
Zinc	NS	NS	(No Comparison)	10000	109
PFAS					
Perfluorooctanesulfonic acid (PFOS)	0.88	44	NS	NS	NS

Sample ID
Sample Date

SB-2 (0-2)_20220509: (0-2 FT BGS)	5/9/2022 CONCENTRATION
Volatile Organic Compounds (mg/kg)	
Tetrachloroethylene (PCE)	16
Trichloroethylene (TCE)	0.75

Analyte/Compound
Concentration

0 60 120
SCALE IN FEET

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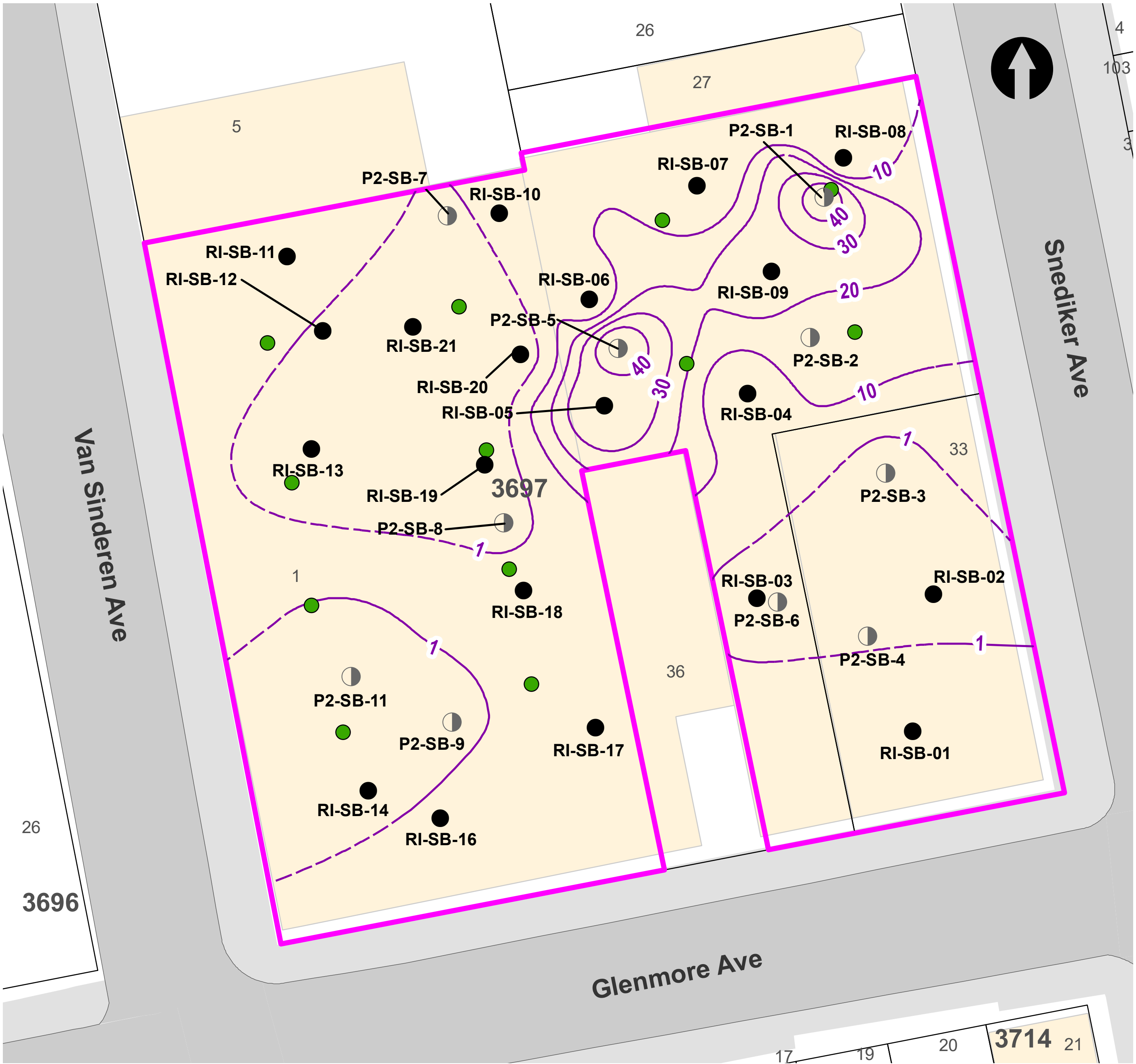
PHASE II SOIL CONCENTRATIONS ABOVE NYSDEC UUSCOs, RRSCOs, AND/OR PGWSCOs

DATE
12/16/2022
PROJECT NO.
220249
FIGURE
4B



Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

▭	PROJECT SITE BOUNDARY
1	LOT BOUNDARY AND TAX LOT NUMBER
3697	BLOCK NUMBER
▭	BUILDING
◐	PHASE II SOIL BORING LOCATION (MAY 2022)
●	REMEDIAL INVESTIGATION SOIL BORING LOCATION (OCTOBER 2022)
—	PCE CONTOUR LINE (PPM = PARTS PER MILLION) (DASHED WHERE INFERRED)
●	FLOOR DRAIN

0 40 80
SCALE IN FEET

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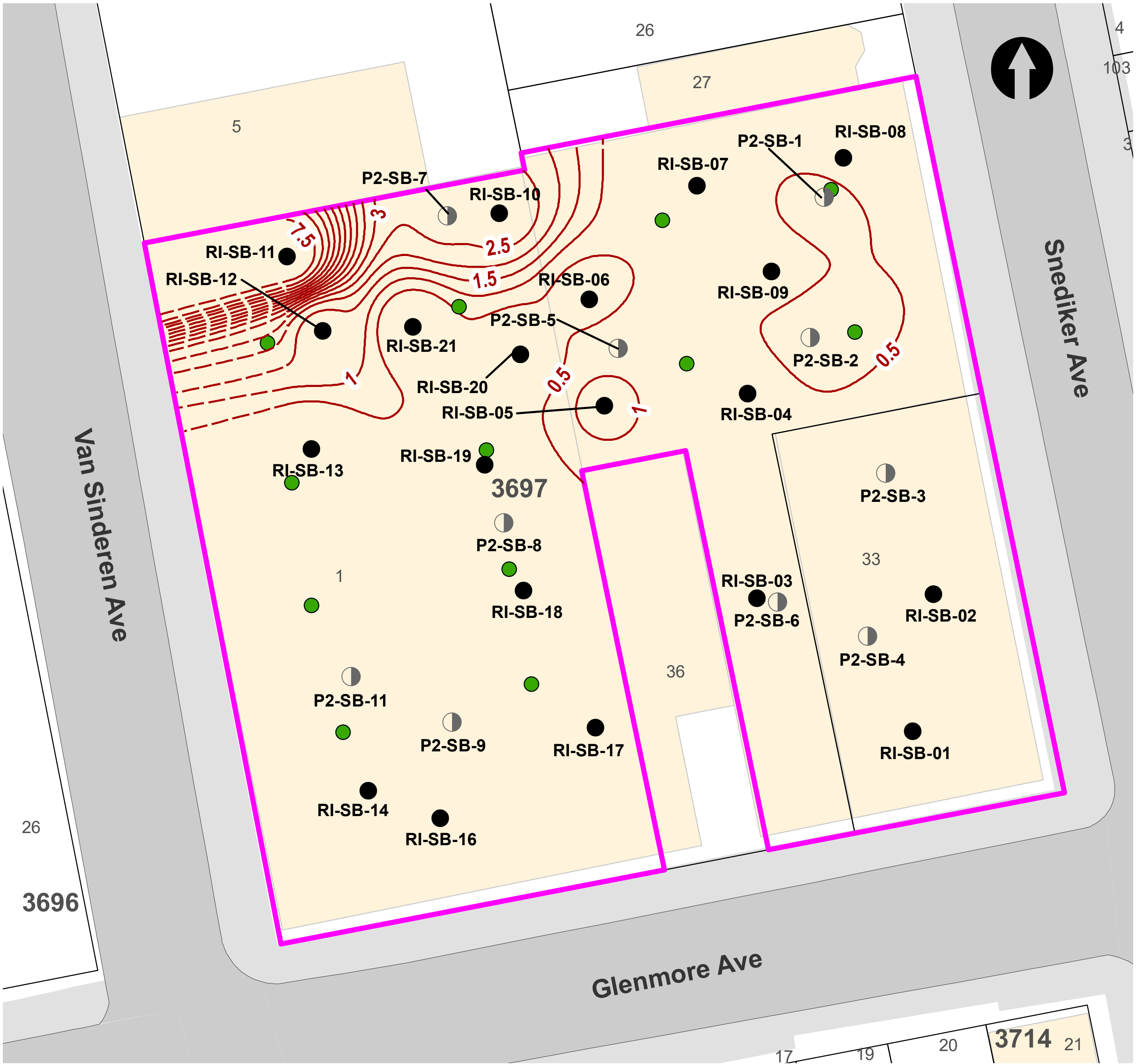
ISOCONTOUR MAP - PCE IN SHALLOW SOIL (0-2 FEET BELOW GRADE)

DATE
12/29/2022
PROJECT NO.
220249
FIGURE
5A

©2022 AKRF Q:\Projects\220249 - 221 GLENMORE AVENUE\Technical\GIS and Graphics\SAR\RMWP\220249 Fig 5A Isocontour Map - PCE Shallow Soil 0-2.mxd12/29/2022 3:39:01 PM mveilleux



Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

- ▭ PROJECT SITE BOUNDARY
- ▭ 1 LOT BOUNDARY AND TAX LOT NUMBER
- 3697 BLOCK NUMBER
- ▨ BUILDING
- ◑ PHASE II SOIL BORING LOCATION (MAY 2022)
- ● REMEDIAL INVESTIGATION SOIL BORING LOCATION (OCTOBER 2022)
- — TCE CONTOUR LINE (PPM = PARTS PER MILLION) (DASHED WHERE INFERRED)
- ● FLOOR DRAIN

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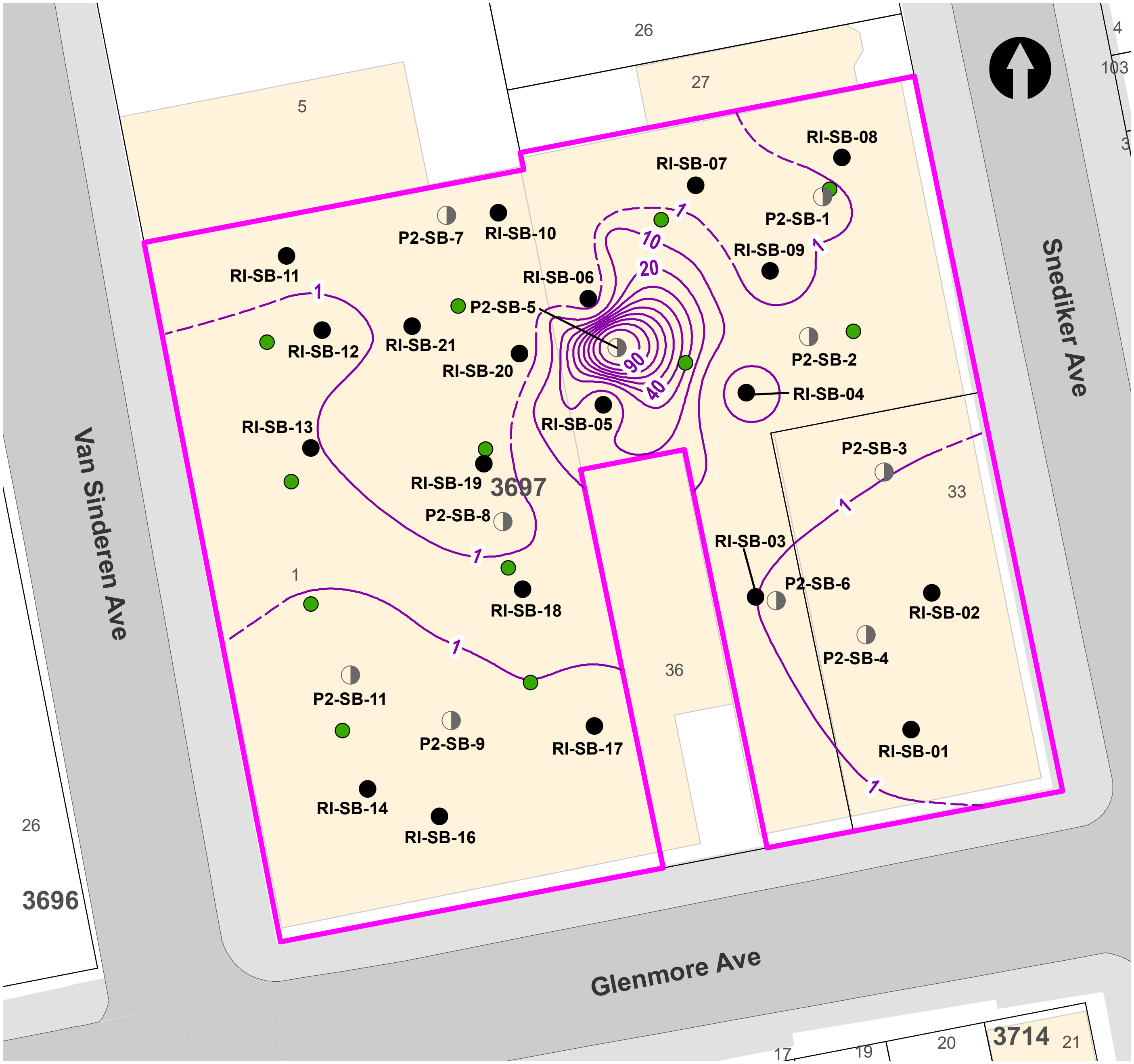
ISOCONTOUR MAP - TCE IN SHALLOW SOIL (0-2 FEET BELOW GRADE)

DATE
12/29/2022
PROJECT NO.
220249
FIGURE
5B

©2022 AKRF Q:\Projects\220249 - 221 GLENMORE AVENUE\Technical\GIS and Graphics\SAR\RMWP\220249 Fig 5B Isocontour Map - TCE Shallow Soil 0-2.mxd12/29/2022 3:10:11 PM mveilleux



Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

▭ PROJECT SITE BOUNDARY

▭ 1 LOT BOUNDARY AND TAX LOT NUMBER

3697 BLOCK NUMBER

▭ BUILDING

◐ PHASE II SOIL BORING LOCATION (MAY 2022)

● REMEDIAL INVESTIGATION SOIL BORING LOCATION (OCTOBER 2022)

— PCE CONTOUR LINE (PPM = PARTS PER MILLION) (DASHED WHERE INFERRED)

● FLOOR DRAIN

0 40 80
SCALE IN FEET

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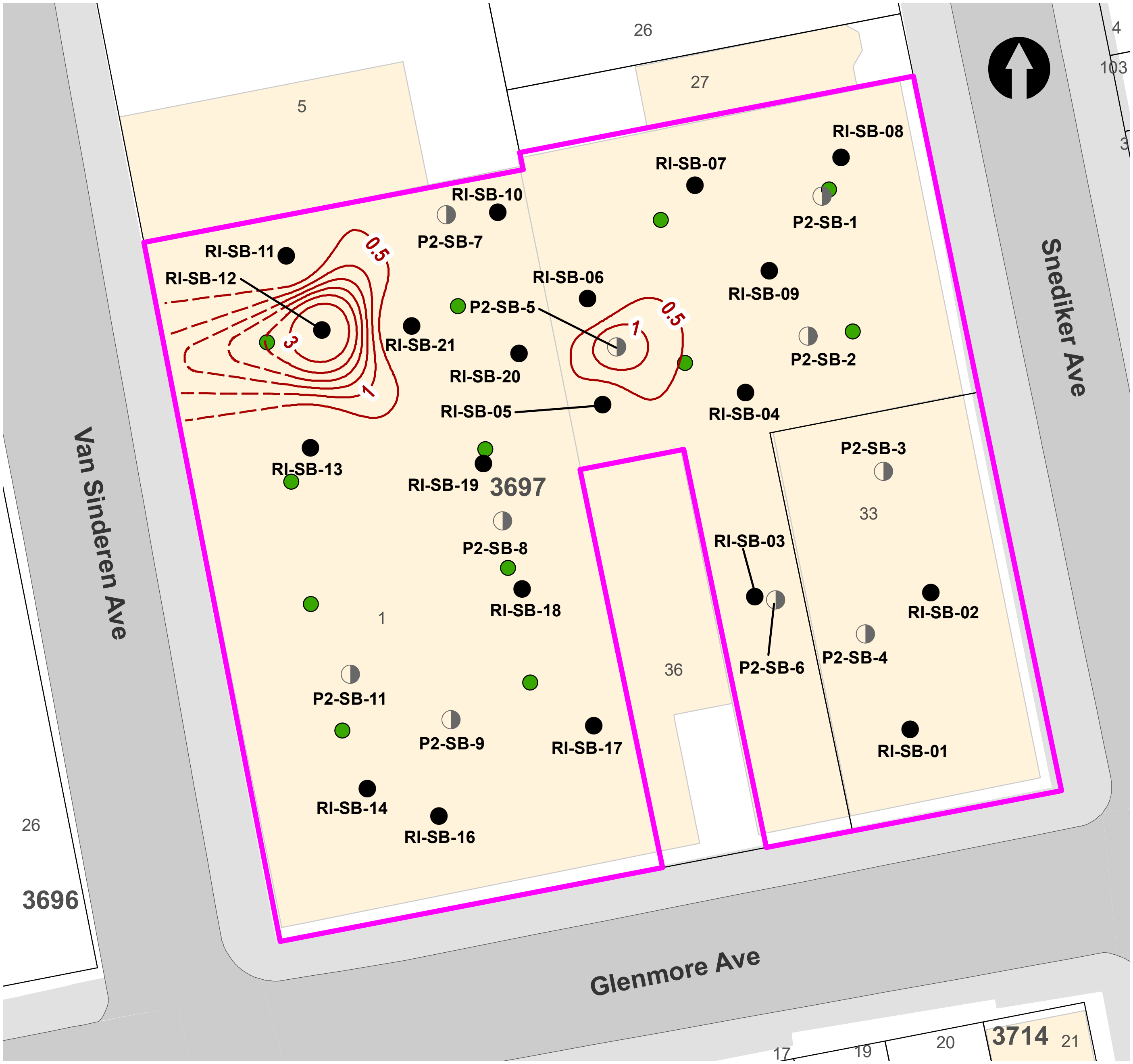
ISOCONTOUR MAP - PCE IN SHALLOW SOIL (2-4 FEET BELOW GRADE)

DATE
12/29/2022

PROJECT NO.
220249

FIGURE
6A



Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

▭	PROJECT SITE BOUNDARY
1	LOT BOUNDARY AND TAX LOT NUMBER
3697	BLOCK NUMBER
▭	BUILDING
◑	PHASE II SOIL BORING LOCATION (MAY
●	REMEDIAL INVESTIGATION SOIL BORING LOCATION (OCTOBER 2022)
—	TCE CONTOUR LINE (PPM = PARTS PER MILLION) (DASHED WHERE INFERRED)
●	FLOOR DRAIN

0 40 80
SCALE IN FEET

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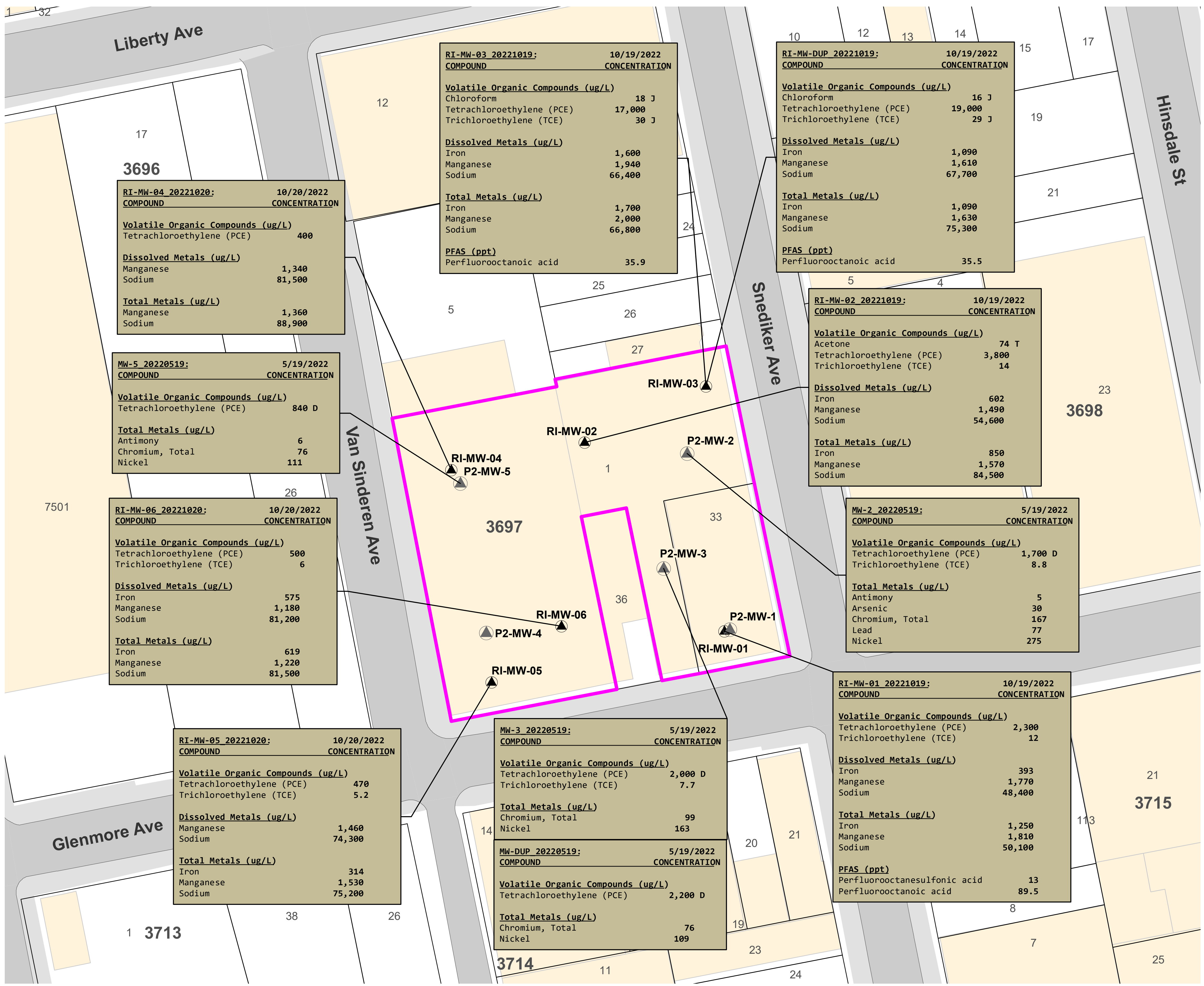
Brooklyn, New York

ISOCONTOUR MAP - TCE IN SHALLOW SOIL (2-4 FEET BELOW GRADE)

DATE
12/28/2022

PROJECT NO.
220249

FIGURE
6B



RI-MW-03_20221019:	10/19/2022
COMPOUND	CONCENTRATION
Volatile Organic Compounds (ug/L)	
Chloroform	**18 J**
Tetrachloroethylene (PCE)	**17,000**
Trichloroethylene (TCE)	**30 J**
Dissolved Metals (ug/L)	
Iron	**1,600**
Manganese	**1,940**
Sodium	**66,400**
Total Metals (ug/L)	
Iron	**1,700**
Manganese	**2,000**
Sodium	**66,800**
PFAS (ppt)	
Perfluorooctanoic acid	**35.9**

RI-MW-DUP_20221019:	10/19/2022
COMPOUND	CONCENTRATION
Volatile Organic Compounds (ug/L)	
Chloroform	**16 J**
Tetrachloroethylene (PCE)	**19,000**
Trichloroethylene (TCE)	**29 J**
Dissolved Metals (ug/L)	
Iron	**1,090**
Manganese	**1,610**
Sodium	**67,700**
Total Metals (ug/L)	
Iron	**1,090**
Manganese	**1,630**
Sodium	**75,300**
PFAS (ppt)	
Perfluorooctanoic acid	**35.5**

RI-MW-04_20221020:	10/20/2022
COMPOUND	CONCENTRATION
Volatile Organic Compounds (ug/L)	
Tetrachloroethylene (PCE)	**400**
Dissolved Metals (ug/L)	
Manganese	**1,340**
Sodium	**81,500**
Total Metals (ug/L)	
Manganese	**1,360**
Sodium	**88,900**

MW-5_20220519:	5/19/2022
COMPOUND	CONCENTRATION
Volatile Organic Compounds (ug/L)	
Tetrachloroethylene (PCE)	**840 D**
Total Metals (ug/L)	
Antimony	**6**
Chromium, Total	**76**
Nickel	**111**

RI-MW-02_20221019:	10/19/2022
COMPOUND	CONCENTRATION
Volatile Organic Compounds (ug/L)	
Acetone	**74 T**
Tetrachloroethylene (PCE)	**3,800**
Trichloroethylene (TCE)	**14**
Dissolved Metals (ug/L)	
Iron	**602**
Manganese	**1,490**
Sodium	**54,600**
Total Metals (ug/L)	
Iron	**850**
Manganese	**1,570**
Sodium	**84,500**

RI-MW-06_20221020:	10/20/2022
COMPOUND	CONCENTRATION
Volatile Organic Compounds (ug/L)	
Tetrachloroethylene (PCE)	**500**
Trichloroethylene (TCE)	**6**
Dissolved Metals (ug/L)	
Iron	**575**
Manganese	**1,180**
Sodium	**81,200**
Total Metals (ug/L)	
Iron	**619**
Manganese	**1,220**
Sodium	**81,500**

MW-2_20220519:	5/19/2022
COMPOUND	CONCENTRATION
Volatile Organic Compounds (ug/L)	
Tetrachloroethylene (PCE)	**1,700 D**
Trichloroethylene (TCE)	**8.8**
Total Metals (ug/L)	
Antimony	**5**
Arsenic	**30**
Chromium, Total	**167**
Lead	**77**
Nickel	**275**

RI-MW-01_20221019:	10/19/2022
COMPOUND	CONCENTRATION
Volatile Organic Compounds (ug/L)	
Tetrachloroethylene (PCE)	**2,300**
Trichloroethylene (TCE)	**12**
Dissolved Metals (ug/L)	
Iron	**393**
Manganese	**1,770**
Sodium	**48,400**
Total Metals (ug/L)	
Iron	**1,250**
Manganese	**1,810**
Sodium	**50,100**
PFAS (ppt)	
Perfluorooctanesulfonic acid	**13**
Perfluorooctanoic acid	**89.5**

RI-MW-05_20221020:	10/20/2022
COMPOUND	CONCENTRATION
Volatile Organic Compounds (ug/L)	
Tetrachloroethylene (PCE)	**470**
Trichloroethylene (TCE)	**5.2**
Dissolved Metals (ug/L)	
Manganese	**1,460**
Sodium	**74,300**
Total Metals (ug/L)	
Iron	**314**
Manganese	**1,530**
Sodium	**75,200**

MW-3_20220519:	5/19/2022
COMPOUND	CONCENTRATION
Volatile Organic Compounds (ug/L)	
Tetrachloroethylene (PCE)	**2,000 D**
Trichloroethylene (TCE)	**7.7**
Total Metals (ug/L)	
Chromium, Total	**99**
Nickel	**163**

MW-DUP_20220519:	5/19/2022
COMPOUND	CONCENTRATION
Volatile Organic Compounds (ug/L)	
Tetrachloroethylene (PCE)	**2,200 D**
Total Metals (ug/L)	
Chromium, Total	**76**
Nickel	**109**

Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

▭	PROJECT SITE BOUNDARY
1	LOT BOUNDARY AND TAX LOT NUMBER
3697	BLOCK NUMBER
▭	BUILDING
▲	REMEDIAL INVESTIGATION GROUNDWATER MONITORING WELL LOCATION (OCTOBER 2022)
▲	PHASE II GROUNDWATER MONITORING WELL LOCATION (MAY 2022)

NYSDEC TOGS Class GA Ambient Water Quality Standard and Guidance Values (AWQSGVs):
New York State Department of Environmental Conservation (NYSDEC) Technical and Operational Guidance Series (TOGS) (1.1.1):

Groundwater PFAS results are compared to guidance values listed in NYSDEC's 2021 *Draft Addendum to the Technical and Operational Guidance (TOGS) No. 1.1.1.*

µg/L: micrograms per Liter = parts per billion (ppb)
ppt: parts per trillion

D: Indicates an identified compound in an analysis that has been diluted.
J: The concentration given is an estimated value.
T: Indicates that a quality control parameter has exceeded laboratory limits

Only Exceedances of NYSDEC AWQSGVs or PFAS Screening Levels are shown in bold font.

	NYSDEC AWQSGVs ug/l	Groundwater Screening Level ppt
Volatile Organic Compounds		
Acetone	50	NS
Chloroform	7	NS
Tetrachloroethylene (PCE)	5	NS
Trichloroethylene (TCE)	5	NS
Metals		
Antimony	3	NS
Arsenic	25	NS
Chromium, Total	50	NS
Iron	300	NS
Lead	25	NS
Manganese	300	NS
Nickel	100	NS
Sodium	20000	NS
PFAS		
Perfluorooctanesulfonic acid (PFOS)	NS	10
Perfluorooctanoic acid (PFOA)	NS	10

Sample ID
Sample Date

RI-MW-04_20221020:	10/20/2022
COMPOUND	CONCENTRATION
Volatile Organic Compounds (ug/L)	
Tetrachloroethylene (PCE)	**400**
Dissolved Metals (ug/L)	
Manganese	**1,340**
Sodium	**81,500**
Total Metals (ug/L)	
Manganese	**1,360**
Sodium	**88,900**

Analyte/Compound
Concentration

0 60 120
SCALE IN FEET

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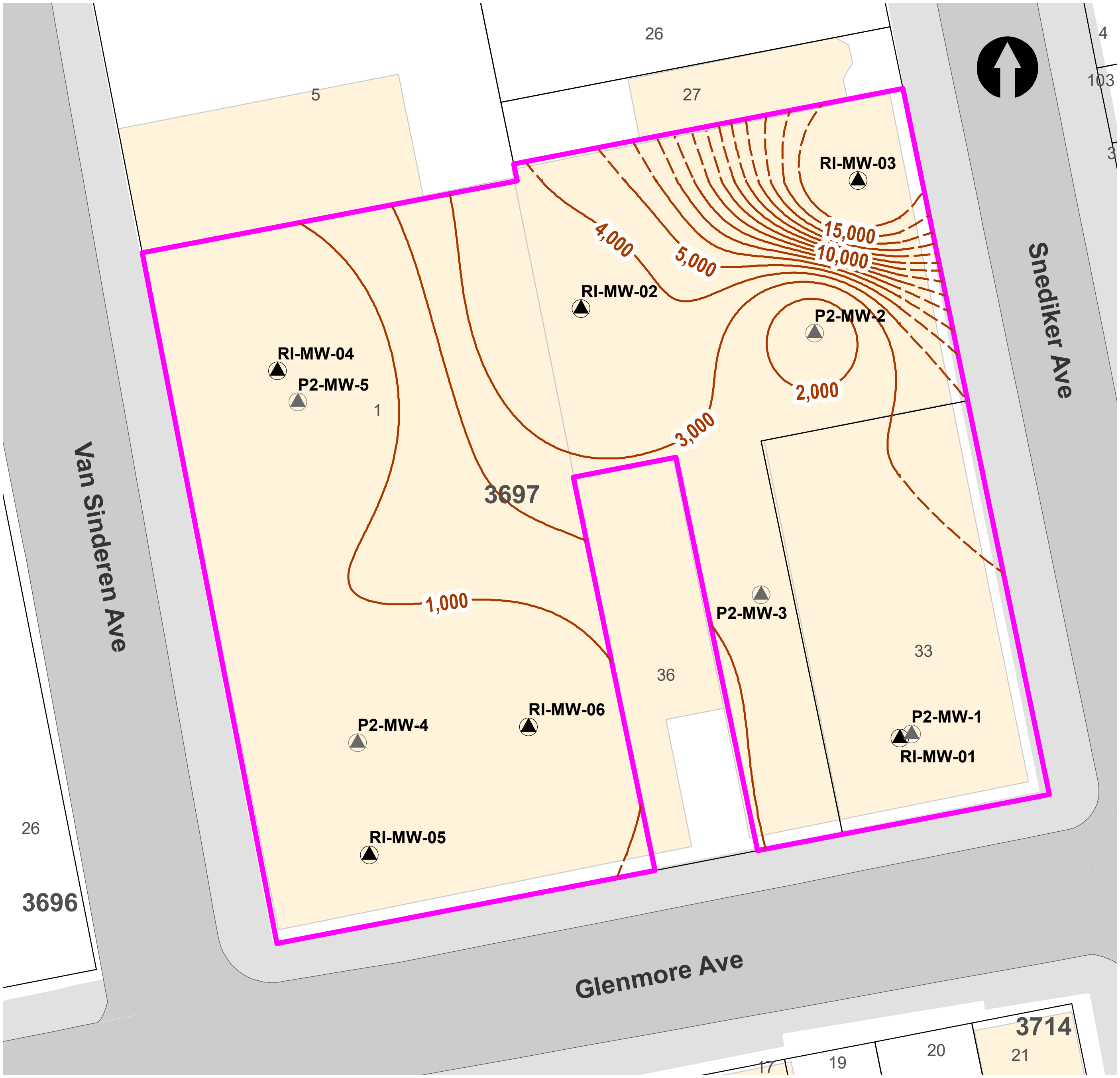
GROUNDWATER CONCENTRATIONS ABOVE NYSDEC AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES AND PFAS GUIDANCE VALUES

DATE
12/28/2022
PROJECT NO.
220249
FIGURE
7



Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

▭	PROJECT SITE BOUNDARY
1	LOT BOUNDARY AND TAX LOT NUMBER
3697	BLOCK NUMBER
▨	BUILDING
▲	PHASE II GROUNDWATER MONITORING WELL LOCATION (MAY 2022)
▲	REMEDIAL INVESTIGATION GROUNDWATER MONITORING WELL LOCATION (OCTOBER 2022)
—	PCE CONTOUR LINE (ppb = parts per billion)

0 40 80
SCALE IN FEET

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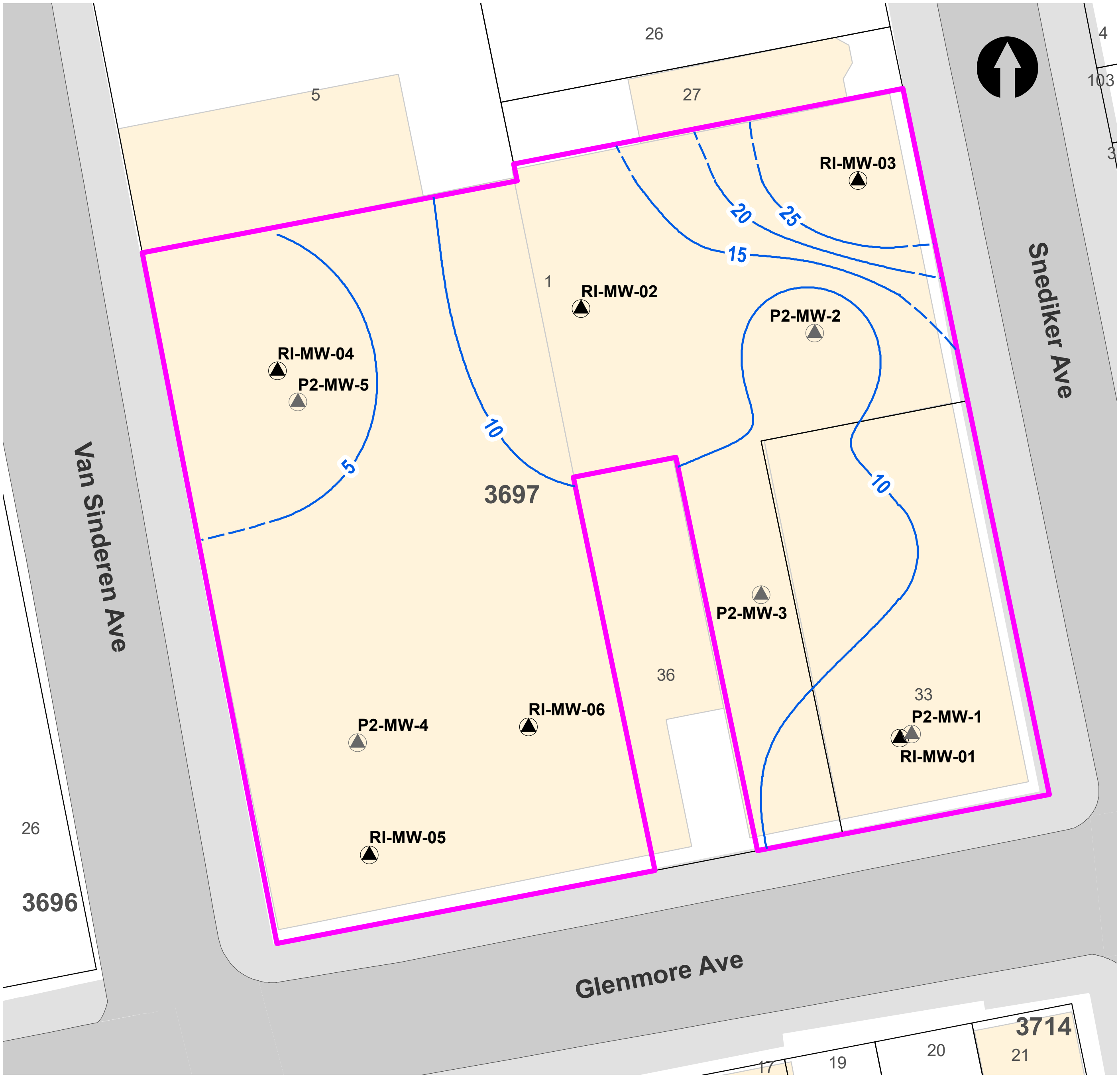
ISOCONTOUR MAP - PCE IN GROUNDWATER

DATE
12/28/2022
PROJECT NO.
220249
FIGURE
8A

©2022 AKRF Q:\Projects\220249 - 221 GLENMORE AVENUE\Technical\GIS and Graphics\SAR\IRMWP\220249 Fig 8A PCE Isocontour Map - Groundwater.mxd12/28/2022 7:02:14 PM mveilleux



Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

▭ PROJECT SITE BOUNDARY

1 LOT BOUNDARY AND TAX LOT NUMBER

3697 BLOCK NUMBER

▭ BUILDING

▲ PHASE II GROUNDWATER MONITORING WELL LOCATION (MAY 2022)

▲ REMEDIAL INVESTIGATION GROUNDWATER MONITORING WELL LOCATION (OCTOBER 2022)

— TCE CONTOUR LINE (ppb = parts per billion)

0 40 80
SCALE IN FEET

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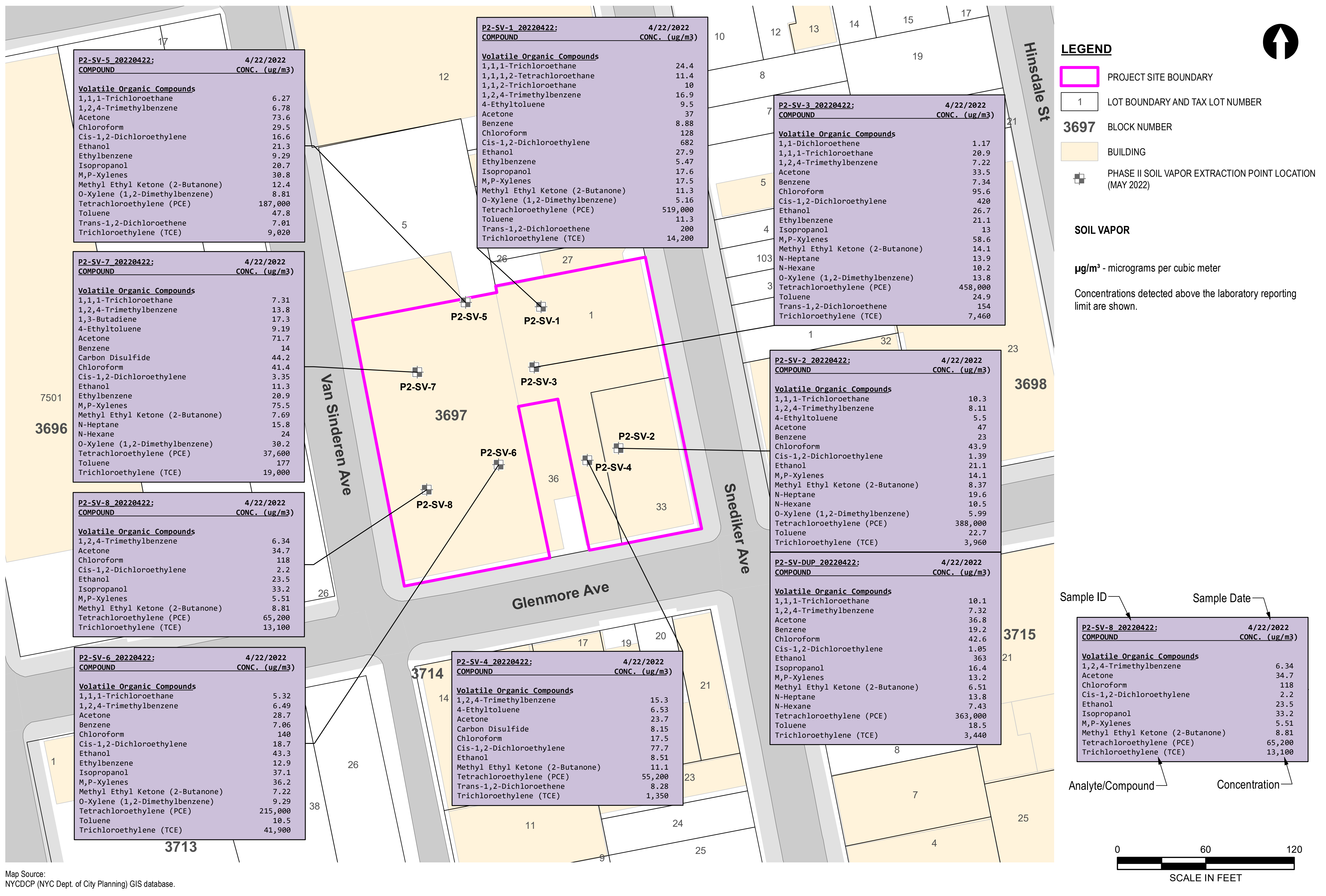
ISOCONTOUR MAP - TCE IN GROUNDWATER

DATE
12/28/2022

PROJECT NO.
220249

FIGURE
8B

©2022 AKRF Q:\Projects\220249 - 221 GLENMORE AVENUE\Technical\GIS and Graphics\SAR\RMWP\220249 Fig 8B TCE Isocontour Map - Groundwater.mxd12/28/2022 7:03:40 PM mveilleux



Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

SOIL VAPOR

µg/m³ - micrograms per cubic meter

Concentrations detected above the laboratory reporting limit are shown.

P2-SV-5_20220422: 4/22/2022

COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,1,1-Trichloroethane	6.27
1,2,4-Trimethylbenzene	6.78
Acetone	73.6
Chloroform	29.5
Cis-1,2-Dichloroethylene	16.6
Ethanol	21.3
Ethylbenzene	9.29
Isopropanol	20.7
M,P-Xylenes	30.8
Methyl Ethyl Ketone (2-Butanone)	12.4
O-Xylene (1,2-Dimethylbenzene)	8.81
Tetrachloroethylene (PCE)	187,000
Toluene	47.8
Trans-1,2-Dichloroethene	7.01
Trichloroethylene (TCE)	9,020

P2-SV-7_20220422: 4/22/2022

COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,1,1-Trichloroethane	7.31
1,2,4-Trimethylbenzene	13.8
1,3-Butadiene	17.3
4-Ethyltoluene	9.19
Acetone	71.7
Benzene	14
Carbon Disulfide	44.2
Chloroform	41.4
Cis-1,2-Dichloroethylene	3.35
Ethanol	11.3
Ethylbenzene	20.9
M,P-Xylenes	75.5
Methyl Ethyl Ketone (2-Butanone)	7.69
N-Heptane	15.8
N-Hexane	24
O-Xylene (1,2-Dimethylbenzene)	30.2
Tetrachloroethylene (PCE)	37,600
Toluene	177
Trichloroethylene (TCE)	19,000

P2-SV-8_20220422: 4/22/2022

COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,2,4-Trimethylbenzene	6.34
Acetone	34.7
Chloroform	118
Cis-1,2-Dichloroethylene	2.2
Ethanol	23.5
Isopropanol	33.2
M,P-Xylenes	5.51
Methyl Ethyl Ketone (2-Butanone)	8.81
Tetrachloroethylene (PCE)	65,200
Trichloroethylene (TCE)	13,100

P2-SV-6_20220422: 4/22/2022

COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,1,1-Trichloroethane	5.32
1,2,4-Trimethylbenzene	6.49
Acetone	28.7
Benzene	7.06
Chloroform	140
Cis-1,2-Dichloroethylene	18.7
Ethanol	43.3
Ethylbenzene	12.9
Isopropanol	37.1
M,P-Xylenes	36.2
Methyl Ethyl Ketone (2-Butanone)	7.22
O-Xylene (1,2-Dimethylbenzene)	9.29
Tetrachloroethylene (PCE)	215,000
Toluene	10.5
Trichloroethylene (TCE)	41,900

P2-SV-1_20220422: 4/22/2022

COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,1,1-Trichloroethane	24.4
1,1,1,2-Tetrachloroethane	11.4
1,1,2-Trichloroethane	10
1,2,4-Trimethylbenzene	16.9
4-Ethyltoluene	9.5
Acetone	37
Benzene	8.88
Chloroform	128
Cis-1,2-Dichloroethylene	682
Ethanol	27.9
Ethylbenzene	5.47
Isopropanol	17.6
M,P-Xylenes	17.5
Methyl Ethyl Ketone (2-Butanone)	11.3
O-Xylene (1,2-Dimethylbenzene)	5.16
Tetrachloroethylene (PCE)	519,000
Toluene	11.3
Trans-1,2-Dichloroethene	200
Trichloroethylene (TCE)	14,200

P2-SV-3_20220422: 4/22/2022

COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,1-Dichloroethene	1.17
1,1,1-Trichloroethane	20.9
1,2,4-Trimethylbenzene	7.22
Acetone	33.5
Benzene	7.34
Chloroform	95.6
Cis-1,2-Dichloroethylene	420
Ethanol	26.7
Ethylbenzene	21.1
Isopropanol	13
M,P-Xylenes	58.6
Methyl Ethyl Ketone (2-Butanone)	14.1
N-Heptane	13.9
N-Hexane	10.2
O-Xylene (1,2-Dimethylbenzene)	13.8
Tetrachloroethylene (PCE)	458,000
Toluene	24.9
Trans-1,2-Dichloroethene	154
Trichloroethylene (TCE)	7,460

P2-SV-2_20220422: 4/22/2022

COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,1,1-Trichloroethane	10.3
1,2,4-Trimethylbenzene	8.11
4-Ethyltoluene	5.5
Acetone	47
Benzene	23
Chloroform	43.9
Cis-1,2-Dichloroethylene	1.39
Ethanol	21.1
M,P-Xylenes	14.1
Methyl Ethyl Ketone (2-Butanone)	8.37
N-Heptane	19.6
N-Hexane	10.5
O-Xylene (1,2-Dimethylbenzene)	5.99
Tetrachloroethylene (PCE)	388,000
Toluene	22.7
Trichloroethylene (TCE)	3,960

P2-SV-DUP_20220422: 4/22/2022

COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,1,1-Trichloroethane	10.1
1,2,4-Trimethylbenzene	7.32
Acetone	36.8
Benzene	19.2
Chloroform	42.6
Cis-1,2-Dichloroethylene	1.05
Ethanol	363
Isopropanol	16.4
M,P-Xylenes	13.2
Methyl Ethyl Ketone (2-Butanone)	6.51
N-Heptane	13.8
N-Hexane	7.43
Tetrachloroethylene (PCE)	363,000
Toluene	18.5
Trichloroethylene (TCE)	3,440

P2-SV-4_20220422: 4/22/2022

COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,2,4-Trimethylbenzene	15.3
4-Ethyltoluene	6.53
Acetone	23.7
Carbon Disulfide	8.15
Chloroform	17.5
Cis-1,2-Dichloroethylene	77.7
Ethanol	8.51
Methyl Ethyl Ketone (2-Butanone)	11.1
Tetrachloroethylene (PCE)	55,200
Trans-1,2-Dichloroethene	8.28
Trichloroethylene (TCE)	1,350

P2-SV-8_20220422: 4/22/2022

COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,2,4-Trimethylbenzene	6.34
Acetone	34.7
Chloroform	118
Cis-1,2-Dichloroethylene	2.2
Ethanol	23.5
Isopropanol	33.2
M,P-Xylenes	5.51
Methyl Ethyl Ketone (2-Butanone)	8.81
Tetrachloroethylene (PCE)	65,200
Trichloroethylene (TCE)	13,100

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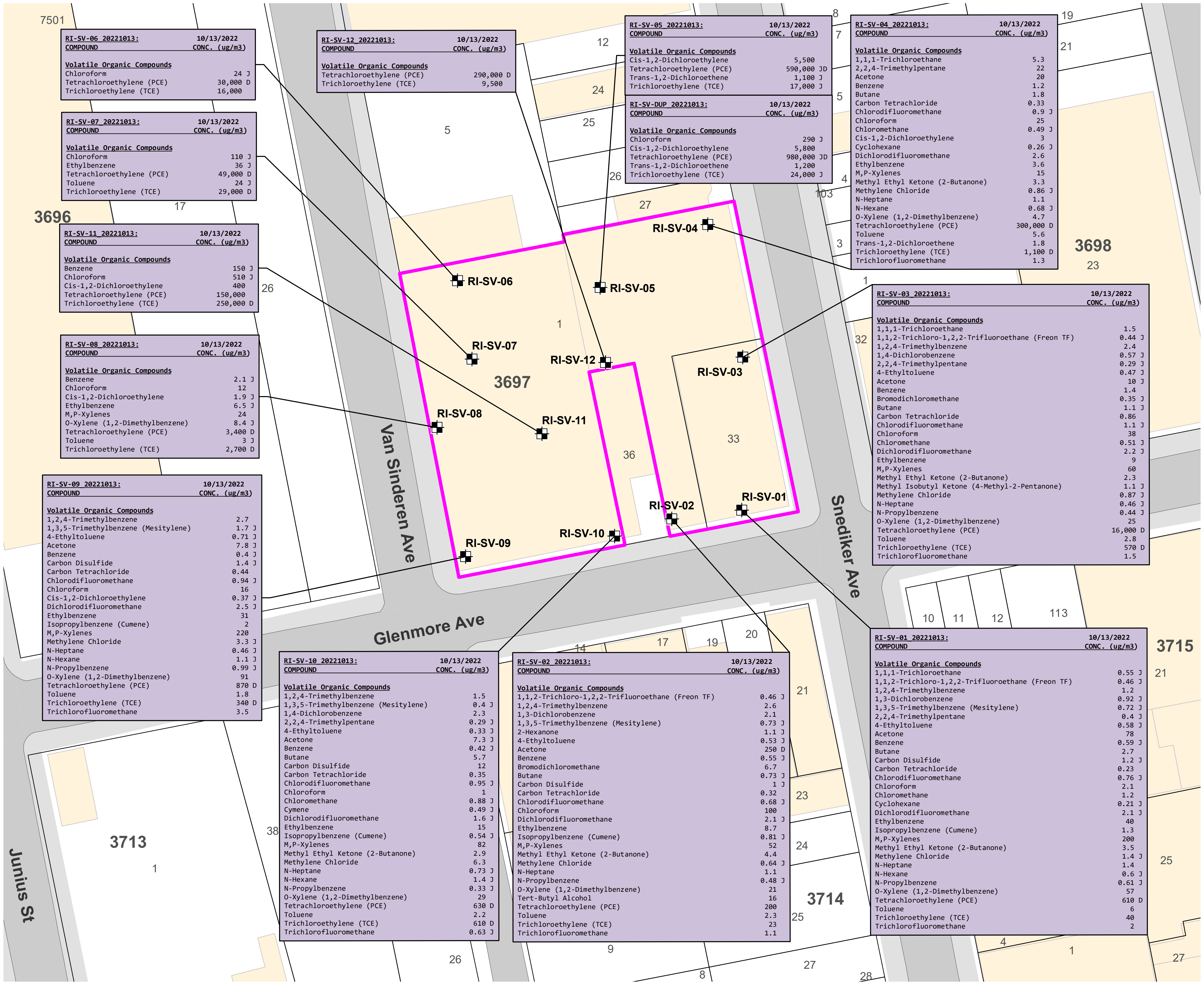
MAY 2022 SOIL VAPOR CONCENTRATIONS

DATE
12/28/2022

PROJECT NO.
220249

FIGURE
9A



RI-SV-06_20221013:	10/13/2022
COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
Chloroform	24 J
Tetrachloroethylene (PCE)	30,000 D
Trichloroethylene (TCE)	16,000

RI-SV-07_20221013:	10/13/2022
COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
Chloroform	110 J
Ethylbenzene	36 J
Tetrachloroethylene (PCE)	49,000 D
Toluene	24 J
Trichloroethylene (TCE)	29,000 D

RI-SV-11_20221013:	10/13/2022
COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
Benzene	150 J
Chloroform	510 J
Cis-1,2-Dichloroethylene	400
Tetrachloroethylene (PCE)	150,000
Trichloroethylene (TCE)	250,000 D

RI-SV-08_20221013:	10/13/2022
COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
Benzene	2.1 J
Chloroform	12
Cis-1,2-Dichloroethylene	1.9 J
Ethylbenzene	6.5 J
M,P-Xylenes	24
O-Xylene (1,2-Dimethylbenzene)	8.4 J
Tetrachloroethylene (PCE)	3,400 D
Toluene	3 J
Trichloroethylene (TCE)	2,700 D

RI-SV-09_20221013:	10/13/2022
COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,2,4-Trimethylbenzene	2.7
1,3,5-Trimethylbenzene (Mesitylene)	1.7 J
4-Ethyltoluene	0.71 J
Acetone	7.8 J
Benzene	0.4 J
Carbon Disulfide	1.4 J
Carbon Tetrachloride	0.44
Chlorodifluoromethane	0.94 J
Chloroform	16
Cis-1,2-Dichloroethylene	0.37 J
Dichlorodifluoromethane	2.5 J
Ethylbenzene	31
Isopropylbenzene (Cumene)	2
M,P-Xylenes	220
Methylene Chloride	3.3 J
N-Heptane	0.46 J
N-Hexane	1.1 J
N-Propylbenzene	0.99 J
O-Xylene (1,2-Dimethylbenzene)	91
Tetrachloroethylene (PCE)	870 D
Toluene	1.8
Trichloroethylene (TCE)	340 D
Trichlorofluoromethane	3.5

RI-SV-12_20221013:	10/13/2022
COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
Tetrachloroethylene (PCE)	290,000 D
Trichloroethylene (TCE)	9,500

RI-SV-05_20221013:	10/13/2022
COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
Cis-1,2-Dichloroethylene	5,500
Tetrachloroethylene (PCE)	590,000 JD
Trans-1,2-Dichloroethene	1,100 J
Trichloroethylene (TCE)	17,000 J

RI-SV-DUP_20221013:	10/13/2022
COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
Chloroform	290 J
Cis-1,2-Dichloroethylene	5,800
Tetrachloroethylene (PCE)	980,000 JD
Trans-1,2-Dichloroethene	1,200
Trichloroethylene (TCE)	24,000 J

RI-SV-04_20221013:	10/13/2022
COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,1,1-Trichloroethane	5.3
2,2,4-Trimethylpentane	22
Acetone	20
Benzene	1.2
Butane	1.8
Carbon Tetrachloride	0.33
Chlorodifluoromethane	0.9 J
Chloroform	25
Chloromethane	0.49 J
Cis-1,2-Dichloroethylene	3
Cyclohexane	0.26 J
Dichlorodifluoromethane	2.6
Ethylbenzene	3.6
M,P-Xylenes	15
Methyl Ethyl Ketone (2-Butanone)	3.3
Methylene Chloride	0.86 J
N-Heptane	1.1
N-Hexane	0.68 J
O-Xylene (1,2-Dimethylbenzene)	4.7
Tetrachloroethylene (PCE)	300,000 D
Toluene	5.6
Trans-1,2-Dichloroethene	1.8
Trichloroethylene (TCE)	1,100 D
Trichlorofluoromethane	1.3

RI-SV-03_20221013:	10/13/2022
COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,1,1-Trichloroethane	1.5
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon TF)	0.44 J
1,2,4-Trimethylbenzene	2.4
1,4-Dichlorobenzene	0.57 J
2,2,4-Trimethylpentane	0.29 J
4-Ethyltoluene	0.47 J
Acetone	10 J
Benzene	1.4
Bromodichloromethane	0.35 J
Butane	1.1 J
Carbon Tetrachloride	0.86
Chlorodifluoromethane	1.1 J
Chloroform	38
Chloromethane	0.51 J
Dichlorodifluoromethane	2.2 J
Ethylbenzene	9
M,P-Xylenes	60
Methyl Ethyl Ketone (2-Butanone)	2.3
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	1.1 J
Methylene Chloride	0.87 J
N-Heptane	0.46 J
N-Propylbenzene	0.44 J
O-Xylene (1,2-Dimethylbenzene)	25
Tetrachloroethylene (PCE)	16,000 D
Toluene	2.8
Trichloroethylene (TCE)	570 D
Trichlorofluoromethane	1.5

RI-SV-10_20221013:	10/13/2022
COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,2,4-Trimethylbenzene	1.5
1,3,5-Trimethylbenzene (Mesitylene)	0.4 J
1,4-Dichlorobenzene	2.3
2,2,4-Trimethylpentane	0.29 J
4-Ethyltoluene	0.33 J
Acetone	7.3 J
Benzene	0.42 J
Butane	5.7
Carbon Disulfide	12
Carbon Tetrachloride	0.35
Chlorodifluoromethane	0.95 J
Chloroform	1
Chloromethane	0.88 J
Cymene	0.49 J
Dichlorodifluoromethane	1.6 J
Ethylbenzene	15
Isopropylbenzene (Cumene)	0.54 J
M,P-Xylenes	82
Methyl Ethyl Ketone (2-Butanone)	2.9
Methylene Chloride	6.3
N-Heptane	0.73 J
N-Hexane	1.4 J
N-Propylbenzene	0.33 J
O-Xylene (1,2-Dimethylbenzene)	29
Tetrachloroethylene (PCE)	630 D
Toluene	2.2
Trichloroethylene (TCE)	610 D
Trichlorofluoromethane	0.63 J

RI-SV-02_20221013:	10/13/2022
COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon TF)	0.46 J
1,2,4-Trimethylbenzene	2.6
1,3-Dichlorobenzene	2.1
1,3,5-Trimethylbenzene (Mesitylene)	0.73 J
2-Hexanone	1.1 J
4-Ethyltoluene	0.53 J
Acetone	250 D
Benzene	0.55 J
Bromodichloromethane	6.7
Butane	0.73 J
Carbon Disulfide	1 J
Carbon Tetrachloride	0.32
Chlorodifluoromethane	0.68 J
Chloroform	100
Dichlorodifluoromethane	2.1 J
Ethylbenzene	8.7
Isopropylbenzene (Cumene)	0.81 J
M,P-Xylenes	52
Methyl Ethyl Ketone (2-Butanone)	4.4
Methylene Chloride	0.64 J
N-Heptane	1.1
N-Propylbenzene	0.48 J
O-Xylene (1,2-Dimethylbenzene)	21
Tert-Butyl Alcohol	16
Tetrachloroethylene (PCE)	200
Toluene	2.3
Trichloroethylene (TCE)	23
Trichlorofluoromethane	1.1

RI-SV-01_20221013:	10/13/2022
COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
1,1,1-Trichloroethane	0.55 J
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon TF)	0.46 J
1,2,4-Trimethylbenzene	1.2
1,3-Dichlorobenzene	0.92 J
1,3,5-Trimethylbenzene (Mesitylene)	0.72 J
2,2,4-Trimethylpentane	0.4 J
4-Ethyltoluene	0.58 J
Acetone	78
Benzene	0.59 J
Butane	2.7
Carbon Disulfide	1.2 J
Carbon Tetrachloride	0.23
Chlorodifluoromethane	0.76 J
Chloroform	2.1
Chloromethane	1.2
Cyclohexane	0.21 J
Dichlorodifluoromethane	2.1 J
Ethylbenzene	40
Isopropylbenzene (Cumene)	1.3
M,P-Xylenes	200
Methyl Ethyl Ketone (2-Butanone)	3.5
Methylene Chloride	1.4 J
N-Heptane	1.4
N-Hexane	0.6 J
N-Propylbenzene	0.61 J
O-Xylene (1,2-Dimethylbenzene)	57
Tetrachloroethylene (PCE)	610 D
Toluene	6
Trichloroethylene (TCE)	40
Trichlorofluoromethane	2

Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

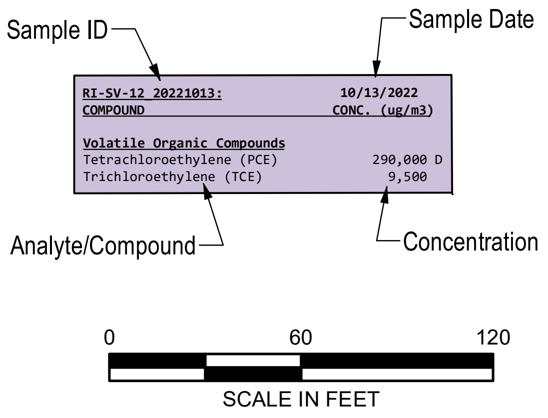
▭	PROJECT SITE BOUNDARY
1	LOT BOUNDARY AND TAX LOT NUMBER
3697	BLOCK NUMBER
🟨	BUILDING
⊞	REMEDAIL INVESTIGATION SOIL VAPOR EXTRACTION POINT LOCATION (OCTOBER 2022)

SOIL VAPOR

D: Analyte concentration obtained from dilution.
J: The concentration given is an estimated value.

µg/m³ - micrograms per cubic meter

Concentrations detected above the laboratory reporting limit are shown.



RI-SV-12_20221013:	10/13/2022
COMPOUND	CONC. (ug/m3)
Volatile Organic Compounds	
Tetrachloroethylene (PCE)	290,000 D
Trichloroethylene (TCE)	9,500

AKRF
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114 Snediker Avenue Site
221-241 Glenmore Avenue
Brooklyn, New York

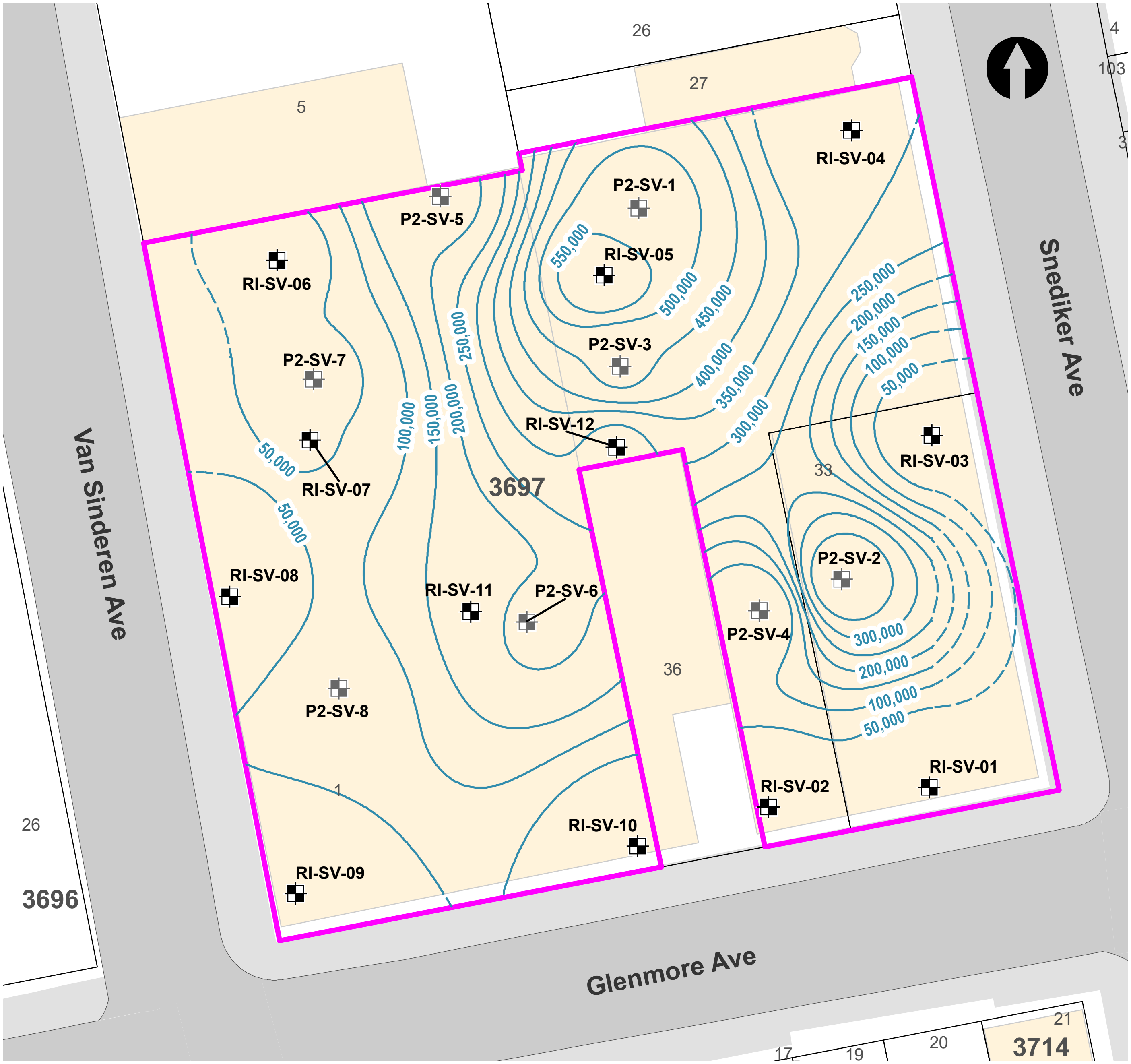
OCTOBER 2022 SOIL VAPOR CONCENTRATIONS

DATE
12/28/2022

PROJECT NO.
220249

FIGURE
9B

©2022 AKRF Q:\Projects\220249 - 221 GLENMORE AVENUE\Technical\GIS and Graphics\SAR\RMWP\220249 Fig 9B October 2022 Soil Vapor Concentrations.mxd12/28/2022 7:08:30 PM mveilleux



Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

▭	PROJECT SITE BOUNDARY
1	LOT BOUNDARY AND TAX LOT NUMBER
3697	BLOCK NUMBER
▭	BUILDING
⊞	PHASE II SOIL VAPOR EXTRACTION POINT LOCATION (MAY 2022)
⊞	REMEDIAL INVESTIGATION SOIL VAPOR EXTRACTION POINT LOCATION (OCTOBER 2022)
—	PCE CONTOUR LINE (µg/m^3 = micrograms per cubic meter) (DASHED WHERE INFERRED)

0 40 80

SCALE IN FEET

AKRF

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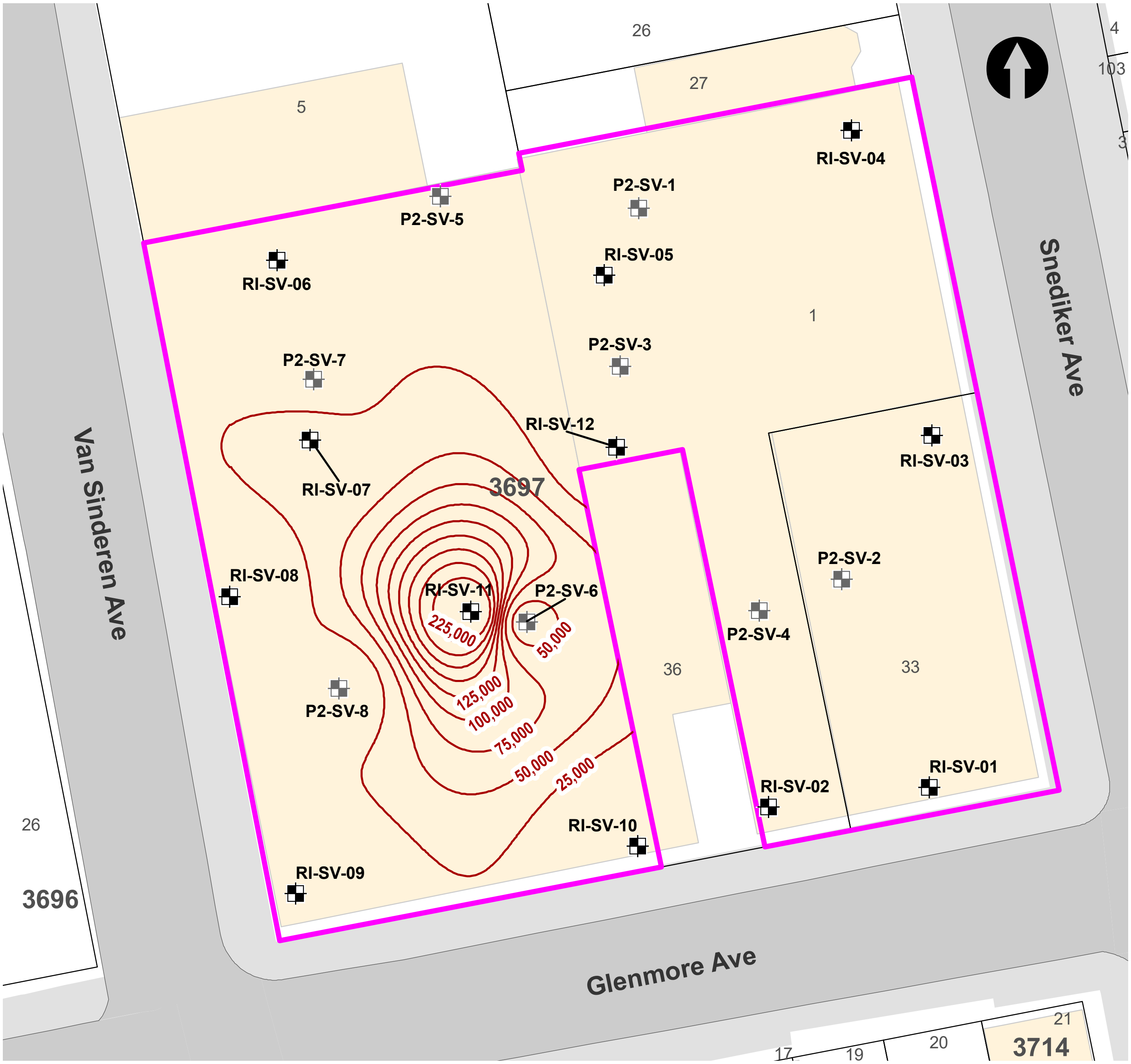
114 Snediker Avenue Site

221-241 Glenmore Avenue

Brooklyn, New York

ISOCONTOUR MAP - PCE IN SOIL VAPOR

DATE	**12/28/2022**
PROJECT NO.	**220249**
FIGURE	**10A**



Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

▭	PROJECT SITE BOUNDARY
1	LOT BOUNDARY AND TAX LOT NUMBER
3697	BLOCK NUMBER
▨	BUILDING
⊞	PHASE II SOIL VAPOR EXTRACTION POINT LOCATION (MAY 2022)
⊞	REMEDIAL INVESTIGATION SOIL VAPOR EXTRACTION POINT LOCATION (OCTOBER 2022)
—	TCE CONTOUR LINE (μg/m³ = micrograms per cubic meter) (DASHED WHERE INFERRED)

0 40 80
SCALE IN FEET

AKRF
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114 Snediker Avenue Site
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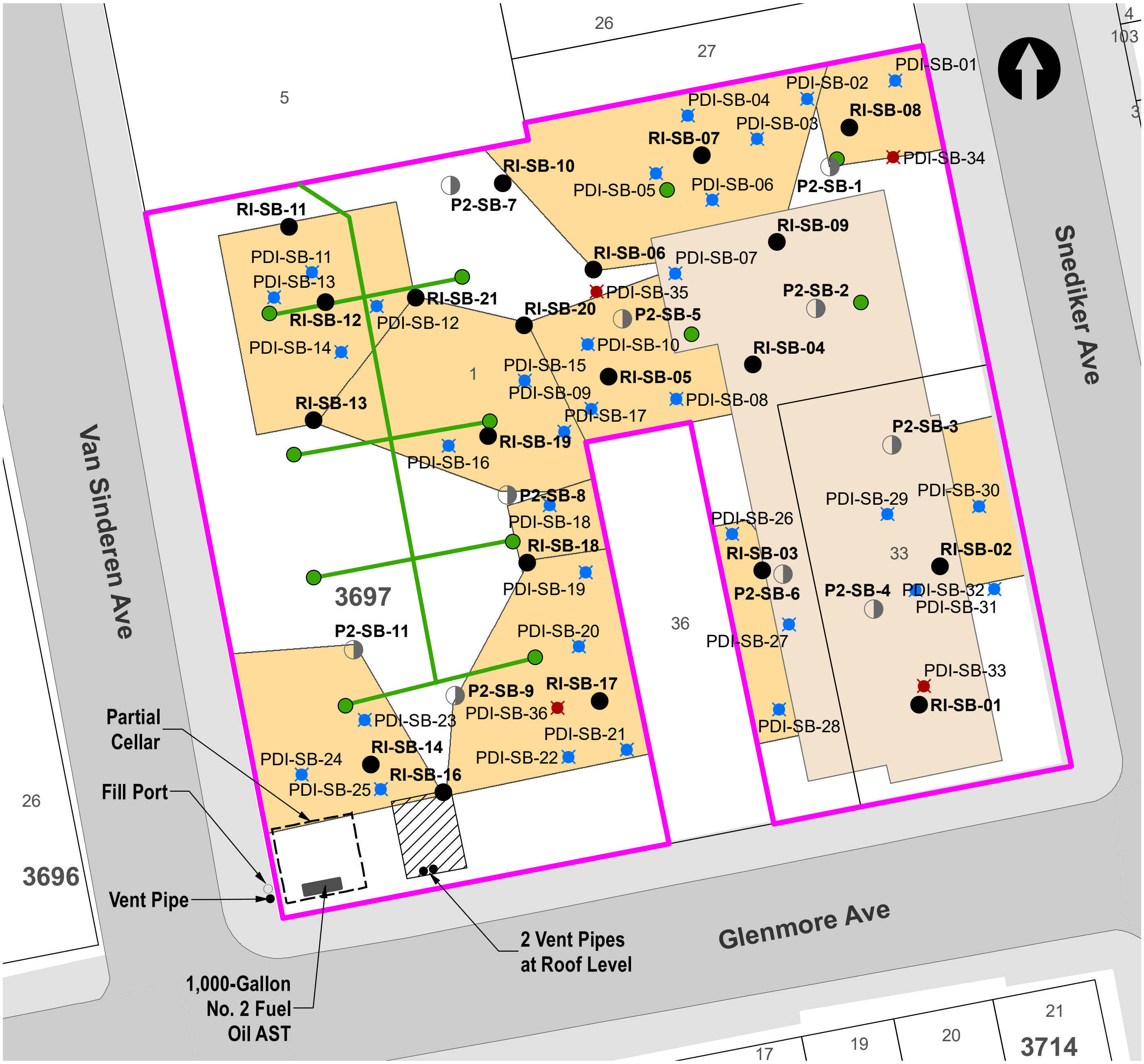
Brooklyn, New York

ISOCONTOUR MAP - TCE IN SOIL VAPOR

DATE
12/28/2022
PROJECT NO.
220249
FIGURE
10B

©2022 AKRF Q:\Projects\220249 - 221 GLENMORE AVENUE\Technical\GIS and Graphics\SAR\RMWP\220249 Fig 10B Isocontour Map - TCE Soil Vapor.mxd12/28/2022 7:15:22 PM mveilleux



LEGEND

Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

▭	PROJECT SITE BOUNDARY
1	LOT BOUNDARY AND TAX LOT NUMBER
3697	BLOCK NUMBER
—	UNDERGROUND PLUMBING
●	FLOOR DRAIN
🟧	SOIL HOTSPOT LOCATION
▭	CELLAR FOOTPRINT
✕	PROPOSED PDI DEEP SOIL BORING LOCATION (CVOC AND HYDROGEOLOGIC ANALYSIS)
✕	PROPOSED PDI SHALLOW HOTSPOT SOIL BORING BORING (CVOC, PAH, AND/OR METALS ANALYSIS)
◐	PHASE II SOIL BORING LOCATION (MAY 2022)
●	REMEDIAL INVESTIGATION SOIL BORING LOCATION (OCTOBER 2022)
▨	GEOPHYSICAL RADAR ANOMALY (POTENTIAL UST AREA)

AST = ABOVEGROUND STORAGE TANK
UST = UNDERGROUND STORAGE TANK

0 40 80
SCALE IN FEET

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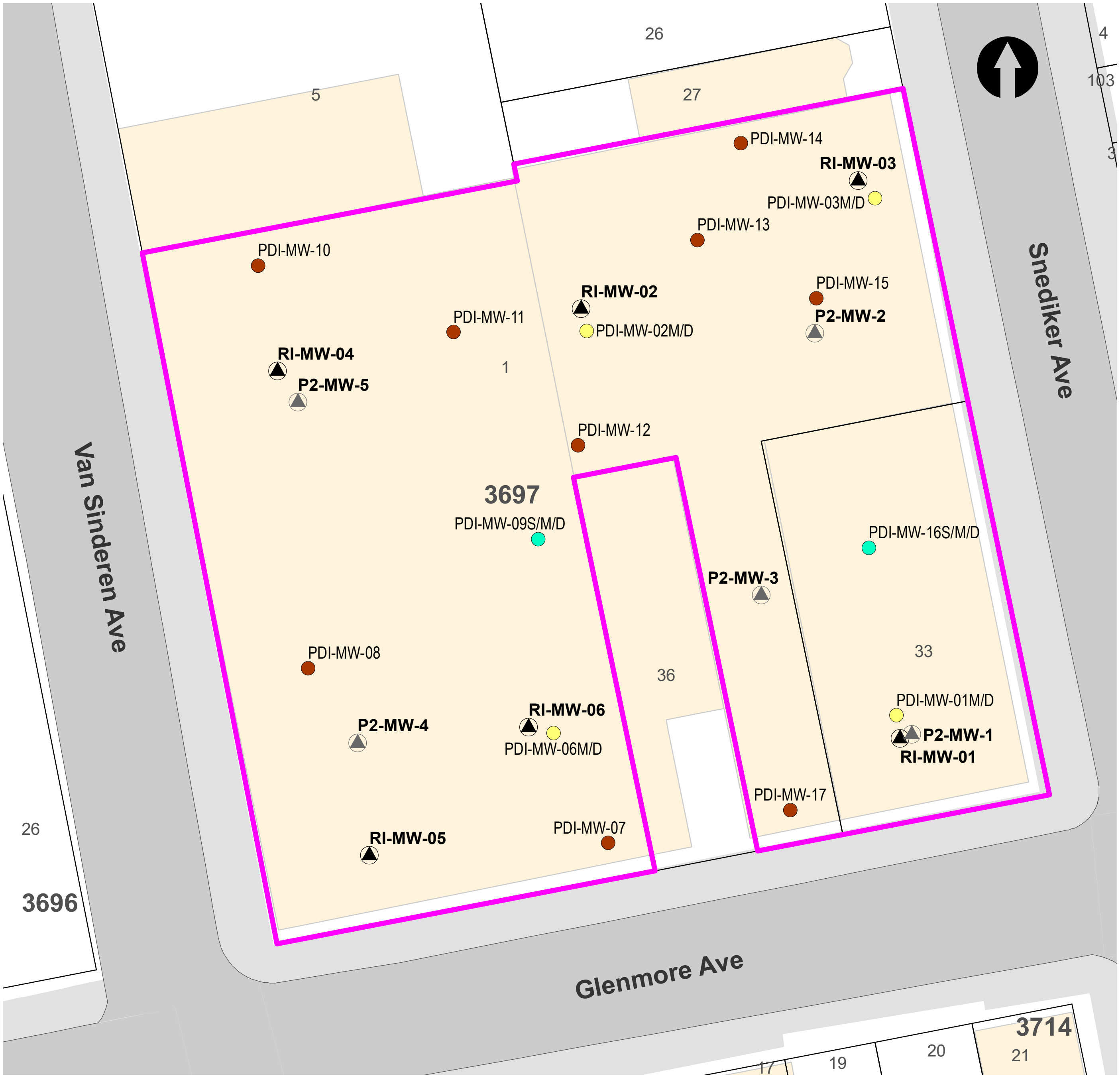
114 Snediker Avenue Site
221-241 Glenmore Avenue
Brooklyn, New York

PROPOSED PRELIMINARY DESIGN INVESTIGATION SOIL SAMPLING LOCATIONS

DATE
12/29/2022

PROJECT NO.
220249

FIGURE
11A



LEGEND

Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

▭	PROJECT SITE BOUNDARY
1	LOT BOUNDARY AND TAX LOT NUMBER
3697	BLOCK NUMBER
▨	BUILDING
▲	PHASE II GROUNDWATER MONITORING WELL LOCATION (MAY 2022)
▲	REMEDIAL INVESTIGATION GROUNDWATER MONITORING WELL LOCATION (OCTOBER 2022)
●	PROPOSED PDI MONITORING WELL LOCATION: INTERMEDIATE AND DEEP ONLY
●	PROPOSED PDI MONITORING WELL LOCATION: SHALLOW ONLY
●	PROPOSED PDI MONITORING WELL LOCATION: SHALLOW, INTERMEDIATE, AND DEEP

0 40 80
SCALE IN FEET

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114 Snediker Avenue Site
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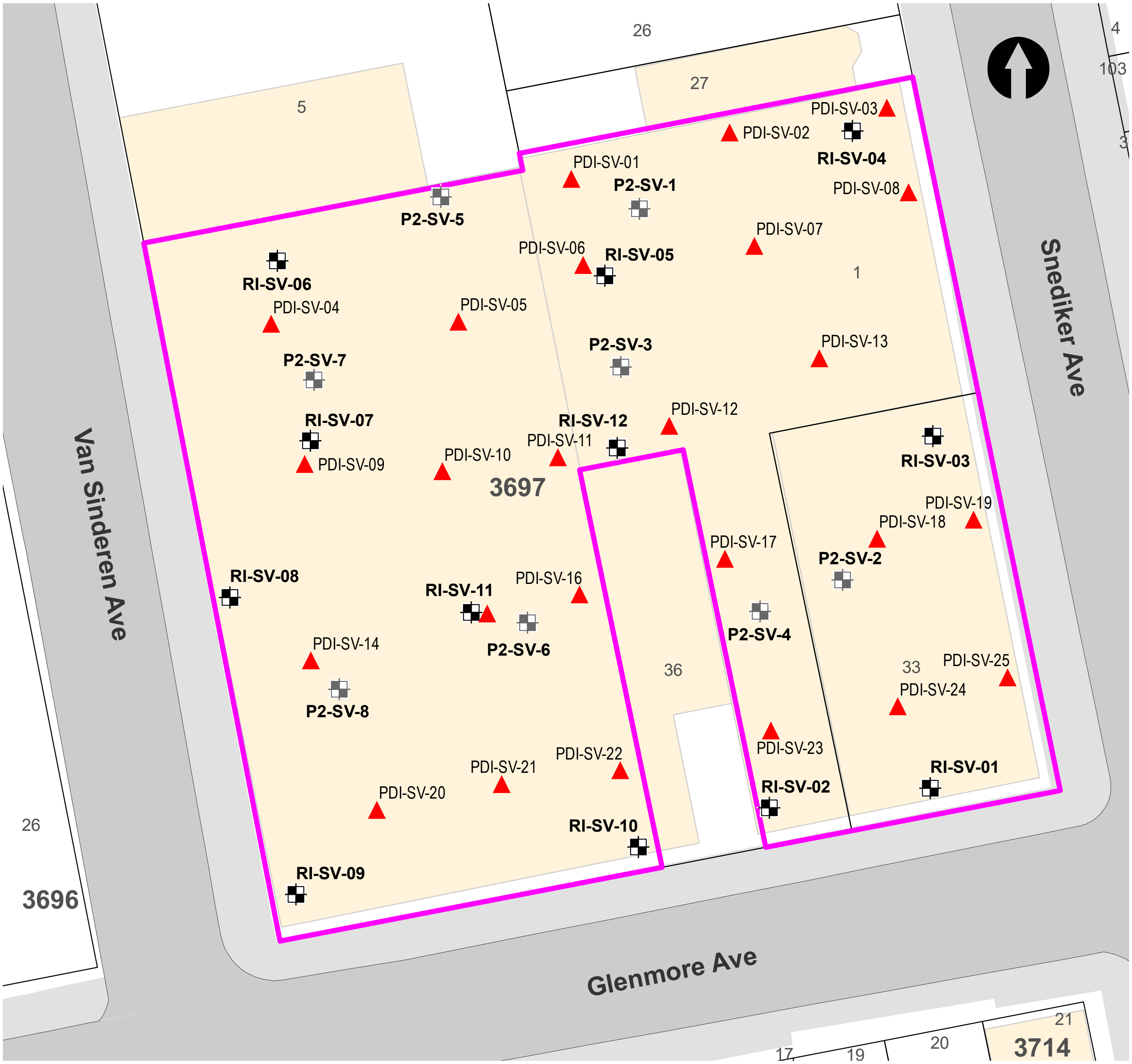
Brooklyn, New York

PROPOSED PRELIMINARY DESIGN INVESTIGATION GROUNDWATER SAMPLING LOCATIONS

DATE	**12/29/2022**
PROJECT NO.	**220249**
FIGURE	**11B**

©2022 AKRF Q:\Projects\220249 - 221 GLENMORE AVENUE\Technical\GIS and Graphics\SAR\RMWP\220249 Fig 11B Proposed Preliminary Design Investigation Groundwater Sampling Locations.mxd12/29/2022 6:04:21 PM mveilleux



Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

▭	PROJECT SITE BOUNDARY
1	LOT BOUNDARY AND TAX LOT NUMBER
3697	BLOCK NUMBER
▭	BUILDING
⊞	PHASE II SOIL VAPOR EXTRACTION POINT LOCATION (MAY 2022)
⊞	REMEDIAL INVESTIGATION SOIL VAPOR EXTRACTION POINT LOCATION (OCTOBER 2022)
▲	PROPOSED NESTED PDI SOIL VAPOR SAMPLING LOCATION: (SV POINTS INSTALLED AT 10 FT BG, 20 FT BG, 30 FT BG, AND 2 FEET ABOVE GROUNDWATER TABLE)

0 40 80
SCALE IN FEET

AKRF
440 Park Avenue South, New York, NY 10016

114 Snediker Avenue Site
221-241 Glenmore Avenue
Brooklyn, New York

PROPOSED PRELIMINARY DESIGN INVESTIGATION SOIL VAPOR SAMPLING LOCATIONS

DATE
12/29/2022

PROJECT NO.
220249

FIGURE
11C

Map Source:
NYCDCP (NYC Dept. of City Planning) GIS database.

LEGEND

☐	PROJECT SITE BOUNDARY
1	LOT BOUNDARY AND TAX LOT NUMBER
3697	BLOCK NUMBER
🟩	EXCAVATION UP TO 2 FEET BELOW GRADE
🟥	EXCAVATION UP TO 6 FEET BELOW GRADE
🟦	EXCAVATION UP TO 9 FEET BELOW GRADE
🟧	EXCAVATION UP TO APPROXIMATELY 15 FEET BELOW GRADE
●	PROPOSED EXCAVATION ENDPOINT SAMPLE LOCATION
●	PROPOSED HOTSPOT ENDPOINT SAMPLE LOCATION

0 40 80
SCALE IN FEET

AKRF
440 Park Avenue South, New York, NY 10016

114 Snediker Avenue Site
221-241 Glenmore Avenue
Brooklyn, New York

PROPOSED IRM EXCAVATION AND ENDPOINT SAMPLING PLAN

DATE
12/30/2022

PROJECT NO.
220249

FIGURE
12

APPENDIX A

HEALTH AND SAFETY PLAN

114 SNEDIKER AVENUE SITE
221-241 GLENMORE AVENUE
BROOKLYN, NEW YORK

Health and Safety Plan

NYSDEC BCP Site No.: TBD
AKRF Project Number: 220249

Prepared for:

New York State Department of Environmental Conservation
Division of Environmental Remediation, Remedial Bureau B
625 Broadway, 12th Floor
Albany, New York 12233

Prepared on Behalf of:

Glenmore Owner LLC
116 East 27th Street, 11th Floor
New York, New York 10016

Prepared by:

AKRF

440 Park Avenue South, 7th Floor
New York, NY 10016
212-696-0670

DECEMBER 2022

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FIGURES

APPENDICES

1.0 INTRODUCTION

This environmental Health and Safety Plan (HASP) has been developed for implementation of the Interim Remedial Measures (IRM) Work Plan activities conducted by all personnel on-site, both AKRF employees and others, at the 114 Snediker Avenue Site located at 221-241 Glenmore Avenue in the New Lots sub-section of the East New York neighborhood of Brooklyn, New York, hereafter referred to as the "Site". The approximately 0.823-acre Site is identified by the City of New York as Borough of Brooklyn, Block 3697, Lots 1 and 33. The Requestor is currently applying to remediate the Site under the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP).

The Site is developed with three adjoining buildings: a two-story building on Lot 33, formerly utilized as storage and workshop spaces on the first floor and management offices on the second floor (southeast portion of the Site, 241 Glenmore Avenue); a single-story former manufacturing building on the northeastern portion of Lot 1 (northeast portion of Site, 221 Glenmore Avenue); and, a single-story former manufacturing building on the western portion of Lot 1, which previously operated as the lighting manufacturing area (western portion of the Site, 221 Glenmore Avenue). The three adjoining buildings were occupied by Legion Lighting Co. Inc. (Legion), an industrial lighting manufacturer. Manufacturing operations ceased in May 2022 and the Site has only been used for storage since. A small sub-grade cellar located in the southwestern corner of Lot 1 (221 Glenmore Avenue) contains an encased 1,000-gallon No. 2 fuel oil aboveground storage tank (AST) and two fuel-oil fired boilers. A Site Location map is provided as Figure 1.

A Phase II Environmental Site Assessment (ESA) was conducted by Impact Environmental Closures, Inc, (IEC) in May 2022 and a Remedial Investigation (RI) was conducted by AKRF in October 2022. The investigations have identified elevated levels of chlorinated volatile organic compounds (CVOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) and metals in soil, chlorinated VOCs, metals and PFOS/PFOA in groundwater and chlorinated VOCs in soil vapor.

The purpose of this HASP is to assign responsibilities, establish personnel protection standards and mandatory safety practices and procedures, and provide for contingencies that may arise during field activities at the Site. The HASP is intended to minimize health and safety risks resulting from the known or potential presence of contaminated materials.

This HASP does not discuss other routine health and safety issues common to general construction and excavation, including but not limited to slips, trips, falls, shoring, and other physical hazards. All AKRF employees are directed that all work must be performed in accordance with the Company's Generic HASP and all Occupation Safety and Health Administration (OSHA) applicable regulations for the work activities required for the project. All project personnel are furthermore directed that they are not permitted to enter Permit Required Confined Spaces (as defined by OSHA). For issues unrelated to contaminated materials, all non-AKRF employees are to be bound by all applicable OSHA regulations as well as any more stringent requirements specified by their employer in their corporate HASP or otherwise.

AKRF is not responsible for providing oversight for issues unrelated to contaminated materials for non-employees. This oversight shall be the responsibility of the employer of that worker or other official designated by that employer.

2.0 HEALTH AND SAFETY GUIDELINES AND PROCEDURES

2.1 Hazard Evaluation

2.1.1 Hazards of Concern

Check all that apply		
(**X**) Organic Chemicals	(**X**) Inorganic Chemicals	( ) Radiological
( ) Biological	( ) Explosive/Flammable	( ) Oxygen Deficient Atm
(**X**) Heat Stress	(**X**) Cold Stress	( ) Carbon Monoxide
Comments: No personnel are permitted to enter permit confined spaces.		

2.1.2 Physical Characteristics

Check all that apply		
(**X**) Liquid	(**X**) Solid	( ) Sludge
(**X**) Vapors	( ) Unknown	( ) Other
Comments:		

2.1.3 Hazardous Materials

Check all that apply					
Chemicals	**Solids**	**Sludges**	**Solvents**	**Oils**	**Other**
( ) Acids	(**X**) Ash	( ) Paints	( ) Halogens	( ) Transformer	( ) Lab
( ) Caustics	( ) Asbestos	( ) Metals	(**X**) Petroleum	( ) Other DF	( ) Pharm
(**X**) Pesticides	( ) Tailings	( ) POTW	(**X**) Chlorinated solvents	( ) Motor or Hydraulic Oil	( ) Hospital
(**X**) Petroleum	(**X**) Other	( )Other:		(**X**) Gasoline	( ) Rad
( ) Inks	Fill material			(**X**) Fuel Oil	( ) MGP
(**X**) PCBs					( ) Mold
(**X**) Metals					( ) Cyanide
(**X**)Other: VOCs & SVOCs					

2.1.4 Chemicals of Concern

Chemical	**REL/PEL/STEL**	**Health Hazards**
Arsenic	REL C: 0.002 mg/m^3 PEL: 0.010 mg/m^3	Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, resp irritation, hyperpigmentation of skin, [potential occupational carcinogen].
Barium	REL: 0.5 mg/m^3 PEL: 0.5 mg/m^3	(ingestion) Irritation of digestive system, muscle weakness, difficulty breathing, blood pressure changes
Benzene	REL: 0.1 ppm N STEL: 1 ppm PEL: 1 ppm O STEL: 5 ppm	Irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen].
Cadmium	PEL: 0.005 mg/m^3	Pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia; [potential occupational carcinogen].
Carbon Disulfide	REL: 1 ppm N STEL: 10 ppm PEL: 20 ppm PEL C: 30 ppm; 30-min man peak: 100 ppm	Dizziness, headache, poor sleep, lassitude (weakness, exhaustion), anxiety, anorexia, weight loss; psychosis; polyneuropathy; Parkinson-like syndrome; ocular changes; coronary heart disease; gastritis; kidney, liver injury; eye, skin burns; dermatitis; reproductive effects.
Carbon Tetrachloride	N STEL: 2 ppm PEL: 10 ppm PEL C: 25 ppm; 5-min max peak 200 ppm	Irritation eyes, skin; central nervous system depression; nausea, vomiting; liver, kidney injury; drowsiness, dizziness, incoordination; [potential occupational carcinogen].
Chromium	REL: 0.5 mg/m^3 PEL: 1 mg/m^3	Irritation eyes, skin; lung fibrosis (histologic).
Copper	REL: 1 mg/m^3 PEL: 1 mg/m^3	Irritation eyes, nose, pharynx; nasal septum perforation; metallic taste; dermatitis; In Animals: lung, liver, kidney damage; anemia.

DDD, DDE, & DDT	REL: 0.5 mg/m^3 PEL: 1 mg/m^3	Irritation eyes, skin; paresthesia tongue, lips, face; tremor; anxiety, dizziness, confusion, malaise (vague feeling of discomfort), headache, lassitude (weakness, exhaustion); convulsions; paresis hands; vomiting; [potential occupational carcinogen].
Ethylbenzene	REL: 100 ppm N STEL: 125 ppm PEL: 100 ppm	Irritation eyes, nose, respiratory system; headache, lassitude (weakness, exhaustion), dizziness, confusion, malaise (vague feeling of discomfort), drowsiness, unsteady gait; narcosis; defatting dermatitis; possible liver injury; reproductive effects.
Fuel Oils	REL: 100 mg/m3	Irritation eyes, skin, nose, throat; burning sensation in chest; headache, nausea, lassitude (weakness, exhaustion), restlessness, incoordination, confusion, drowsiness; vomiting, diarrhea; dermatitis; chemical pneumonitis (aspiration liquid).
Lead	REL: 0.050 mg/m^3 PEL:0.050 mg/m^3	Lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypertension.
Mercury	REL: 0.05 mg/m^3 REL C: 0.1 mg/m^3 PEL: 0.1 mg/m^3	Irritation eyes, skin; cough, chest pain, dyspnea (breathing difficulty), bronchitis, pneumonitis; tremor, insomnia, irritability, indecision, headache, lassitude (weakness, exhaustion); stomatitis, salivation; gastrointestinal disturbance, anorexia, weight loss; proteinuria.
Methylene Chloride	PEL: 25 ppm O STEL: 125 ppm	Irritation eyes, skin; lassitude (weakness, exhaustion), drowsiness, dizziness; numb, tingle limbs; nausea; [potential occupational carcinogen].

PAHs	REL: 0.1 mg/m^3 PEL: 0.2 mg/m^3	Effects reported from occupational exposure to PAHs include chronic bronchitis, chronic cough irritation, bronchogenic cancer, dermatitis, cutaneous photosensitization, and pilosebaceous reactions. Reported health effects associated with chronic exposure to coal tar and its by-products (e.g., PAHs): Skin: erythema, burns, and warts on sun-exposed areas with progression to cancer. The toxic effects of coal tar are enhanced by exposure to ultraviolet light. Eyes: irritation and photosensitivity. Respiratory system: cough, bronchitis, and bronchogenic cancer. Gastrointestinal system: leukoplakia, buccal-pharyngeal cancer, and cancer of the lip. Hematopoietic system: leukemia (inconclusive) and lymphoma. Genitourinary system: hematuria and kidney and bladder cancers.
PCBs	REL: 0.001 mg/m^3 PEL: 0.5 mg/m^3	Irritation eyes, chloracne; liver damage; reproductive effects; [potential occupational carcinogen].
Tetrachloroethylene (PCE)	PEL: 100 ppm PEL C: 200 ppm; max peak: 300 ppm	Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen].
Toluene	REL: 100 ppm N STEL: 150 ppm PEL: 200 ppm PEL C: 300 ppm; 10-min max peak: 500 ppm	Irritation eyes, nose; lassitude (weakness, exhaustion), confusion, euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); anxiety, muscle fatigue, insomnia; paresthesia; dermatitis; liver, kidney damage.
Trichloroethylene (TCE)	PEL: 100 ppm PEL C: 200 ppm; 5-min max peak: 300 ppm	Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen].
Xylene	REL: 100 ppm N STEL: 150 ppm PEL: 100 ppm	Irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis.

Zinc	REL: 5 mg/m^3 REL C: 15 mg/m^3 N STEL: 10 mg/m^3 PEL: 5 mg/m^3 (ZnO fume); 15 mg/m^3 (ZnO dust)	Chills, elevated body temperature, myalgia, cough, fatigue, chest pain, stomach cramps, nausea, anemia, changes in cholesterol levels, and vomiting.
Notes: REL: Recommended exposure limit (NIOSH) PEL: Permissible exposure limits (OSHA) STEL: Short-term exposure limit N: NIOSH O: OSHA C: Ceiling		

The potential health effects from these known and suspected on-site contaminants are provided in Appendix B.

2.2 Designated Personnel

AKRF will appoint one of its on-site personnel as the Site Safety Officer (SSO). This individual will be responsible for the implementation of the HASP. The SSO will work under the direction of a Qualified Environmental Professional (QEP) and will be experienced in the implementation of air monitoring and hazardous materials sampling programs. Health and safety training required for the SSO and all field personnel are outlined in Section 2.3 of this HASP.

2.3 Training

All personnel who enter the work area while intrusive activities are being performed will have completed a 40-hour training course that meets OSHA requirements of 29 CFR Part 1910, Occupational Safety and Health Standards. In addition, all personnel will have up-to-date 8-hour refresher training. The training will allow personnel to recognize and understand the potential hazards to health and safety. All field personnel must attend a training program, whose purpose is to:

- Make them aware of the potential hazards they may encounter;
- Provide the knowledge and skills necessary for them to perform the work with minimal risk to health and safety
- Make them aware of the purpose and limitations of safety equipment; and
- Ensure that they can safely avoid or escape from emergencies.

Each member of the field crew will be instructed in these objectives before he/she goes onto the Site. A Site safety meeting will be conducted at the start of the project. Additional meetings shall be conducted, as necessary, for new personnel working at the Site.

2.4 Medical Surveillance Program

All AKRF and subcontractor personnel performing field work involving subsurface disturbance at the Site are required to have passed a complete medical surveillance examination in accordance with 29 CFR 1910.120 (f). A physician’s medical release for work will be confirmed by the SSO before an employee can begin Site activities. The medical release shall consider the type of work to be performed and the required personal protective equipment (PPE). The medical examination will, at a minimum, be provided annually and upon termination of hazardous waste Site work.

2.5 Site Work Zones

During any activities involving subsurface disturbance, the work area must be divided into various zones to prevent the spread of contamination, ensure that proper protective equipment is donned, and provide an area for decontamination.

The Exclusion Zone is defined as the area where exposure to impacted media could be encountered. The Contamination Reduction Zone (CRZ) is the area where decontamination procedures take place and is located next to the Exclusion Zone. The Support is the zone area where support facilities such as vehicles, fire extinguisher, and first aid supplies are located. The emergency staging area (part of the Support Zone) is the area where all workers on-site would assemble in the event of an emergency. A summary of these areas is provided below. These zones may be changed by the SSO, depending on that day's activities. All field personnel will be informed of the location of these zones before work begins.

Task	Exclusion Zone	CRZ	Support Zone
Soil Excavation	15 feet from excavation border and excavation equipment or vehicles	15 feet from excavation border and excavation equipment or vehicles	As Needed
Soil Borings/Soil Vapor Point Installations/Monitoring Well Installations	10 feet from drill rig	25 feet from drill rig	As Needed
Comments: Control measures such as "caution tape" and/or traffic cones will be placed around the perimeter of the work area when work is being done in a public area.			

2.6 Personal Protection Equipment

The personal protection equipment required for various kinds of site investigation tasks are based on 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response, Appendix B, "General Description and Discussion of the Levels of Protection and Protective Gear."

AKRF field personnel and other site personnel shall wear, at a minimum, Level D personal protective equipment. The protection will be based on the air monitoring described in the Community Air Monitoring Plan (CAMP) as part of the IRM.

LEVEL OF PROTECTION & PPE		Excavation/ Sampling
Level D (**X**) Steel Toe Shoes (**X**) Hard Hat (within 25 ft of drill rig) (**X**) Work Gloves (**X**) Face Covering (Covid-19)	(**X**) Safety Glasses ( ) Face Shield (**X**) Ear Plugs (within 25 ft of drill rig) (**X**) Nitrile Gloves (**X**) Tyvek for drill rig operator if NAPL present	Yes

LEVEL OF PROTECTION & PPE		**Excavation/ Sampling**
Level C ***(in addition to Level D)*** (**X**) Half-Face Respirator OR (**X**) Full Face Respirator ( ) Full-Face PAPR	( ) Particulate Cartridge ( ) Organic Cartridge (**X**) Dual Organic/ Particulate Cartridge	If PID > 10 ppm or particulate > 5 µg/m^3 in (breathing zone)
Comments: Cartridges to be changed out at least once per shift unless warranted beforehand (e.g., more difficult to breathe or any odors detected).		

2.7 General Work Practices

To protect the health and safety of the field personnel, field personnel will adhere to the guidelines listed below during activities involving subsurface disturbance:

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited, except in designated areas on the Site. These areas will be designated by the SSO.
- Workers must wash their hands thoroughly on leaving the work area and before eating, drinking, or any other such activity.
- The workers should shower as soon as possible after leaving the Site. Contact with contaminated or suspected surfaces should be avoided.
- The buddy system should always be used; each buddy should watch for signs of fatigue, exposure, and heat/cold stress.
- Supplemental COVID-19 procedures (Appendix A) shall be adhered to during work-related commute and on-site activities, as applicable.

3.0 EMERGENCY PROCEDURES AND EMERGENCY RESPONSE PLAN

The field crew will be equipped with emergency equipment, such as a first aid kit and disposable eye washes. In the case of a medical emergency, the SSO will determine the nature of the emergency and he/she will have someone call for an ambulance, if needed. If the nature of the injury is not serious, i.e., the person can be moved without expert emergency medical personnel, he/she should be taken to a hospital by on-site personnel. Directions to the hospital are provided below, and a hospital route map is provided as Figure 2.

3.1 Hospital Directions

Hospital Name:	Brookdale Hospital – The Radutzky Emergency Care Pavilion
Phone Number:	(718) 240-5363
Address/Location:	1 Brookdale Plaza, Brooklyn, New York 11212
Directions:	1. Starting on Glenmore Avenue, continue east towards Snediker Avenue 2. Turn RIGHT onto Hinsdale Street 3. Turn RIGHT onto New Lots Avenue 4. Turn LEFT onto Junius Street 5. Slight RIGHT onto Gregory “Jocko” Jackson Blvd/Linden Blvd 6. Slight RIGHT toward Linden Blvd 7. Slight LEFT onto Linden Blvd 8. The emergency room will be on the RIGHT

3.2 Emergency Contacts

Company	Individual Name	Title	Contact Number
AKRF	Deborah Shapiro, QEP	QA/QC Officer	646-388-9544 (office)
	Rebecca Kinal, PE	Remedial Engineer	914-922-2362 (office)
	Bryan Zieroff	Project Manager	914-922-2383 (office) 203-246-1566 (mobile)
	Mark Jepsen	Project Manager Alternate	646-388-9567 (office) 614-560-5425 (mobile)
	Antonio Cardenas	Field Team Leader/SSO	(718) 551-7193 (mobile)
	Tim Larigan	Alternate Field Team Leader/SSO	862-368-8791 (mobile)
Glenmore Owner LLC	Joanna Kandel	BCP Applicant Representative	(646) 849-4289 (office)
Ambulance, Fire Department & Police Department	-	-	911
NYSDEC Spill Hotline	-	-	800-457-7362

4.0 APPROVAL & ACKNOWLEDGMENTS OF HASP

APPROVAL

Signed: ______________________________ Date: ______________________________

AKRF Project Manager

Signed: ______________________________ Date: ______________________________

AKRF Health and Safety Officer

Below is an affidavit that must be signed by all workers who enter the site. A copy of the HASP must be on-site at all times and will be kept by the SSO.

AFFIDAVIT

I,_________________________(name), of_______________________________(company name), have read the Health and Safety Plan (HASP) for the property located at 221-241 Glenmore Avenue, Brooklyn, New York. I agree to conduct all on-site work in accordance with the requirements set forth in this HASP and understand that failure to comply with this HASP could lead to my removal from the site.

Signed: ______________________ Company: ____________________ Date: ________
Signed: ______________________ Company: ____________________ Date: ________
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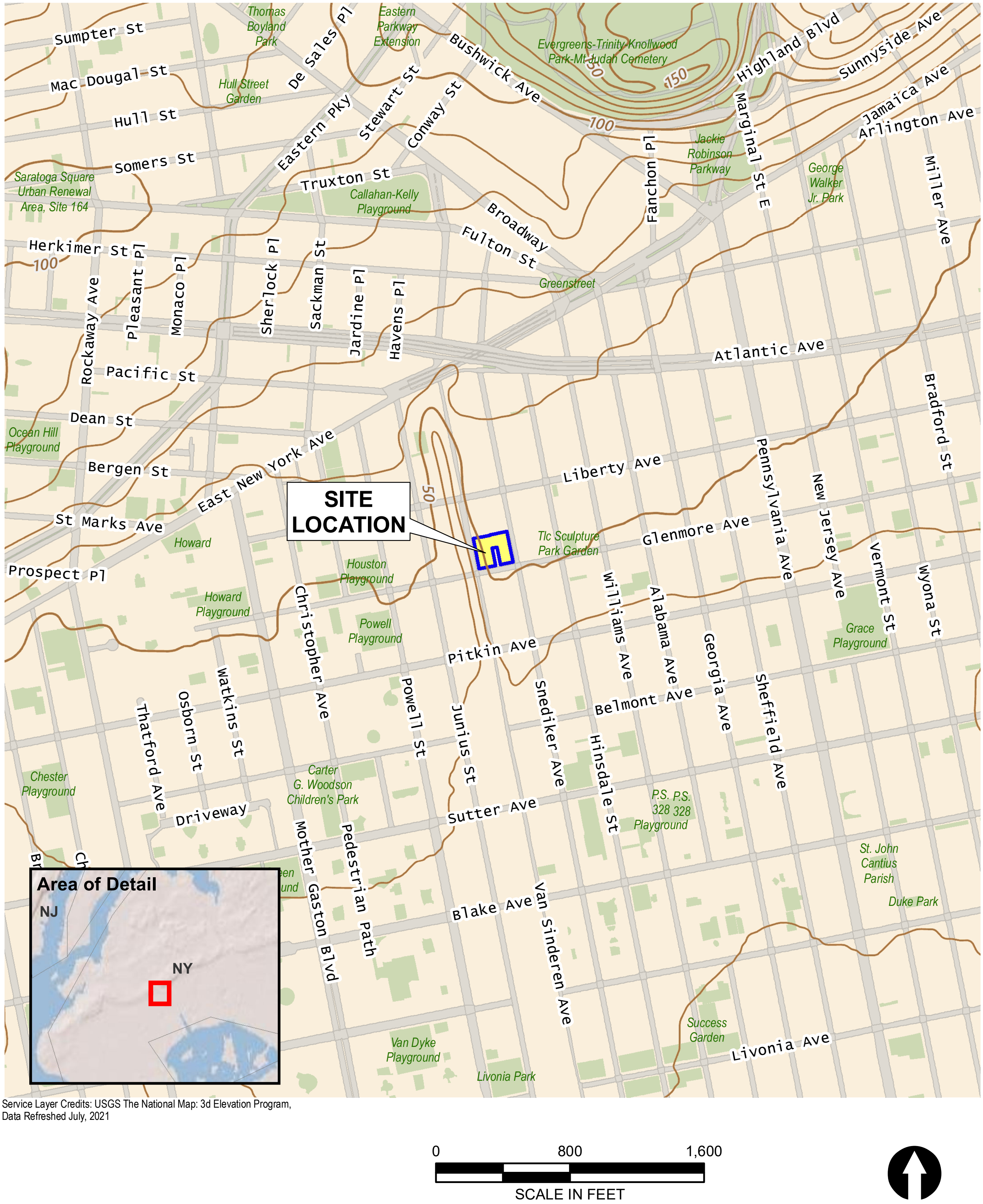
FIGURES



Service Layer Credits: USGS The National Map: 3d Elevation Program, Data Refreshed July, 2021

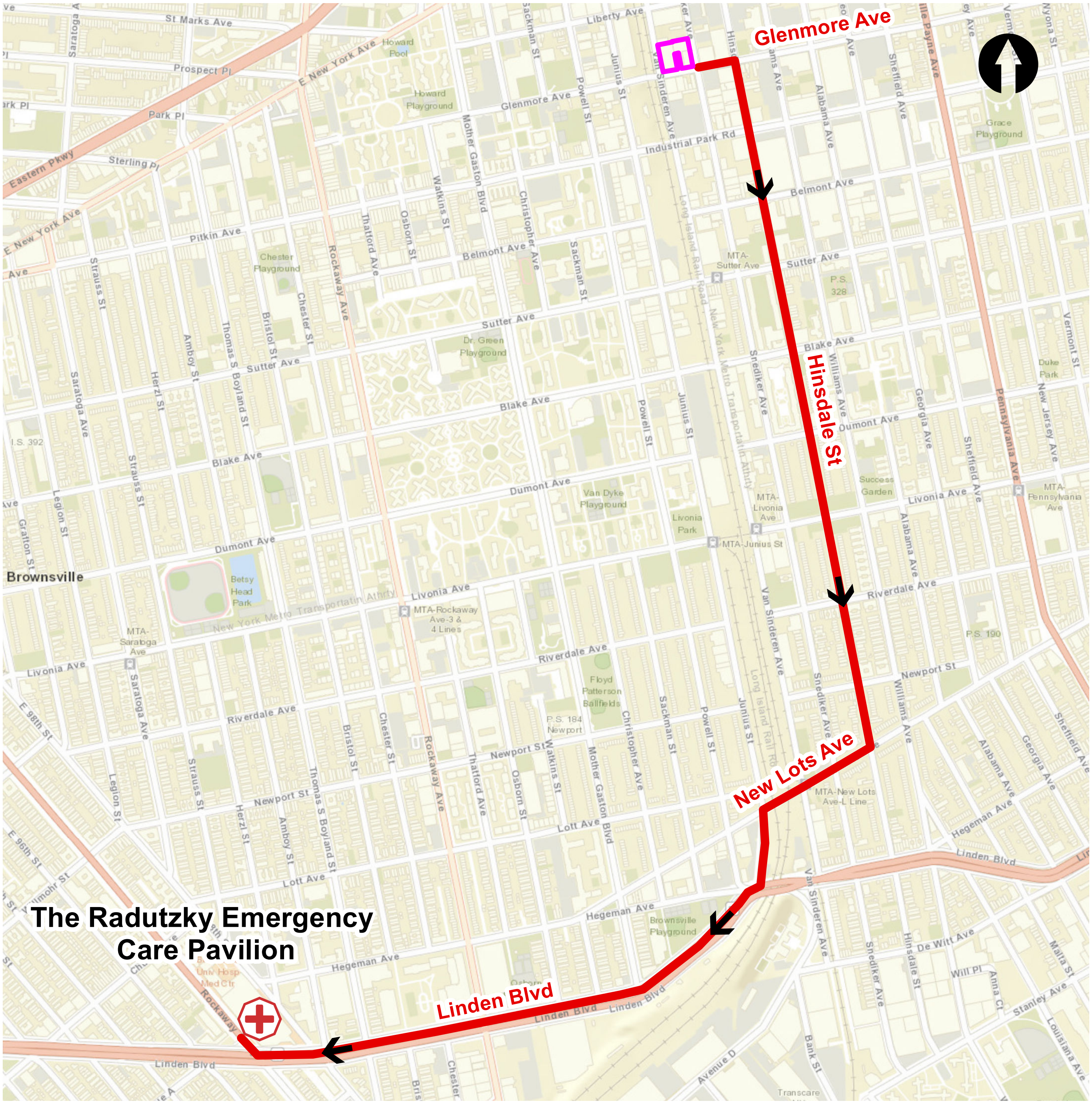
©2022 AKRF Q:\Projects\220249 - 221 GLENMORE AVENUE\Technical\GIS and Graphics\SAR\RIR\220249 Fig 1 Site Location.mxd12/16/2022 11:07:18 AM mveilleux

AKRF
440 Park Avenue South, New York, NY 10016

114 Snediker Avenue Site
221-241 Glenmore Avenue
Brooklyn, New York

SITE LOCATION

DATE	12/16/2022
PROJECT NO.	220249
FIGURE	1



Service Layer Credits: ESRI World Street Map 2021

The Radutzky Emergency Care Pavilion
1 Brookdale Plaza
Brooklyn, NY 11212
(718) 240-5363

LEGEND

- ▭ PROJECT SITE BOUNDARY
- ← ROUTE TO HOSPITAL
- ⊕ HOSPITAL LOCATION

0 1,000 2,000
SCALE IN FEET

AKRF
440 Park Avenue South, New York, NY 10016

114 Snediker Avenue Site
221-241 Glenmore Avenue
Brooklyn, New York

HOSPITAL ROUTE MAP

DATE	**12/7/2022**
PROJECT NO.	**220249**
FIGURE	**2**

APPENDIX A

POTENTIAL HEALTH EFFECTS FROM ON-SITE CONTAMINANTS

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

BENZENE
CAS # 71-43-2

Agency for Toxic Substances and Disease Registry ToxFAQs **September 1997**

This fact sheet answers the most frequently asked health questions (FAQs) about benzene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Benzene is a widely used chemical formed from both natural processes and human activities. Breathing benzene can cause drowsiness, dizziness, and unconsciousness; long-term benzene exposure causes effects on the bone marrow and can cause anemia and leukemia. Benzene has been found in at least 813 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is benzene?
(Pronounced běn′zēn′)

Benzene is a colorless liquid with a sweet odor. It evaporates into the air very quickly and dissolves slightly in water. It is highly flammable and is formed from both natural processes and human activities.

Benzene is widely used in the United States; it ranks in the top 20 chemicals for production volume. Some industries use benzene to make other chemicals which are used to make plastics, resins, and nylon and synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Natural sources of benzene include volcanoes and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke.

What happens to benzene when it enters the environment?

☐ Industrial processes are the main source of benzene in the environment.

☐ Benzene can pass into the air from water and soil.

☐ It reacts with other chemicals in the air and breaks down within a few days.

☐ Benzene in the air can attach to rain or snow and be carried back down to the ground.

☐ It breaks down more slowly in water and soil, and can pass through the soil into underground water.

☐ Benzene does not build up in plants or animals.

How might I be exposed to benzene?

☐ Outdoor air contains low levels of benzene from tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions.

☐ Indoor air generally contains higher levels of benzene from products that contain it such as glues, paints, furniture wax, and detergents.

☐ Air around hazardous waste sites or gas stations will contain higher levels of benzene.

☐ Leakage from underground storage tanks or from hazardous waste sites containing benzene can result in benzene contamination of well water.

☐ People working in industries that make or use benzene may be exposed to the highest levels of it.

☐ A major source of benzene exposures is tobacco smoke.

How can benzene affect my health?

Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death.

The major effect of benzene from long-term (365 days or longer) exposure is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection.

Some women who breathed high levels of benzene for many months had irregular menstrual periods and a decrease in the size of their ovaries. It is not known whether benzene exposure affects the developing fetus in pregnant women or fertility in men.

Animal studies have shown low birth weights, delayed bone formation, and bone marrow damage when pregnant animals breathed benzene.

How likely is benzene to cause cancer?

The Department of Health and Human Services (DHHS) has determined that benzene is a known human carcinogen. Long-term exposure to high levels of benzene in the air can cause leukemia, cancer of the blood-forming organs.

Is there a medical test to show whether I've been exposed to benzene?

Several tests can show if you have been exposed to benzene. There is test for measuring benzene in the breath; this test must be done shortly after exposure. Benzene can also be measured in the blood, however, since benzene disappears rapidly from the blood, measurements are accurate only for recent exposures.

In the body, benzene is converted to products called metabolites. Certain metabolites can be measured in the urine. However, this test must be done shortly after exposure and is not a reliable indicator of how much benzene you have been exposed to, since the metabolites may be present in urine from other sources.

Has the federal government made recommendations to protect human health?

The EPA has set the maximum permissible level of benzene in drinking water at 0.005 milligrams per liter (0.005 mgL). The EPA requires that spills or accidental releases into the environment of 10 pounds or more of benzene be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit of 1 part of benzene per million parts of air (1 ppm) in the workplace during an 8-hour workday, 40-hour workweek.

Glossary

Anemia: A decreased ability of the blood to transport oxygen.

Carcinogen: A substance with the ability to cause cancer.

CAS: Chemical Abstracts Service.

Chromosomes: Parts of the cells responsible for the development of hereditary characteristics.

Metabolites: Breakdown products of chemicals.

Milligram (mg): One thousandth of a gram.

Pesticide: A substance that kills pests.

References

This ToxFAQs information is taken from the 1997 Toxicological Profile for Benzene (update) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 404-498-0093. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

CARBON DISULFIDE

CAS # 75-15-0

Agency for Toxic Substances and Disease Registry ToxFAQs **September 1997**

This fact sheet answers the most frequently asked health questions (FAQs) about carbon disulfide. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to carbon disulfide can occur by breathing it in the air and by drinking water or eating foods that contain it. Breathing very high levels can be life threatening because of its effects on the nervous system. Breathing low levels for long periods may result in headaches, tiredness, trouble sleeping, and slight changes in the nerves. Carbon disulfide has been found in at least 210 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is carbon disulfide?

(Pronounced kär′bən dī-sŭl′fīd′)

Pure carbon disulfide is a colorless liquid with a pleasant odor that is like the smell of chloroform. The impure carbon disulfide that is usually used in most industrial processes is a yellowish liquid with an unpleasant odor, like that of rotting radishes.

Carbon disulfide evaporates at room temperature, and the vapor is more than twice as heavy as air. It easily explodes in air and also catches fire very easily.

In nature, small amounts of carbon disulfide are found in gases released to the earth's surface as, for example, in volcanic eruptions or over marshes. Commercial carbon disulfide is made by combining carbon and sulfur at very high temperatures.

What happens to carbon disulfide when it enters the environment?

- ☐ The amount of carbon disulfide released into the air through natural processes is difficult to judge because it is so small.
- ☐ Carbon disulfide evaporates rapidly when released to the environment.
- ☐ Most carbon disulfide in the air and surface water is from manufacturing and processing activities.
- ☐ It is found naturally in coastal and ocean waters.
- ☐ Carbon disulfide does not stay dissolved in water very long, and it also moves through soils fairly quickly.
- ☐ Carbon disulfide does not appear to be taken up in significant amounts by the organisms living in water.

How might I be exposed to carbon disulfide?

- ☐ The people most often exposed to carbon disulfide are workers in plants that use carbon disulfide in their manufacturing processes.
- ☐ People may be exposed by breathing air, drinking water, or eating foods that contain it.
- ☐ People may also be exposed through skin contact with soil, water, or other substances that contain carbon disulfide.

How can carbon disulfide affect my health?

At very high levels, carbon disulfide may be life-threatening because of its effects on the nervous system. People who breathed carbon disulfide near an accident involving a railroad car showed changes in breathing and some chest pains.

Some workers who breathed high levels during working hours for at least 6 months had headaches, tiredness, and trouble sleeping. However, these workers may have been exposed to other chemicals besides carbon disulfide. Among workers who breathed lower levels, some developed very slight changes in their nerves.

Studies in animals indicate that carbon disulfide can affect the normal functions of the brain, liver, and heart. After pregnant rats breathed carbon disulfide in the air, some of the newborn rats died or had birth defects.

High concentrations of carbon disulfide have caused skin burns when the chemical accidentally touched people's skin.

How likely is carbon disulfide to cause cancer?

The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the EPA have not classified carbon disulfide for carcinogenicity.

There are no definitive data in humans or animals that indicate a carcinogenic potential for carbon disulfide.

Is there a medical test to show whether I've been exposed to carbon disulfide?

One chemical test using urine can be done to tell whether the levels of breakdown substances from carbon disulfide are higher than normal. However, the test is not specific for carbon disulfide exposure.

A second test based on a specific breakdown substance is more sensitive and specific. It also requires special equipment and cannot tell you exactly how much carbon disulfide you were exposed to or predict whether harmful effects will occur.

These tests aren't available at most doctors' offices, but can be done at special laboratories that have the right equipment.

Has the federal government made recommendations to protect human health?

The EPA requires that spills or accidental releases into the environment of 100 pounds or more of carbon disulfide be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) has set a limit of 20 parts of carbon disulfide per million parts of air (20 ppm) for an 8-hour workday for a 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) recommends that workroom air levels of carbon disulfide not exceed 1 ppm for a 10-hour workday, 40-hour workweek.

Glossary

Carcinogenicity: Ability of a substance to cause cancer.

CAS: Chemical Abstracts Service.

Dissolve: To disappear gradually.

Evaporate: To change into vapor or a gas.

References

This ToxFAQs information is taken from the 1996 Toxicological Profile for Carbon Disulfide produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone:1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

CARBON TETRACHLORIDE

CAS # 56-23-5

Division of Toxicology ToxFAQs™ **August 2005**

This fact sheet answers the most frequently asked health questions (FAQs) about carbon tetrachloride. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Carbon tetrachloride does not occur naturally. Exposure to this substance results mostly from breathing air, drinking water, or coming in contact with soil that is contaminated with it. Exposure to very high amounts of carbon tetrachloride can damage the liver, kidneys, and nervous system. Carbon tetrachloride can cause cancer in animals. Carbon tetrachloride has been found in at least 425 of the 1,662 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is carbon tetrachloride?

Carbon tetrachloride is a manufactured chemical that does not occur naturally. It is a clear liquid with a sweet smell that can be detected at low levels. It is also called carbon chloride, methane tetrachloride, perchloromethane, tetrachloroethane, or benziform.

Carbon tetrachloride is most often found in the air as a colorless gas. It is not flammable and does not dissolve in water very easily. It was used in the production of refrigeration fluid and propellants for aerosol cans, as a pesticide, as a cleaning fluid and degreasing agent, in fire extinguishers, and in spot removers. Because of its harmful effects, these uses are now banned and it is only used in some industrial applications.

What happens to carbon tetrachloride when it enters the environment?

❏ It moves very quickly into the air upon release, so most of it is in the air.

❏ It evaporates quickly surface water.

❏ Only a small amount sticks to soil particles; the rest evaporates or moves into the groundwater.

❏ It is very stable in air (lifetime 30-100 years).

❏ It can be broken down or transformed in soil and water within several days.

❏ When it does break down, it forms chemicals that can destroy ozone in the upper atmosphere.

❏ It does not build up in animals. We do not know if it build up in plants.

How might I be exposed to carbon tetrachloride?

❏ Breathing contaminated air near manufacturing plants or waste sites.

❏ Breathing workplace air when it is used.

❏ Drinking contaminated water near manufacturing plants and waste sites.

❏ Breathing contaminated air and skin contact with water while showering or cooking with contaminated water.

❏ Swimming or bathing in contaminated water.

❏ Contact with or eating contaminated soil (pica child) at waste sites.

How can carbon tetrachloride affect my health?

High exposure to carbon tetrachloride can cause liver, kidney, and central nervous system damage. These effects can occur after ingestion or breathing carbon tetrachloride, and possibly from exposure to the skin. The liver is especially sensitive to carbon tetrachloride because it enlarges and cells are damaged or destroyed. Kidneys also are damaged, causing a build up of wastes in the blood. If exposure is low and brief, the liver and kidneys can repair the damaged cells and function normally again. Effects of carbon tetrachloride are more severe in persons who drink large amounts of alcohol.

If exposure is very high, the nervous system, including the brain, is affected. People may feel intoxicated and experience headaches, dizziness, sleepiness, and nausea and vomiting. These effects may subside if exposure is stopped, but in severe cases, coma and even death may occur.

There have been no studies of the effects of carbon tetrachloride on reproduction in humans, but studies in rats showed that long-term inhalation may cause decreased fertility.

How likely is carbon tetrachloride to cause cancer?

Studies in humans have not been able to determine whether or not carbon tetrachloride can cause cancer because usually there has been exposure to other chemicals at the same time. Swallowing or breathing carbon tetrachloride for years caused liver tumors in animals. Mice that breathed carbon tetrachloride also developed tumors of the adrenal gland.

The Department of Health and Human Services (DHHS) has determined that carbon tetrachloride may reasonably be anticipated to be a carcinogen. The International Agency for Research on Cancer (IARC) has determined that carbon tetrachloride is possibly carcinogenic to humans, whereas the EPA determined that carbon tetrachloride is a probable human carcinogen.

How can carbon tetrachloride affect children?

The health effects of carbon tetrachloride have not been studied in children, but they are likely to be similar to those seen in adults exposed to the chemical. We do not know whether children differ from adults in their susceptibility to carbon tetrachloride.

A few survey-type studies suggest that maternal drinking water exposure to carbon tetrachloride might possibly be related to certain birth defects. Studies in animals showed that carbon tetrachloride can cause early fetal deaths, but did not cause birth defects. A study with human breast milk in a test tube suggested that it would be possible for carbon tetrachloride to pass from the maternal circulation to breast milk, but there is no direct demonstration of this occurring.

How can families reduce the risks of exposure to carbon tetrachloride?

❏ Discard any product that contains carbon tetrachloride that you may have at home and may have used in the past.

❏ Household chemicals should be stored out of the reach of children in their original containers.

❏ Sometimes older children sniff household chemical products to get high. Talk to your children about the dangers of sniffing chemicals.

Is there a medical test to determine whether I've been exposed to carbon tetrachloride?

Several sensitive and specific tests are available to measure carbon tetrachloride in exposed persons. The most convenient way is simply to measure carbon tetrachloride in the exhaled air. Carbon tetrachloride also can be measured in blood, fat, or other tissues. These tests are not usually done in the doctor's office because they require special equipment. Although these tests can show that a person has been exposed to carbon tetrachloride, the results cannot be used to reliably predict whether any adverse health effect might result. Because carbon tetrachloride leaves the body fairly quickly, these methods are best suited to detecting exposures that have occurred within the last several days.

Has the federal government made recommendations to protect human health?

The EPA has set a limit for carbon tetrachloride in drinking water of 5 parts of carbon tetrachloride per billion parts of water (5 ppb). The EPA has also set limits on how much carbon tetrachloride can be released from an industrial plant into waste water and is preparing to set limits on how much carbon tetrachloride can escape from an industrial plant into outside air.

The Occupational Safety and Health Administration (OSHA) set a limit of 10 ppm for carbon tetrachloride in workplace air for an 8-hour workday, 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological Profile for Carbon Tetrachloride (Update). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-0093. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

COPPER

CAS # 7440-50-8

Division of Toxicology ToxFAQs™ September 2002

This fact sheet answers the most frequently asked health questions (FAQs) about copper. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Copper is a reddish metal that occurs naturally in the environment. It also occurs naturally in plants and animals. Low levels of copper are essential for maintaining good health. High levels can cause harmful effects such as irritation of the nose, mouth and eyes, vomiting, diarrhea, stomach crumps, and nausea. Copper has been found in at least 884 of the 1,613 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is copper?

Copper is a reddish metal that occurs naturally in rocks, soil, water, and air. Copper also occurs naturally in plants and animals.

Metallic copper can be easily molded or shaped. Metallic copper can be found in the U.S. penny, electrical wiring, and some water pipes. Metallic copper is also found in mixtures (called alloys) with other metals such as brass and bronze. Copper is also found as part of other compounds forming salts. Copper salts occur naturally, but are also manufactured. The most common copper salt is copper sulfate. Most copper compounds are blue-green in color. Copper compounds are commonly used in agriculture to treat plant diseases like mildew, for water treatment and, as preservatives for wood, leather, and fabrics.

What happens to copper when it enters the environment?

☐ Copper can enter the environment from the mining of copper and other metals and from factories that make or use metallic copper or copper compounds.

☐ It can also enter the environment through domestic waste water, combustion of fossil fuels and wastes, wood production, phosphate fertilizer production, and natural sources (e.g., windblown dust from soils, volcanoes, decaying vegetation, forest fires, and sea spray).

☐ Copper in soil strongly attaches to organic material and minerals.

☐ Copper that dissolves in water becomes rapidly bound to particles suspended in the water.

☐ Copper does not typically enter groundwater.

☐ Copper carried by particles emitted from smelters and ore processing plants is carried back to the ground by gravity or in rain or snow.

☐ Copper does not break down in the environment.

How might I be exposed to copper?

☐ Breathing air, drinking water, eating food, and by skin contact with soil, water, or other copper-containing substances.

☐ Some copper in the environment can be taken up by plants and animals.

☐ Higher exposure may occur if your water is corrosive and you have copper plumbing and brass water fixtures. ☐ You may be exposed to higher amounts of copper if you drink water or swim in lakes or reservoirs recently treated with copper to control algae or receive cooling water from a power plant that may have high amounts of dissolved copper.

☐ Using some garden products (e.g., fungicides) to control plant diseases.

☐ Living near bronze and brass production facilities may expose you to higher copper levels in soil.

☐ You may breathe copper-containing dust or have skin contact if you work in the industry of mining copper or processing the ore. You may breathe high levels if you grind or weld copper metal.

How can copper affect my health?

Copper is essential for good health, but high amounts can be harmful. Long-term exposure to copper dust can irritate your nose, mouth, and eyes, and cause headaches, dizziness, nausea, and diarrhea.

Drinking water with higher than normal levels of copper may cause vomiting, diarrhea, stomach cramps, and nausea. Intentionally high intakes of copper can cause liver and kidney damage and even death.

How likely is copper to cause cancer?

We do not know whether copper can cause cancer in humans. The EPA has determined that copper is not classifiable as to carcinogenicity.

How can copper affect children?

Exposure to high levels of copper will result in the same type of effects in children and adults. Studies in animals suggest that the young children may have more severe effects than adults; we do not know if this would also be true in humans. There is a very small percentage of infants and children who are unusually sensitive to copper.

We do not know if copper can cause birth defects or other developmental effects in humans. Studies in animals suggest that ingestion of high levels of copper may cause a decrease in fetal growth.

How can families reduce the risk of exposure to copper?

☐ The greatest potential source of copper exposure is through drinking water, especially in water that is first drawn in the morning after sitting in copper pipes and brass faucets overnight.

☐ To reduce exposure, run the water for at least 15-30 seconds before using it.

☐ If you are exposed to copper at work, you may carry copper home on your skin, clothes, or tools. You can avoid this by showering, and changing clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

Is there a medical test to show whether I've been exposed to copper?

Copper is normally found in all tissues of the body, blood, urine, feces, hair, and nails. High levels of copper in these samples can show that you have been exposed to higher than normal levels of copper. Tests to measure copper levels in the body are not routinely available at the doctor's office because they require special equipment. These tests cannot tell the extent of exposure or whether you will experience harmful effects.

Has the federal government made recommendations to protect human health?

The EPA has determined that drinking water should not contain more than 1.3 milligrams of copper per liter of water (1.3 mg/L).

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.1 mg per cubic meter (0.1 mg/m^3) of copper fumes (vapor generated from heating copper) and 1 mg/m^3 of copper dusts (fine metallic copper particles) and mists (aerosol of soluble copper) in workroom air during an 8-hour work shift, 40-hour workweek.

The Food and Nutrition Board of the Institute of Medicine recommends dietary allowances (RDAs) of 340 micrograms (340 µg) of copper per day for children aged 1-3 years, 440 µg/day for children aged 4-8 years, 700 µg/day for children aged 9-13 years, 890 µg/day for children aged 14-18 years, and 900 µg/day for adults.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2002. Toxicological Profile for Copper (Draft for Public Comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

DDT, DDE, AND DDD

CAS # 50-29-3, 72-55-9, 72-54-8

Division of Toxicology ToxFAQs™ **September 2002**

This fact sheet answers the most frequently asked health questions (FAQs) about DDT, DDE, and DDD. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to DDT, DDE, and DDD occurs mostly from eating foods containing small amounts of these compounds, particularly meat, fish and poultry. High levels of DDT can affect the nervous system causing excitability, tremors and seizures. In women, DDE can cause a reduction in the duration of lactation and an increased chance of having a premature baby. DDT, DDE, and DDD have been found in at least 441 of the 1,613 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are DDT, DDE, and DDD?

DDT (dichlorodiphenyltrichloroethane) is a pesticide once widely used to control insects in agriculture and insects that carry diseases such as malaria. DDT is a white, crystalline solid with no odor or taste. Its use in the U.S. was banned in 1972 because of damage to wildlife, but is still used in some countries.

DDE (dichlorodiphenyldichloroethylene) and DDD (dichlorodiphenyldichloroethane) are chemicals similar to DDT that contaminate commercial DDT preparations. DDE has no commercial use. DDD was also used to kill pests, but its use has also been banned. One form of DDD has been used medically to treat cancer of the adrenal gland.

What happens to DDT, DDE, and DDD when they enter the environment?

❑ DDT entered the environment when it was used as a pesticide; it still enters the environment due to current use in other countries.
❑ DDE enters the environment as contaminant or breakdown product of DDT; DDD also enters the environment as a breakdown product of DDT.
❑ DDT, DDE, and DDD in air are rapidly broken down by sunlight. Half of what's in air breaks down within 2 days.
❑ They stick strongly to soil; most DDT in soil is broken down slowly to DDE and DDD by microorganisms; half the DDT in soil will break down in 2-15 years, depending on the type of soil.
❑ Only a small amount will go through the soil into groundwater; they do not dissolve easily in water.
❑ DDT, and especially DDE, build up in plants and in fatty tissues of fish, birds, and other animals.

How might I be exposed to DDT, DDE, and DDD?

❑ Eating contaminated foods, such as root and leafy vegetables, fatty meat, fish, and poultry, but levels are very low.
❑ Eating contaminated imported foods from countries that still allow the use of DDT to control pests.
❑ Breathing contaminated air or drinking contaminated water near waste sites and landfills that may contain higher levels of these chemicals.
❑ Infants fed on breast milk from mothers who have been exposed.
❑ Breathing or swallowing soil particles near waste sites or landfills that contain these chemicals.

How can DDT, DDE, and DDD affect my health?

DDT affects the nervous system. People who accidentally swallowed large amounts of DDT became excitable and had tremors and seizures. These effects went away after the exposure stopped. No effects were seen in people who took small daily doses of DDT by capsule for 18 months.

A study in humans showed that women who had high amounts of a form of DDE in their breast milk were unable to breast feed their babies for as long as women who had little DDE in the breast milk. Another study in humans showed that women who had high amounts of DDE in breast milk had an increased chance of having premature babies.

In animals, short-term exposure to large amounts of DDT in food affected the nervous system, while long-term exposure to smaller amounts affected the liver. Also in animals, short-term oral exposure to small amounts of DDT or its breakdown products may also have harmful effects on reproduction.

How likely are DDT, DDE, and DDD to cause cancer?

Studies in DDT-exposed workers did not show increases in cancer. Studies in animals given DDT with the food have shown that DDT can cause liver cancer.

The Department of Health and Human Services (DHHS) determined that DDT may reasonable be anticipated to be a human carcinogen. The International Agency for Research on Cancer (IARC) determined that DDT may possibly cause cancer in humans. The EPA determined that DDT, DDE, and DDD are probable human carcinogens.

How can DDT, DDE, and DDD affect children?

There are no studies on the health effects of children exposed to DDT, DDE, or DDD. We can assume that children exposed to large amounts of DDT will have health effects similar to the effects seen in adults. However, we do not know whether children differ from adults in their susceptibility to these substances.

There is no evidence that DDT, DDE, or DDD cause birth defects in people. A study showed that teenage boys whose mothers had higher DDE amounts in the blood when they were pregnant were taller than those whose mothers had lower DDE levels. However, a different study found the opposite in preteen girls. The reason for the discrepancy between these studies is unknown.

Studies in rats have shown that DDT and DDE can mimic the action of natural hormones and in this way affect the development of the reproductive and nervous systems. Puberty was delayed in male rats given high amounts of DDE as juveniles. This could possibly happen in humans.

A study in mice showed that exposure to DDT during the first weeks of life may cause neurobehavioral problems later in life.

How can families reduce the risk of exposure to DDT,DDE, and DDE?

❏ Most families will be exposed to DDT by eating food or drinking liquids contaminated with small amounts of DDT.
❏ Cooking will reduce the amount of DDT in fish.
❏ Washing fruit and vegetables will remove most DDT from their surface.
❏ Follow health advisories that tell you about consumption of fish and wildlife caught in contaminated areas.

Is there a medical test to show whether I’ve been exposed to DDT, DDE, and DDD?

Laboratory tests can detect DDT, DDE, and DDD in fat, blood, urine, semen, and breast milk. These tests may show low, moderate, or excessive exposure to these compounds, but cannot tell the exact amount you were exposed to, or whether you will experience adverse effects. These tests are not routinely available at the doctor’s office because they require special equipment.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) sets a limit of 1 milligram of DDT per cubic meter of air (1 mg/m^3) in the workplace for an 8-hour shift, 40-hour workweek.

The Food and Drug Administration (FDA) has set limits for DDT, DDE, and DDD in foodstuff at or above which the agency will take legal action to remove the products from the market.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2002. Toxicological Profile for DDT/DDE/DDD (Update). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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ETHYLBENZENE

CAS # 100-41-4

Agency for Toxic Substances and Disease Registry ToxFAQs **June 1999**

This fact sheet answers the most frequently asked health questions (FAQs) about ethylbenzene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Ethylbenzene is a colorless liquid found in a number of products including gasoline and paints. Breathing very high levels can cause dizziness and throat and eye irritation. Ethylbenzene has been found in at least 731 of the 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is ethylbenzene?

(Pronounced ĕth′ əl bĕn′ zēn′)

Ethylbenzene is a colorless, flammable liquid that smells like gasoline. It is found in natural products such as coal tar and petroleum and is also found in manufactured products such as inks, insecticides, and paints.

Ethylbenzene is used primarily to make another chemical, styrene. Other uses include as a solvent, in fuels, and to make other chemicals.

What happens to ethylbenzene when it enters the environment?

- Ethylbenzene moves easily into the air from water and soil.
- It takes about 3 days for ethylbenzene to be broken down in air into other chemicals.
- Ethylbenzene may be released to water from industrial discharges or leaking underground storage tanks.
- In surface water, ethylbenzene breaks down by reacting with other chemicals found naturally in water.
- In soil, it is broken down by soil bacteria.

How might I be exposed to ethylbenzene?

- Breathing air containing ethylbenzene, particularly in areas near factories or highways.
- Drinking contaminated tap water.
- Working in an industry where ethylbenzene is used or made.
- Using products containing it, such as gasoline, carpet glues, varnishes, and paints.

How can ethylbenzene affect my health?

Limited information is available on the effects of ethylbenzene on people's health. The available information shows dizziness, throat and eye irritation, tightening of the chest, and a burning sensation in the eyes of people exposed to high levels of ethylbenzene in air.

Animals studies have shown effects on the nervous system, liver, kidneys, and eyes from breathing ethylbenzene in air.

How likely is ethylbenzene to cause cancer?

The EPA has determined that ethylbenzene is not classifiable as to human carcinogenicity.

No studies in people have shown that ethylbenzene exposure can result in cancer. Two available animal studies suggest that ethylbenzene may cause tumors.

How can ethylbenzene affect children?

Children may be exposed to ethylbenzene through inhalation of consumer products, including gasoline, paints, inks, pesticides, and carpet glue. We do not know whether children are more sensitive to the effects of ethylbenzene than adults.

It is not known whether ethylbenzene can affect the development of the human fetus. Animal studies have shown that when pregnant animals were exposed to ethylbenzene in air, their babies had an increased number of birth defects.

How can families reduce the risk of exposure to ethylbenzene?

Exposure to ethylbenzene vapors from household products and newly installed carpeting can be minimized by using adequate ventilation.

Household chemicals should be stored out of reach of children to prevent accidental poisoning. Always store household chemicals in their original containers; never store them in containers children would find attractive to eat or drink from, such as old soda bottles. Gasoline should be stored in a gasoline can with a locked cap.

Sometimes older children sniff household chemicals, including ethylbenzene, in an attempt to get high. Talk with your children about the dangers of sniffing chemicals.

Is there a medical test to show whether I've been exposed to ethylbenzene?

Ethylbenzene is found in the blood, urine, breath, and some body tissues of exposed people. The most common way to test for ethylbenzene is in the urine. This test measures substances formed by the breakdown of ethylbenzene. This test needs to be done within a few hours after exposure occurs, because the substances leave the body very quickly.

These tests can show you were exposed to ethylbenzene, but cannot predict the kind of health effects that might occur.

Has the federal government made recommendations to protect human health?

The EPA has set a maximum contaminant level of 0.7 milligrams of ethylbenzene per liter of drinking water (0.7 mg/L).

The EPA requires that spills or accidental releases into the environment of 1,000 pounds or more of ethylbenzene be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) has set an occupational exposure limit of 100 parts of ethylbenzene per million parts of air (100 ppm) for an 8-hour workday, 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for ethylbenzene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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FUEL OILS

CAS # 8008-20-6, 70892-10-3, 68476-30-2, 68476-34-6, 68476-31-3

Agency for Toxic Substances and Disease Registry ToxFAQs **September 1996**

This fact sheet answers the most frequently asked health questions (FAQs) about fuel oils. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Fuel oils are liquid mixtures produced from petroleum, and their use mostly involves burning them as fuels. Drinking or breathing fuel oils may cause nausea or nervous system effects. However, exposure under normal use conditions is not likely to be harmful. Fuel oils have been found in at least 26 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are fuel oils?

(Pronounced fyo͞o′əl oilz)

Fuel oils are a variety of yellowish to light brown liquid mixtures that come from crude petroleum. Some chemicals found in fuel oils may evaporate easily, while others may more easily dissolve in water.

Fuel oils are produced by different petroleum refining processes, depending on their intended uses. Fuel oils may be used as fuel for engines, lamps, heaters, furnaces, and stoves, or as solvents.

Some commonly found fuel oils include kerosene, diesel fuel, jet fuel, range oil, and home heating oil. These fuel oils differ from one another by their hydrocarbon compositions, boiling point ranges, chemical additives, and uses.

What happens to fuel oils when they enter the environment?

☐ Some chemicals found in fuel oils may evaporate into the air from open containers or contaminated soil or water.

☐ Some chemicals found in fuel oils may dissolve in water after spills to surface waters or leaks from underground storage tanks.

☐ Some chemicals found in fuel oils may stick to particles in water, which will eventually cause them to settle to the bottom sediment.

☐ Some of the chemicals found in fuel oils may be broken down slowly in air, water, and soil by sunlight or small organisms.

☐ Some of the chemicals found in fuel oils may build up significantly in plants and animals.

How might I be exposed to fuel oils?

☐ Using a home kerosene heater or stove, or using fuel oils at work.

☐ Breathing air in home or building basements that has been contaminated with fuel oil vapors entering from the soil.

☐ Drinking or swimming in water that has been contaminated with fuel oils from a spill or a leaking underground storage tank.

☐ Touching soil contaminated with fuel oils.

☐ Using fuel oils to wash paint or grease from skin or equipment.

How can fuel oils affect my health?

Little information is available about the health effects that may be caused by fuel oils. People who use kerosene stoves for cooking do not seem to have any health problems related to their exposure.

Breathing some fuel oils for short periods may cause nausea, eye irritation, increased blood pressure, headache, lightheadedness, loss of appetite, poor coordination, and difficulty concentrating. Breathing diesel fuel vapors for long periods may cause kidney damage and lower your blood's ability to clot.

Drinking small amounts of kerosene may cause vomiting, diarrhea, coughing, stomach swelling and cramps, drowsiness, restlessness, painful breathing, irritability, and unconsciousness. Drinking large amounts of kerosene may cause convulsions, coma, or death. Skin contact with kerosene for short periods may cause itchy, red, sore, or peeling skin.

How likely are fuel oils to cause cancer?

The International Agency for Research on Cancer (IARC) has determined that some fuel oils (heavy) may possibly cause cancer in humans, but for other fuel oils (light) there is not enough information to make a determination. IARC has also determined that occupational exposures to fuel oils during petroleum refining are probably carcinogenic in humans.

Some studies with mice have suggested that repeated contact with fuel oils may cause liver or skin cancer. However, other mouse studies have found this not to be the case. No studies are available in other animals or in people on the carcinogenic effects of fuel oils.

Is there a medical test to show whether I've been exposed to fuel oils?

There is no medical test that shows if you have been exposed to fuel oils. Tests are available to determine if some of the chemicals commonly found in fuel oils are in your blood. However, the presence of these chemicals in blood may not necessarily mean that you have been exposed to fuel oils.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) and the Air Force Office of Safety and Health (AFOSH) have set a permissible exposure level (PEL) of 400 parts of petroleum distillates per million parts of air (400 ppm) for an 8-hour workday, 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) recommends that average workplace air levels not exceed 350 milligrams of petroleum distillates per cubic meter of air (350 mg/m^3) for a 40-hour workweek.

The Department of Transportation (DOT) lists fuel oils as hazardous materials and, therefore, regulates their transportation.

Glossary

Carcinogenic: Able to cause cancer.

CAS: Chemical Abstracts Service.

Evaporate: To change into a vapor or a gas.

Hydrocarbon: Any compound made up of hydrogen and carbon.

Milligram (mg): One thousandth of a gram.

ppm: Parts per million.

Sediment: Mud and debris that have settled to the bottom of a body of water.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for fuel oils. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333. Phone:1-888-422-8737, FAX: 404-498-0093. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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LEAD

CAS # 7439-92-1

Division of Toxicology and Environmental Medicine ToxFAQs™ August 2007

This fact sheet answers the most frequently asked health questions (FAQs) about lead. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to lead can happen from breathing workplace air or dust, eating contaminated foods, or drinking contaminated water. Children can be exposed from eating lead-based paint chips or playing in contaminated soil. Lead can damage the nervous system, kidneys, and reproductive system. Lead has been found in at least 1,272 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is lead?

Lead is a naturally occurring bluish-gray metal found in small amounts in the earth's crust. Lead can be found in all parts of our environment. Much of it comes from human activities including burning fossil fuels, mining, and manufacturing.

Lead has many different uses. It is used in the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays. Because of health concerns, lead from paints and ceramic products, caulking, and pipe solder has been dramatically reduced in recent years. The use of lead as an additive to gasoline was banned in 1996 in the United States.

What happens to lead when it enters the environment?

❑ Lead itself does not break down, but lead compounds are changed by sunlight, air, and water.

❑ When lead is released to the air, it may travel long distances before settling to the ground.

❑ Once lead falls onto soil, it usually sticks to soil particles.

❑ Movement of lead from soil into groundwater will depend on the type of lead compound and the characteristics of the soil.

How might I be exposed to lead?

❑ Eating food or drinking water that contains lead. Water pipes in some older homes may contain lead solder. Lead can leach out into the water.

❑ Spending time in areas where lead-based paints have been used and are deteriorating. Deteriorating lead paint can contribute to lead dust.

❑ Working in a job where lead is used or engaging in certain hobbies in which lead is used, such as making stained glass.

❑ Using health-care products or folk remedies that contain lead.

How can lead affect my health?

The effects of lead are the same whether it enters the body through breathing or swallowing. Lead can affect almost every organ and system in your body. The main target for lead toxicity is the nervous system, both in adults and children. Long-term exposure of adults can result in decreased performance in some tests that measure functions of the nervous system. It may also cause weakness in fingers, wrists, or ankles. Lead exposure also causes small increases in blood pressure, particularly in middle-aged and older people and can cause anemia. Exposure to high lead levels can severely damage the brain and kidneys in adults or children and ultimately cause death. In pregnant women, high levels of exposure to lead may cause miscarriage. High-level exposure in men can damage the organs responsible for sperm production.

How likely is lead to cause cancer?

We have no conclusive proof that lead causes cancer in humans. Kidney tumors have developed in rats and mice that had been given large doses of some kind of lead compounds. The Department of Health and Human Services

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CAS # 7439-92-1

(DHHS) has determined that lead and lead compounds are reasonably anticipated to be human carcinogens and the EPA has determined that lead is a probable human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic lead is probably carcinogenic to humans and that there is insufficient information to determine whether organic lead compounds will cause cancer in humans.

How can lead affect children?

Small children can be exposed by eating lead-based paint chips, chewing on objects painted with lead-based paint, or swallowing house dust or soil that contains lead.

Children are more vulnerable to lead poisoning than adults. A child who swallows large amounts of lead may develop blood anemia, severe stomachache, muscle weakness, and brain damage. If a child swallows smaller amounts of lead, much less severe effects on blood and brain function may occur. Even at much lower levels of exposure, lead can affect a child's mental and physical growth.

Exposure to lead is more dangerous for young and unborn children. Unborn children can be exposed to lead through their mothers. Harmful effects include premature births, smaller babies, decreased mental ability in the infant, learning difficulties, and reduced growth in young children. These effects are more common if the mother or baby was exposed to high levels of lead. Some of these effects may persist beyond childhood.

How can families reduce the risks of exposure to lead?

❑ Avoid exposure to sources of lead.

❑ Do not allow children to chew or mouth surfaces that may have been painted with lead-based paint.

❑ If you have a water lead problem, run or flush water that has been standing overnight before drinking or cooking with it.

❑ Some types of paints and pigments that are used as make-up or hair coloring contain lead. Keep these kinds of products away from children

❑ If your home contains lead-based paint or you live in an area contaminated with lead, wash children's hands and faces often to remove lead dusts and soil, and regularly clean the house of dust and tracked in soil.

Is there a medical test to determine whether I've been exposed to lead?

A blood test is available to measure the amount of lead in your blood and to estimate the amount of your recent exposure to lead. Blood tests are commonly used to screen children for lead poisoning. Lead in teeth or bones can be measured by X-ray techniques, but these methods are not widely available. Exposure to lead also can be evaluated by measuring erythrocyte protoporphyrin (EP) in blood samples. EP is a part of red blood cells known to increase when the amount of lead in the blood is high. However, the EP level is not sensitive enough to identify children with elevated blood lead levels below about 25 micrograms per deciliter (μg/dL). These tests usually require special analytical equipment that is not available in a doctor's office. However, your doctor can draw blood samples and send them to appropriate laboratories for analysis.

Has the federal government made recommendations to protect human health?

The Centers for Disease Control and Prevention (CDC) recommends that states test children at ages 1 and 2 years. Children should be tested at ages 3–6 years if they have never been tested for lead, if they receive services from public assistance programs for the poor such as Medicaid or the Supplemental Food Program for Women, Infants, and Children, if they live in a building or frequently visit a house built before 1950; if they visit a home (house or apartment) built before 1978 that has been recently remodeled; and/or if they have a brother, sister, or playmate who has had lead poisoning. CDC considers a blood lead level of 10 μg/dL to be a level of concern for children.

EPA limits lead in drinking water to 15 μg per liter.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for lead (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

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MERCURY
CAS # 7439-97-6

Agency for Toxic Substances and Disease Registry ToxFAQs **April 1999**

This fact sheet answers the most frequently asked health questions (FAQs) about mercury. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to mercury occurs from breathing contaminated air, ingesting contaminated water and food, and having dental and medical treatments. Mercury, at high levels, may damage the brain, kidneys, and developing fetus. This chemical has been found in at least 714 of 1,467 National Priorities List sites identified by the Environmental Protection Agency.

What is mercury?
(Pronounced mū̃r′kyə-rē)

Mercury is a naturally occurring metal which has several forms. The metallic mercury is a shiny, silver-white, odorless liquid. If heated, it is a colorless, odorless gas.

Mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds or "salts," which are usually white powders or crystals. Mercury also combines with carbon to make organic mercury compounds. The most common one, methylmercury, is produced mainly by microscopic organisms in the water and soil. More mercury in the environment can increase the amounts of methylmercury that these small organisms make.

Metallic mercury is used to produce chlorine gas and caustic soda, and is also used in thermometers, dental fillings, and batteries. Mercury salts are sometimes used in skin lightening creams and as antiseptic creams and ointments.

What happens to mercury when it enters the environment?

☐ Inorganic mercury (metallic mercury and inorganic mercury compounds) enters the air from mining ore deposits, burning coal and waste, and from manufacturing plants.

☐ It enters the water or soil from natural deposits, disposal of wastes, and volcanic activity.

☐ Methylmercury may be formed in water and soil by small organisms called bacteria.

☐ Methylmercury builds up in the tissues of fish. Larger and older fish tend to have the highest levels of mercury.

How might I be exposed to mercury?

☐ Eating fish or shellfish contaminated with methylmercury.

☐ Breathing vapors in air from spills, incinerators, and industries that burn mercury-containing fuels.

☐ Release of mercury from dental work and medical treatments.

☐ Breathing contaminated workplace air or skin contact during use in the workplace (dental, health services, chemical, and other industries that use mercury).

☐ Practicing rituals that include mercury.

How can mercury affect my health?

The nervous system is very sensitive to all forms of mercury. Methylmercury and metallic mercury vapors are more harmful than other forms, because more mercury in these forms reaches the brain. Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, kidneys, and developing fetus. Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems.

Short-term exposure to high levels of metallic mercury vapors may cause effects including lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation.

How likely is mercury to cause cancer?

There are inadequate human cancer data available for all forms of mercury. Mercuric chloride has caused increases in several types of tumors in rats and mice, and methylmercury has caused kidney tumors in male mice. The EPA has determined that mercuric chloride and methylmercury are possible human carcinogens.

How can mercury affect children?

Very young children are more sensitive to mercury than adults. Mercury in the mother's body passes to the fetus and may accumulate there. It can also can pass to a nursing infant through breast milk. However, the benefits of breast feeding may be greater than the possible adverse effects of mercury in breast milk.

Mercury's harmful effects that may be passed from the mother to the fetus include brain damage, mental retardation, incoordination, blindness, seizures, and inability to speak. Children poisoned by mercury may develop problems of their nervous and digestive systems, and kidney damage.

How can families reduce the risk of exposure to mercury?

Carefully handle and dispose of products that contain mercury, such as thermometers or fluorescent light bulbs. Do not vacuum up spilled mercury, because it will vaporize and increase exposure. If a large amount of mercury has been spilled, contact your health department. Teach children not to play with shiny, silver liquids.

Properly dispose of older medicines that contain mercury. Keep all mercury-containing medicines away from children.

Pregnant women and children should keep away from rooms where liquid mercury has been used.

Learn about wildlife and fish advisories in your area from your public health or natural resources department.

Is there a medical test to show whether I've been exposed to mercury?

Tests are available to measure mercury levels in the body. Blood or urine samples are used to test for exposure to metallic mercury and to inorganic forms of mercury. Mercury in whole blood or in scalp hair is measured to determine exposure to methylmercury. Your doctor can take samples and send them to a testing laboratory.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 2 parts of mercury per billion parts of drinking water (2 ppb).

The Food and Drug Administration (FDA) has set a maximum permissible level of 1 part of methylmercury in a million parts of seafood (1 ppm).

The Occupational Safety and Health Administration (OSHA) has set limits of 0.1 milligram of organic mercury per cubic meter of workplace air (0.1 mg/m^3) and 0.05 mg/m^3 of metallic mercury vapor for 8-hour shifts and 40-hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for mercury. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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METHYLENE CHLORIDE

CAS # 75-09-2

Division of Toxicology ToxFAQs™ **February 2001**

This fact sheet answers the most frequently asked health questions (FAQs) about methylene chloride. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to methylene chloride occurs mostly from breathing contaminated air, but may also occur through skin contact or by drinking contaminated water. Breathing in large amounts of methylene chloride can damage the central nervous system. Contact of eyes or skin with methylene chloride can result in burns. Methylene chloride has been found in at least 882 of 1,569 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is methylene chloride?

Methylene chloride is a colorless liquid with a mild, sweet odor. Another name for it is dichloromethane. Methylene chloride does not occur naturally in the environment.

Methylene chloride is used as an industrial solvent and as a paint stripper. It may also be found in some aerosol and pesticide products and is used in the manufacture of photographic film.

What happens to methylene chloride when it enters the environment?

❏ Methylene chloride is mainly released to the environment in air. About half of the methylene chloride in air disappears in 53 to 127 days.

❏ Methylene chloride does not easily dissolve in water, but small amounts may be found in drinking water.

❏ We do not expect methylene chloride to build up in plants or animals.

How might I be exposed to methylene chloride?

❏ The most likely way to be exposed to methylene chloride is by breathing contaminated air.

❏ Breathing the vapors given off by products containing methylene chloride. Exposure to high levels of methylene chloride is likely if methylene chloride or a product containing it is used in a room with inadequate ventilation.

How can methylene chloride affect my health?

If you breathe in large amounts of methylene chloride you may feel unsteady, dizzy, and have nausea and a tingling or numbness of your finger and toes. A person breathing smaller amounts of methylene chloride may become less attentive and less accurate in tasks requiring hand-eye coordination. Skin contact with methylene chloride causes burning and redness of the skin.

How likely is methylene chloride to cause cancer?

We do not know if methylene chloride can cause cancer in humans. An increased cancer risk was seen in mice breathing large amounts of methylene chloride for a long time.

The World Health Organization (WHO) has determined that methylene chloride may cause cancer in humans.

The Department of Health and Human Services (DHHS) has determined that methylene chloride can be reasonably anticipated to be a cancer-causing chemical.

The EPA has determined that methylene chloride is a probable cancer-causing agent in humans.

How can methylene chloride affect children?

It is likely that health effects seen in children exposed to high amounts of methylene chloride will be similar to the effects seen in adults. We do not know if methylene chloride can affect the ability of people to have children or if it causes birth defects. Some birth defects have been seen in animals inhaling very high levels of methylene chloride.

How can families reduce the risk of exposure to methylene chloride?

❏ Families may be exposed to methylene chloride while using products such as paint removers. Such products should always be used in well-ventilated areas and skin contact should be avoided.
❏ Children should not be allowed to remain near indoor paint removal activities.

Is there a medical test to show whether I've been exposed to methylene chloride?

❏ Several tests can measure exposure to methylene chloride. These tests are not routinely available in your doctor's office.
❏ Methylene chloride can be detected in the air you breathe out and in your blood. These tests are only useful for detecting exposures that have occurred within a few days.
❏ It is also possible to measure carboxyhemoglobin (a chemical formed in the blood as methylene chloride breaks down in the body) in the blood or formic acid (a breakdown product of methylene chloride) in the urine. These tests are not specific for methylene chloride.

Has the federal government made recommendations to protect human health?

❏ The EPA requires that releases of methylene chloride of 1,000 pounds or more be reported to the federal government.
❏ The EPA recommends that exposure of children to methylene chloride be limited to less than 10 milligrams per liter of drinking water (10 mg/L) for 1 day or 2 mg/L for 10 days.
❏ The Food and Drug Administration (FDA) has established limits on the amounts of methylene chloride that can remain after processing of spices, hops extract, and decaffeinated coffee.
❏ The Occupational Safety and Health Administration (OSHA) has set limits of 25 parts methylene chloride per million parts of workplace air (25 ppm) for 8-hour shifts and 40-hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for methylene chloride. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is http://www.atsdr.cdc.gov/toxfaq.html . ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

Agency for Toxic Substances and Disease Registry ToxFAQs **September 1996**

This fact sheet answers the most frequently asked health questions (FAQs) about polycyclic aromatic hydrocarbons (PAHs). For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to polycyclic aromatic hydrocarbons usually occurs by breathing air contaminated by wild fires or coal tar, or by eating foods that have been grilled. PAHs have been found in at least 600 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polycyclic aromatic hydrocarbons?

(Pronounced pŏl′ĭ-sī′klĭk ăr′ə-măt′ĭk hī′drə-kar′bənz)

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides.

What happens to PAHs when they enter the environment?

- ☐ PAHs enter the air mostly as releases from volcanoes, forest fires, burning coal, and automobile exhaust.
- ☐ PAHs can occur in air attached to dust particles.
- ☐ Some PAH particles can readily evaporate into the air from soil or surface waters.
- ☐ PAHs can break down by reacting with sunlight and other chemicals in the air, over a period of days to weeks.
- ☐ PAHs enter water through discharges from industrial and wastewater treatment plants.
- ☐ Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes or rivers.
- ☐ Microorganisms can break down PAHs in soil or water after a period of weeks to months.
- ☐ In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water.
- ☐ PAH contents of plants and animals may be much higher than PAH contents of soil or water in which they live.

How might I be exposed to PAHs?

- ☐ Breathing air containing PAHs in the workplace of coking, coal-tar, and asphalt production plants; smokehouses; and municipal trash incineration facilities.
- ☐ Breathing air containing PAHs from cigarette smoke, wood smoke, vehicle exhausts, asphalt roads, or agricultural burn smoke.
- ☐ Coming in contact with air, water, or soil near hazardous waste sites.
- ☐ Eating grilled or charred meats; contaminated cereals, flour, bread, vegetables, fruits, meats; and processed or pickled foods.
- ☐ Drinking contaminated water or cow's milk.

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☐ Nursing infants of mothers living near hazardous waste sites may be exposed to PAHs through their mother's milk.

How can PAHs affect my health?

Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people.

Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people.

How likely are PAHs to cause cancer?

The Department of Health and Human Services (DHHS) has determined that some PAHs may reasonably be expected to be carcinogens.

Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

Is there a medical test to show whether I've been exposed to PAHs?

In the body, PAHs are changed into chemicals that can attach to substances within the body. There are special tests that can detect PAHs attached to these substances in body tissues or blood. However, these tests cannot tell whether any health effects will occur or find out the extent or source of your exposure to the PAHs. The tests aren't usually available in your doctor's office because special equipment is needed to conduct them.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m^3). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m^3 averaged over an 8-hour exposure period.

The National Institute for Occupational Safety and Health (NIOSH) recommends that the average workplace air levels for coal tar products not exceed 0.1 mg/m^3 for a 10-hour workday, within a 40-hour workweek. There are other limits for workplace exposure for things that contain PAHs, such as coal, coal tar, and mineral oil.

Glossary

Carcinogen: A substance that can cause cancer.

Ingest: Take food or drink into your body.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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POLYCHLORINATED BIPHENYLS

Division of Toxicology ToxFAQs™ February 2001

This fact sheet answers the most frequently asked health questions (FAQs) about polychlorinated biphenyls. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Polychlorinated biphenyls (PCBs) are a mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment. Health effects that have been associated with exposure to PCBs include acne-like skin conditions in adults and neurobehavioral and immunological changes in children. PCBs are known to cause cancer in animals. PCBs have been found in at least 500 of the 1,598 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polychlorinated biphenyls?

Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. PCBs have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils.

What happens to PCBs when they enter the environment?

❏ PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.

❏ PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.

❏ PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs can travel long distances in the air and be deposited in areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also bind strongly to soil.

❏ PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

How might I be exposed to PCBs?

❏ Using old fluorescent lighting fixtures and electrical devices and appliances, such as television sets and refrigerators, that were made 30 or more years ago. These items may leak small amounts of PCBs into the air when they get hot during operation, and could be a source of skin exposure.

❏ Eating contaminated food. The main dietary sources of PCBs are fish (especially sportfish caught in contaminated lakes or rivers), meat, and dairy products.

❏ Breathing air near hazardous waste sites and drinking contaminated well water.

❏ In the workplace during repair and maintenance of PCB transformers; accidents, fires or spills involving transformers, fluorescent lights, and other old electrical devices; and disposal of PCB materials.

How can PCBs affect my health?

The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects. Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs.

Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

How likely are PCBs to cause cancer?

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. The EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans.

How can PCBs affect children?

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs or of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. Transplacental transfers of PCBs were also reported In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

How can families reduce the risk of exposure to PCBs?

❏ You and your children may be exposed to PCBs by eating fish or wildlife caught from contaminated locations. Certain states, Native American tribes, and U.S. territories have issued advisories to warn people about PCB-contaminated fish and fish-eating wildlife. You can reduce your family's exposure to PCBs by obeying these advisories.

❏ Children should be told not play with old appliances, electrical equipment, or transformers, since they may contain PCBs.

❏ Children should be discouraged from playing in the dirt near hazardous waste sites and in areas where there was a transformer fire. Children should also be discouraged from eating dirt and putting dirty hands, toys or other objects in their mouths, and should wash hands frequently.

❏ If you are exposed to PCBs in the workplace it is possible to carry them home on your clothes, body, or tools. If this is the case, you should shower and change clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

Is there a medical test to show whether I've been exposed to PCBs?

Tests exist to measure levels of PCBs in your blood, body fat, and breast milk, but these are not routinely conducted. Most people normally have low levels of PCBs in their body because nearly everyone has been environmentally exposed to PCBs. The tests can show if your PCB levels are elevated, which would indicate past exposure to above-normal levels of PCBs, but cannot determine when or how long you were exposed or whether you will develop health effects.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.0005 milligrams of PCBs per liter of drinking water (0.0005 mg/L). Discharges, spills or accidental releases of 1 pound or more of PCBs into the environment must be reported to the EPA. The Food and Drug Administration (FDA) requires that infant foods, eggs, milk and other dairy products, fish and shellfish, poultry and red meat contain no more than 0.2-3 parts of PCBs per million parts (0.2-3 ppm) of food. Many states have established fish and wildlife consumption advisories for PCBs.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological profile for polychlorinated biphenyls (PCBs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 404-498-0093. ToxFAQs™ Internet address is http://www.atsdr.cdc.gov/toxfaq.html . ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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TRICHLOROETHYLENE

CAS # 79-01-6

Division of Toxicology ToxFAQs™ **July 2003**

This fact sheet answers the most frequently asked health questions (FAQs) about trichloroethylene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Trichloroethylene is a colorless liquid which is used as a solvent for cleaning metal parts. Drinking or breathing high levels of trichloroethylene may cause nervous system effects, liver and lung damage, abnormal heartbeat, coma, and possibly death. Trichloroethylene has been found in at least 852 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is trichloroethylene?

Trichloroethylene (TCE) is a nonflammable, colorless liquid with a somewhat sweet odor and a sweet, burning taste. It is used mainly as a solvent to remove grease from metal parts, but it is also an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers.

Trichloroethylene is not thought to occur naturally in the environment. However, it has been found in underground water sources and many surface waters as a result of the manufacture, use, and disposal of the chemical.

What happens to trichloroethylene when it enters the environment?

❑ Trichloroethylene dissolves a little in water, but it can remain in ground water for a long time.

❑ Trichloroethylene quickly evaporates from surface water, so it is commonly found as a vapor in the air.

❑ Trichloroethylene evaporates less easily from the soil than from surface water. It may stick to particles and remain for a long time.

❑ Trichloroethylene may stick to particles in water, which will cause it to eventually settle to the bottom sediment.

❑ Trichloroethylene does not build up significantly in plants and animals.

How might I be exposed to trichloroethylene?

❑ Breathing air in and around the home which has been contaminated with trichloroethylene vapors from shower water or household products such as spot removers and typewriter correction fluid.

❑ Drinking, swimming, or showering in water that has been contaminated with trichloroethylene.

❑ Contact with soil contaminated with trichloroethylene, such as near a hazardous waste site.

❑ Contact with the skin or breathing contaminated air while manufacturing trichloroethylene or using it at work to wash paint or grease from skin or equipment.

How can trichloroethylene affect my health?

Breathing small amounts may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating.

Breathing large amounts of trichloroethylene may cause impaired heart function, unconsciousness, and death. Breathing it for long periods may cause nerve, kidney, and liver damage.

Drinking large amounts of trichloroethylene may cause nausea, liver damage, unconsciousness, impaired heart function, or death.

Drinking small amounts of trichloroethylene for long periods may cause liver and kidney damage, impaired immune system function, and impaired fetal development in pregnant women, although the extent of some of these effects is not yet clear.

Skin contact with trichloroethylene for short periods may cause skin rashes.

How likely is trichloroethylene to cause cancer?

Some studies with mice and rats have suggested that high levels of trichloroethylene may cause liver, kidney, or lung cancer. Some studies of people exposed over long periods to high levels of trichloroethylene in drinking water or in workplace air have found evidence of increased cancer. Although, there are some concerns about the studies of people who were exposed to trichloroethylene, some of the effects found in people were similar to effects in animals.

In its 9th Report on Carcinogens, the National Toxicology Program (NTP) determined that trichloroethylene is "reasonably anticipated to be a human carcinogen." The International Agency for Research on Cancer (IARC) has determined that trichloroethylene is "probably carcinogenic to humans."

Is there a medical test to show whether I've been exposed to trichloroethylene?

If you have recently been exposed to trichloroethylene, it can be detected in your breath, blood, or urine. The breath test, if it is performed soon after exposure, can tell if you have been exposed to even a small amount of trichloroethylene.

Exposure to larger amounts is assessed by blood and urine tests, which can detect trichloroethylene and many of its breakdown products for up to a week after exposure. However, exposure to other similar chemicals can produce the same breakdown products, so their detection is not absolute proof of exposure to trichloroethylene. This test isn't available at most doctors' offices, but can be done at special laboratories that have the right equipment.

Has the federal government made recommendations to protect human health?

The EPA has set a maximum contaminant level for trichloroethylene in drinking water at 0.005 milligrams per liter (0.005 mg/L) or 5 parts of TCE per billion parts water.

The EPA has also developed regulations for the handling and disposal of trichloroethylene.

The Occupational Safety and Health Administration (OSHA) has set an exposure limit of 100 parts of trichloroethylene per million parts of air (100 ppm) for an 8-hour workday, 40-hour workweek.

Glossary

Carcinogenicity: The ability of a substance to cause cancer.
CAS: Chemical Abstracts Service.
Evaporate: To change into a vapor or gas.
Milligram (mg): One thousandth of a gram.
Nonflammable: Will not burn.
ppm: Parts per million.
Sediment: Mud and debris that have settled to the bottom of a body of water.
Solvent: A chemical that dissolves other substances.

References

This ToxFAQs information is taken from the 1997 Toxicological Profile for Trichloroethylene (update) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is http://www.atsdr.cdc.gov/toxfaq.html . ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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TETRACHLOROETHYLENE

CAS # 127-18-4

Agency for Toxic Substances and Disease Registry ToxFAQs September 1997

This fact sheet answers the most frequently asked health questions (FAQs) about tetrachloroethylene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Tetrachloroethylene is a manufactured chemical used for dry cleaning and metal degreasing. Exposure to very high concentrations of tetrachloroethylene can cause dizziness, headaches, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. Tetrachloroethylene has been found in at least 771 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is tetrachloroethylene?

(Pronounced tĕt′rə-klôr′ ō-ĕth′ə-lēn′)

Tetrachloroethylene is a manufactured chemical that is widely used for dry cleaning of fabrics and for metal-degreasing. It is also used to make other chemicals and is used in some consumer products.

Other names for tetrachloroethylene include perchloroethylene, PCE, and tetrachloroethene. It is a nonflammable liquid at room temperature. It evaporates easily into the air and has a sharp, sweet odor. Most people can smell tetrachloroethylene when it is present in the air at a level of 1 part tetrachloroethylene per million parts of air (1 ppm) or more, although some can smell it at even lower levels.

What happens to tetrachloroethylene when it enters the environment?

☐ Much of the tetrachloroethylene that gets into water or soil evaporates into the air.

☐ Microorganisms can break down some of the tetrachloroethylene in soil or underground water.

☐ In the air, it is broken down by sunlight into other chemicals or brought back to the soil and water by rain.

☐ It does not appear to collect in fish or other animals that live in water.

How might I be exposed to tetrachloroethylene?

☐ When you bring clothes from the dry cleaners, they will release small amounts of tetrachloroethylene into the air.

☐ When you drink water containing tetrachloroethylene, you are exposed to it.

How can tetrachloroethylene affect my health?

High concentrations of tetrachloroethylene (particularly in closed, poorly ventilated areas) can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death.

Irritation may result from repeated or extended skin contact with it. These symptoms occur almost entirely in work (or hobby) environments when people have been accidentally exposed to high concentrations or have intentionally used tetrachloroethylene to get a "high."

In industry, most workers are exposed to levels lower than those causing obvious nervous system effects. The health effects of breathing in air or drinking water with low levels of tetrachloroethylene are not known.

Results from some studies suggest that women who work in dry cleaning industries where exposures to tetrachloroethylene can be quite high may have more menstrual problems and spontaneous abortions than women who are not exposed. However, it is not known if tetrachloroethylene was responsible for these problems because other possible causes were not considered.

Results of animal studies, conducted with amounts much higher than those that most people are exposed to, show that tetrachloroethylene can cause liver and kidney damage. Exposure to very high levels of tetrachloroethylene can be toxic to the unborn pups of pregnant rats and mice. Changes in behavior were observed in the offspring of rats that breathed high levels of the chemical while they were pregnant.

How likely is tetrachloroethylene to cause cancer?

The Department of Health and Human Services (DHHS) has determined that tetrachloroethylene may reasonably be anticipated to be a carcinogen. Tetrachloroethylene has been shown to cause liver tumors in mice and kidney tumors in male rats.

Is there a medical test to show whether I've been exposed to tetrachloroethylene?

One way of testing for tetrachloroethylene exposure is to measure the amount of the chemical in the breath, much the same way breath-alcohol measurements are used to determine the amount of alcohol in the blood.

Because it is stored in the body's fat and slowly released into the bloodstream, tetrachloroethylene can be detected in the breath for weeks following a heavy exposure.

Tetrachloroethylene and trichloroacetic acid (TCA), a breakdown product of tetrachloroethylene, can be detected in the blood. These tests are relatively simple to perform. These tests aren't available at most doctors' offices, but can be performed at special laboratories that have the right equipment.

Because exposure to other chemicals can produce the same breakdown products in the urine and blood, the tests for breakdown products cannot determine if you have been exposed to tetrachloroethylene or the other chemicals.

Has the federal government made recommendations to protect human health?

The EPA maximum contaminant level for the amount of tetrachloroethylene that can be in drinking water is 0.005 milligrams tetrachloroethylene per liter of water (0.005 mg/L).

The Occupational Safety and Health Administration (OSHA) has set a limit of 100 ppm for an 8-hour workday over a 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) recommends that tetrachloroethylene be handled as a potential carcinogen and recommends that levels in workplace air should be as low as possible.

Glossary

Carcinogen: A substance with the ability to cause cancer.

CAS: Chemical Abstracts Service.

Milligram (mg): One thousandth of a gram.

Nonflammable: Will not burn.

References

This ToxFAQs information is taken from the 1997 Toxicological Profile for Tetrachloroethylene (update) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone:1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
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TOLUENE
CAS # 108-88-3

Division of Toxicology ToxFAQs™ **February 2001**

This fact sheet answers the most frequently asked health questions (FAQs) about toluene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to toluene occurs from breathing contaminated workplace air, in automobile exhaust, some consumer products paints, paint thinners, fingernail polish, lacquers, and adhesives. Toluene affects the nervous system. Toluene has been found at 959 of the 1,591 National Priority List sites identified by the Environmental Protection Agency

What is toluene?

Toluene is a clear, colorless liquid with a distinctive smell. Toluene occurs naturally in crude oil and in the tolu tree. It is also produced in the process of making gasoline and other fuels from crude oil and making coke from coal.

Toluene is used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber and in some printing and leather tanning processes.

What happens to toluene when it enters the environment?

❑ Toluene enters the environment when you use materials that contain it. It can also enter surface water and groundwater from spills of solvents and petrolieum products as well as from leasking underground storage tanks at gasoline stations and other facilities.

❑ When toluene-containing products are placed in landfills or waste disposal sites, the toluene can enter the soil or water near the waste site.

❑ Toluene does not usually stay in the environment long.

❑ Toluene does not concentrate or buildup to high levels in animals.

How might I be exposed to toluene?

❑ Breathing contaminated workplace air or automobile exhaust.

❑ Working with gasoline, kerosene, heating oil, paints, and lacquers.

❑ Drinking contaminated well-water.

❑ Living near uncontrolled hazardous waste sites containing toluene products.

How can toluene affect my health?

Toluene may affect the nervous system. Low to moderate levles can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, loss of appetite, and

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Agency for Toxic Substances and Disease Registry

hearing and color vision loss. These symptoms usually disappear when exposure is stopped.

Inhaling High levels of toluene in a short time can make you feel light-headed, dizzy, or sleepy. It can also cause unconsciousness, and even death.

High levels of toluene may affect your kidneys.

How likely is toluene to cause cancer?

Studies in humans and animals generally indicate that toluene does not cause cancer.

The EPA has determined that the carcinogenicity of toluene can not be classified.

How can toluene affect children?

It is likely that health effects seen in children exposed to toluene will be similar to the effects seen in adults.
Some studies in animals suggest that babies may be more sensitive than adults.

Breathing very high levels of toluene during pregnancy can result in children with birth defects and retard mental abilities, and growth. We do not know if toluene harms the unborn child if the mother is exposed to low levels of toluene during pregnancy.

How can families reduce the risk of exposure to toluene?

❑ Use toluene-containing products in well-ventilated areas.

❑ When not in use, toluene-containing products should be tightly covered to prevent evaporation into the air.

Is there a medical test to show whether I've been exposed to toluene?

There are tests to measure the level of toluene or its breakdown products in exhaled air, urine, and blood. To determine if you have been exposed to toluene, your urine or blood must be checked within 12 hours of exposure. Several other chemicals are also changed into the same breakdown products as toluene, so some of these tests are not specific for toluene.

Has the federal government made recommendations to protect human health?

EPA has set a limit of 1 milligram per liter of drinking water (1 mg/L).

Discharges, releases, or spills of more than 1,000 pounds of toluene must be reported to the National Response Center.

The Occupational Safety and Health Administration has set a limit of 200 parts toluene per million of workplace air (200 ppm).

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for Toluene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is http://www.atsdr.cdc.gov/toxfaq.html . ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

XYLENE
CAS # 1330-20-7

Agency for Toxic Substances and Disease Registry ToxFAQs September 1996

This fact sheet answers the most frequently asked health questions (FAQs) about xylene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to xylene occurs in the workplace and when you use paint, gasoline, paint thinners and other products that contain it. People who breathe high levels may have dizziness, confusion, and a change in their sense of balance. This substance has been found in at least 658 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is xylene?

(Pronounced zī′lēn)

Xylene is a colorless, sweet-smelling liquid that catches on fire easily. It occurs naturally in petroleum and coal tar and is formed during forest fires. You can smell xylene in air at 0.08–3.7 parts of xylene per million parts of air (ppm) and begin to taste it in water at 0.53–1.8 ppm.

Chemical industries produce xylene from petroleum. It's one of the top 30 chemicals produced in the United States in terms of volume.

Xylene is used as a solvent and in the printing, rubber, and leather industries. It is also used as a cleaning agent, a thinner for paint, and in paints and varnishes. It is found in small amounts in airplane fuel and gasoline.

What happens to xylene when it enters the environment?

- ☐ Xylene has been found in waste sites and landfills when discarded as used solvent, or in varnish, paint, or paint thinners.
- ☐ It evaporates quickly from the soil and surface water into the air.
- ☐ In the air, it is broken down by sunlight into other less harmful chemicals.
- ☐ It is broken down by microorganisms in soil and water.
- ☐ Only a small amount of it builds up in fish, shellfish, plants, and animals living in xylene-contaminated water.

How might I be exposed to xylene?

- ☐ Breathing xylene in workplace air or in automobile exhaust.
- ☐ Breathing contaminated air.
- ☐ Touching gasoline, paint, paint removers, varnish, shellac, and rust preventatives that contain it.
- ☐ Breathing cigarette smoke that has small amounts of xylene in it.
- ☐ Drinking contaminated water or breathing air near waste sites and landfills that contain xylene.
- ☐ The amount of xylene in food is likely to be low.

How can xylene affect my health?

Xylene affects the brain. High levels from exposure for short periods (14 days or less) or long periods (more than 1 year) can cause headaches, lack of muscle coordination, dizziness, confusion, and changes in one's sense of balance. Exposure of people to high levels of xylene for short periods can also cause irritation of the skin, eyes, nose, and throat; difficulty in breathing; problems with the lungs; delayed reaction time; memory difficulties; stomach discomfort; and possibly changes in the liver and kidneys. It can cause unconsciousness and even death at very high levels.

Studies of unborn animals indicate that high concentrations of xylene may cause increased numbers of deaths, and delayed growth and development. In many instances, these same concentrations also cause damage to the mothers. We do not know if xylene harms the unborn child if the mother is exposed to low levels of xylene during pregnancy.

How likely is xylene to cause cancer?

The International Agency for Research on Cancer (IARC) has determined that xylene is not classifiable as to its carcinogenicity in humans.

Human and animal studies have not shown xylene to be carcinogenic, but these studies are not conclusive and do not provide enough information to conclude that xylene does not cause cancer.

Is there a medical test to show whether I've been exposed to xylene?

Laboratory tests can detect xylene or its breakdown products in exhaled air, blood, or urine. There is a high degree of agreement between the levels of exposure to xylene and the levels of xylene breakdown products in the urine. However, a urine sample must be provided very soon after exposure ends because xylene quickly leaves the body. These tests are not routinely available at your doctor's office.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 10 ppm of xylene in drinking water.

The EPA requires that spills or accidental releases of xylenes into the environment of 1,000 pounds or more must be reported.

The Occupational Safety and Health Administration (OSHA) has set a maximum level of 100 ppm xylene in workplace air for an 8-hour workday, 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) also recommend exposure limits of 100 ppm in workplace air.

NIOSH has recommended that 900 ppm of xylene be considered immediately dangerous to life or health. This is the exposure level of a chemical that is likely to cause permanent health problems or death.

Glossary

Evaporate: To change from a liquid into a vapor or a gas.

Carcinogenic: Having the ability to cause cancer.

CAS: Chemical Abstracts Service.

ppm: Parts per million.

Solvent: A liquid that can dissolve other substances.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for xylenes (update). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333. Phone:1-888-422-8737, FAX: 404-498-0093. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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ZINC

CAS # 7440-66-6

Division of Toxicology ToxFAQs™ **August 2005**

This fact sheet answers the most frequently asked health questions (FAQs) about zinc. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Zinc is a naturally occurring element. Exposure to high levels of zinc occurs mostly from eating food, drinking water, or breathing workplace air that is contaminated. Low levels of zinc are essential for maintaining good health. Exposure to large amounts of zinc can be harmful. It can cause stomach cramps, anemia, and changes in cholesterol levels. Zinc has been found in at least 985 of the 1,662 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is zinc?

Zinc is one of the most common elements in the earth's crust. It is found in air, soil, and water, and is present in all foods. Pure zinc is a bluish-white shiny metal.

Zinc has many commercial uses as coatings to prevent rust, in dry cell batteries, and mixed with other metals to make alloys like brass, and bronze. A zinc and copper alloy is used to make pennies in the United States.

Zinc combines with other elements to form zinc compounds. Common zinc compounds found at hazardous waste sites include zinc chloride, zinc oxide, zinc sulfate, and zinc sulfide. Zinc compounds are widely used in industry to make paint, rubber, dyes, wood preservatives, and ointments.

What happens to zinc when it enters the environment?

❑ Some is released into the environment by natural processes, but most comes from human activities like mining, steel production, coal burning, and burning of waste.

❑ It attaches to soil, sediments, and dust particles in the air.

❑ Rain and snow remove zinc dust particles from the air.

❑ Depending on the type of soil, some zinc compounds can move into the groundwater and into lakes, streams, and rivers.

❑ Most of the zinc in soil stays bound to soil particles and does not dissolve in water.

❑ It builds up in fish and other organisms, but it does not build up in plants.

How might I be exposed to zinc?

❑ Ingesting small amounts present in your food and water.

❑ Drinking contaminated water or a beverage that has been stored in metal containers or flows through pipes that have been coated with zinc to resist rust.

❑ Eating too many dietary supplements that contain zinc.

❑ Working on any of the following jobs: construction, painting, automobile mechanics, mining, smelting, and welding; manufacture of brass, bronze, or other zinc-containing alloys; manufacture of galvanized metals; and manufacture of machine parts, rubber, paint, linoleum, oilcloths, batteries, some kind of glass, ceramics, and dyes.

How can zinc affect my health?

Zinc is an essential element in our diet. Too little zinc can cause problems, but too much zinc is also harmful.

Harmful effects generally begin at levels 10-15 times higher than the amount needed for good health. Large doses taken by mouth even for a short time can cause stomach cramps, nausea, and vomiting. Taken longer, it can cause anemia and decrease the levels of your good cholesterol. We do not know if high levels of zinc affect reproduction in humans. Rats that were fed large amounts of zinc became infertile.

Inhaling large amounts of zinc (as dusts or fumes) can cause a specific short-term disease called metal fume fever. We do not know the long-term effects of breathing high levels of zinc.

Putting low levels of zinc acetate and zinc chloride on the skin of rabbits, guinea pigs, and mice caused skin irritation. Skin irritation will probably occur in people.

How likely is zinc to cause cancer?

The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have not classified zinc for carcinogenicity. Based on incomplete information from human and animal studies, the EPA has determined that zinc is not classifiable as to its human carcinogenicity.

How can zinc affect children?

Zinc is essential for proper growth and development of young children. It is likely that children exposed to very high levels of zinc will have similar effects as adults. We do not know whether children are more susceptible to the effects of excessive intake of zinc than the adults.

We do not know if excess zinc can cause developmental effects in humans. Animal studies have found decreased weight in the offspring of animals that ingested very high amounts of zinc.

How can families reduce the risks of exposure to zinc?

❏ Children living near waste sites that contain zinc may be exposed to higher levels of zinc through breathing contaminated air, drinking contaminated drinking water, touching or eating contaminated soil.

❏ Discourage your children from eating soil or putting their hands in their mouths and teach them to wash their hands frequently and before eating.

❏ If you use medicines or vitamin supplements containing zinc, make sure you use them appropriately and keep them out of the reach of children.

Is there a medical test to determine whether I've been exposed to zinc?

There are tests available to measure zinc in your blood, urine, hair, saliva, and feces. These tests are not usually done in the doctor's office because they require special equipment. High levels of zinc in the feces can mean high recent zinc exposure. High levels of zinc in the blood can mean high zinc consumption and/or high exposure. Tests to measure zinc in hair may provide information on long-term zinc exposure; however, the relationship between levels in your hair and the amount of zinc you were exposed to is not clear.

Has the federal government made recommendations to protect human health?

The EPA recommends that drinking water should contain no more than 5 milligrams per liter of water (5 mg/L) because of taste. The EPA requires that any release of 1,000 pounds (or in some cases 5,000 pounds) into the environment be reported to the agency.

To protect workers, the Occupational Safety and Health Administration (OSHA) has set an average limit of 1 mg/m^3 for zinc chloride fumes and 5 mg/m^3 for zinc oxide (dusts and fumes) in workplace air during an 8-hour workday, 40-hour workweek.

Similarly, the National Institute for Occupational Safety and Health (NIOSH) has set the same standards for up to a 10-hour workday over a 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological Profile for Zinc (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Cadmium- ToxFAQs™

CAS # 7440-43-9

This fact sheet answers the most frequently asked health questions (FAQs) about cadmium. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to cadmium happens mostly in the workplace where cadmium products are made. The general population is exposed from breathing cigarette smoke or eating cadmium contaminated foods. Cadmium damages the kidneys, lungs, and bones. Cadmium has been found in at least 1,014 of the 1,669 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is cadmium?

Cadmium is a natural element in the earth's crust. It is usually found as a mineral combined with other elements such as oxygen (cadmium oxide), chlorine (cadmium chloride), or sulfur (cadmium sulfate, cadmium sulfide).

All soils and rocks, including coal and mineral fertilizers, contain some cadmium. Most cadmium used in the United States is extracted during the production of other metals like zinc, lead, and copper. Cadmium does not corrode easily and has many uses, including batteries, pigments, metal coatings, and plastics.

What happens to cadmium when it enters the environment?

- Cadmium enters soil, water, and air from mining, industry, and burning coal and household wastes.
- Cadmium does not break down in the environment, but can change forms.
- Cadmium particles in air can travel long distances before falling to the ground or water.
- Some forms of cadmium dissolve in water.
- Cadmium binds strongly to soil particles.
- Fish, plants, and animals take up cadmium from the environment.

How might I be exposed to cadmium?

- Eating foods containing cadmium; low levels are found in all foods (highest levels are found in leafy vegetables, grains, legumes, and kidney meat).
- Smoking cigarettes or breathing cigarette smoke.
- Breathing contaminated workplace air.
- Drinking contaminated water.
- Living near industrial facilities which release cadmium into the air.

How can cadmium affect my health?

Breathing high levels of cadmium can severely damage the lungs. Eating food or drinking water with very high levels severely irritates the stomach, leading to vomiting and diarrhea.

Long-term exposure to lower levels of cadmium in air, food, or water leads to a buildup of cadmium in the kidneys and possible kidney disease. Other long-term effects are lung damage and fragile bones.

How likely is cadmium to cause cancer?

The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have determined that cadmium and cadmium compounds are human carcinogens. The EPA determined that cadmium is a probable human carcinogen (group B1).

Cadmium

CAS # 7440-43-9

How can cadmium affect children?

The health effects in children are expected to be similar to the effects seen in adults (kidney and lung damage depending on the route of exposure).

A few studies in animals indicate that younger animals absorb more cadmium than adults. Animal studies also indicate that the young are more susceptible than adults to a loss of bone and decreased bone strength from exposure to cadmium.

We don't know if cadmium causes birth defects in people. Studies in animals exposed to high levels of cadmium during pregnancy have resulted in harmful effects to the young. Young animals exposed to cadmium before birth have shown effects on behavior and learning. There is also some information from animal studies that high enough exposures to cadmium before birth can reduce body weights and affect the skeleton in the developing young.

How can families reduce the risk of exposure to cadmium?

- Do not allow children to play with batteries. Dispose of nickel-cadmium batteries properly.
- Cadmium is a component of tobacco smoke. Avoid smoking and smoking in enclosed spaces like inside the home or car in order to limit exposure to children and other family members.
- If you work with cadmium, use all safety precautions to avoid carrying cadmium-containing dust home from work on your clothing, skin, hair, or tools.
- A balanced diet can reduce the amount of cadmium taken into the body from food and drink.

Is there a medical test to determine whether I've been exposed to cadmium?

Cadmium can be measured in blood, urine, hair, or nails. Urinary cadmium has been shown to accurately reflect the amount of cadmium in the body.

The amount of cadmium in your blood shows your recent exposure to cadmium. The amount of cadmium in your urine shows both your recent and your past exposure.

Has the federal government made recommendations to protect human health?

The EPA has determined that exposure to cadmium in drinking water at concentrations of 0.04 milligrams per liter (0.04 mg/L) for up to 10 days is not expected to cause any adverse effects in a child.

The EPA has determined that lifetime exposure to 0.005 mg/L cadmium is not expected to cause any adverse effects.

The Food and Drug Administration (FDA) has determined that the cadmium concentration in bottled drinking water should not exceed 0.005 mg/L.

The Occupational Health and Safety Administration (OSHA) has limited workers' exposure to an average of 5 $\mu g/m^3$ for an 8-hour workday, 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2012. Toxicological Profile for Cadmium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Chromium - ToxFAQs™

CAS # 7440-47-3

This fact sheet answers the most frequently asked health questions (FAQs) about chromium. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to chromium occurs from ingesting contaminated food or drinking water or breathing contaminated workplace air. Chromium(VI) at high levels can damage the nose and cause cancer. Ingesting high levels of chromium(VI) may result in anemia or damage to the stomach or intestines. Chromium(III) is an essential nutrient. Chromium has been found in at least 1,127 of the 1,669 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is chromium?

Chromium is a naturally occurring element found in rocks, animals, plants, and soil. It can exist in several different forms. Depending on the form it takes, it can be a liquid, solid, or gas. The most common forms are chromium(0), chromium(III), and chromium(VI). No taste or odor is associated with chromium compounds.

The metal chromium, which is the chromium(0) form, is used for making steel. Chromium(VI) and chromium(III) are used for chrome plating, dyes and pigments, leather tanning, and wood preserving.

What happens to chromium when it enters the environment?

- Chromium can be found in air, soil, and water after release from the manufacture, use, and disposal of chromium-based products, and during the manufacturing process.
- Chromium does not usually remain in the atmosphere, but is deposited into the soil and water.
- Chromium can easily change from one form to another in water and soil, depending on the conditions present.
- Fish do not accumulate much chromium in their bodies from water.

How might I be exposed to chromium?

- Eating food containing chromium(III).
- Breathing contaminated workplace air or skin contact during use in the workplace.
- Drinking contaminated well water.
- Living near uncontrolled hazardous waste sites containing chromium or industries that use chromium.

How can chromium affect my health?

Chromium(III) is an essential nutrient that helps the body use sugar, protein, and fat.

Breathing high levels of chromium(VI) can cause irritation to the lining of the nose, nose ulcers, runny nose, and breathing problems, such as asthma, cough, shortness of breath, or wheezing. The concentrations of chromium in air that can cause these effects may be different for different types of chromium compounds, with effects occurring at much lower concentrations for chromium(VI) compared to chromium(III).

The main health problems seen in animals following ingestion of chromium(VI) compounds are irritation and ulcers in the stomach and small intestine and anemia. Chromium(III) compounds are much less toxic and do not appear to cause these problems.

Sperm damage and damage to the male reproductive system have also been seen in laboratory animals exposed to chromium(VI).

Skin contact with certain chromium(VI) compounds can cause skin ulcers. Some people are extremely sensitive tochromium(VI) or chromium(III). Allergic reactions consisting of severe redness and swelling of the skin have been noted.

Chromium

CAS # 7440-47-3

How likely is chromium to cause cancer?

The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the EPA have determined that chromium(VI) compounds are known human carcinogens.

In workers, inhalation of chromium(VI) has been shown to cause lung cancer. Chromium(VI) also causes lung cancer in animals. An increase in stomach tumors was observed in humans and animals exposed to chromium(VI) in drinking water.

How can chromium affect children?

It is likely that health effects seen in children exposed to high amounts of chromium will be similar to the effects seen in adults.

We do not know if exposure to chromium will result in birth defects or other developmental effects in people. Some developmental effects have been observed in animals exposed to chromium(VI).

How can families reduce the risk of exposure to chromium?

- Children should avoid playing in soils near uncontrolled hazardous waste sites where chromium may have been discarded.
- Chromium is a component of tobacco smoke. Avoid smoking in enclosed spaces like inside the home or car in order to limit exposure to children and other family members.
- Although chromium(III) is an essential nutrient, you should avoid excessive use of dietary supplements containing chromium.

Is there a medical test to determine whether I've been exposed to chromium?

Since chromium(III) is an essential element and naturally occurs in food, there will always be some level of chromium in your body. Chromium can be measured in hair, urine, and blood.

Higher than normal levels of chromium in blood or urine may indicate that a person has been exposed to chromium. However, increases in blood and urine chromium levels cannot be used to predict the kind of health effects that might develop from that exposure.

Has the federal government made recommendations to protect human health?

The EPA has established a maximum contaminant level of 0.1 mg/L for total chromium in drinking water.

The FDA has determined that the chromium concentration in bottled drinking water should not exceed 0.1 mg/L.

The Occupational Health and Safety Administration (OSHA) has limited workers' exposure to an average of 0.005 mg/m^3 chromium(VI), 0.5 mg/m^3 chromium(III), and 1.0 mg/m^3 chromium(0) for an 8-hour workday, 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2012. Toxicological Profile for Chromium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

BARIUM

CAS # 7440-39-3

Division of Toxicology and Human Health Sciences ToxFAQs™ June 2013

This fact sheet answers the most frequently asked health questions (FAQs) about barium and barium compounds. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because these substances may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to barium occurs mostly in the workplace or from drinking contaminated water. Ingesting drinking water containing levels of barium above the EPA drinking water guidelines for relatively short periods of time can cause gastrointestinal disturbances and muscle weakness. Ingesting high levels for a long time can damage the kidneys. Barium and barium compounds have been found in at least 798 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is barium?

Barium is a silvery-white metal which exists in nature only in ores containing mixtures of elements. It combines with other chemicals such as sulfur or carbon and oxygen to form barium compounds.

Barium compounds are used by the oil and gas industries to make drilling muds. Drilling muds make it easier to drill through rock by keeping the drill bit lubricated. They are also used to make paint, bricks, ceramics, glass, and rubber.

Barium sulfate is sometimes used by doctors to perform medical tests and to take x-rays of the gastrointestinal tract.

What happens to barium when it enters the environment?

- Barium gets into the air during the mining, refining, and production of barium compounds, and from the burning of coal and oil.
- The length of time that barium will last in air, land, water, or sediments depends on the form of barium released.
- Barium compounds, such as barium sulfate and barium carbonate, which do not dissolve well in water, can last a long time in the environment.
- Barium compounds, such as barium chloride, barium nitrate, or barium hydroxide, that dissolve easily in water usually do not last in these forms for a long time in the environment. The barium in these compounds that is dissolved in water quickly combines with sulfate or carbonate that are naturally found in water and become the longer lasting forms (barium sulfate and barium carbonate).
- Fish and aquatic organisms can accumulate barium.

How might I be exposed to barium?

- Ingesting small amounts present in your food and water or breathing air containing very low levels of barium.
- Living in areas with unusually high natural levels of barium in the drinking water.
- Working in a job that involves barium production or use.
- Living or working near waste sites where barium has been disposed of.

How can barium affect my health?

The health effects of the different barium compounds depend on how well the compound dissolves in water or in the stomach contents. Barium compounds that do not dissolve well, such as barium sulfate, are not generally harmful.

Barium has been found to potentially cause gastrointestinal disturbances and muscular weakness when people are exposed to it at levels above the EPA drinking water standards for relatively short periods of time. Some people who eat or drink amounts of barium above background levels found in food and water for a short period may experience vomiting, abdominal cramps, diarrhea, difficulties in breathing, increased or decreased blood pressure, numbness around the face, and muscle weakness. Eating or drinking very large amounts of barium compounds that easily dissolve can cause changes in heart rhythm or paralysis and possibly death. Animals that drank barium over long periods had damage to the kidneys, decreases in body weight, and some died.

How likely is barium to cause cancer?

The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have not classified barium as to its carcinogenicity. The EPA has determined that barium is not likely to be carcinogenic to humans following ingestion and that there is insufficient information to determine whether it will be carcinogenic to humans following inhalation exposure.

How can barium affect children?

We do not know whether children will be more or less sensitive than adults to barium toxicity. A study in rats that swallowed barium found a decrease in newborn body weight; we do not know if a similar effect would be seen in humans.

How can families reduce the risk of exposure to barium?

- The greatest potential source of barium exposure is through food and drinking water. However, the amount of barium in foods and drinking water are typically too low to be of concern.

Is there a medical test to determine whether I've been exposed to barium?

There is no routine medical test to determine whether you have been exposed to barium. Doctors can measure barium in body tissues and fluids, such as bones, blood, urine, and feces, using very complex instruments. These tests cannot be used to predict the extent of the exposure or potential health effects.

The geometric mean barium level measured in the U.S. general population aged 6 and older is reported by the Centers for Disease Control and Prevention (CDC) as 1.56 µg/g creatinine (measured in urine).

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 2.0 milligrams of barium per liter of drinking water (2.0 mg/L), which is the same as 2 ppm.

The Occupational Safety and Health Administration (OSHA) has set Permissible Exposure Limits (PELs) of 0.5 milligrams of soluble barium compounds per cubic meter of workplace air (0.5 mg/m^3) for 8 hour shifts and 40 hour work weeks. The OSHA limits for barium sulfate dust are 15 mg/m^3 of total dust and 5 mg/m^3 for respirable fraction.

The National Institute for Occupational Safety and Health (NIOSH) has set Recommended Exposure Limits (RELs) of 0.5 mg/m^3 for soluble barium compounds. The NIOSH has set RELs of 10 mg/m^3 (total dust) for barium sulfate and 5 mg/m^3 (respirable fraction).

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Barium and Compounds (*Update*). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

http://www.cdc.gov/exposurereport/pdf/FourthReport_UpdatedTables_Sep2012.pdf

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30333. Phone: 1-800-232-4636, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

APPENDIX B

REPORT FORMS

WEEKLY SAFETY REPORT FORM

Week Ending: ________________ Project Name/Number: ________________________________

Report Date: ________________ Project Manager Name: ________________________________

Summary of any violations of procedures occurring that week:

____

____

____

Summary of any job related injuries, illnesses, or near misses that week:

____

____

____

____

Summary of air monitoring data that week (include and sample analyses, action levels exceeded, and actions taken):

____

____

____

Comments:

____

____

____

Name: ____________________________ Company: ________________________________

Signature: ____________________________ Title: ________________________________

INCIDENT REPORT FORM

Date of Report: ____

Injured: ____

Employer: ____

Site: ____________________ Site Location: ____________________

Report Prepared By: ____________________ ____________________
Signature Title

ACCIDENT/INCIDENT CATEGORY (check all that applies)

___Injury
__ Property Damage
__ On-site Equipment
__ Mechanical

___ Illness
___ Fire
___ Motor Vehicle
___ Spill

___ Near Miss
___ Chemical Exposure
___ Electrical
___ Other

DATE AND TIME OF ACCIDENT/INCIDENT: Narrative report of Accident/Incident: Identify: 1) actions leading to or contributing to the accident/incident; 2) the accident/incident occurrence; and 3) actions following the accident/incident.

WITNESS TO ACCIDENT/INCIDENT:

Name: ____________________ Company: ____________________
Address: ____________________ Address: ____________________
Phone No.: ____________________ Phone No.: ____________________
Name: ____________________ Company: ____________________
Address: ____________________ Address: ____________________
Phone No.: ____________________ Phone No.: ____________________

INJURED - ILL:

Name: ____________________ SSN: ____

Address: ____________________ Age: ____

Length of Service: ____________________ Time on Present Job: _____________________________

Time/Classification: ____

SEVERITY OF INJURY OR ILLNESS:

____ Disabling ___ Non-disabling ___ Fatality

____ Medical Treatment ___ First Aid Only

ESTIMATED NUMBER OF DAYS AWAY FROM JOB: _______________________________

NATURE OF INJURY OR ILLNESS: ____

____

____

____

CLASSIFICATION OF INJURY:

__ Abrasions

__ Bites

__ Blisters

__ Bruises

__ Chemical Burns

__ Cold Exposure

__ Concussion

__ Lacerations

_____ Dislocations

_____ Faint/Dizziness

_____ Fractures

_____ Frostbite

_____ Heat Burns

_____ Heat Exhaustion

_____ Heat Stroke

____ Punctures

____ Radiation Burns

____ Respiratory Allergy

____ Sprains

____ Toxic Resp. Exposure

____ Toxic Ingestion

____ Dermal Allergy

Part of Body Affected: ____

Degree of Disability: ____

Date Medical Care was Received: ____

Where Medical Care was Received: ____

Address (if off-site): ____

(If two or more injuries, record on separate sheets)

PROPERTY DAMAGE:

Description of Damage: ______________________________

____

Cost of Damage: $ ______________________________

ACCIDENT/INCIDENT LOCATION: ______________________________

ACCIDENT/INCIDENT ANALYSIS: Causative agent most directly related to accident/incident (Object, substance, material, machinery, equipment, conditions)

____

____

____

____

Was weather a factor?:______________________________

____

Unsafe mechanical/physical/environmental condition at time of accident/incident (Be specific):

____

____

____

Personal factors (Attitude, knowledge or skill, reaction time, fatigue):

____

____

ON-SITE ACCIDENTS/INCIDENTS:

Level of personal protection equipment required in Site Safety Plan:

____

____

Modifications:

____

Was injured using required equipment?:

____

____

If not, how did actual equipment use differ from plan?:

____

____

ACTION TAKEN TO PREVENT RECURRENCE: (Be specific. What has or will be done? When will it be done? Who is the responsible party to insure that the correction is made?

ACCIDENT/INCIDENT REPORT REVIEWED BY:

SSO Name Printed	SSO Signature

OTHERS PARTICIPATING IN INVESTIGATION:

Signature	Title
Signature	Title
Signature	Title

ACCIDENT/INCIDENT FOLLOW-UP: Date:

Outcome of accident/incident:

Physician's recommendations:

Date injured returned to work:

Follow-up performed by:

Signature	Title

ATTACH ANY ADDITIONAL INFORMATION TO THIS FORM

APPENDIX C

EMERGENCY HAND SIGNALS

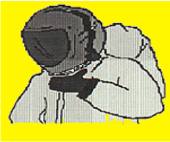
EMERGENCY SIGNALS

In most cases, field personnel will carry portable radios for communication. If this is the case, a transmission that indicates an emergency will take priority over all other transmissions. All other site radios will yield the frequency to the emergency transmissions.

Where radio communications is not available, the following air-horn and/or hand signals will be used:

EMERGENCY HAND SIGNALS

OUT OF AIR, CAN'T BREATHE!



Hand gripping throat

LEAVE AREA IMMEDIATELY, NO DEBATE!

(No Picture) Grip partner's wrist or place both hands around waist

NEED ASSISTANCE!

Hands on top of head

OKAY! – I'M ALL RIGHT!

- I UNDERSTAND!

Thumbs up

NO! - NEGATIVE!

Thumbs down

APPENDIX B

COMMUNITY AIR MONITORING PLAN

114 SNEDIKER AVENUE SITE

221-241 GLENMORE AVENUE
BROOKYLN, NEW YORK

Community Air Monitoring Plan

BCP Site No.: TBD
AKRF Project Number: 220249

Prepared For:

New York State Department of Environmental Conservation
Division of Environmental Remediation, Remedial Bureau B
625 Broadway, 12th Floor
Albany, New York 12233

Prepared On Behalf Of:

Glenmore Owner LLC
116 East 27th Street, 11th Floor
New York, NY 10016

Prepared by:

AKRF

440 Park Avenue South, 7th Floor
New York, NY 10016
212-696-0670

DECEMBER 2022

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FIGURES

TABLES

1.0 INTRODUCTION

This Community Air Monitoring Plan (CAMP) has been developed for implementation of the Interim Remedial Measures (IRM) Work Plan activities conducted by all personnel on-site, both AKRF employees and others, at the 114 Snediker Avenue Site located at 221-241 Glenmore Avenue in the New Lots sub-section of the East New York neighborhood of Brooklyn, New York, hereafter referred to as the “Site”. The approximately 0.823-acre Site is identified by the City of New York as Borough of Brooklyn, Block 3697, Lots 1 and 33. The Requestor is currently applying to remediate the Site under the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP).

The Site is developed with three adjoining buildings: a two-story building on Lot 33, formerly utilized as storage and workshop spaces on the first floor and management offices on the second floor (southeast portion of the Site, 241 Glenmore Avenue); a single-story former manufacturing building on the northeastern portion of Lot 1 (northeast portion of Site, 221 Glenmore Avenue); and, a single-story former manufacturing building on the western portion of Lot 1, which previously operated as the lighting manufacturing area (western portion of the Site, 221 Glenmore Avenue). The three adjoining buildings were occupied by Legion Lighting Co. Inc. (Legion), an industrial lighting manufacturer. Manufacturing operations ceased in May 2022 and the Site has only been used for storage since. A small sub-grade cellar located in the southwestern corner of Lot 1 (221 Glenmore Avenue) contains an encased 1,000-gallon No. 2 fuel oil aboveground storage tank (AST) and two fuel-oil fired boilers. A Site Location map is provided as Figure 1.

The Site is abutted to the north by light manufacturing and a multi-family residential building; to the east by Snediker Avenue followed by a five-story office building occupied by the New York City Police Department and an asphalt-paved parking lot followed by light manufacturing with commercial, industrial, and residential uses beyond; to the south by Glenmore Avenue followed by mixed-use industrial, residential, and commercial properties; and to the west by Van Sinderen Avenue and an elevated railway for the L-line of the NYC Metropolitan Transit Authority. An adjacent property (Lot 36) divides a portion of Lot 1 along Glenmore Avenue forming a “U” shape and includes a 1-story metal frame garage and driveway. The surrounding area was primarily commercial and industrial properties with sparse residential development. One sensitive receptor (Brooklyn Children Learning Academy) is located at 91 Junius Street, approximately 262 feet to the west.

A Phase II Environmental Site Assessment (ESA) was conducted by Impact Environmental Closures, Inc, (IEC) in May 2022 and a Remedial Investigation was conducted by AKRF in October 2022. The investigations have identified elevated levels of chlorinated volatile organic compounds (CVOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) and metals in soil, chlorinated VOCs, metals and PFOS/PFOA in groundwater and chlorinated VOCs in soil vapor.

2.0 COMMUNITY AIR MONITORING PROGRAM (CAMP)

The purpose of the CAMP is to outline appropriate monitoring, mitigation measures, and reporting requirements to ensure that the surrounding community is not affected during implementation of the Interim Remedial Measures field activities. Community air monitoring will be conducted during all intrusive Site activities in compliance with the New York State Department of Health (NYSDOH) Generic CAMP. Results of the air monitoring will be used to determine the appropriate response action, if needed. Field personnel will be trained in the proper operation of all field instruments at the start of the program. The equipment will be calibrated according to manufacturer specifications at the start of each day of fieldwork. If an instrument fails calibration, the project manager will be contacted immediately to obtain a replacement instrument and arrange for repairs. Real-time air monitoring for volatile compounds and particulates at the perimeter of the exclusion zone will be performed as described below.

2.1 Volatile Organic Compounds and Particulates

Continuous monitoring for VOCs will be conducted during all ground intrusive activities, including soil excavation, subsurface drilling and groundwater monitoring well installation. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background concentrations. VOCs will be monitored continuously at the downwind perimeter of the exclusion zone. Monitoring will be conducted with a photoionization detector (PID) equipped with a 10.6 eV lamp capable of calculating 15-minute running average concentrations and equipped with an audible alarm to indicate exceedances of action levels. An inspection of the monitoring stations will be conducted on at least an hourly basis. All 15-minute average PID readings will be recorded and available for NYSDEC and NYSDOH personnel to review. The action levels and their respective required responses are summarized in Table 1.

Continuous monitoring for particulates will be conducted during all ground intrusive activities, which will involve the measurement of respirable dust. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background concentrations. Particulates will be monitored continuously at the downwind perimeter of the exclusion zone. Community air monitoring for dust particulates will be conducted using a DustTrak® or equivalent to measure the concentration of airborne respirable particulates less than 10 micrometers in size (PM_{10}). The dust monitor will be capable of calculating 15-minute running average concentrations and equipped with an audible alarm to indicate exceedance of action levels. An inspection of the monitoring stations will be conducted on at least an hourly basis. All 15-minute average readings will be recorded and available for NYSDEC and NYSDOH personnel to review.

The action levels and their respective required responses are summarized in Table 1.

2.2 Action Levels and Required Actions

The action levels and required responses are listed in Table 1 below:

Table 1
CAMP Action Levels and Required Responses

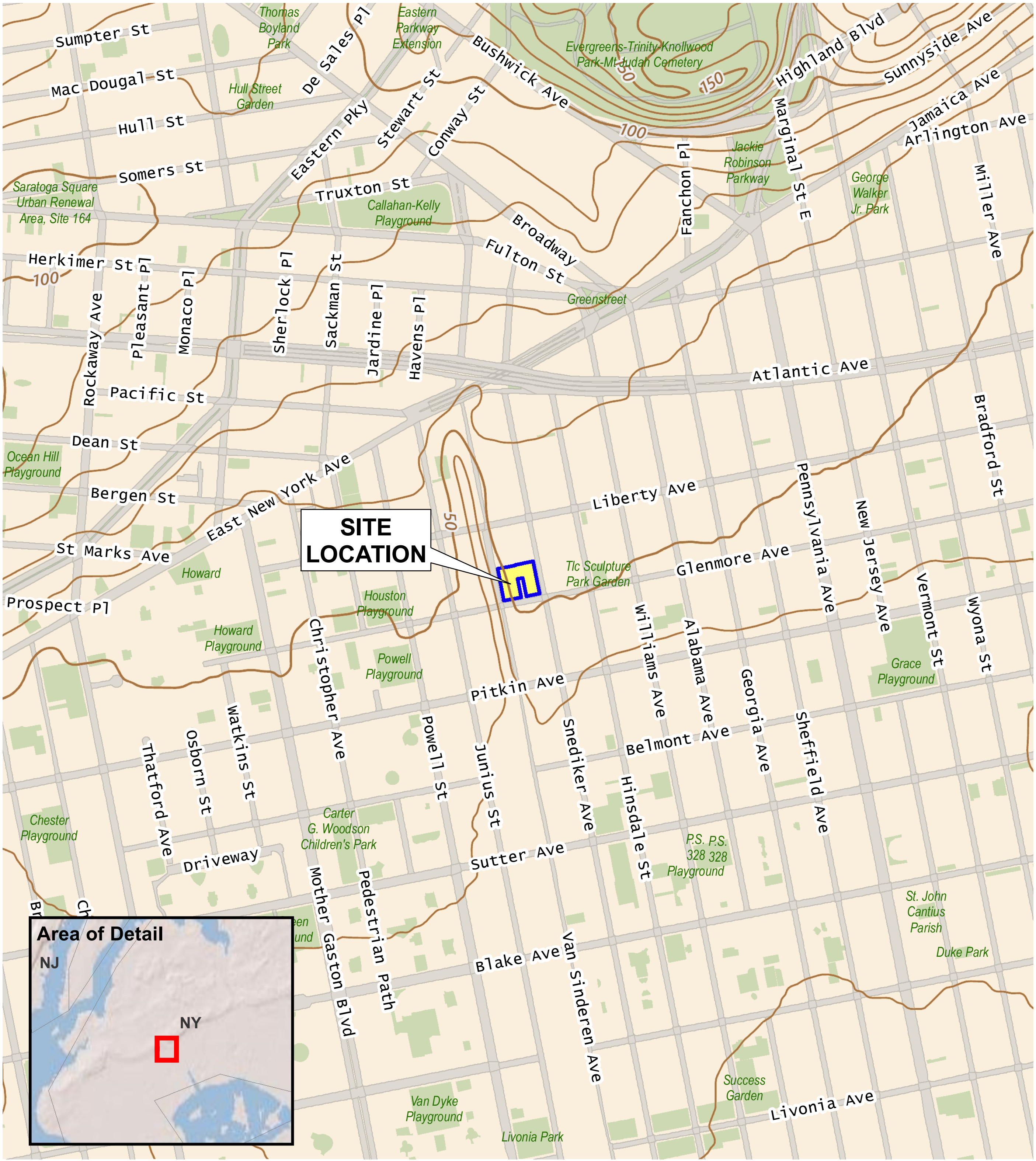
Monitoring	Action Level[1]	Response Action
Particulates	15-minute average between 0.100 mg/m^3 and 0.150 mg/m^3 above background	Implement dust suppression measures and continue monitoring. Work may continue if levels remain below 0.150 mg/m^3 and no visible dust is migrating from the work area.
	15-minute average greater than 0.150 mg/m^3 above background	Stop work until dust suppression measures mitigate levels to below 0.150 mg/m^3.
Volatile Organic Compounds (VOCs)	15-minute average between 5 and 25 ppm	Stop work, identify source of vapors and mitigate. Work may continue if instantons readings rapidly decrease below 5 ppm above background.
	15-minute average more than 25 ppm	Shutdown of work. Mitigate levels to below 5 ppm.

Notes:
[1] - 15-minute time-weighted average
parts per million = ppm
milligrams per cubic meter = mg/m^3

2.3 Reporting

CAMP summary reports will be prepared and submitted to NYSDEC and NYSDOH for review as part of the daily and monthly reports. In the event there is an action level exceedance or complaint, NYSDEC and NYSDOH will be notified within 24 hours (same day to the extent possible) of the exceedance or complaint. The notification will include a description of the exceedance or complaint, the cause of the exceedance, and any corrective actions taken. All recorded CAMP data will be included in the Construction Completion Report (CCR).

FIGURE



Service Layer Credits: USGS The National Map: 3d Elevation Program, Data Refreshed July, 2021

0 800 1,600

SCALE IN FEET

©2022 AKRF Q:\Projects\220249 - 221 GLENMORE AVENUE\Technical\GIS and Graphics\SAR\RIR\220249 Fig 1 Site Location.mxd12/16/2022 11:07:18 AM mveilleux

AKRF

440 Park Avenue South, New York, NY 10016

114 Snediker Avenue Site

221-241 Glenmore Avenue

Brooklyn, New York

SITE LOCATION

DATE

12/16/2022

PROJECT NO.

220249

FIGURE

1

APPENDIX C

QUALITY ASSURANCE PROJECT PLAN

114 SNEDIKER AVENUE SITE

221-241 GLENMORE AVENUE
BROOKYLN, NEW YORK

QUALITY ASSURANCE PROJECT PLAN

NYSDEC BCP Site Number: TBD
AKRF Project Number: 200249

Prepared For:

New York State Department of Environmental Conservation
Division of Environmental Remediation, Remedial Bureau B
625 Broadway, 12th Floor
Albany, New York 12233

Prepared On Behalf Of:

Glenmore Owner LLC
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Prepared by:

AKRF, Inc.
440 Park Avenue South, 7th Floor
New York, New York 10016
212-696-0670

DECEMBER 2022

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TABLES

ATTACHMENTS

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) describes the protocols and procedures that will be followed during implementation of the Interim Remedial Measures Work Plan (IRMWP) for the 114 Snediker Avenue Site located at 221-241 Glenmore Avenue in the New Lots sub-section of the East New York neighborhood of Brooklyn, New York, hereafter referred to as the “Site”. The approximately 0.823-acre Site is identified by the City of New York as Borough of Brooklyn, Block 3697, Lots 1 and 33. The Requestor is currently applying to remediate the Site under the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP).

The objective of this QAPP is to provide for Quality Assurance (QA) and maintain Quality Control (QC) of environmental investigative and sampling activities conducted under the New York State Department of Environmental Conservation (NYSDEC) oversight in the Brownfield Cleanup Program (BCP) (BCP Site No. TBD). Adherence to this QAPP will ensure that defensible data will be obtained during environmental work at the Site.

2.0 PROJECT TEAM

The project team will be drawn from AKRF professional and technical personnel, and AKRF's subcontractors. All field personnel and subcontractors will have completed a 40-hour training course and updated 8-hour refresher course that meet the Occupational Safety and Health Administration (OSHA) requirements of 29 CFR Part 1910. The following sections describe the key project personnel and their responsibilities.

2.1 Remedial Engineer

The Remedial Engineer (RE) for this project will be Rebecca Kinal, P.E. The RE will have primary direct responsibility for implementation of the IRM program for the Site. The RE will coordinate the work of other contractors and subcontractors involved in all aspects of IRM construction, including soil excavation, stockpiling, characterization, removal and disposal, air monitoring, emergency spill response services, import of backfill material, and management of waste transport and disposal. The RE will be responsible for all appropriate communication with NYSDEC and New York State Department of Health (NYSDOH). Ms. Kinal's resume is included in Attachment A.

2.2 Quality Assurance/Quality Control Officer

Mrs. Deborah Shapiro, Qualified Environmental Professional (QEP) will serve as the quality assurance/quality control (QA/QC) officer and will be responsible for adherence to the QAPP including quality assurance/quality control (QA/QC). The QA/QC officer will review the procedures with all personnel prior to commencing any fieldwork and will be responsible for reviewing the Data Usability Summary Reports (DUSRs) prepared by a third-party data validator for soil, groundwater, and soil vapor analytical results. Mrs. Shapiro's resume is included in Attachment A.

2.3 Project Manager

The project manager will be responsible for directing and coordinating all elements of the IRMWP. The project manager will prepare reports and participate in meetings with the Site owner/Volunteer, and/or the NYSDEC. Bryan Zieroff will serve as the project manager for the IRMWP. Mr. Zieroff's resume is included in Attachment A.

2.4 Project Manager Alternate

The project manager alternate will be responsible for assisting the project manager. The project manager alternate will help prepare reports and participate in meetings with the Site owner/Volunteer, and/or the NYSDEC. Mark Jepsen will serve as the project manager alternate for the IRWMP. Mr. Jepsen's resume is included in Attachment A.

2.5 Field Team Leader, Field Technician, Site Safety Officer (SSO), and Alternates

The field team leader will be responsible for supervising the daily sampling and health and safety activities in the field and will ensure adherence to the work plan and Health and Safety Plan (HASP), included as Appendix A of the IRMWP. The field team leader will also act as the field technician and Site Safety Officer (SSO) and will report to the project manager or project manager alternate on a regular basis regarding daily progress and any deviations from the work plan. The field team leader will be a qualified and responsible person able to act professionally and promptly during environmental work at the Site. Antonio Cardenas will be the field team leader. The field team leader alternate is Tim Larigan. Mr. Cardenas' and Mr. Larigan's resumes are included in Attachment A.

2.6 Laboratory Quality Assurance/Quality Control (QA/QC) Officer

The laboratory QA/QC officer will be responsible for quality control procedures and checks in the laboratory and ensuring adherence to laboratory protocols. The QA/QC officer will track the movement of samples from the time they are checked in at the laboratory to the time that analytical results are issued, and will conduct a final check on the analytical calculations and sign off on the laboratory reports. The laboratory QA/QC officer will be Carl Armbruster of Eurofins TestAmerica Laboratories (TestAmerica), the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified laboratory being employed for all environmental sampling at the Site. Mr. Ambruster's resume is included in Attachment A.

2.7 Thirty-Party Data Validator

The third-party data validator will be responsible for reviewing the final data packages for soil, groundwater, and soil vapor and preparing a DUSR that will provide performance information with regard to accuracy, precision, sensitivity, representation, completeness, and comparability associated with the laboratory analyses for the investigation. The third-party data validator will be Lori Beyer of L.A.B. Validation Corporation of East Northport, New York. Ms. Beyer's resume is included in Attachment A.

3.0 STANDARD OPERATING PROCEDURES (SOPS)

The following sections describe the SOPs for the Interim Remedial Measures included in the IRMWP. During these activities, safety monitoring will be performed as described in the HASP, included as Appendix A of the IRMWP.

3.1 EXCAVATION AND REMOVAL OF CONTAMINATED MATERIAL

Contaminated soil will be removed across the Site, encompassing an approximate 35,854-square feet area as detailed in the IRMWP. Soil excavation work will comprise the following activities:

1. The location of existing groundwater monitor wells located within or beneath the concrete floor slab will be preserved during the excavation activities to the extent practicable.
2. Excavated soil will be removed using an excavator to a depth of approximately two feet below grade (bg) across the Site. Additionally, soil hotspots will be excavated beyond two feet bg based on the results of the Preliminary Design investigation (PDI) and in accordance with the Support of Excavation (SOE) Plan. Excavated soils will be managed in separate waste streams as indicated by future waste characterization sampling.
3. All excavated material requiring staging for overnight or longer will follow the procedures in Section 3.1.1.

Proposed IRM excavation areas are depicted on Figure 12 of the IRMWP.

3.1.1 Stockpiling/Staging Area

Prior to excavation and removal of contaminated material, the stockpiling/staging area will be selected and prepared prior to the commencement of excavation activities. Staging area(s) will be prepared for staging any contaminated material overnight or longer using the procedures described below:

The material staging area(s) will be prepared by placing 6-mil plastic on the ground and covered with additional 6-mil plastic sheeting. Sealable containers with tight-fitting covers may also be utilized for the staging of VOC-contaminated material overnight or longer.

3.2 SOIL BORING INSTALLATION

Proposed soil boring sample locations are depicted on Figure 11A of the IRMWP. Utility mark-outs are required by law, and the drilling contractor is required to call OneCall New York at least two days prior to intrusive work. If there are any questions regarding locations of utilities in the sidewalk, the respective utility(s) will be contacted to clarify any concerns and/or the sampling location would be adjusted.

Borings will be advanced using a Geoprobe® 7822DT track-mounted DPP drilling rig (or equivalent) and a Geoprobe® Sonic drilling rig. All borings not slated for groundwater monitoring wells will be advanced to the depths as stated in the IRMWP. Soil will be inspected for evidence of contamination (e.g., odors, staining), screened for the presence of VOCs with a PID equipped with a 11.7 electron volt (eV) lamp, and logged using the modified Burmister soil classification system. The PID will be calibrated prior to sampling in accordance with the manufacturer's recommendations. Each soil boring location will be surveyed using a GPS handheld device to determine their accurate location. At each boring location, AKRF field personnel will record and document subsurface conditions.

3.3 GROUNDWATER MONITORING WELL INSTALLATION AND DEVELOPMENT

Proposed monitoring well locations are depicted on Figure 11B of the IRMWP. Six existing RI (“RI”) groundwater monitoring wells and four existing Phase II (“P2”) groundwater monitoring wells have been installed throughout the Site. During the IRM activities, existing monitoring wells are to be maintained to the extent practicable. The following procedures should be followed in the event that a monitor well requires replacement or redevelopment. The well locations and/or screen depths may be adjusted based on observations and data compiled during the necessary field activities.

Each monitoring well will be screened as detailed in the IRMWP. Overburden monitoring wells will be installed or re-installed by a Geoprobe Sonic drill rig. The wells will be constructed with two-inch or four-inch diameter PVC. Monitoring well construction details are provided in the IRMWP.

Any replacement monitor wells will be constructed as outlined in the IRMWP. The annular space around all well screens will be backfilled with sand filter pack extending from the bottom of the boring to one to two feet above the screen. The annular space around the well riser will be sealed with bentonite extending one to two feet above the sand filter pack and completed with a non-shrinking cement mixture to approximately one foot below grade. Any replacement monitoring wells will be completed using flush-to-grade manholes. A concrete apron will be set around the manhole to prevent drainage of surface runoff toward the well. The screen interval for any replacement monitoring wells will be determined according to the following procedure:

- Measure the depth to water in the open hole using a Solinst® Water Table Meter – Model 101 or equivalent.
- If the groundwater recharge into the borehole is limited due to low hydraulic conductivity, the point of saturation identified during soil sampling will be used to assist with identifying the depth to groundwater.
- Place PVC riser and the appropriate length of PVC 0.02-slotted screen as per the IRWMP starting at a depth to be determined and extending to the bottom of the borehole (immediately above bedrock), if feasible.
- Install No. 2 sand filter pack around the well screen to a depth of one to two feet above the top of the screen.
- Install a bentonite seal to a depth of one to two feet above the filter pack.
- Backfill the remaining annular space using a bentonite-cement grout.
- Complete the well with a locking cap and flush-to-grade manhole (road box) set in concrete. Provide a concrete apron around the base of the manhole to direct run-off away from the well.
- Decontaminate the probe and drilling rods prior to and following installation of each injection well as described in Section 3.6 of this QAPP.
- Document monitoring well installation data (location, depth, construction details, water level measurements) in the field logbook or on field data sheets.
- Following monitoring well installation, the wells will be developed according to the following procedure:
    - Measure the depth to water using an oil/water interface probe and the total depth of the well using a weighted tape. Use these measurements to calculate the length of the

water column. Calculate the volume of water in the well using 0.163 volumes per foot of water column (gallons) as the conversion factors for a 2-inch diameter well.

- For the first five minutes of well development, develop the well using a check valve pump and re-circulate the water back into the well to create maximum agitation. This method is intended to remove fines from the sand pack, the adjacent formation and from the well.
- After the first five minutes of well development, develop the well using a check valve pump and discharge the water to five-gallon buckets. Transfer water from the buckets to 55-gallon drums designated for well development water.
- During development, collect periodic samples and analyze for turbidity and water quality indicators (pH, temperature, dissolved oxygen, reduction-oxidation potential, and specific conductivity) with measurements collected approximately every five minutes.
- Continue developing the well until turbidity is less than 50 nephelometric turbidity units (NTUs) for three successive readings and until water quality indicators have stabilized to within 10% for pH, temperature and specific conductivity for three successive readings, or until at least three well volumes have been purged from the well.
- Document the volume of water removed and any other observations made during well development in the field logbook or on field data sheets.
- Decontaminate the equipment prior to and following development at each well location as described in Section 3.6 of this QAPP. All well development water, decontamination, and purge water will be containerized in 55-gallon drums and handled as described in Section 3.9 of this QAPP.

3.4 SOIL GAS POINT INSTALLATION

Soil gas samples will be collected using a stainless-steel probe, consisting of a drive point and internal perforated sampling port with a retractable tip, connected to Teflon sampling tubing. The sampling tubing will extend from the sampling port through a drive casing to above grade. Collectively, the retractable tip, sampling port and sampling tube are referred to as the “soil gas sampler”. Soil gas samples proposed as part of the PDI will be installed by a Geoprobe Sonic drill rig. The proposed soil gas point installation details are provided in the IRMWP.

The soil gas sampler will be installed using the following procedures:

1. Prepare the sampling point location by drilling through the building slab using a Geoprobe Sonic drill rig.
2. Attach new, clean $^{3}/_{16}$-inch inside diameter Teflon tubing to the sampling probe.
3. Drive the sampling probe and attached tubing to various sampling depths specified in the IRMWP.
4. Backfill the soil gas sampler with clean sand filter pack to prevent intake clogging.
5. Backfill annular space around the soil gas sampler with grout to required depths based on the details included in the IRMWP.
6. Retract the drive casing to expose the perforated sampling port.
7. Seal the gap between the foundation slab and tubing with hydrated bentonite.

8. Record total depths (interval below grade) to which probe is advanced and withdrawn for sample collection.

3.5 SURVEYING AND WATER TABLE READINGS

Any re-installed or newly installed monitoring wells will be surveyed by a New York State-licensed surveyor. Three elevation measurements will be taken at each well location: the elevation of the ground beside the well; the elevation on the rim of the protective casing; and the elevation of the top of PVC casing.

Water table readings will be taken in the groundwater monitoring wells using an oil/water interface probe. The gate boxes will be unlocked and opened at each well location. The oil/water interface probe will be turned on and sound tested. The probe of the meter will be inserted into the PVC casing. The probe will be lowered down the casing until the meter alarm indicates the probe is at the water table. A reading of the depth from the top of the PVC casing to the groundwater table will be recorded in the field notebook. The probe will then be lowered to the bottom of the well. If the meter alarm changes cadence indicating separate phase product, a reading of the product thickness will be documented.

3.6 DECONTAMINATION OF SAMPLING EQUIPMENT

All sampling equipment (drilling rods and casing, macro core samplers, probe rods and pumps, etc.) will be either dedicated or decontaminated between sampling locations. The decontamination procedure will be as follows:

1. Scrub using tap water/Simple Green® mixture and bristle brush.
2. Rinse with tap water.
3. Scrub again with tap water/ Simple Green® and bristle brush.
4. Rinse with tap water.
5. Rinse with distilled water.
6. Air-dry the equipment, if possible.

Decontamination will be conducted within 55-gallon drums or on plastic sheeting (or equivalent) that is bermed to prevent discharge to the ground or drains.

3.7 HEAVY EQUIPMENT DECONTAMINATION

Decontamination of chemically contaminated heavy equipment will be accomplished using high-pressure steam or dry decontamination with brushes and shovels. Decontamination will take place on a decontamination pad and all liquids used in the decontamination procedure will be collected. Vehicles or equipment brought into an exclusion zone will be treated as contaminated, and will be decontaminated prior to removal. All liquids used in the decontamination procedure will be collected, stored and disposed of in accordance with Federal, State and local regulations. Personnel performing this task will wear the proper PPE as prescribed in Table 2 of the Site-Specific Health and Safety Plan (HASP).

A decontamination area will be established around the planned excavation area, adjacent to the environmental enclosure. The floor of the decontamination area will be covered with 6-mil plastic sheeting, as necessary, and bermed to prevent spreading of decontamination fluids or potential discharge to the ground surface.

3.8 MANAGEMENT OF INVESTIGATION DERIVED WASTE

All investigation-derived waste (IDW) and condensate water generated during the IRM operations will be containerized in DOT-approved 55-gallon drums. The drums will be sealed at the end of each work day and labeled with the date, the well or boring number(s), the type of waste (i.e., drill cuttings, development water or purge water) and the name of an AKRF point-of-contact. Soil samples collected from soil boring activities will be used for remedial design and/or waste characterization of soils, since such data would be biased towards areas which are expected to be most contaminated. Groundwater data from groundwater samples collected during the monitoring program will be used to characterize development and purged groundwater. Notwithstanding, additional waste characterization soil or groundwater samples will be collected, if warranted. All IDW will be disposed of or treated according to applicable local, state and federal regulations.

4.0 SAMPLING AND LABORATORY PROCEDURES

4.1 END-POINT/SOIL BORING SOIL SAMPLING

Per NYSDEC DER-10 Section 5.4, side-wall samples will be collected a minimum one sample for every 30 linear feet and bottom samples will be collected at a frequency of one every 900-SF. The proposed excavation areas and number of endpoint samples, as well as soil boring samples are further detailed in the IRMWP. As outlined in Section 4.4 of this QAPP, soil samples will be analyzed for the parameters listed Section 4.6, Table 1.

Soil sampling will be conducted according to the following procedures:

- Characterize the sample according to the modified Burmister soil classification system.
- While advancing soil borings and field screening for evidence of contamination (e.g. odors, staining, elevated PID measurements), collect an aliquot of soil from each sampling interval and place in labeled sealable plastic bags. The bag should be labeled with the soil boring number and the depth the sample was collected. Place the plastic bags in a chilled cooler to await selection of samples for laboratory analysis.
- After selecting which samples will be analyzed in the laboratory, fill the required laboratory-supplied sample jars with the soil from the selected sampling location or labeled sealable plastic bags. Seal and label the sample jars as described in Section 4.7.1 of this QAPP and place in an ice-filled cooler.
- Samples analyzed for the emerging contaminants (if any), per- and polyfluorinated compounds (PFAS), should be contained in a separate cooler and the sample containers should be labeled with ballpoint pen, not permanent marker.
- Complete the proper chain of custody (COC) paperwork and seal the cooler.
- Record boring number, sample depth and sample observations (evidence of contamination, PID readings, soil classification) in field log book and boring log data sheet, if applicable.
- Decontaminate any soil sampling equipment between sample locations as described in Section 3.6/3.7 of this QAPP.

4.2 GROUNDWATER SAMPLING

Groundwater sampling will be conducted according to the following procedures:

- Prepare the sampling area by placing plastic sheeting over the well. Cut a hole in the sheeting to provide access to the well cover.
- Slowly remove the locking cap and immediately measure the vapor concentrations in the well with a PID calibrated to the manufacturer's specifications.
- Measure the depth to water and total well depth, and check for the presence of non-aqueous phase liquid (NAPL) using an oil/water interface probe. Measure the thickness of NAPL, if any, and record in field book and well log. Collect a sample of NAPL using a disposable plastic weighted bailer or similar collection device. Groundwater samples will not be collected from wells containing measurable NAPL.
- Use the water level and total well depth measurements to calculate the length of the mid-point of the water column within the screened interval. For example, for a well where the total

depth is 20 feet, screened interval is 10 to 20 feet, and depth to water is 14 feet, the mid-point of the water column within the screened interval would be 17 feet.

- For a two- or four-inch well, connect dedicated tubing to either a submersible or a bladder pump and lower the pump such that the intake of the pump is set at the mid-point of the water column within the screened interval of the well. Connect the discharge end of the tubing to the flow-through cell of a Horiba Quanta multi-parameter (or equivalent) meter. Connect tubing to the output of the cell and place the discharge end of the tubing in a 5-gallon bucket.
- Activate the pump at the lowest flow rate setting of the pump.
- Measure the depth to water within the well. The pump flow rate may be increased such that the water level measurements do not change by more than 0.3 foot as compared to the initial static reading. The well-purging rate should be adjusted so as to produce a smooth, constant (laminar) flow rate and so as not to produce excessive turbulence in the well. The expected targeted purge rate will be approximately 0.5 liter and will be no greater than 3.8 liters/minute.
- Transfer discharged water from the 5-gallon buckets to 55-gallon drums designated for well-purge water.
- During purging, collect periodic samples and analyze for water quality indicators (e.g., turbidity, pH, temperature, dissolved oxygen, reduction-oxidation potential, and specific conductivity) with measurements collected approximately every five minutes.
- Continue purging the well until turbidity is less than 50 nephthalometric turbidity units (NTU) and water quality indicators have stabilized to the extent practicable. The criteria for stabilization will be three successive readings for the following parameters and criteria:

Table 1
Stabilization Criteria

Parameter	**Stabilization Criteria**
PH	+/- 0.1 pH units
Specific Conductance	+/- 3% mS/cm
ORP/Eh	+/- 10mV
Turbidity	<50 NTU
Dissolved Oxygen	+/- 0.3 mg/l

Notes: mS/cm = millisievert per centimeter
mV = millivolts
NTU = nephthalometric turbidity units
mg/l = milligrams per liter

- If the water quality parameters do not stabilize and/or turbidity is greater than 50 NTU within two hours, purging may be discontinued. Efforts to stabilize the water quality for the well must be recorded in the field book, and samples may then be collected as described herein.
- After purging, disconnect the tubing to the inlet of the flow-through cell. Collect groundwater samples directly from the discharge end of the tubing and place into the required sample containers as described in Section 4.4 of this QAPP. Label the containers as described in Section 4.6.1 of this QAPP and place in an ice-filled cooler for shipment to the laboratory.

- Collect one final field sample and analyze for turbidity and water quality parameters (pH, temperature, dissolved oxygen, reduction-oxidation potential, and specific conductivity).
- Once sampling is complete, remove the pump and tubing from the well. Disconnect the tubing and place it back in the well for reuse during the next sampling event. Dispose of the sample filter in a 55-gallon drum designated for disposable sampling materials and personal protective equipment (PPE). The purge water will be managed as described in Section 3.2 of this QAPP.
- Decontaminate the pump, oil/water interface probe, and flow-through cell, as described in Section 3.1 of this QAPP.
- Record all measurements (depth to water, depth to NAPL, water quality parameters, turbidity), calculations (well volume), and observations in the project logbook and field data sheet, if applicable.
- Sampling for emerging contaminants will be conducted in accordance with the January 2021 NYSDEC-issued sampling protocol ("Sampling, Analysis, and Assessment of PFAS"), with the exception that a low-density polyethylene (LDPE) bladder will be used as no industry-approved high-density polyethylene (HDPE) alternative currently exists. If necessary, well sampling details will be noted on groundwater sampling logs, included as an appendix to the FER.
- Collect the groundwater sample from each proposed sample location in laboratory-supplied glassware, label the sample in accordance with Section 4.7.1, and place in an ice-filled cooler for shipment to the laboratory. Samples analyzed for the emerging contaminants, PFAS, should be contained in a separate cooler.
- Complete the proper COC paperwork and seal the cooler.
- Record sample location, sample depth, and sample observations (evidence of contamination, PID readings, free phase liquid, etc.) in field logbook and boring log data sheet, if applicable.
- Decontaminate any groundwater sampling equipment between sample locations as described in Section 3.6/3.7 of this QAPP.

One MS/MSD and one blind duplicate will be collected for every sample batch, not to exceed 20 samples, and at a frequency of one per day for equipment blanks. Category B electronic data deliverables will be requested from the laboratory.

4.3 SOIL VAPOR SAMPLING

Soil vapor sampling will be conducted according to the following procedures:

- Field screen the sample for evidence of contamination (e.g., odors, etc.) using olfactory methods and screen the purged vapors for VOCs using a PID equipped with an 10.7 eV lamp.
- Collect the soil vapor samples from each proposed sample location in laboratory-supplied SUMMA® canisters, label the sample in accordance with Section 4.7.1, and place in shipment container for shipment to the laboratory.
- Complete the proper COC paperwork and seal the shipment container.
- Record sample location, sample depth, and sample observations (odors, PID readings, etc.) in field logbook and boring log data sheet, if applicable.

4.4 LABORATORY METHODS

Table 1 summarizes the laboratory methods that will be used to analyze field samples and the sample container type, preservation, and applicable holding times. TestAmerica of Edison, New Jersey, a NYSDOH ELAP-certified laboratory subcontracted to AKRF, will be used for all chemical analyses in accordance with the Division of Environmental Remediation (DER)-10 2.1(b) and 2.1(f) with Category B Deliverables.

Table 2
Laboratory Analytical Methods for Analysis Groups

Matrix	Analysis	EPA Method	Bottle Type	Preservative	Hold Time
Soil and Soil QA/QC	Volatile Organic Compounds (VOCs)	8260C	EnCore® or TerraCore® samplers (3) and 2 oz. plastic jar	≤ 6 ºC	14 days to extract; 40 days to analyze
	Semivolatile Organic Compounds (SVOCs)	8270D	8 oz. Glass Jar	≤ 6 ºC	14 days to extract; 40 days to analyze
	1,4-Dioxane	8270D; 0.1 mg/kg RL	4 oz. Glass Jar	≤ 6 ºC	14 days to extract; 40 days to analyze
	Total Analyte List (TAL) Metals, and Hexavalent Chromium	6000/7000 Series, 6010C, and 7196A	8 oz. Glass Jar	≤ 6 ºC	6 months holding time; Mercury 28 days holding time; Hexavalent chromium 30 days to extract, 7 days to analyze
	Pesticides	8081B	8 oz. Glass Jar	≤ 6 ºC	14 days to extract; 40 days to analyze
	Herbicides	8151A	8 oz. Glass Jar	≤ 6 ºC	14 days to extract; 40 days to analyze
	Polychlorinated Biphenyls (PCBs)	8082A	8 oz. Glass Jar	≤ 6 ºC	14 days to extract; 40 days to analyze
	Per- and Polyfluorinated Compounds (PFAS)	1633; 0.5 µg/kg RL	4 oz. HDPE Plastic Container	≤ 6 ºC	90 days to extract; 28 days to analyze
Groundwater and Groundwater QA/QC	VOCs	8260C	5 40 mL Glass Vials	HCl to pH < 2 and ≤ 6 ºC	48 hours to extract; 14 days to analyze
	SVOCs	8270D	2,000 mL Amber Jar	≤ 6 ºC	7 days to extract; 40 days to analyze
	1,4-Dioxane	8270D plus Selective Ion Monitoring (SIM); 0.35 µg/L RL	1 L Amber Jar	≤ 6 ºC	7 days to extract; 40 days to analyze
	TAL Metals	6000/7000 Series	2,000 mL Amber Jar	HNO_3 to pH < 2	6 months for metals; 28 days for mercury; 24 hours for hex. chromium
	Pesticides	8081B	2,000 mL Amber Jar	≤ 6 ºC	7 days to extract; 40 days to analyze
	Herbicides	8151A	2,000 mL Amber Jar	≤ 6 ºC	7 days to extract; 40 days to analyze
	PCBs	8082A	2,000 mL Amber Jar	≤ 6 ºC	7 days to extract; 40 days to analyze
	Per- and Polyfluorinated Compounds (PFAS)	1633; 2 ng/L RL	2 x 500 mL HDPE Bottles 1 x 250 mL HDPE Bottle	≤ 6 ºC	14 days to analyze
Soil Vapor	VOCs	TO-15	6L SUMMA® Canister	None	14 days

Notes: QA/QC samples will be analyzed for the same parameters as the parent sample, with the exception of the trip blank(s), which will be analyzed for VOCs by EPA Method 8260C only.
EPA – Environmental Protection Agency

Hg – Mercury
RCRA – Resource Conservation and Recovery Act
mg/kg – milligrams per kilogram (parts per million)
µg/L – parts per billion
ng/L – parts per trillion
RL – Reporting Limit

4.5 QUALITY CONTROL (QC) SAMPLING

In addition to the laboratory analysis of the soil and groundwater samples, additional analysis will be included for QC measures, as required by the Category B sampling techniques. These samples will include a field blank, trip blank, matrix spike/matrix spike duplicate (MS/MSD), and blind duplicate samples at a frequency of one sample per 20 field samples collected. QC samples will be analyzed for the same parameters as the accompanying samples, with the exception of any trip blanks, which will be analyzed for the VOC list only. Additionally, one equipment blank will be collected during each day of groundwater sampling.

4.6 SAMPLE HANDLING

4.6.1 Sample Identification

All samples will be consistently identified in all field documentation, chain-of-custody (COC) documents, and laboratory reports. Soil, groundwater, and soil vapor samples collected during the IRM will be identified with “PDI-” and “SB-” for soil borings “MW-” for groundwater monitoring wells, “SV-” for soil vapor points, and the soil boring, groundwater monitoring well number, soil vapor point sample number. All samples will be amended with the collection date at the end of the sample name in a year, month, day (YYYYMMDD) format. Blind duplicate sample nomenclature will consist of the sample type, followed by an “X”; MS/MSD samples nomenclature will consist of the parent sample name only, but triplicate sample volume will be collected and the COC comment section will explain that the additional volume is for running the MS/MSD; and trip and field blanks will consist of “TB-” and “FB-”, respectively, followed by “S” for soil and “GW” for groundwater, and a sequential number of the trip/field blanks collected within the sample digestion group (SDG). Special characters, including primes/apostrophes (’), will not be used for sample nomenclature.

PDI Sampling

Soil, groundwater, and soil vapor samples will be collected as part of the PDI. Table 3 provides examples of the sampling identification scheme for samples collected during PDI under the IRM.

Table 3
PDI Sample Nomenclature

Sample Description	Sample Designation
Groundwater sample collected from groundwater monitoring well PDI-MW-09 on January 19, 2023	PDI-MW-09_20230119
Blind duplicate sample of groundwater sample collected from groundwater monitoring well PDI-MW-09 on January 19, 2023	PDI-MW-X_20230119
Second field blank collected during the IRM on January 19, 2023 with the soil samples	PDI-FB-S-02_20230119
Soil sample collected from soil boring PDI-SB-26 between 0 and 2 feet below grade on January 19, 2023	PDI-SB-26_0-2_20230119

Sample Description	Sample Designation
Second blind duplicate soil sample of SDG collected from soil boring PDI-SB-26 between 0 and 2 feet below grade on January 19, 2023	PDI-SB-X2_0-2_20230119
Soil vapor sample collected from temporary soil vapor point PDI-SV-16 on January 19, 2023	PDI-SV-16_20230119

Endpoint Soil Sampling

Soil endpoint samples will be identified with “EP-” and the endpoint sample number in sequential order that the endpoint sample was collected, and the depth below grade the sample was collected from in parentheses. Table 4 provides examples of the sampling identification scheme for the post-excavation endpoint samples.

Table 4
Endpoint Sample Nomenclature

Sample Description	Sample Designation
Post-excavation endpoint soil sample EP-01 collected from 15 feet below grade on October 1, 2023	EP-01_15_20231001
Matrix spike/matrix spike duplicate sample of post-excavation endpoint soil sample EP-01 collected from 15 feet below grade on October 1, 2023	EP-01_15_20231001_MS EP-01_15_20231001_SD
Duplicate of post-excavation endpoint soil sample EP-01 collected from 15 feet below grade on October 1, 2023	EP-X_15_20231001
Trip blank sample collected during a soil sampling event on October 1, 2023	TB-S-20231001
Field blank sample collected during a groundwater sampling event on October 1, 2023	FB-GW-20231001

Waste Classification/ Tank Excavation Soil Sampling

In addition to the nomenclature detailed above, any confirmatory endpoint samples collected from a tank excavation, if encountered, will be identified by the tank number and the cardinal direction of the sidewalls. The sample(s) collected from the bottom of the excavation will be amended with a “B-”, followed by the number of bottom samples collected from the excavation in sequential order. Waste classification samples will be amended with “WC-” and the alphanumeric grid identification. Additionally, samples will be amended with the depth the sample was collected in feet below grade in parentheses. Table 5 below provides examples of the sampling identification scheme for proposed waste classification samples and any hotspot or tank excavation samples.

Table 5
Waste Classification/Hotspot/Tank Excavation Sample Nomenclature

Sample Description	Sample Designation
Waste classification composite sample collected between grade and 5 feet below grade in grid C6 on May 7, 2023	WC-C6-C_0-5_20230507
Waste classification grab sample collected between grade and 5 feet below grade in grid C6 on May 7, 2023	WC-C6-G_0-5_20230507
Soil sample collected from the northern sidewall of a tank grave encountered at 4 feet below grade on August 15, 2023	UST-N_4_20230815

Sample Labeling and Shipping

All sample containers will be provided with labels containing the following information:

- Project identification, including Site name, BCP Site number, Site address
- Sample identification
- Date and time of collection
- Analysis(es) to be performed
- Sampler’s initials

Once the samples are collected and labeled, they will be placed in chilled coolers and stored in a cool area away from direct sunlight to await shipment to the laboratory. All samples will be shipped to the laboratory at least twice per week. At the start and end of each workday, field personnel will add ice to the cooler(s) as needed.

The samples will be prepared for shipment by placing each sample in laboratory-supplied glassware, then wrapping each container in bubble wrap to prevent breakage, and adding freezer packs and/or fresh ice in sealable plastic bags. The COC form will be properly completed by the sampler in ink, and all sample shipment transactions will be documented with signatures, and the date and time of custody transfer. Samples will be shipped overnight (e.g., Federal Express) or transported by a laboratory courier. All coolers shipped to the laboratory will be sealed with mailing tape and a COC seal to ensure that the samples remain under strict COC protocol.

Sample Custody

Field personnel will be responsible for maintaining the sample coolers in a secured location until they are picked up and/or sent to the laboratory. The record of possession of samples from the time they are obtained in the field to the time they are delivered to the laboratory or shipped off-site will be documented on COC forms. The COC forms will contain the following information: project name; names of sampling personnel; sample number; date and time of collection and matrix; and signatures of individuals involved in sample transfer, and the dates and times of transfers. Laboratory personnel will note the condition of the custody seal and sample containers at sample check-in.

4.7 FIELD INSTRUMENTATION

Field personnel will be trained in the proper operation of all field instruments at the start of the field program. Instruction manuals for the equipment will be on file at the Site for referencing proper operation, maintenance, and calibration procedures. The equipment will be calibrated according to manufacturer specifications at the start of each day of fieldwork. If an instrument fails calibration, the project manager or QA/QC officer will be contacted immediately to obtain a replacement instrument. A calibration log will be maintained to record the date of each calibration, any failure to calibrate and corrective actions taken. The PID will be equipped with a 10.6 eV lamp and will be calibrated each day using 100 parts per million (ppm) isobutylene standard gas in accordance with the manufacturer’s standards.

4.8 QUALITY ASSURANCE (QA)

All soil, groundwater, and soil vapor laboratory analytical data will be reviewed by a third-party validator and a Data Usability Summary Report (DUSR) will be prepared to document the usability and validity of the data. The Construction Completion Report (CCR) will include a detailed description of endpoint sampling activities, data summary tables, concentration map showing sample locations and concentrations, DUSR, and laboratory reports.

ATTACHMENT A

RESUMES OF REMEDIAL ENGINEER, QA/QC OFFICER AND PROJECT DIRECTOR, PROJECT MANAGER, AND FIELD TEAM LEADER/FIELD TECHNICIAN/SITE SAFETY OFFICER/ALTERNATE

ANTONIO CARDENAS

PROJECT SCIENTIST

Antonio Cardenas is a Project Scientist in AKRF's Site Assessment & Remediation group. He earned a Bachelor of Science degree in Geology from City College of the City University of New York. Mr. Cardenas is proficient in ArcGIS, PHREEQC, ENVI, and Matlab, as well as Microsoft Word, Excel and PowerPoint. He speaks fluent Spanish.

BACKGROUND

Education
BS, City College of the City University of New York, Geology, 2017

Licenses/Certifications
AMFER Certificate, US EPA Air Monitoring for Emergency Response Training Program
OSHA 30 Hour Construction
OSHA 40 Hour HAZWOPER
OSHA 8 Hour Refresher

Years of Experience
2 years in the industry
2 years with AKRF

RELEVANT EXPERIENCE

American Museum of Natural History, The Gilder Project, New York, NY

AKRF performed the waste classification and soil resuse sampling for the AMNH expansion. Hazardous material (Lead) was delineated and discovered underground storage tanks were closed and disposed of. Mr. Cardenas conducted air monitoring, construction oversight, and handled the special manifests for the disposal of the hazardous materials. Mr. Cardenas also spoke with the applicable parties to determine which grids were best to sample for resuse, as well as performing the sampling.

Hunters Point South/North - Long Island City, NY

AKRF conducted the waste classification and designed the SSDS system for both Hunters Point South and Hunters Point North. Mr Cardenas conducted air monitoring, construction oversight, soil disposal tracking, and inspected the SSDS system that was installed and made sure the specifications were followed.

1100 Myrtle Avenue, Brooklyn, NY

AKRF performed a remedial investigation for the site. Mr. Cardenas assisted and performed soil boring classification and sampling. He also performed well development for monitoring wells and did low flow groundwater sampling.

MARK JEPSEN

ENVIRONMENTAL SCIENTIST

Mark Jepsen is an Environmental Scientist in AKRF's Hazardous Materials group. He has a great deal of experience in both environmental science and natural resources, including environmental remediation and consulting, groundwater quality and soil science, hydrology, and geology.

Since Joining AKRF at the beginning of 2014, Mr. Jepsen has overseen a wide variety of environmental investigations. He has performed oversight at large scale construction sites entailing complex remediation techniques. He has performed various Phase I site visits and reports. Additionally, Mr. Jepsen has followed up these Phase I investigations with performing Phase II remedial investigations including soil, groundwater, and soil vapor sampling. Also, Mr. Jepsen has a great deal of experience creating environmental reports discussing results found during the preliminary and supplemental investigations, Remedial Action Work Plans (RAWPs), Construction Health and Safety Plans (CHASP), Remedial Closure Reports, Environmental Bid Specifications and Design Coordination. Mr. Jepsen has a knowledgeable background in environmental issues and challenges pertaining to the New York metropolitan area and technical guidelines. Mr. Jepsen has a great deal of experience working on projects involved with multiple governmental regulators including NYSDEC, NJDEP, NYCDEP, and NYCOER.

Before joining AKRF, Mr. Jepsen worked for Bluestone Environmental Services in Somerset, New Jersey. He was responsible for performing a wide array of field work activities including groundwater sampling, monitoring well gauging, soil sampling, and more for Bluestone's various clients including: ExxonMobil, International-Matex Tank Terminals (IMTT) and various gas stations. He was responsible for maintaining an understanding of large and active remediation sites and dealing with an extensive groundwater monitoring well network, as well as acting as an on-site safety supervisor for all Bluestone employees and subcontractors.

BACKGROUND

Education
B.S., Environmental Science, The Ohio State University, 2012

New Jersey Regulatory Seminars
Combined Sewer Outfalls (CSO) for LSRPs: Remediation Alternatives to Better Manage Storm Water

Certifications
40 Hour OSHA HAZWOPER – annual refresher every year
10 Hour OSHA Construction Training
Gold Certified Brownfield Professional by New York City Office of Environmental Remediation
Transportation Worker Identification Credential (TWIC)
NYSDEC Erosion and Sediment Control Inspector
Boating license

Years of Experience
Date started at AKRF: March 2014
Prior industry experience: Bluestone Environmental Services (NJ) – January 2013 to March 2014

RELEVANT AKRF EXPERIENCE

432 East 14th Street, Environmental Management Specifications, Design Coordination and Pre-Characterization of Soil for Off-site Disposal, New York, NY

Mr. Jepsen supported AKRF's preparation of Environmental Management Specifications and Design Coordination, and collection and laboratory analysis of soil samples to pre-characterize soil beneath the Site for off-site disposal. Mr. Jepsen also performed the Phase II remedial investigation of this site which included soil, groundwater, and soil vapor sampling. Mr. Jepsen was also responsible for construction oversight during the foundation excavation for the proposed building. Following completion of excavation, Mr. Jepsen was responsible for inspecting the vapor barrier system installed as an engineering control for the proposed building. He has also been involved with creating the Remedial Closure Report.

77 Commercial Street, Environmental Services, Greenpoint, NY

Mr. Jepsen supported AKRF's environmental services, including Preparation of a Remedial Investigation (Phase II) Work Plan; Remedial Investigation (RI) and Report; Preparation of a Remedial Action Work Plan (RAWP) and Construction Health and Safety Plan (CHASP); Pre-Characterization of Soil for Off-site Disposal; Environmental Monitoring; Remedial Closure Report; and Environmental Bid Specifications and Design Coordination.

Bronx Pro 2264-2272 Morris Avenue, Environmental Consulting Services, Bronx, NY

Mr. Jepsen is supporting AKRF's environmental consulting services for this site including, Phase I Environmental Site Assessment (ESA) and update, Phase II remedial site investigations and subsurface sampling, ongoing construction oversight and vapor barrier inspections.

Memorial Sloan Kettering Cancer Center Hospital 74th Street, Environmental Services, New York, NY

Mr. Jepsen supported AKRF's environmental services, including construction oversight and air monitoring, groundwater sampling, and monitoring well decommissioning. Also, Mr. Jepsen has overseen large scale UST closure and removal at this site. Mr. Jepsen was responsible for the on-site implementation of AKRF's Remedial Action Work Plan (RAWP) and Construction Health and Safety Plan (CHASP). He has also been involved with creating the Remedial Closure Report.

School Construction Authority, New York, NY

Under an on-call contract, AKRF provides the New York City School Construction Authority (NYCSCA) with hazardous materials consulting services. Mr. Jepsen is involved with various due diligence and environmental assessment projects including Phase I Environmental Site Assessments (ESAs); Phase II (Subsurface) Environmental Site Investigations (soil, groundwater and soil vapor intrusion investigations); Indoor Air Quality (IAQ) Assessments; Underground Storage Tank (UST) and Aboveground Storage Tank (AST) inspections relating to boiler conversions; and peer review of other consultant's due diligence reports.

Indoor Air Quality Monitoring, New York, NY

Mr. Jepsen has performed a variety of indoor air quality investigations and surveys at sites including educational institutions and various residential buildings. Mr. Jepsen performed interviews pertaining to environmental site conditions and background with property owners and operators.

11 Greene Street, Environmental Consulting Services, New York, NY

Investigation and remediation of the Site is being conducted to satisfy NYC Office of Environmental Remediation (NYCOER) requirements under the Voluntary Clean-Up Program (VCP) and CEQR. Mr. Jepsen is supporting AKRF's environmental consulting services for this site including Waste Classification testing and delineation, preparation of a Remedial Investigation (Phase II) Work Plan; Remedial Investigation (RI) and Report; Preparation of a NYCDEP Dewatering Application and Permit; Preparation of a Remedial Action Work Plan (RAWP) and Construction Health and Safety Plan (CHASP); Pre-Characterization of Soil for Off-site Disposal; Environmental Monitoring; and Environmental Bid Specifications and Design Coordination.

3200 Jerome Avenue, Environmental Consulting Services, Bronx, New York

AKRF conducted a Phase I ESA and an Indoor Air Quality Survey of this property in the Bronx during due diligence investigations for the NYCSCA which identified levels of trichloroethene (TCE) in indoor air that exceeded the New York State Department of Health (NYSDOH) standards. NYCSCA subsequently terminated its lease of the site and discontinued its use as a school. Following the termination of NYCSCA's lease of the site, AKRF was retained by the owner to conduct an investigation and cleanup. Mr. Jepsen helped to conduct groundwater sampling requirements set by the NYSDEC as part of the Brownfield Cleanup Agreement for the project site. Mr. Jepsen is supporting the ongoing operations and maintenance of an active sub-slab depressurization system installed beneath the building. Mr. Jepsen has also overseen in-situ chemical oxidation (ISCO) groundwater treatment injection activities performed on-site.

98-100 Franklin Street, Manhattan, NY

AKRF completed a Phase I Environmental Site Assessment (ESA), Phase II ESI, prepared a Remedial Action Work Plan, a NYCDEP Dewatering Application and Permit, and performed soil waste classification sampling (which required the preparation of a NYC Transit Subsurface Investigation Permit to perform the associated soil borings) for the proposed redevelopment for a 29,564-square foot, eight-story mixed-use building with a cellar. As the assistant project manager, Mr. Jepsen coordinated with the client and contactors and performed oversight of on-site remediation activities.

NYSDOT/NYSTA Tappan Zee Hudson River Crossing, Rockland and Westchester Counties, NY

AKRF completed an EIS for this project on a fast-track schedule. Findings of the study were utilized to develop numerous documents prepared to guide the construction team, including a Remedial Action Plan and a Construction Health and Safety Plan for the five-year bridge replacement project. As part of the findings of the study, additional mitigation was required to ensure safety of endangered species inhabiting the Hudson River. Mr. Jepsen has been responsible for captaining and assisting in vessel-based monitoring of endangered species within and surrounding the marine construction zone of the new Tappan Zee Bridge located in Tarrytown and Nyack, NY on the Hudson River.

Previous Experience

International-Matex Tank Terminals (IMTT) and ExxonMobil, Environmental Consulting Services, Bayonne, NJ

Mr. Jepsen was responsible for conducting operations and maintenance of an extensive groundwater monitoring well network at an active storage tank terminal located in Bayonne, NJ. Mr. Jepsen also conducted site investigation field activities; including soil, groundwater sampling, and monitoring well installation. Mr. Jepsen aided with the operation and maintenance of active remedial systems, including oil recovery skimming systems and water treatment and discharge systems. Mr. Jepsen was responsible for maintaining client relationships and acting as an on-site safety supervisor for all Bluestone employees and subcontractors. Mr. Jepsen assisted with relevant compliance reporting requirements, remedial work plans, and general work permitting

Various Gas Stations, Environmental Consulting Services, Various Locations, NJ

Mr. Jepsen conducted site investigation field activities, including groundwater sampling and monitoring well installation at various gas stations with open petroleum spills reported the NJDEP. Mr. Jepsen acted as an on-site safety supervisor for all Bluestone employees and subcontractors. Mr. Jepsen assisted with relevant compliance reporting requirements.

REBECCA KINAL, PE

VICE PRESIDENT/ENVIRONMENTAL ENGINEER

Rebecca Kinal, PE has extensive experience in the assessment and remediation of soil and groundwater contamination and other hazardous/non-hazardous waste problems. Ms. Kinal's experience includes environmental due diligence, soil and groundwater investigations, leaking underground storage tank studies, soil gas/vapor intrusion surveys, and oversight of small- and large-scale remediation programs, including design of groundwater remediation systems and vapor mitigation systems. She has directed numerous Phase I and Phase II assessments and remediation programs, many of them in conjunction with commercial/residential developers, law firms, lending institutions, and public agencies. She is experienced in the cleanup of contaminated properties under New York State Brownfield Cleanup Program (BCP) regulations and the New York City "E-designation" program. As a part of this work, her duties have included technical and report review, engineering design, proposal writing, scheduling, budgeting, and acting as liaison between clients and regulatory agencies, and project coordination with federal, state, and local authorities.

BACKGROUND

Education

MS, Rensselaer Polytechnic Institute, Hydrogeology, 1995
BS, Lafayette College, Civil Engineering, 1992

Licenses/Certifications

Professional Engineer, NY - 082046-1
OSHA 40 Hour HAZWOPER,

Years of Experience

23 years in the industry
19 years with AKRF

RELEVANT EXPERIENCE

New York City School Construction Authority On-Call Contracts for Environmental Consulting Services, Various Sites, NY

Ms. Kinal has served as the project manager for AKRF's on-call hazardous materials consulting contract with the New York City School Construction Authority for over 10 years. For potential new school sites, assignments include initial due diligence; Phase I environmental site assessments (ESAs); and subsurface investigation of soil, groundwater, and soil vapor to determine the suitability of a site for development as a school, likely remediation requirements, and associated costs. For sites undergoing design and development, assignments include preparation of remediation plans, contract specifications, and design drawings. The work has also included conducting indoor air quality testing, vapor intrusion assessments, preparation of specifications and construction management for petroleum storage tank removals, and investigation and remediation of spills for existing schools. Due to the sensitivity of school sites, work under this contract is often conducted on short notice and during non-school hours. Under the contract, Ms. Kinal has managed several major efforts, including emergency remediation work related to flooding from Superstorm Sandy, expedited due diligence for large portfolios of proposed Universal Pre-Kindergarten (UPK and 3K) sites, and large Phase II investigations of sites with NYC Office of Environmental Remediation (OER) E-designations and/or contamination warranting potential NYSDEC involvement.

Montefiore Medical Center, Various Locations, NY

Ms. Kinal provides environmental due diligence assistance to Montefiore Medical Center (MMC) for the ongoing expansion of their facilities, primarily in the Bronx and Westchester County. She conducts and manages environmental due diligence tasks related to their property transactions, including Phase I Environmental Site Assessments (ESAs), Phase II investigations, indoor air quality surveys/vapor intrusion assessments, and remediation cost estimates. She also assists MMC in making decisions with respect to environmental risk issues. Projects have ranged from small, single-lot properties to large hospital campuses.

Transaction Support, Confidential Client, Various Locations

Ms. Kinal provided transaction support related to the proposed sale of a large construction equipment supply company. She managed inspections of 12 of the company's storage and maintenance yards located in New York, New Jersey, Connecticut, Rhode Island and Massachusetts to assess environmental concerns, and advise the client regarding environmental liabilities related to the proposed sale. The work was completed on an expedited turnaround to comply with the due diligence time-frame.

Brooklyn Technical High School Athletic Field Improvements, Brooklyn, NY

Ms. Kinal provided environmental support services to the selected contractor for improvements to the Brooklyn Tech H.S. athletic field facilities. These services included: preparation of an in situ sampling plan for waste characterization and disposal; supervision of waste characterization sampling activities; development and implementation of a community air monitoring program during all soil disturbance; and coordination for removal of a petroleum storage tank discovered construction.

Street-Works Development, Hamilton Green (200 Hamilton Avenue), White Plains, NY

AKRF prepared the EIS under the New York State Environmental Quality Review Act (SEQRA) and provided site planning and environmental services for the development of Hamilton Green—a new vibrant, mixed-use community in downtown White Plains, NY. Ms. Kinal managed environmental due diligence and remediation planning for the project, which included Phase I and II environmental assessments, a petroleum Spill investigation, preparation of remediation cost estimates, and application and acceptance to the NYSDEC Brownfield Cleanup Program (BCP).

Redevelopment at Polychrome R&D and Manufacturing Sites, AvalonBay, Yonkers, NY

Ms. Kinal served as the Engineer of Record for remediation of the former Polychrome research and development (R&D) site, a NYSDEC Brownfield redevelopment project along the Hudson River. The remediation included hot spot excavation, LNAPL collection, in-situ soil stabilization (ISS), soil management, groundwater treatment, dewatering, shoreline permitting, groundwater discharge permitting, and a site-wide engineered cover systems, including a vapor barrier and sub-slab depressurization system (SSDS). Ms. Kinal reviewed the design documents, supervised field inspections, provided support to the project team regarding contractor submittals and field changes, and certified the Final Engineering Report and Site Management Plan. The Site received its Certificate of Completion in December 2019.

New York City Department of Design & Construction (NYCDDC), East Side Coastal Resiliency (ESCR), New York, NY

AKRF was retained by the NYCDDC to provide a multi-disciplinary design for the protection of Lower Manhattan against another catastrophic hurricane. The main components of the design include levees, berms, retaining walls, cut-off walls, and increasing the ground elevation to mitigate and limit surging flood waters from entering Lower Manhattan. A large portion of the project's subsurface has been impacted by manufactured gas plant (MGP)-related contamination. Ms. Kinal serves as the Engineer of Record for MGP mitigation design components of the project. Her work includes certification of the Mitigation Work Plan submitted to NYSDEC and review of contract specifications and drawings.

United States Tennis Association, USTA NTC Master Plan Support, Queens, NY

AKRF prepared an EIS for the New York City Departments of City Planning (DCP) and Environmental Protection (DEP) as co-lead agencies to analyze the expansion of the National Tennis Center, which includes multiple improvements and construction projects at the USTA campus over several years. As part of the EIS requirements, AKRF prepared a Remedial Action Plan for implementation during the proposed project's construction. In accordance with the RAP, vapor mitigation systems were incorporated into the design for several of the proposed structures at the facility, including two new stadiums, a new transportation center, and several practice court facilities. Ms. Kinal prepared the specifications and design drawings for the vapor mitigation and provided construction support to review contractor submittals and inspect the vapor barrier and sub-slab depressurization system installations.

New York City Economic Development Corporation (NYCEDC), Yankee Stadium, Bronx, NY

Ms. Kinal performed the hazardous materials analysis for the Draft Environmental Impact Statement for the proposed new Yankee Stadium. The analysis included a Phase I Environmental Site Assessment of the entire project area and Subsurface (Phase II) Investigation in areas where environmental conditions were identified. The Phase II investigation included geophysical surveys to search for potential underground storage tanks; and soil, soil gas, and groundwater sampling at over 40 locations to determine potential environmental impacts during and after the proposed construction. Remedial Action Plans (RAPs) and Construction Health and Safety Plans (CHASPs) were developed to specify environmental monitoring, soil management protocols, and health and safety requirements during construction of the new stadium and redevelopment of the old stadium site. Ms. Kinal also managed an extensive community air monitoring program during demolition of the old Yankee Stadium and construction of the New York City Department of Parks and Recreation's Heritage Field, which included short-term and long-term monitoring for airborne particulates and lead.

Roosevelt Union Free School District, Roosevelt UFSD

Ms. Kinal managed environmental investigation and remediation activities for the sites of three new elementary schools and a new middle school in Roosevelt, New York. Remediation activities include removal/closure of contaminated dry wells and underground petroleum storage tanks, and excavation and off-site disposal of petroleum- and pesticide-contaminated soil. Remediation of the new middle school site, which also included a sub-slab depressurization system, was conducted through coordination with the NYSDEC, NYSDOH, New York State Education Department (NYSED), and the local school district. Upon completion of the remediation and school construction, Ms. Kinal managed confirmatory indoor air testing and preparation of a Final Engineering Report to document the site clean-up. The NYSDEC issued a Certificate of Completion, allowing the new school to open on schedule.

Lori A. Beyer

SUMMARY: General Manager/Laboratory Director with a solid technical background combined with Management experience in environmental testing industry. Outstanding organizational, leadership, communication and technical skills. Customer focused, quality oriented professional with consistently high marks in customer/employee satisfaction.

EXPERIENCE:

1998-Present L.A.B. Validation Corporation, 14 West Point Drive, East Northport, NY
President

- Perform Data Validation activities relating to laboratory generated Organic and Inorganic Environmental Data.

1998-Present American Analytical Laboratories, LLC. 56 Toledo Street, Farmingdale, NY
Laboratory Director/Technical Director

- Plan, direct and control the operation, development and implementation of programs for the entire laboratory in order to meet AAL's financial and operational performance standards.
- Ensures that all operations are in compliance with AAL's QA manual and other appropriate regulatory requirements.
- Actively maintains a safe and healthy working environmental that is demanded by local laws/regulations.
- Monitors and manages group's performance with respect to data quality, on time delivery, safety, analyst development/goal achievement and any other key performance indices.
- Reviews work for accuracy and completeness prior to release of results to customers.

1996-1998 Nytest Environmental, Inc. (NEI) Port Washington, New York
General Manager

- Responsible for controlling the operation of an 18,000 square foot facility to meet NEI's financial and operational performance standards.
- Management of 65 FTEs including Sales and Operations
- Ensure that all operations are in compliance with NEI's QA procedures
- Ensures that productivity indicators, staffing levels and other cost factors are held within established guidelines
- Maintains a quantified model of laboratory's capacity and uses this model as the basis for controlling the flow of work into and through the lab so as to ensure that customer requirements and lab's revenue and contribution targets are achieved.

1994-1996 Nytest Environmental, Inc. (NEI) Port Washington, New York
Technical Project Manager

- Responsible for the coordination and implementation of environmental testing programs requirements between NEI and their customers
- Supervise Customer Service Department
- Assist in the development of major proposals
- Complete management of all Federal and State Contracts and assigned commercial contracts
- Provide technical assistance to the customer, including data validation and interpretation
- Review and implement Project specific QAPP's.

1995-1996 Nytest Environmental, Inc. (NEI) Port Washington, New York
Corporate QA/QC Officer

- Responsible for the implementation of QA practices as required in the NJDEP and EPA Contracts
- Primary contact for NJDEP QA/QC issues including SOP preparation, review and approval
- Responsible for review, verification and adherence to the Contract requirements and NEI QA Plan

1992-1994 Nytest Environmental, Inc. (NEI) Port Washington, New York
Data Review Manager

- Responsible for the accurate compilation, review and delivery of analytical data to the company's customers. Directly and effectively supervised a department of 22 personnel.
- Managed activities of the data processing software including method development, form creation, and production
- Implement new protocol requirements for report and data management formats
- Maintained control of data storage/archival areas as EPA/CLP document control officer

1987-1991 Nytest Environmental, Inc. (NEI) Port Washington, New York
Data Review Specialist

- Responsible for the review of GC, GC/MS, Metals and Wet Chemistry data in accordance with regulatory requirements
- Proficient with USEPA, NYSDEC, NJDEP and NEESA requirements
- Review data generated in accordance with SW846, NYSDEC ASP, EPA/CLP and 40 CFR Methodologies

1986-1987 Nytest Environmental, Inc (NEI) Port Washington, New York
GC/MS VOA Analyst

EDUCATION:

1982-1985 State University of New York at Stony Brook, New York; BS Biology/Biochemistry
1981-1982 University of Delaware; Biology/Chemistry
5/91 Rutgers University; Mass Spectral Data Interpretation Course, GC/MS Training
8/92 Westchester Community College; Organic Data Validation Course
9/93 Westchester Community College; Inorganic Data Validation Course

Westchester Community College
Professional Development Center

Awards this Certificate of Achievement To

LORI BEYER

for Successfully Completing

ORGANIC DATA VALIDATION COURSE (35 HOURS)

Dr. John Samuelian

Date AUGUST 1992

Assistant Dean
Professional Development Center

President

The Professional
Development Center

SUNY
WESTCHESTER COMMUNITY COLLEGE
Valhalla, New York 10595

Westchester Community College
Professional Development Center

Awards this Certificate of Achievement To

LORI BEYER

for Successfully Completing

INORGANIC DATA VALIDATION

Instructor: Dale Boshart

Date MARCH 1993

Assistant Dean
Professional Development Center

President

The Professional
Development Center

SUNY
WESTCHESTER COMMUNITY COLLEGE
Valhalla, New York 10595

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Thomas C. Jorling
Commissioner

July 8, 1992

Ms. Elaine Sall
Program Coordinator
Westchester Community College
Valhalla, NY 10595-1698

Dear Elaine,

Thank you for your letter of June 29, 1992. I have reviewed the course outline for organic data validation, qualifications for teachers and qualifications for students. The course that you propose to offer would be deemed equivalent to that which is offered by EPA. The individuals who successfully complete the course and pass the final written exam would be acceptable to perform the task of organic data validation for the Department of Environmental Conservation, Division of Hazardous Waste Remediation.

As we have discussed in our conversation of July 7, 1992, you will forward to me prior to the August course deadline, the differences between the EPA SOW/90 and the NYSDEC ASP 12/91. You stated these differences will be compiled by Mr. John Samulian.

I strongly encourage you to offer an inorganic data validation course. I anticipate the same list of candidates would be interested in an inorganic validation course as well, since most of the data to be validated consists of both organic and inorganic data.

Thank you for you efforts and please contact me if I can be of any further assistance.

Sincerely,

Maureen P. Serafini

Maureen P. Serafini
Environmental Chemist II
Division of Hazardous Waste
Remediation

The Professional Development Center
AT
WESTCHESTER COMMUNITY COLLEGE

914 285-6619

October 2, 1992

Ms. Lori Beyer
3 sparkill Drive
East Northport, NY 11731

Dear Ms. Beyer:

Congratulations upon successful completion of the Organic Data Validation course held August 17 - 21, 1992, through Westchester Community College, Professional Development Center. This course has been deemed by New York State Department of Environmental Conservation as equivalent to EPA's Organic Data Validation Course.

Enclosed is your Certificate. Holders of this Certificate are deemed competent to perform organic data validation for the New York State DEC Division of Hazardous Waste Remediation.

The Professional Development Center at Westchester Community College plans to continue to offer courses and seminars which will be valuable to environmental engineers, chemists and related personnel. Current plans include a TCLP seminar on November 17th and a conference on Environmental Monitoring Regulations on November 18th.

We look forward to seeing you again soon at another environmental program or event. Again, congratulations.

Very truly yours,

Passing Grade is 70%
Your Grade is 99%

Elaine Sall
Program Coordinator

ES/bf

SUNY
WESTCHESTER COMMUNITY COLLEGE
Valhalla, New York 10595

The Professional
Development Center
AT
WESTCHESTER COMMUNITY COLLEGE

914 285-6619

June 21, 1993

Dear Ms. Beyer:

Enclosed is your graded final examination in the Inorganic Data Validation course you completed this past March. A score of 70% was required in order to receive a certificate of satisfactory completion. Persons holding this certificate are deemed acceptable to perform Inorganic Data Validation for the New York State Department of Environmental Conservation, Division of Hazardous Waste Remediation.

I am also enclosing a course evaluation for you to complete if you have not already done so. The information you provide will greatly aid us in structuring further courses. We wish to make these course offerings as relevant, targeted and comprehensive as possible. Your evaluation is vital to that end.

Congratulations on your achievement. I look forward to seeing you again at another professional conference or course. We will be co-sponsoring an environmental monitoring conference on October 21, 1993 with the New York Water Pollution Control Association, Lower Hudson Chapter, at IBM's Yorktown Heights, NY site. Information regarding this event will be going out in August.

Very truly yours,

Elaine Sall

Elaine Sall
Program Coordinator

ES/bf

Enclosures

SUNY
WESTCHESTER COMMUNITY COLLEGE
Valhalla, New York 10595

TIMOTHY G. LARIGAN

PROFESSIONAL II

Timothy G. Larigan is an environmental scientist with 5 years of experience in environmental remediation/compliance, Phase I/Phase II Environmental Assessments; project management; technical reporting; data analysis; field sampling; contractor oversight; wetlands delineation and permitting. He has directed environmental remediation, due diligence, asbestos, and wetlands projects and completed them within the proposed timeframe and budget. Mr. Larigan has also managed client and regulatory agency interactions. He has performed various field activities such as soil, groundwater, and vapor sampling and wetlands delineation. He has a working knowledge of GIS software and SAS statistical software.

BACKGROUND

Education

BS, Stockton University, Environmental Science, 2015

Licenses/Certifications

Regulatory Training in Underground Storage Tanks Certificate
Wetlands Delineation Certificate
OSHA 40 Hour HAZWOPER
OSHA 30 Hour Construction

Years of Experience

5 years in the industry
<1 year with AKRF

RELEVANT EXPERIENCE

J2 147-07 94th Avenue LLC, Alvista Towers, Queens, NY

Environmental Scientist. This historical meat refrigeration facility is enrolled in the Brownfield Cleanup Program to remediate the property and construct a 23-story affordable residential building. Although the site has an E-Designation for hazardous materials, noise, and air quality, AKRF assisted with applying for entry into the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program, due to the presence of contaminated soil and soil vapor beneath the site. AKRF is providing environmental consulting services throughout the project. Mr. Larigan is responsible for performing a Phase I Environmental Site Assessment (ESA) and preparing a Phase I ESA Report.

Site 9 DSA Owner LLC, Essex Crossing Site 9, New York, NY

Environmental Scientist. This approximately 20,300 square foot property has been developed with mixed-use residential and commercial/industrial buildings (e.g. printer shop, machine shop, photo shop) since the late-1800s. The site was later redeveloped as the Essex Street Market, which operated until 2019. Mr. Larigan is responsible for performing a Phase I Environmental Site Assessment (ESA) and preparing a Phase I ESA Report, along with preparing a Phase II Work Plan and Health and Safety Plan (HASP) for a proposed Phase II subsurface investigation. Mr. Larigan is also responsible for performing a limited subsurface investigation, consisting of soil sample collection, for due diligence purposes.

TIMOTHY G. LARIGAN

PROFESSIONAL II

4NYCHousing Inc., 201-207 Seventh Avenue, New York, NY

Environmental Scientist. This historical mixed-use residential and commercial/industrial property was developed in the late-1800s, and has been vacant since 2018. Mr. Larigan is responsible for conducting soil, groundwater, and vapor sample collection as part of a Phase II investigation, along with preparing a subsurface investigation report, documenting the findings of the Phase II investigation.

DLANDstudio Architecture + Landscape Architecture pllc, Stapleton Playground, Staten Island, NY

Environmental Scientist. This public park and historical gasoline filling station has been closed to the public and undergoing renovations since 2019. During excavation for park improvements, petroleum-contaminated soil was discovered and spill was reported to the New York State Department of Environmental Conservation (NYSDEC). Mr. Larigan is responsible for overseeing the installation of groundwater monitoring wells, performing quarterly groundwater monitoring/sampling events, and preparing quarterly groundwater evaluation reports as part of an environmental investigation at the site related to the spill.

PREVIOUS EXPERIENCE

Atlantic Environmental Solutions, Inc., Hoboken, NJ
Project Manager/Senior Environmental Scientist
While at another firm, Mr. Larigan was responsible for the following:

- Managed site remediation projects, underground storage tank removal projects, and Phase I/Phase II environment assessments
- Directed asbestos surveys, mold assessments, and wetlands delineation/permitting projects
- Prepared proposals, bids, and work authorizations for environmental services with detailed scopes of work, schedules, and cost estimates
- Performed technical review, data analysis, and problem solving for site remediation projects and managed client and regulatory agency interactions

Brinkerhoff Environmental Services, Inc., Manasquan, NJ
Environmental Scientist
While at another firm, Mr. Larigan was responsible for the following:

- Performed soil, groundwater, and vapor sampling in accordance with State technical requirements;
- Prepared environmental reports, including Phase I/Phase II ESAs, Remedial Investigation and Remedial Action reports, and environmental permit applications in accordance with State requirements;
- Directed and oversaw in-situ chemical oxidation (ISCO) treatments, and installation of sub-slab vapor mitigation systems and other presumptive remedies/engineering controls in accordance with State technical requirements
- Performed geophysical surveys utilizing Ground Penetrating Radar (GPR) and Electromagnetic technology.

Personnel Resume

Carl Armbruster
QA Manager

Qualifications Summary

Mr. Armbruster has over 30 years of experience in the environmental laboratory and engineering industry that includes extensive technical, management/leadership experience in all aspects of the laboratory business. He is an action-oriented manager dedicated to ensuring the laboratory maintains a quality program that holds the highest credentials in PT scores, accreditations and customer satisfaction. His unique experience lends itself to working successfully with employees, managers and clients at all levels.

Professional Experience

Quality Assurance Manager – TestAmerica Edison - 2005 to Present

Mr. Armbruster is responsible for establishing and implementing the quality assurance program at the Edison facility; and for interfacing with the corporate Quality Assurance Director to ensure adherence with the overall Quality Management Plan. He is also responsible for monitoring implementation and compliance with NELAC and TestAmerica's QMP, conducting annual management system audits and data audits, as well as providing regulatory updates and technical support to the Laboratory Director, Operations Manager, Client Services and Sales department.

Project Manager/Assistant Technical Director – STL Edison --2000 to 2005

Laboratory Director − STL Whippany − 1998 to 2000

Account Manager − Clean Harbors Environmental Services − 1997 to 1998

Laboratory Manager − Waste Management Inc., and Chemical Waste Management Inc − 1988 to 1997

Environmental Scientist − ICF Technology − 1987 to 1988

Analytical Chemist − IT Corporation – 1985 to 1987

Analytical Chemist − Hess Environmental Laboratories – 1983 to 1985

Education

- MS in Biology – East Stroudsburg University, 1984
- BS in Environmental Studies - East Stroudsburg University, 1980

DEBORAH SHAPIRO, QEP

SENIOR VICE PRESIDENT

Deborah Shapiro is a Senior Vice President in the Site Assessment and Remediation Department. Ms. Shapiro supervises project teams and manages all aspects of assessment and remediation projects across the New York Metropolitan Area. Ms. Shapiro works with developers, non-profit organizations, architects, local community groups, local businesses, and government agencies. Her projects fall under the regulatory oversight of NYSDEC, NYCDEP, and NYCOER including the New York State Brownfield Cleanup Program (BCP), New York City Voluntary Cleanup Program (VCP), NYSDEC petroleum spills program, RCRA/UIC closures, and NYCOER's E-designation program. Ms. Shapiro has also assisted commercial and industrial property owners with maintaining the integrity of their portfolios by providing compliance related cleanup and chemical storage management services. Ms. Shapiro has also been a moderator and panelist at numerous conferences.

Ms. Shapiro manages all aspects of redevelopment projects from the initial Phase I ESA, Phase II, and remediation through post-remedial site management. In addition, her experience includes groundwater investigations, monitoring, and sampling programs; Brownfield and hazardous waste site investigations; In-Situ Chemical Oxidation; underground storage tank studies, including soil contamination delineation, classification, removal and disposal; waste characterization sampling; exposure assessments; on-going remedial action (especially AS/SVE), and permitting.

BACKGROUND

Education

M.S., Environmental Science, American University, 2001
B.A., Environmental Studies, American University, 1998

Professional Licenses/Certifications

Qualified Environmental Professional
Health and Safety Operations at Hazardous Materials Sites 29 CFR 1910.120

OSHA 8 Hour HAZWOPER Supervisor

OSHA 10 Hour Occupational Construction Safety and Health

CPR

Professional Memberships

Past President, New York City Brownfield Partnership
Board Member, Residents for a More Beautiful Port Washington
Member, Institute of Professional Environmental Practitioners (IPEP)

Awards

Big Apple Brownfield Award recipient as part of the Elton Crossing redevelopment team 2017
Big Apple Brownfield Award recipient as part of the Courtlandt Crescent redevelopment team 2013
Big Apple Brownfield Award recipient as part of the Via Verde redevelopment team 2012
Big Apple Brownfield Award recipient as part of the Cornerstone B1 (LaTerraza) redevelopment team 2011

Years of Experience

Year started in company: 2013
Year started in industry: 1998

RELEVANT EXPERIENCE

Elton Crossing, Bronx, NY

AKRF provided environmental consulting services in connection with the purchase and redevelopment of the Elton Crossing site at 899 Elton Avenue in the Bronx, NY. The work initially involved the preparation of a Phase II subsurface investigation including soil and soil vapor testing to determine if the site would be eligible for the New York State Brownfield Cleanup Program (NYSBCP). Upon completion of the investigation, AKRF prepared a NYCBCP Application and the site was accepted into the NYSBCP. AKRF managed all aspects of the brownfield cleanup including; development of Investigation Work Plans, performing Remedial Investigations and Reports, preparation of Phase I ESAs, preparation of a Citizen Participation Plan, distribution of public notices, preparation and implementation of a Remedial Action Work Plan (RAWP), design of a sub-slab depressurization system, preparation of the Final Engineering Report and Site Management Plan, and sampling and management of soil disposal. AKRF is in the midst of implementing the Site Management Plan. As project manager, Ms. Shapiro was responsible for managing all technical components of the project, communication with NYSDEC and the Client, and managing the budget.

Second Farms, Bronx, NY

AKRF, Inc. was initially contracted by the New York City Office of Environmental Remediation (NYCOER) to conduct a subsurface investigation of a 1.12-acre parcel in the Bronx, New York under the United States Environmental Protection Agency (USEPA) Brownfield Assessment Grant program. The investigation included a geophysical survey and utility mark-outs, and the collection and analysis of soil, groundwater, soil vapor, indoor air and ambient air samples. AKRF continued working on the project for the developer by preparing a Remedial Action Plan and Environmental Assessment Statement. AKRF is in the midst of implementing the remedy.As project manager, Ms. Shapiro was responsible for managing all technical components of the project, communication with OER, NYCDEP, and the Client, and managing the budget.

Bradhurst Cornerstone II Residences, Manhattan, NY

AKRF, Inc. prepared a Part 58 Environmental Assessment and a City Environmental Quality Review Environmental Assessment Statement for the Bradhurst Cornerstone II Apartments project. Issues of concern for the environmental review included the identification of project commitments for certain of the four sites related to historic resources, hazardous materials, air quality, and building attenuation. As part of the mitigation of hazardous materials, AKRF conducted a Phase II investigation, and prepared a Remedial Action Plan and Construction Health and Safety Plan. As project manager, Ms. Shapiro was responsible for managing all technical components of the hazardous materials portion of the project, communication with the regulatory agency and the Client, and managing the budget.

Lambert Houses, Bronx, NY

AKRF performed an EIS of the Lambert Houses affordable housing complex located in the West Farms section of the Bronx, NY. Lambert Houses consisted of multi-story apartment buildings, parking garage, and a multi-tenant retail/commercial building alongside the elevated NYC subway. AKRF also conducted a Phase I ESA with a vapor intrusion screen of the Property to satisfy HUD’s vapor intrusion requirements. The Phase I and vapor intrusion screens were prepared in accordance with ASTM E1527-05, ASTM E2600, and EPA’s All Appropriate Inquiry (AAI) rule. After completion of the EIS, an E designation for hazardous materials was placed on the Site. A Subsurface Investigation was conducted and a Remedial Action Work Plan was prepared under OER oversight. The Site was subsequently entered in the NYC Voluntary Cleanup Program. AKRF is in the midst of implementing the RAWP, which included remediation of a hydraulic oil spill. As project manager, Ms. Shapiro was responsible for managing all technical components of the hazardous materials portion of the project, communication with the regulatory agency and the Client, and managing the budget.

Brook 156, Bronx, NY

AKRF was retained to provide environmental consulting services in connection with the purchase and development of the Site. AKRF prepared a Phase I Environmental Site Assessment (ESA) of the NYC-owned former gasoline service station and a former railroad. A Tier 1 Vapor Encroachment Screening was also conducted to satisfy HUD's vapor intrusion requirements. AKRF prepared a Remedial Investigation Work Plan (RIWP) and conducted a Remedial Investigation (RI) at the site, which included the collection and analysis of soil, soil vapor, and groundwater. The results of the RI, which were documented in a Remedial Investigation Report (RIR), were used to prepare a New York City Brownfield Cleanup Program (NYCBCP) application. The site was accepted into the New York State Brownfield Cleanup Program (NYSBCP). AKRF prepared a Citizen Participation Plan (CPP), distributed public notices, and conducted multiple Remedial Investigations to further investigate soil, soil vapor, and groundwater at the site prior to redevelopment. The results of the investigations were used to prepare a Remedial Action Work Plan (RAWP), which is undergoing review and approval by NYSDEC. The proposed remedy includes excavation of soil, design and installation of a soil vapor extraction system and sub-slab depressurization system, contingent groundwater treatment program, and installation of a vapor barrier and composite cover system. As project manager, Ms. Shapiro is responsible for managing all technical components of the project, communication with NYSDEC and the Client, and managing the budget.

On-Call Environmental Consulting Services (Various Locations), New York City Mayor's Office of Environmental Remediation (OER) (administered by NYCEDC)

Ms. Shapiro is managing an on-call contract with the OER for brownfields environmental assessment and remediation. The work has included conducting Phase I environmental site assessments (ESAs) and multi-media sampling of soil, groundwater, and soil vapor for various sites funded by EPA grants. The work plans and investigation reports were completed in accordance with OER and EPA requirements. AKRF also implemented a remedial plan for capping a park site in Staten Island. In addition, AKRF provided support to OER and an affordable housing developer to expedite an application for entry into the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP), as well as preparation and implementation of the remedial investigation and remedial plan.

Atlantic Chestnut, Brooklyn, NY

AKRF was retained to provide environmental consulting services in connection with the purchase and redevelopment of former burned manufacturing buildings encompassing an entire city block in Brooklyn, New York. As part of due diligence, AKRF prepared a Phase I Environmental Site Assessment (ESA) Report for the property. After acquisition, the property was divided into three separate sites (3264 Fulton Street, 235 Chestnut Street, and 3301 Atlantic Avenue). AKRF prepared a Subsurface (Phase II) Investigation Work Plans and conducted Phase IIs at each of the sites, which included the collection and analysis of soil, soil vapor, and groundwater samples. Based on the results of the Phase IIs, which were documented in Subsurface (Phase II) Reports, New York State Brownfield Cleanup Program (NYSBCP) applications were prepared for each of the sites. After acceptance into the NYSBCP, AKRF prepared Citizen Participation Plans (CPPs) and distributed public notices. AKRF prepared Remedial Investigation (RI) Work Plans (RIWPs) and implemented numerous Remediation Investigations for each of the sites to further investigate contaminated media at the site prior to redevelopment, and prepared the RI Reports (RIRs). AKRF is in the midst of preparing Interim Remedial Work Plans for each Site, which include installation of a Soil Vapor Extraction to prevent the off-site migration of contaminants. As project manager, Ms. Shapiro was responsible for managing all technical components of the project, communication with NYSDEC and the Client, and managing the budget.

BRYAN ZIEROFF, LEP

SENIOR HYDROGEOLOGIST

Bryan Zieroff has 15 years of experience in the environmental consulting industry. Mr. Zieroff's experience includes the conceptual design, implementation and reporting of detailed field investigations including assessments of ground-water supplies for residential, municipal and industrial users, and evaluation, monitoring and remediation of soil and ground-water contamination for sites regulated by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA), Connecticut's Remediation Standard Regulations, and by the New York State Department of Environmental Conservation's (New York State Department of Environmental Conservation's (NYSDEC)) cleanup programs. These studies include investigations at sites impacted by petroleum products, chlorinated solvents, metals and landfill leachate. Mr. Zieroff's tasks often include characterization of the extent of contamination in soil, ground water, and soil vapor, evaluation of compliance with the established regulatory criteria, and operation and maintenance of remediation systems. Mr. Zieroff's familiarity with various field investigation techniques enhances his management skills.

BACKGROUND

Education

B.S., Geological Sciences, The Ohio State University, 1994

Licenses/Certifications

Certified Professional Geologist-American Institute of Professional Geologists, License # CPG-11197

40 Hour HAZWOPER and Annual Refresher Training

Supervisors of Hazardous Waste Operations (8 Hour)

Professional Memberships

American Institute of Professional Geologists

Association of Ground-Water Scientists and Engineers (National Ground Water Association)

Environmental Professionals' Organization of Connecticut (EPOC)

Years of Experience

Year started in company: 2006

Year started in industry: 1995

RELEVANT EXPERIENCE

Gedney Way Leaf and Yard Waste Composting Facility, White Plains, NY

Mr. Zieroff is Project Manager for a remediation and landfill closure project at an existing composting facility. The project included documenting the entire disposal history and completing a site-wide investigation to confirm the extent of a solvent release and to provide data necessary to complete landfill closure. The investigation was required to satisfy the requirements in the NYSDEC DER-10 and 6NYCRR Part 360. After receiving state approval of the Site Investigation Report, the project has moved into the remediation and landfill closure design phase. The remedial design includes the testing and implementation of a chemical oxidation injection program, and landfill closure includes design, state approval, and construction of a landfill cap.

New City Plaza, New City, NY

Mr. Zieroff is Project Manager for an investigation and remediation project at a former dry cleaning facility. Investigation and remediation at the site currently are being conducted under review of the NYSDEC Brownfield Cleanup Program. Tasks have included preparation and state approval of a Site Investigation Work Plan, Site Quality Assurance Project Plan, Health and Safety Plan, a Community Participation Plan, and completion of the investigation phase of the Brownfield's program. Interim Remedial activities include contamination source removal from soil and installation of a sub-slab depressurization system to address soil vapor. A feasibility study is currently being completed to determine the optimal remedial approach for site-wide remediation.

Orangeburg Pipe Site, Orangeburg, NY

Mr. Zieroff completed a subsurface investigation to determine the extent of soil and groundwater contamination at the former Orangeburg Pipe facility. The investigation results were used to develop a Remedial Action Plan to address solid waste, petroleum contamination, worker safety during site development, and capping requirements to satisfy the NYSDEC Voluntary Remediation Program. The Remedial Action Plan included a Heath and Safety Plan, Community Air Monitoring Plan, and specifications for soil management, a vapor mitigation system and dewatering procedures during the construction of multiple commercial buildings.

Magna Metals Facility, Cortlandt, NY

Mr. Zieroff managed a soil-gas investigation project at an existing commercial warehouse and office building. The project included installation of permanent soil gas sampling points and completion of a sampling program that met the requirements of the New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York. Site activities included a pre-sampling investigation with the NYSDOH to document materials storage, air flow specifications, historical uses, site uses and areas of concern for sub-slab and ambient air sampling. The investigation work was being conducted to satisfy the NYSDEC consent order.

Paragon Paint Company Facility, Long Island City, NY

Mr. Zieroff was Project Manager for an investigation and remediation project at a former paint manufacturing facility. The project has included a multiple subsurface investigations to determine the extent of solvent and petroleum contamination at the site. All phases of remediation at the site are being completed under review of the NYSDEC Brownfield Cleanup Program. Tasks include completion and state approval of a Site Investigation Work Plan, Quality Assurance Project Plan, Health and Safety Plan, Community Participation Plan, Remedial Action Plan, and Final Remediation Report.

Pathmark Stores Site, Bronx, NY

Mr. Zieroff completed a Remedial Action Plan, Construction Health and Safety Plan and a Soil Management Plan for a former materials storage facility associated with Manhattan College. The plans were completed to provide worker safety and soil handling guidelines during the construction of a large retail facility and parking garage. Development activities at the site were conducted under oversight of the New York City Department of Environmental Protection (NYCDEP). A Notice of Satisfaction was received after project completion.

Yale and Towne Site, Stamford, CT

Mr. Zieroff provided oversight services for a remediation project at a former industrial site. The site included over 35 buildings and 87 areas of environmental concern that required investigation and remediation. Tasks included providing technical support in understanding the Connecticut regulatory requirements, investigation and remediation costs, and confirmation of appropriate schedules to address the environmental issues during redevelopment of the project site.

Aluminum Company of America (ALCOA) Facility, Guilford, CT

Mr. Zieroff managed a ground-water remediation project at an existing aluminum manufacturing facility. The project included soil, vapor and ground-water sampling to confirm the extent of a solvent release, determination of ground water and aquifer characteristics, operation and maintenance of a ground-water pump-and-treat system and compliance sampling in association with a Connecticut Department of Environmental Protections (CTDEP) consent order.

Coats North America Facility, Watertown, CT

Mr. Zieroff was the Project Manager for site compliance work at an existing synthetic treads facility. The project included an evaluation of activities, chemical uses and waste handling practices to determine areas of environmental concern. Investigations to determine the status of these areas included installation of monitoring wells, soil and ground-water sampling, soil-vapor sampling, liquid storage tank removal and Resource Conservation and Recovery Act (RCRA) closure of waste storage areas. The project activities were completed in compliance with the CTDEP property transfer program.

United Parcel Service, Storm Water Management, 9 Connecticut Facilities

Mr. Zieroff managed the design and implementation of a storm water pollution prevention project at nine United Parcel Service facilities. The project included analysis of drainage areas, determination of sheet flow characteristics and the collection of storm-water discharge samples and SMR reporting in accordance with the CTDEP General Permit for the Discharge of Storm Water.

Meriden Enterprise Center, Meriden, CT

Mr. Zieroff developed and directed a subsurface investigation to determine the nature and extent of contamination related to releases from multiple underground storage tank farms, silverware plating, machining and furniture stripping operations. Project activities included ground-penetrating radar, drilling of test borings, installation of monitoring wells, developing a conceptual site model for the established releases and preparing a report detailing remedial alternatives for the property and owner requirements under the CTDEP Property Transfer Act.

Development properties in Kent, Ridgefield, and Greenwich, CT and Mahopac and Brewster, NY

Mr. Zieroff directed an evaluation and testing program of bedrock water-supply wells to determine long-term yield, impact on local users, and water quality results. The project included compilation of data, construction of hydrographs, determination of aquifer characteristics and reporting.

Bettsville Quarry, Bettsville, OH

Mr. Zieroff directed a pumping test of dewatering wells to determine yield requirements for dewatering a carbonate rock quarry. The dewatering program included a determination of offsite impacts to local ground-water users. Mr. Zieroff developed an offsite monitoring program to document and protect local users during the quarry dewatering process.

Burning Tree Country Club, Greenwich, CT

Mr. Zieroff directed an in-situ percolation test to determine recharge rates for a proposed upgrade to the facility septic system. The project included compilation of slug test data and software analysis to determine K values.