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Remedial Investigation Work Plan

Former Goodman Brothers Steel Drum Co.
291 Richardson Street
Brooklyn, New York
NYSDEC Site Number: C224292

July 2020

Prepared for:
CR 17 LLC.
1036 Manhattan Avenue
Brooklyn, New York 11222

CASTLETON
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REMEDIAL INVESTIGATION WORK PLAN
FORMER GOODMAN BROTHERS STEEL DRUM CO
291 RICHARDSON STREET
BROOKLYN, NEW YORK
DEC SITE NO: C224292
JULY 2020

"I, Mr. Frank Castellano, certify that I am currently a Qualified Environmental Professional (QEP) as defined in 6 NYCRR Part 375 and that this Remedial Investigation Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the Department of Environmental Remediation Technical Guidance for Site Investigation and Remediation (DER-10)."

Castleton Environmental Geologic Services, DPC.

Frank P. Castellano
Principal

Table of Contents

Figures

Tables

Appendices

1.0 INTRODUCTION

Castleton Environmental Geologic Services, DPC. (Castleton), has prepared the following Remedial Investigation Work Plan (RIWP) for the property located 291 Richardson Street in the Greenpoint/East Williamsburg section of Kings County (Borough of Brooklyn), New York (the site). The site is comprised of a single parcel that is part of the Former Goodman Brothers Steel Drum Co. (Goodman Bros) property. The Goodman Bros property is listed on the New York State Department of Environmental Conservation's (NYSDEC) Environmental Site Remediation Database under site code C224292.

The proposed work is being performed on behalf of CR 17 LLC (the Volunteer) as part of their commitment to investigate and to remediate, if and to the extent required, the site under the NYSDEC Brownfield Cleanup Program (BCP). This RIWP details the proposed site investigation activities that will be deployed to characterize the nature and extent of site contamination identified in previous investigations, including:

- Installation of approximately 14 shallow soil and soil vapor probes/screening points.
- Installation of three sub-slab vapor, one soil vapor, three indoor air, and one outdoor air samples.
- Installation of an estimated six to eight direct push soil and groundwater boring screening/sample probes.
- Installation of three shallow and one deep groundwater monitoring wells.

The RIWP is accompanied by a site-specific Health and Safety Plan (HASP) which addresses potential hazards, contaminants of concern based on past use, and safety requirements associated with investigation activities in accordance with American Society for Testing and Materials (ASTM) and Occupational Safety and Health Administration (OSHA) guidelines. In addition, a Quality Assurance Project Plan (QAPP) has been prepared and included in this RIWP to provide quality assurance/quality control procedures to ensure the data derived during investigation activities are of sufficient quality to be relied upon for its intended use.

2.0 SITE DESCRIPTION

2.1 Site Location and Current Usage

The project site is located at 291 Richardson Street, in the Greenpoint/East Williamsburg Industrial section of Brooklyn, New York (Figure 1) and is identified as Block No. 2849 Lot 120. The site is located on the north site of Richardson Street and measures approximately 0.08 acres in size. One, single story, 2,375-square foot building occupies the property. The slab-on-grade building was constructed circa 1970 and occupies the entire northern portion of the parcel while the remaining southern portion is entirely paved with concrete.

A Site Plan is provided as Figure 2.

The 0.08-acre site was formerly part of a larger, NYSDEC Class 2 Inactive Hazardous Waste Site known as the Former Goodman Brothers Steel Drum Company property. The Goodman Bros. property, listed as NYSDEC Site Number 224211, is located on the south side of Division Place between Kingsland and Debevoise Avenues and is identified as 18 Division Place on the NYSDEC Environmental Site Remediation database.

2.2 Description of Site and Surrounding Property

The site and surrounding area are zoned as M1-1, which permits industrial and manufacturing uses. The site is currently occupied, the specific use in warehousing. The surrounding parcels are currently used for a combination of commercial and industrial purposes. The nearest residential property abuts the site to the east. Based upon review of the NYSDEC Environmental Zone (En-zone) map, the site is not in an En-zone. The current zoning and land use of the site and surrounding area is depicted on Figure 3.

2.3 Site Geology and Hydrogeology

The near surface geology in the Greenpoint portion of the Brooklyn is similar to other heavily developed areas found in this region. The site and surrounding area surficial geology is generally considered “urban land” and is characterized by a non-homogenous distribution of soil and fill types classically referred to as historic fill. Excavation and backfilling for building foundations, utility conduits, railway systems, and other construction has resulted in a varied subsurface profile. No bedrock outcroppings are expected at the site.

Based upon soil boring data collected during the 2018 Phase II ESA, groundwater at the site was not encountered in soil borings up to a depth of 15-feet below ground surface (bgs). Site geology consisted of silty and clayey sands during previous investigations. The nearest body of water is Newtown Creek, located approximately 0.75 mile to the east. Therefore, groundwater flow is estimated to be towards the east or southeast.

2.4 Past Use of the Site

The operations at the Former Goodman Bros. property, including 291 Richardson Street, from approximately 1909 through 2004, consisted of the reconditioning and recycling of used steel drums. Available records listed the Former Goodman Bros. property as a former Resource Conservation and Recovery Act (RCRA) Large Quantity Generator of F001 wastes (including spent halogenated solvents used in degreasing: tetrachloroethylene (PCE), trichloroethylene (TCE), methylene chloride, 1,1,1-TCE, carbon tetrachloride, and chlorinated fluorocarbons).

The site was sold by Goodman Brothers on December 9, 2004 to Richmond Properties and subsequently occupied by the general contractor MMY Construction (MMY). The site was utilized by MMY for the storage of tools and construction equipment such as scaffolding and ladders from 2004 util June 2018. Following MMY, the site was occupied and utilized by Windmill Studios, a commercial film and television studio through February 2019. The site is currently occupied by the custom marble wholesaler AFP Custom Marble, from June 1, 2019 to the present.

3.0 PREVIOUS ENVIRONMENTAL DOCUMENTATION

A subsurface investigation was performed by Gannet Flemming Engineers and Architects, P.C. (Gannet) as part of a Draft RCRA Facility Closure Plan for the Former Goodman Bros. property in April 2003. The primary contaminants of concern identified in soil and groundwater above their respective guidance and standards include the chlorinated solvent including PCE, and its associated breakdown products, TCE,1,1,1-TCE, cis-1,2-dichloroethylene (DCE), and vinyl chloride. Petroleum related volatile organic compounds (VOCs) were also identified, including benzene, toluene, ethylbenzene, and xylene (BTEX compounds). In addition, polychlorinated biphenyls (PCBs), lead, and mercury were identified. Each of the contaminants listed above, with the exception of PCBs, have migrated offsite in groundwater.

A figure included in the April 2003 Draft Facility Closure Plan depicted the Areas of Concern (AOCs) and sample locations performed as part of the investigation. The AOCs specific to 291 Richardson Street, including the former wastewater treatment facility and the area identified by the NYSDEC AOC No. 2 – Above Ground Storage Tanks (ASTs) are depicted on Figure 4.

More detail regarding the contaminant profile for the Former Goodman Bros. property can be found in the site record from the NYSDEC Environmental Site Remediation Database, included as Appendix A.

While soil and groundwater impacts have been identified across the Former Goodman Bros. property, limited data exists for the site (291 Richardson Street). Data from a recent Phase II Environmental Site Assessment (ESA) as well as information extracted from previous investigations performed on the site are summarized below.

Previous environmental documents related to the site include:

- *Draft Facility Closure Plan*, April 2003, by Gannett Fleming Engineers, PC.
- *Phase II ESA,* December 2018, by Castleton Environmental Inc.
- *Data Summary Report Former Goodman Brothers Steel Drum Company. Site No. 224211,* January 2020, by URS.

A brief summary of the findings of these reports are provided below. Digital PDF copies of the above referenced reports are included as Appendix B.

3.1 Draft Facility Closure Plan - April 2003

As described above, a Draft Facility Closure initiative was performed on behalf of Goodman Bros. by Gannet in April 2003 as part their efforts to close out the facility RCRA permit(s) related to the former site operations. The field investigation consisted of nine soil borings and the collection and laboratory analysis of soil and groundwater samples.

Two of the nine soil borings (SB-6 and SB-8) were performed on 291 Richardson Street. SB-6 was performed in the northern portion of the site and SB-8 the southern portion. The locations of the soil borings are depicted on Figure 4.

Two soil samples: SB-6(1-4) and SB-6(8-12) were collected from SB-6, and one soil sample, SB-8(0.5-4), was collected from SB-8. The samples were analyzed for VOCs, semi-VOCs (SVOCs), Metals, and PCBs.

The April 2003 report compared the resulting analytical data to the Technical and Administrative Guidance Memorandum (TAGM) #4046 which was the prevailing guidance for evaluating soil at the time. The dataset has been compared to the current NYSDEC Part 375 Soil Cleanup Objectives (SCOs) for the discussion below:

- <u>Soil Analytical Results:</u> One VOC, PCE, was reported above (110.0 ppm) its Restricted Residential SCO of 19 ppm in SB-6(1-4). The concentration of several VOCs, including 1,1,1-TCE, TCE, toluene, chlorobenzene, ethylbenzene, 1,2,4-trimethylbenzene, p-isopropyltoluene, and 1,2-dichlorobenzene were also detected above their respective Unrestricted Use SCOs in this sample. One VOC, 1,2-dichlorobenzene was reported (1.5 ppm) above its Unrestricted Use SCO of 1.1 ppm in the SB-6 deep interval (8-12). The concentrations of VOCs were not reported above Unrestricted Use SCOs in SB-8(0.5-4).
- One PCB, arochlor 1254, was reported (2.7 ppm) above its Commercial SCO of 1 ppm in SB-6 (1-4).
- The remaining SVOCs, metals, and PCBs were reported as non-detect or below their respective Unrestricted Use SCOs in SB-6(1-4), SB-6(8-12), and SB-8(0.5-4).

The soil analytical results from SB-6(1-4), SB-6(8-12), and SB-8(0.5-4) are summarized in Table 1. The soil boring locations and their associated chemical concentrations in excess of applicable SCOs are depicted on Figure 4.

In addition, two groundwater samples (GW02 and GW03) were collected from SB-6 and SB-8 respectively. The analytical results were compared to the NYSDEC Class GA Ambient Groundwater Quality Standards (GQS) as specified in the Technical Operation and Guidance Series (TOGS 1.1.1), dated June 1998 and also been compared to the updated TOGS 1.1.1 Addendum dated April 2000, as described below:

Groundwater Analytical Results

- The concentration of several chlorinated VOCs (CVOCs) and petroleum VOCs (PVOCs) were reported above their respective GQS in GW02 and GW03. The highest concentration reported was PCE (5,100 ug/L) in GW02. The concentration of PCE in GW03 was reported at 56 ug/L.

- The remaining VOCs, SVOCs, metals, and PCBs were reported as non-detect or below their respective GQS in GW02 and GW03.

The groundwater analytical results from GW02 and GW03 are summarized in Table 2. The groundwater sample locations and their associated chemical concentrations in excess of applicable GQSs are depicted on Figure 5.

3.2 Phase II Environmental Site Assessment – December 2018

A Phase II ESA was performed by Castleton in December 2018 in response to a Phase I ESA that identified the site's former industrial use, as well as its relationship to the adjacent Former Goodman Bros. property, as Recognized Environmental Conditions (RECs) requiring further evaluation.

The Phase II ESA subsurface investigation consisted of the performance of a geophysical survey, installation of soil borings, and the collection and laboratory analysis of select soil samples.

The geophysical survey identified no anomalies indicative of underground storage tanks (USTs). A utility hatch located in the driveway of the site was investigated and determined to serve as a vault for accessing the site's sanitary sewer lines which connect to the municipal system.

The investigation included the installation a total of six soil borings via direct push technology (Geoprobe). Soil was logged continuously from grade, logged, and field screened for the presence of VOCs using a photoionization detector (PID). PID readings ranged from 0.0-parts per million (ppm) to 1,045-ppm. Soil was observed to consist of silty sand and clayey sand. Groundwater was not encountered.

Based on field observations, a total of four soil samples were submitted to a New York State Department of Health (NYSDOH) Environmental Laboratory Accreditation Program (ELAP) certified laboratory and analyzed for the presence of:

- VOCs via United States Environmental Protection Agency (USEPA) Method 8260
- SVOCs via USEPA Method 8270
- Target Analyte List (TAL) Metals by USEPA Method 6010/7473

The soil analytical results reported the concentration of one VOC, PCE, above (94 ppm) its NYSDEC Part 375 Restricted Residential SCO of 19 ppm in the sample SB01(0-2). The concentrations of several VOCs including 1,1-DCE, 1,2,4-trimethylbenzene, acetone, cis-1,2-DCE, ethyl benzene, methylene chloride, toluene, TCE, vinyl chloride, and xylenes were reported above their respective Unrestricted Use SCOs, but below their Restricted Residential SCOs in the samples SB01(0-2), SB01(18-20), SB04, and UH01The remaining VOCs were reported as non-detect or below their Unrestricted Use SCOs.

The concentrations of several SVOCs including 1,2-dichlorobenzene, chrysene, indeno(1,2,3-cd)pyrene, and phenol above their respective Unrestricted Use SCOs, but below their respective Restricted Residential SCOs. The remaining SVOCs were reported as non-detect or below their Unrestricted Use SCOs.

The concentration of one metal, mercury, was reported above (2.990 ppm) its Commercial SCO of 2.8 ppm but below its Industrial SCO of 5.7 ppm in the sample SB04. Mercury was also reported above its Restricted Residential SCO in UH01 and above its Unrestricted Use SCO in SB01(0-2) and SB01(18-20). Lead was reported above (521 ppm) its Restricted Residential SCO of 400 ppm in SB04 and above its Unrestricted Use SCO in SB01(18-20) and UH01. Cadmium was reported above (6.360 ppm and 6.530 ppm) its Restricted Residential SCO of 4.3 ppm in SB04 and UH01 respectively.The concentration of several metals including barium, chromium, copper, nickel, and zinc, were reported above their Unrestricted Use SCOs, but below their Restricted Residential SCOs in SB01(0-2), SB01(18-20), SB04, and UH01.

The dataset from the December 2018 Phase II ESA is summarized in Table 1. The soil boring locations and their associated chemical concentrations in excess of applicable SCOs are depicted on Figure 5.

3.3 Phase I Remedial Investigation Report

The January 2020 Data Summary Report was prepared by URS Corporation – New York (URS) to summarize the field activities and analytical results associated with the Phase I Remedial Investigation (RI) completed during April through August 2019.The investigation was performed within the Former Goodman Brothers Steel Drum Company properties, excluding 291 Richardson Street. The Phase I RI work was performed to determine the nature and extent of contamination in soil, groundwater, and soil vapor. A summary of the report is provided below:

The analytical results for soil collected from the Former Goodman Brothers properties were compared to the NYSDEC Part 375 Commercial SCOs and Protection of Groundwater SCOs. Results indicated that the Protection of Groundwater SCOs were exceeded for numerous VOCs, including CVOCs and PVOCs; SVOCs including phenols and polyaromatic hydrocarbons (PAHs); and the metals arsenic, barium, cadmium, lead, and mercury. Contaminants exceeding their Commercial SCOs included PCE, TCE, two PAHs, arsenic, barium, cadmium, copper, lead, mercury, and PCBs. Some of the highest contaminant concentrations were in shallow soils, well above the groundwater table, indicating the source of contamination is from an onsite release.

The evaluation of soil vapor showed the highest flame-ionization detector (FID) readings in the northern portion of the Goodman site, along Division Place, were VOC concentrations of up to 46,997 ppm were observed. The soil vapor sampling analytical results, when compared to the New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York Decision Matrices, indicated that results from seven out of ten sampling locations recommended mitigative measures. These locations are located along Division Place, north of 291 Richardson Street.

Significantly elevated concentrations of CVOCs and benzene, toluene, ethyl benzene, and xylene (BTEX) compounds were reported from groundwater samples in monitoring wells at the Goodman Brothers properties and surrounding area. Cis-1,2-DCE was reported at the highest concentration, followed by vinyl chloride (VC), PCE, and TCE. The horizontal extent of the cis-1,2-DCE plume extends to Debevoise Avenue to the east and is most concentrated at the Goodman Brothers site. The overall vertical extent of VOC contamination has not yet been delineated completely. Groundwater results for CVOCs in the deep groundwater zone indicate a broader zone of impact as a result of co-mingling of multiple suspected source areas. In addition, several SVOCs, pesticides, and few metals were also detected above their GQS.

As a result of the investigation, it was concluded that, significantly elevated concentrations of contaminants including many VOCs, SVOCs, PCBs, and metals were identified in unsaturated soils beneath the concrete floors of 14 Division Place and 18 Division Place (northwest of 291 Richardson Street). Fewer contaminants and at much lower concentrations of VOCs, SVOCs, and metals were reported at the 275 (west of 291 Richardson Street) and 289 Richardson Street (adjacent to the western property boundary) properties. The most impacted areas of soil contamination in the unsaturated zone corresponds to the eastern portion of 18 Division Place. The source of the significant soil contamination has also adversely impacted shallow and deeper groundwater at and around the Goodman Brothers site as well as downgradient.

4.0 REMEDIAL INVESTIGATION WORK PLAN

Similar to the scope of work proposed in the January 14, 2019 Phase I RI Work Plan prepared by URS, Castleton will perform the following activities to characterize and delineate contamination in soil vapor, soil, and groundwater at the 291 Richardson Street site (Site Number: C224292).

Shallow soil, subsurface soil, and groundwater sampling will be conducted in accordance with NYSDEC Department of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation, dated December 2002. Sampling for 1,4-Dioxane and polyfluoroalkyl substances (PFAS) Under DECs Part 375 Remedial Programs, dated June 2019, and Guidelines for Sampling and Analysis of PFAS Under NYSDECs Part 375 Remedial Programs, dated January 2020.

All sub-slab vapor, soil vapor, and ambient air samples will be collected and analyzed in accordance with the NYSDOH *Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, (October 2006), with updates (2015).

A proposed sampling plan is provided as Figure 6. However, as described in the following sections, sample locations may be modified during RI activities based on screening and sampling results.

4.1 Geophysical Survey

Prior to performing ground intrusive activities, a geophysical survey will be performed to identify below grade obstructions, buried utilities, and identify evidence of buried USTs and/or former UST graves, buried drywells and/or former drywell locations, and clear the proposed subsurface sampling locations. The survey will consist of the use of several remote sensing techniques including the use of a magnetometer to detect ferrous objects, a ground penetrating radar (GPR) survey to detect changes in soil density, and a utility tracing instrument to trace identified piping and utilities.

4.2 Shallow Soil and Soil Vapor Screening

To begin delineating the contaminants of concern at the site, approximately 14 soil probes will be installed to screen shallow soil and soil vapor throughout the site.

Prior to installing soil probes, the locations will be screened for the presence of vapors containing VOCs. Vapor screening will be performed by installing 0.25-inch outside diameter (OD) by 0.125-inch inside diameter (ID) Teflon tubing to approximately two-inches below the concrete or asphalt slab and number two filter sand to The top two-inches of annular space will be sealed using bentonite clay or equivalent. The tubing will be purged of approximately one-liter of air volume prior to recording the concentration of VOCs. Purging and screening for VOCs will be performed using a PID capable of reading in the parts per million (ppm) range (e.g.: ppmRae). A PID capable of reading down to the parts per billion (ppb) level (e.g.: ppbRae) will be available depending on the field screening levels.

Following the vapor screening, soil probes will be installed at select locations using a hand-held direct push (Geoprobe®), or similar equipment to approximately two-feet bgs. The lithology of recovered soil will be logged continuously using the Unified Soil Classification System (USCS) and screened for the presence of VOCs using a PID. A minimum of one sample will be retained from each soil probe location for laboratory analysis. Based on field observations, an estimated seven soil samples will be selected and submitted to a NYSDOH ELAP certified laboratory and tested for the following analytes:

- Target Compound List (TCL) VOCs via USEPA Method 8260
- TCL SVOCs via USEPA Method 8270
- TCL Pesticides and Polychlorinated Biphenyls (PCBs) by USEPA Methods 8081/8082
- TAL Metals by USEPA Methods 6010/7471
- PFAS by USEPA Method 537m PFAS Analyte List
- 1,4-Dioxane by USEPA Method 8270 SIM

A summary of the estimated frequency and analysis of shallow soil samples is provided in Table 2.

4.2.1 – Soil Sampling in Areas of Exposed Grounds

Based on the current condition of the site, exposed grounds are not anticipated. However, to evaluate the potential for exposures to contaminants if exposed grounds are encountered, surface soils from the zero to two-inch interval bgs be collected from areas not covered by buildings or pavement.

After soil sampling and screening for vapors is complete, each location will be backfilled and restored to match the surrounding surface.

4.3 Soil Vapor Intrusion Investigation

A soil vapor investigation will be performed to quantify the presence of VOCs in vapor throughout the site and determine if a vapor intrusion condition exists within the building. In order to assess the likely worse case conditions, the sampling will be performed during the heating season (approximately November 15 through March 31). Indoor air and co-located sub-slab soil vapor samples collected outside the heating season cannot be used to rule out exposure risk. The locations of each vapor sampling location will be determined based on the vapor screening described in Section 4.2. The rational for the sub-slab vapor, soil vapor, and ambient air sampling locations is described below:

- An estimated three sub-slab vapor samples will be collected within the building footprint to assess sub-slab vapor quality.
- An estimated one soil vapor sample will be collected from the southern portion of the building to assess soil vapor quality.
- An estimated three indoor ambient air samples will be collected concurrently in the locations of the sub-slab vapor samples to assess indoor air quality and potential vapor intrusion conditions.
- One outdoor ambient air sample (control) will be collected to assess background air conditions.

4.3.1 Soil and Sub-Slab Vapor Sampling

The sub-slab vapor samples points will be set no more than two inches below the building slab. The soil vapor samples will be set approximately two-feet bgs. A hammer drill will be used to drill through the concrete or asphalt where necessary. Dedicated polyethylene tubing will be used at each sample point. The sample point will be sealed with bentonite or other another non-VOC containing and non-shrinking product.

As part of the vapor intrusion evaluation, a tracer gas (helium) will be used in accordance with NYSDOH protocols to serve as a quality assurance/quality control (QA/QC) device to verify the integrity of the soil vapor probe seal. Helium will be used as the tracer gas and a box will serve to keep it in contact with the probe during testing. A portable monitoring device will be used to analyze a sample of soil vapor for the tracer prior to sampling. If the tracer sample results show a significant presence of the tracer, the probe seals will be adjusted to prevent infiltration.

One to three volumes will be purged prior to sample collection to ensure samples collected are representative. Flow rate of both purging and sampling will not exceed 0.2 L/min. Sampling will occur for approximately eight-hours. A sample log sheet will be maintained summarizing sample identification, date and time of sample collection, sampling depth, identity of samplers, sampling methods and devices, soil vapor purge volumes, volume of the soil vapor extracted, vacuum of canisters before and after the samples are collected, apparent moisture content of the sampling zone, and chain of custody protocols.

Sub-slab and soil vapor samples will be collected in Summa canisters which have been certified clean by the laboratory. The samples will be submitted to a NYSDOH ELAP certified laboratory and tested for the following analytes:

- VOCs via USEPA Method TO-15

4.3.2 Indoor and Outdoor Ambient Air Sampling

Indoor air samples will be placed approximately 3 to 5 feet above the building slab proximate to sub-slab vapor locations. The outdoor air sample will be placed 3 to 5 feet above ground level. Samples will be collected using Summa canisters (batch certified clean by the laboratory) fitted with flow controllers not to exceed 200 ml/min and will run for approximately eight-hours.

Indoor and outdoor ambient air samples will be submitted to a NYSDOH ELAP certified laboratory and tested for the following analytes:

- VOCs by USEPA Method TO-15

4.4 Installation of Soil and Groundwater Borings

To delineate the horizontal and vertical extent of impact, an estimated six to eight soil borings will be installed using direct push technology (Geoprobe®) to the groundwater table interface (groundwater estimated at 15-feet bgs). Soil and groundwater boring locations will be determined based on the results of the geophysical survey and shallow soil/vapor screening. Direct push drilling equipment will be outfitted with a two-inch diameter macro-core sampler using dedicated acetate liners. Subsurface soil will be collected continuously from grade to a depth corresponding to approximately ten feet into the groundwater table interface. The lithology of recovered soil will be logged continuously using the USCS and screened for the presence of VOCs using a PID. Subsurface soil samples shall be selected and retained for laboratory analysis from the intervals exhibiting the highest visual/olfactory and/or PID response. If no evidence of impact is observed, a soil sample shall be collected from the interval immediately above the groundwater table interface. Additional soil samples may be collected from select boring locations based on field observations. Step out soil borings may be installed based on field observations and/or initial analytical results.

Soil samples will be submitted to a NYSDOH ELAP laboratory and tested for the following analytes:

- TCL VOCs via USEPA Method 8260
- TCL SVOCs via USEPA Method 8270
- TCL Pesticides PCBs by USEPA Methods 8081/8082
- TAL Metals by USEPA Methods 6010/7471
- PFAS by USEPA Method 537m PFAS Analyte List
- 1,4-Dioxane by USEPA Method 8270 SIM

Following the completion of subsurface soil sampling, a temporary groundwater sampling point will be installed in each boring to collect groundwater samples. Due to the shallow geologic formation the temporary wells will be screened in, sampling the temporary wells will generate highly turbid samples. Therefore, sampling the temporary wells for SVOCs, metals, pesticides, PCBs, and PFAS may not provide results representative of dissolved-phase contamination.

The groundwater sampling points will be installed by deploying a properly decontaminated stainless-steel across the groundwater table interface without a sand pack and proper well development. Pre-packed temporary well screens may be used where groundwater water samples exhibit excessive turbidity. Following temporary well installation, the water table from each will be purged using low flow technology until measured groundwater parameters adequately stabilize prior to sampling for VOCs only.

Groundwater samples retained for laboratory analysis shall be placed in laboratory supplied glassware and packed in a cooler on ice for delivery under proper Chain of Custody procedures. The groundwater samples will be submitted to a NYSDOH ELAP laboratory and tested for VOCs by USEPA Method 8260 only.

A summary of the estimated frequency and analysis of subsurface soil and groundwater is provided in Table 2.

4.5 Installation of Shallow and Deep Groundwater Monitoring Wells

To monitor the degree of impact to groundwater at the site and groundwater flow, a groundwater monitoring network consisting of three shallow and one deep monitoring wells will be installed. The final selection of monitoring well locations will be determined based on the results of the above tasks. The monitoring wells will be installed by direct push (Geoprobe®) or other drilling technology as necessary.

4.5.1 Soil Characterization and Sampling

During monitoring well installation, soil will be collected continuously from grade to the final depth of the well. The lithology of recovered soil will be logged continuously using the USCS and screened for the presence of VOCs using a PID. From each monitoring well location, two soil samples will be selected and retained for laboratory analysis from the intervals exhibiting the highest visual/olfactory and/or PID response. If no evidence of impact is observed, soil samples will be collected from relatively shallow depth intervals and the interval immediately above the groundwater table interface. Additional soil samples may be collected from select boring locations based on field observations.

Subsurface soil samples retained for laboratory analysis shall be placed in laboratory supplied glassware and packed in a cooler on ice for delivery under proper Chain of Custody procedures. Soil samples will be submitted to a NYSDOH ELAP laboratory and tested for the following analytes:

- TCL VOCs via USEPA Method 8260
- TCL SVOCs via USEPA Method 8270
- TCL Pesticides PCBs by USEPA Methods 8081/8082
- TAL Metals by USEPA Methods 6010/7471
- PFAS by USEPA Method 537m PFAS Analyte List
- 1,4-Dioxane by USEPA Method 8270 SIM

A summary of the estimated frequency and analysis of subsurface soil is provided in Table 2.

4.5.2 Shallow and Deep Monitoring Well Construction

The shallow monitoring well will be installed using direct push technology (Geoprobe®) to span the groundwater table interface using a two-inch diameter schedule 40 polyvinyl chloride (PVC) screen (0.010-inch slot) and riser. A #00 sand will be used as a sand filter pack around the screen zone. The filter pack will be sealed using an approximately two-feet thick layer of bentonite. The remaining exposed riser will be backfilled using #02 sand to approximately one foot bgs.

The final depth of the deep monitoring well will be determined based on the results of the soil characterization and sampling performed during drill activities and be installed using direct push technology (Geoprobe®). If the final depth of the well cannot be achieved using the Geoprobe, alternate drilling methods such as hollow-stem auger (HAS) or roto-sonic will be considered The deep well will be constructed using 10-feet of two-inch diameter schedule 40 PVC well screen (0.010-inch slot), and riser. Similarly, a #00 sand will be used as a sand filter pack around the screen zone. The filter pack will be sealed using an approximately two-feet thick layer of bentonite. The remaining exposed riser will be backfilled using #02 sand to approximately one-foot bgs.

The location, depth, and drilling method will be approved by the NYSDEC prior to mobilization to install the deep monitoring well.

Each well will be completed with flush mounted boxes and covers set in concrete pads.

The proposed locations of shallow and deep monitoring wells are shown on Figure 9.

4.5.3 Monitoring Well Development

Following the installation of shallow and deep monitoring wells and prior to sampling, each new monitoring well will be properly developed in accordance with applicable guidance. Each well will be developed by vigorously pumping/surging until the discharge water is relatively sediment free and the groundwater parameters (pH, temperature, and specific conductivity) have stabilized. The intent of the development effort is to remove fine sediment from the annulus surrounding the well screen to improve performance. The turbidity and groundwater parameters of discharge water will be continuously monitored in an effort to keep the volume of water discharged to a minimum. A turbidity reading of 50-nephelometric turbidity units (NTUs) and steady state (+/- 10%) groundwater parameters will be used as guidance for discontinuing well development.

4.5.4 Well Elevation Survey and Measure Water Levels and Product Thickness

An elevation survey for each installed monitoring well will be completed to measure and routinely monitor the relative groundwater elevation. The monitoring well elevation will be referenced to an arbitrary vertical datum.

After the relative elevation of monitoring wells is determined, a round of water levels will be measured using an interface probe capable of measuring to the nearest one-hundredth of a foot. If non-aqueous phase liquid (NAPL) is observed, the NAPL thickness will be measured and a NAPL sample will be collected using a dedicated polyethylene bailer. If collected NAPL samples will be submitted to a NYSDOH ELAP certified laboratory and tested for the following analytes:

- Specific Gravity by USEPA Method D1298
- TCL VOCs by USEPA Method 8260
- Gasoline Range and Diesel Range Organics (GRO/DRO) by USEPA Method 8015

4.5.5 Groundwater Sampling

An initial round of groundwater sampling will be performed from each well to characterize shallow and deep groundwater quality at the site. One representative groundwater sample will be collected from each well using low-flow sampling techniques. Sampling will be conducted in accordance with NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation, datedMay 2010, and Sampling Guidelines and Protocols, dated March 1991.

Groundwater samples retained for laboratory analysis shall be placed in laboratory supplied glassware and packed in a cooler on ice for delivery under proper Chain of Custody procedures. Soil samples will be submitted to a NYSDOH ELAP laboratory and tested for the following analytes:

- TCL VOCs via USEPA Method 8260
- TCL SVOCs via USEPA Method 8270
- TCL Pesticides PCBs by USEPA Methods 8081/8082

- TAL Metals by USEPA Methods 6010/7471
- PFAS by USEPA Method 537m PFAS Analyte List
- 1,4-Dioxane by USEPA Method 8270 SIM

5.0 QUALITY ASSURANCE/QUALITY CONTROL

QA/QC procedures will be used to provide performance information with regard to accuracy, precision, sensitivity, representation, completeness, and comparability associated with the sampling and analysis for this investigation. Field QA/QC procedures will be used (1) to document that samples are representative of actual conditions at the Site and (2) identify possible cross-contamination from field activities or sample transit. Laboratory QA/QC procedures and analyses will be used to demonstrate whether analytical results have been biased either by interfering compounds in the sample matrix, or by laboratory techniques that may have introduced systematic or random errors to the analytical process. At a minimum, QA/QC procedures shall meet ASP-B protocol requirements.

A site-specific Quality Assurance Project Plan detailed the field and laboratory QA/QC procedures is provided as Appendix C.

5.1 Data Usability Summary Report (DUSR)

A Data Usability Summary Report (DUSR) will be prepared by a third-party contractor, which will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation and chain of custody procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method.

6.0 REPORTING

Following the complete delineation of impact at the site, a Remedial Investigation Report (RIR) will be prepared to document the results of the remedial investigation (RI). The RIR shall document the results of the RI and make further recommendations as to whether remediation is necessary. As specified in Appendix 3-B of DER-10, a Qualitative Human Health Exposure Assessment (QHHEA) will be completed as part of the RIR.

If it is determined that additional delineation is required beyond the anticipated scope of work described, an interim RIR may be prepared to summarize the investigation activities and results and propose further investigation efforts as necessary.

Regular progress reports shall be prepared and submitted to the NYSDEC during site activities.

7.0 HEALTH AND SAFETY PLAN (HASP)

A site-specific HASP has been prepared for the site. The Site Safety Coordinator will be Brian Barth. Investigative work performed under this Work Plan will be in full compliance with applicable health and safety laws and regulations, including Site and OSHA worker safety requirements and HAZWOPER requirements. Confined space entry, if any, will comply with OSHA requirements and industry standards and will address potential risks. The parties performing the investigation work will ensure that performance of work is in compliance with the HASP and applicable laws and regulations.

All field personnel involved in investigation activities will participate in training required under 29 CFR 1910.120, including 40-hour hazardous waste operator training and annual 8-hour refresher training. Site Safety Officer will be responsible for maintaining workers training records.

A copy of the site-specific HASP is provided as Appendix D.

8.0 COMMUNITY AIR MONITORING PLAN

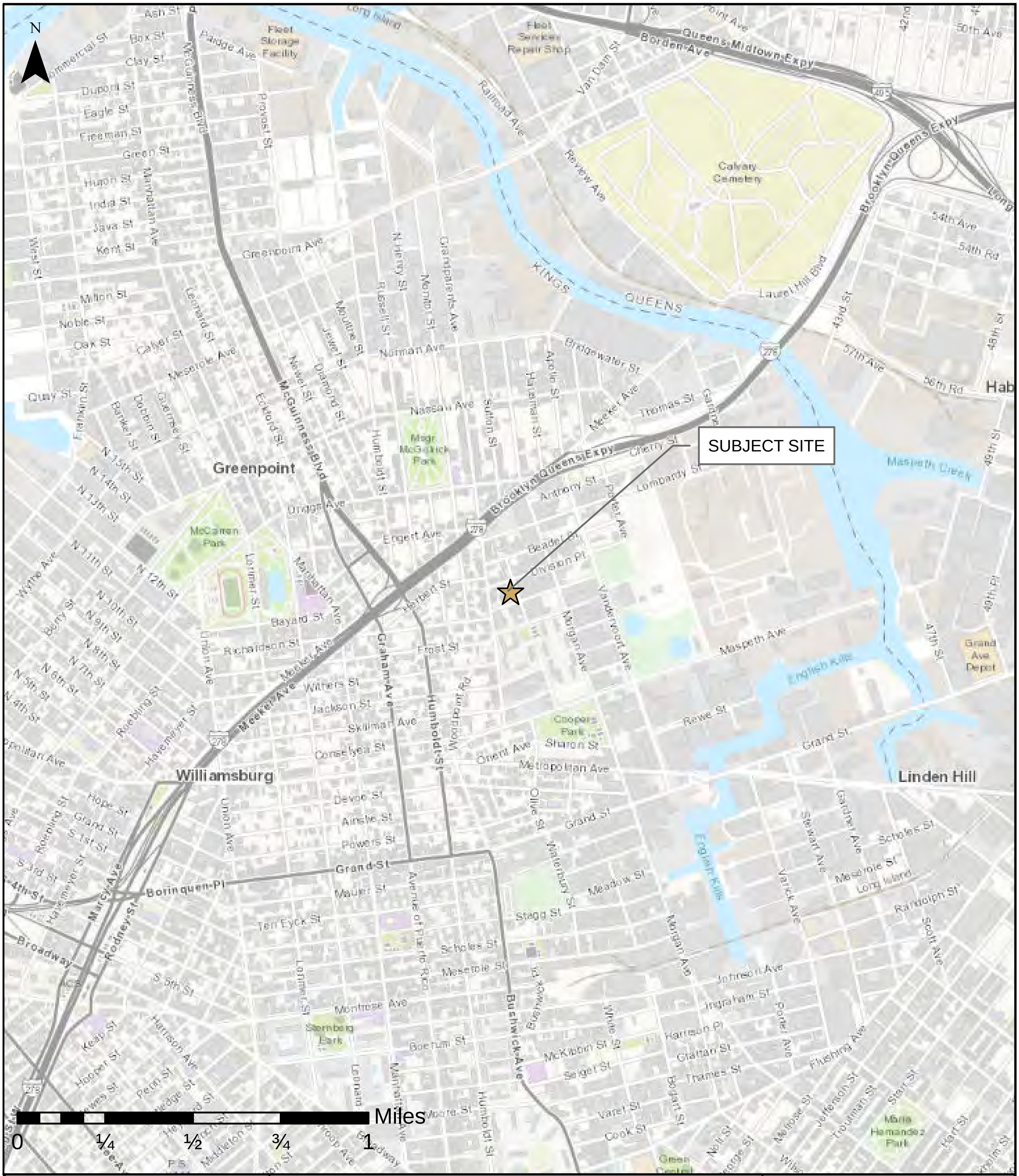
A Community Air Monitoring Plan (CAMP) is required per DER-10 (Appendix 1A, NYSDOH, Generic CAMP) during all intrusive activities. Real-time continuous air monitoring for VOCs and particulates will be performed during ground intrusive activities. Periodic monitoring for VOCs will be performed during non-intrusive activities such as groundwater sampling from existing monitoring wells.

The monitoring shall be consistent with the NYSDOH *Generic Community Air Monitoring Plan,* dated May 2010 (contained in DER-10). If work is performed within 20 feet of potentially exposed individuals or structures, and for indoor work with co-located residences or facilities, the monitoring shall also be consistent with the *Special Requirements for Work Within 20-feet of Potentially Exposed Individuals or Structures,* dated June 2000.

CAMP data summary tables will be maintained during CAMP activities and provided to the NYSDEC and NYSDOH at a minimum of a weekly basis. The Departments will be notified immediately (within 24 hours) of any CAMP Action Level exceedances and corrective measures taken.

A copy of the CAMP documents is included in Appendix E.

FIGURES



Site Location

291 Richardson Street
Brooklyn, New York

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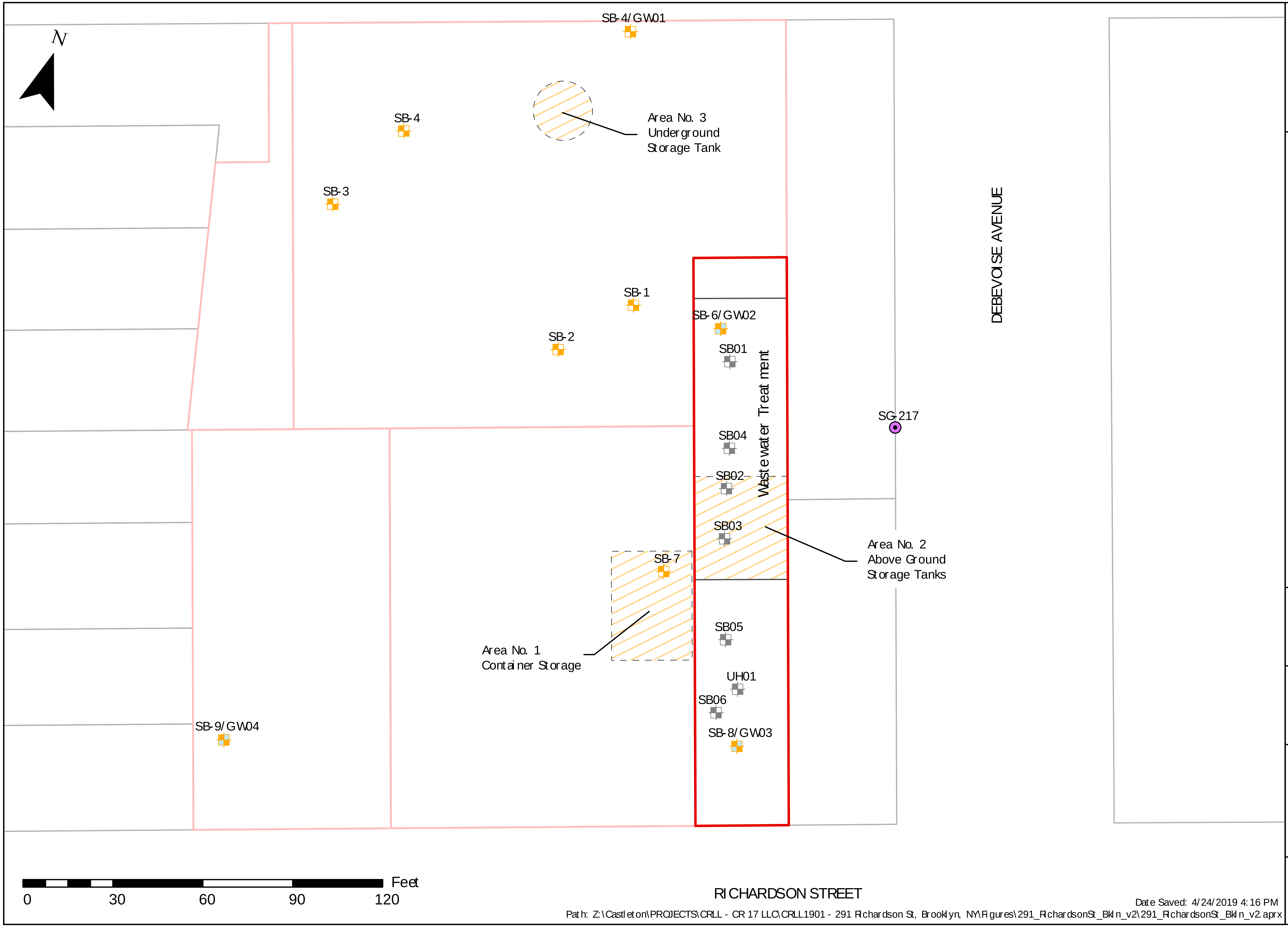
FIGURE:

1



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- ▨ Soil Boring - Castleton 2018
- ● Soil Gas - EnviroTrak 2016
- ▨ Soil Boring - Gannet Flemming 2003
- ▨ Soil & Groundwater - Gannett 2003
- ▨ AOC - NYSDEC 2005
- 🟥 Site Boundary
- ☐ Former Goodman Site Parcels
- ☐ Surrounding Parcels

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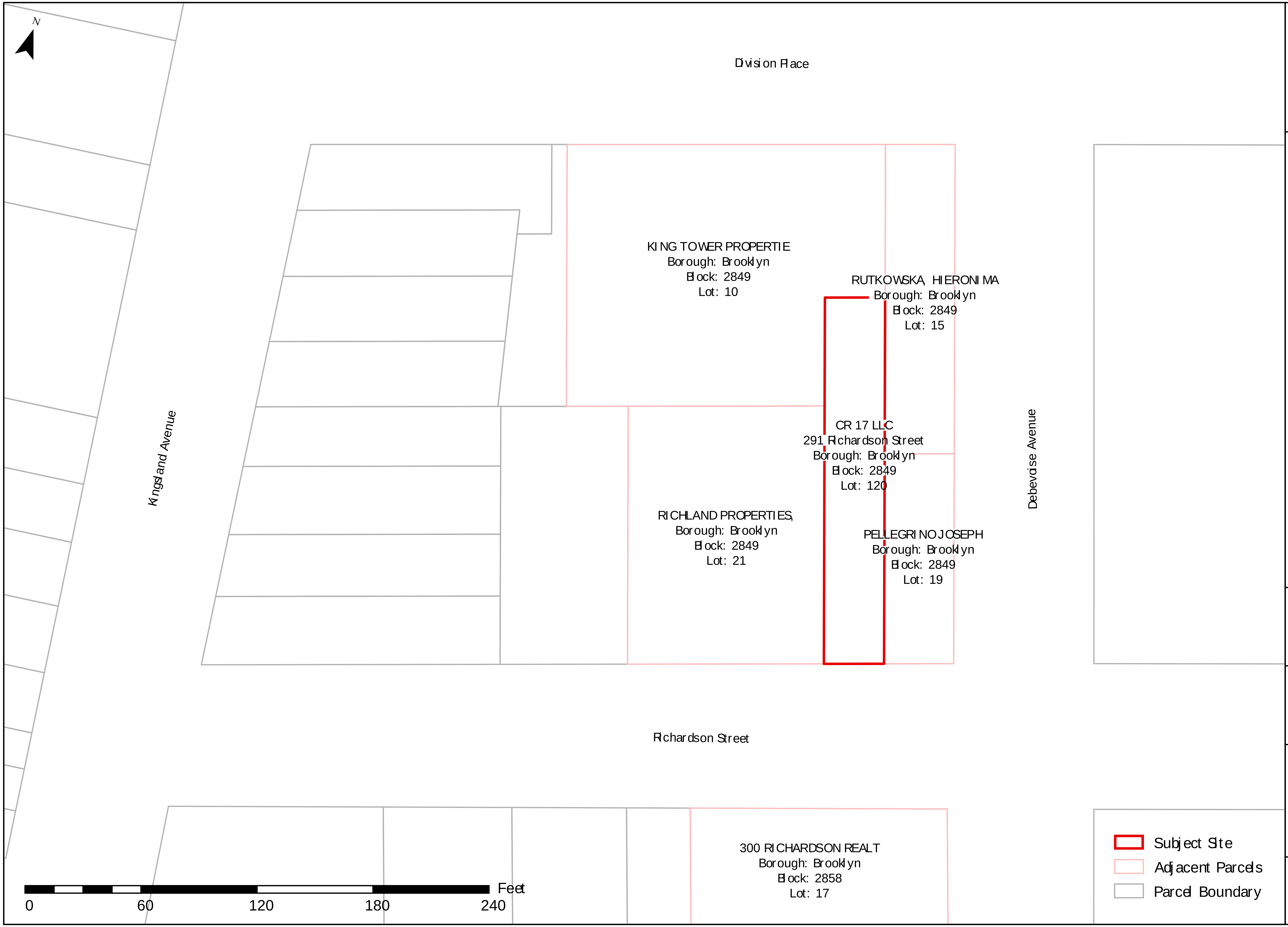
SITE PLAN

291 RICHARDSON ST
BROOKLYN, NY

FIGURE:
2



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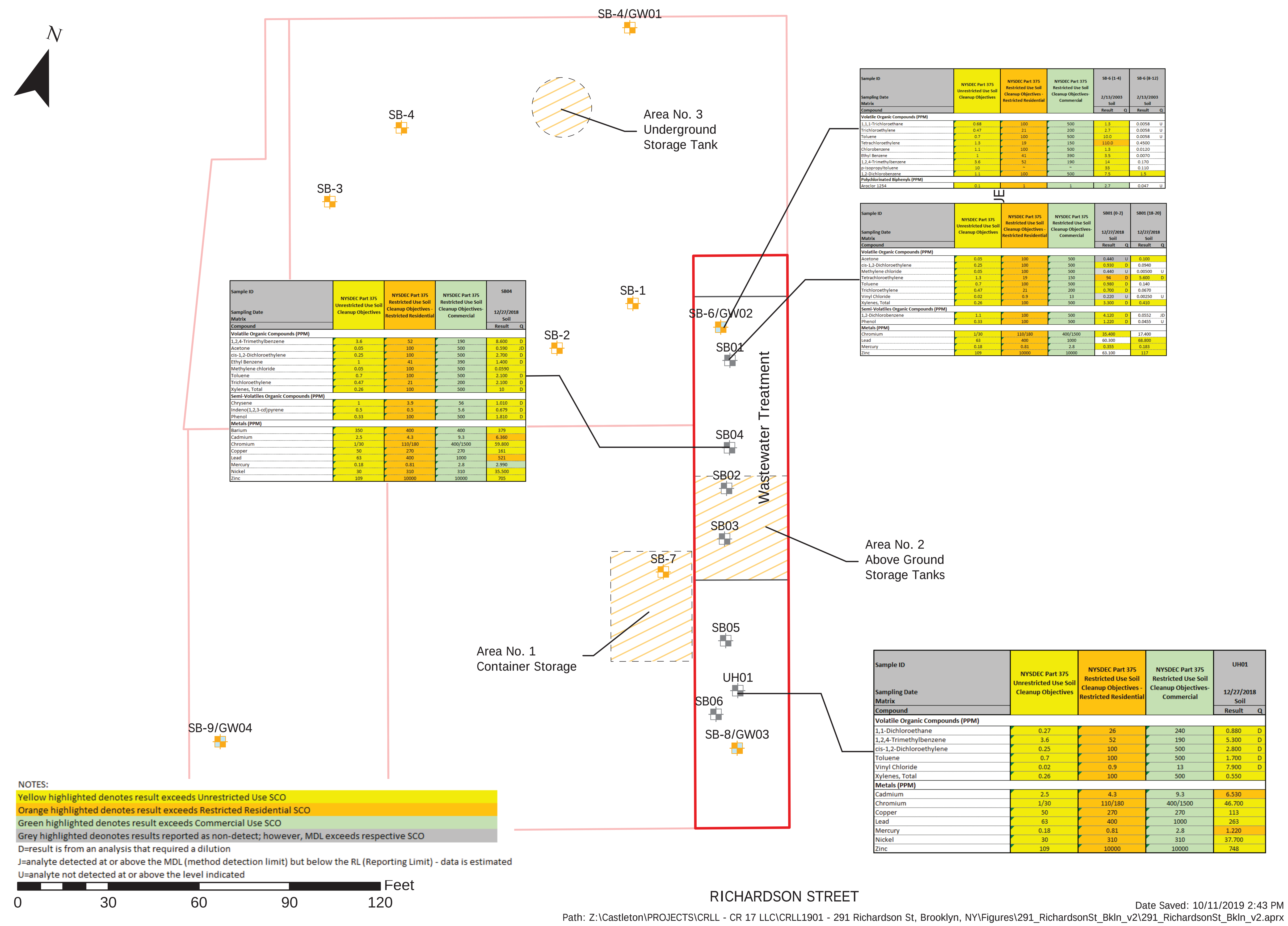
Tax Parcel Information

291 Richardson St
Brooklyn, NY

FIGURE:
3



Sample ID	NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives	NYSDEC Part 375 Restricted Use Soil Cleanup Objectives - Restricted Residential	NYSDEC Part 375 Restricted Use Soil Cleanup Objectives- Commercial	SB-6 (1-4)		SB-6 (8-12)	
Sampling Date				2/13/2003		2/13/2003	
Matrix				Soil		Soil	
Compound				Result	Q	Result	Q
Volatile Organic Compounds (PPM)							
1,1,1-Trichloroethane	0.68	100	500	1.3		0.0058	U
Trichloroethylene	0.47	21	200	2.7		0.0058	U
Toluene	0.7	100	500	10.0		0.0058	U
Tetrachloroethylene	1.3	19	150	110.0		0.4500	
Chlorobenzene	1.1	100	500	1.3		0.0120	
Ethyl Benzene	1	41	390	3.5		0.0070	
1,2,4-Trimethylbenzene	3.6	52	190	14		0.170	
p-Isopropyltoluene	10	~	~	33		0.110	
1,2-Dichlorobenzene	1.1	100	500	7.5		1.5	
Polychlorinated Biphenyls (PPM)							
Aroclor 1254	0.1	1	1	2.7		0.047	U

Sample ID	NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives	NYSDEC Part 375 Restricted Use Soil Cleanup Objectives - Restricted Residential	NYSDEC Part 375 Restricted Use Soil Cleanup Objectives- Commercial	SB01 (0-2)		SB01 (18-20)	
Sampling Date				12/27/2018		12/27/2018	
Matrix				Soil		Soil	
Compound				Result	Q	Result	Q
Volatile Organic Compounds (PPM)							
Acetone	0.05	100	500	0.440	U	0.100	
cis-1,2-Dichloroethylene	0.25	100	500	0.930	D	0.0940	
Methylene chloride	0.05	100	500	0.440	U	0.00500	U
Tetrachloroethylene	1.3	19	150	94	D	5.600	D
Toluene	0.7	100	500	0.980	D	0.140	
Trichloroethylene	0.47	21	200	0.700	D	0.0670	
Vinyl Chloride	0.02	0.9	13	0.220	U	0.00250	U
Xylenes, Total	0.26	100	500	3.300	D	0.410	
Semi-Volatiles Organic Compounds (PPM)							
1,2-Dichlorobenzene	1.1	100	500	4.120	D	0.0552	JD
Phenol	0.33	100	500	1.220	D	0.0455	U
Metals (PPM)							
Chromium	1/30	110/180	400/1500	35.400		17.400	
Lead	63	400	1000	60.300		68.800	
Mercury	0.18	0.81	2.8	0.355		0.183	
Zinc	109	10000	10000	63.100		117	

Sample ID	NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives	NYSDEC Part 375 Restricted Use Soil Cleanup Objectives - Restricted Residential	NYSDEC Part 375 Restricted Use Soil Cleanup Objectives- Commercial	SB04	
Sampling Date				12/27/2018	
Matrix				Soil	
Compound				Result	Q
Volatile Organic Compounds (PPM)					
1,2,4-Trimethylbenzene	3.6	52	190	8.600	D
Acetone	0.05	100	500	0.590	JD
cis-1,2-Dichloroethylene	0.25	100	500	2.700	D
Ethyl Benzene	1	41	390	1.400	D
Methylene chloride	0.05	100	500	0.0590	
Toluene	0.7	100	500	2.100	D
Trichloroethylene	0.47	21	200	2.100	D
Xylenes, Total	0.26	100	500	10	D
Semi-Volatiles Organic Compounds (PPM)					
Chrysene	1	3.9	56	1.010	D
Indeno(1,2,3-cd)pyrene	0.5	0.5	5.6	0.679	D
Phenol	0.33	100	500	1.810	D
Metals (PPM)					
Barium	350	400	400	379	
Cadmium	2.5	4.3	9.3	6.360	
Chromium	1/30	110/180	400/1500	59.800	
Copper	50	270	270	161	
Lead	63	400	1000	521	
Mercury	0.18	0.81	2.8	2.990	
Nickel	30	310	310	35.500	
Zinc	109	10000	10000	705	

Sample ID	NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives	NYSDEC Part 375 Restricted Use Soil Cleanup Objectives - Restricted Residential	NYSDEC Part 375 Restricted Use Soil Cleanup Objectives- Commercial	UH01	
Sampling Date				12/27/2018	
Matrix				Soil	
Compound				Result	Q
Volatile Organic Compounds (PPM)					
1,1-Dichloroethane	0.27	26	240	0.880	D
1,2,4-Trimethylbenzene	3.6	52	190	5.300	D
cis-1,2-Dichloroethylene	0.25	100	500	2.800	D
Toluene	0.7	100	500	1.700	D
Vinyl Chloride	0.02	0.9	13	7.900	D
Xylenes, Total	0.26	100	500	0.550	
Metals (PPM)					
Cadmium	2.5	4.3	9.3	6.530	
Chromium	1/30	110/180	400/1500	46.700	
Copper	50	270	270	113	
Lead	63	400	1000	263	
Mercury	0.18	0.81	2.8	1.220	
Nickel	30	310	310	37.700	
Zinc	109	10000	10000	748	

NOTES:
Yellow highlighted denotes result exceeds Unrestricted Use SCO
Orange highlighted denotes result exceeds Restricted Residential SCO
Green highlighted denotes result exceeds Commercial Use SCO
Grey highlighted deonotes results reported as non-detect; however, MDL exceeds respective SCO
D=result is from an analysis that required a dilution
J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated
U=analyte not detected at or above the level indicated

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- ⊞ Soil & Groundwater - Gannett 2003
- ▨ AOC - NYSDEC 2005
- ☐ Site Boundary
- ☐ Former Goodman Site Parcels
- ☐ Surrounding Parcels

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PROJECT:	CRLL1901
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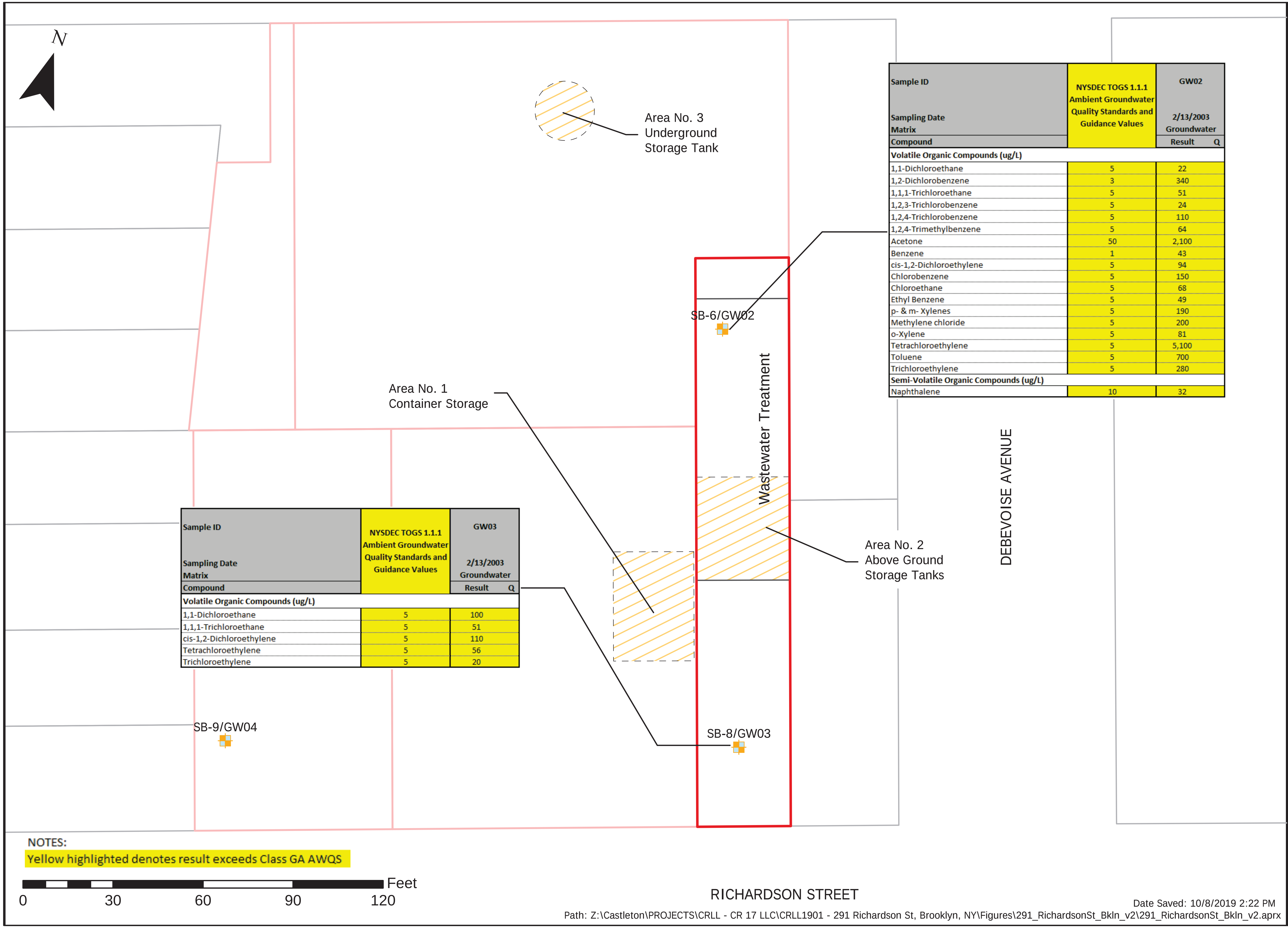
SOIL CONTAMINATION

291 RICHARDSON ST
BROOKLYN, NY

FIGURE:
4



Sample ID Sampling Date Matrix	NYSDEC TOGS 1.1.1 Ambient Groundwater Quality Standards and Guidance Values	GW02 2/13/2003 Groundwater	
Compound		Result	Q
Volatile Organic Compounds (ug/L)			
1,1-Dichloroethane	5	22	
1,2-Dichlorobenzene	3	340	
1,1,1-Trichloroethane	5	51	
1,2,3-Trichlorobenzene	5	24	
1,2,4-Trichlorobenzene	5	110	
1,2,4-Trimethylbenzene	5	64	
Acetone	50	2,100	
Benzene	1	43	
cis-1,2-Dichloroethylene	5	94	
Chlorobenzene	5	150	
Chloroethane	5	68	
Ethyl Benzene	5	49	
p- & m- Xylenes	5	190	
Methylene chloride	5	200	
o-Xylene	5	81	
Tetrachloroethylene	5	5,100	
Toluene	5	700	
Trichloroethylene	5	280	
Semi-Volatile Organic Compounds (ug/L)			
Naphthalene	10	32	

Sample ID Sampling Date Matrix	NYSDEC TOGS 1.1.1 Ambient Groundwater Quality Standards and Guidance Values	GW03 2/13/2003 Groundwater	
Compound		Result	Q
Volatile Organic Compounds (ug/L)			
1,1-Dichloroethane	5	100	
1,1,1-Trichloroethane	5	51	
cis-1,2-Dichloroethylene	5	110	
Tetrachloroethylene	5	56	
Trichloroethylene	5	20	

NOTES:

Yellow highlighted denotes result exceeds Class GA AWQS

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▣	Soil & Groundwater - Gannett 2003
▨	AOC - NYSDEC 2005
🟥	Site Boundary
▭	Former Goodman Site Parcels
▭	Surrounding Parcels

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Brooklyn, NY 11222

PROJECT:	CRLL1901
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GROUNDWATER CONTAMINATION

291 RICHARDSON ST
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FIGURE:
5

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- ● Proposed Shallow Soil/Vapor Points
- ▨ AOC - NYSDEC 2005
- 🟥 Site Boundary
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RI WP
Proposed Shallow Soil and
Soil Vapor Screening Points

291 RICHARDSON ST
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FIGURE:
6

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● Indoor Air
● Outdoor Air
● Sub-Slab Vapor
● Soil Vapor
▨ AOC - NYSDEC 2005
▭ Site Boundary
▭ Former Goodman Site Parcels

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RIWP
Proposed Shallow
and Deep
Monitoring Wells

291 RICHARDSON ST
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FIGURE:
7

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- ✚ Proposed Soil/Groundwater Boring
- ▨ AOC - NYSDEC 2005
- 🟥 Site Boundary
- ▭ Former Goodman Site Parcels

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Brooklyn, NY 11222

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RIWP
Proposed Soil
and Groundwater
Borings

291 RICHARDSON ST
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FIGURE:

8

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RI WP
Proposed Shallow
and Deep
Monitoring Wells

291 RICHARDSON ST
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FIGURE:
9

TABLES

TABLE 1
291 Richardson Street, Brooklyn, New York
Soil Data Summary

Sample ID	NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives	NYSDEC Part 375 Restricted Use Soil Cleanup Objectives - Restricted Residential	NYSDEC Part 375 Restricted Use Soil Cleanup Objectives- Commercial	SB-6 (1-4)		SB-6 (8-12)		SB-8 (0.5-4)		SB01 (0-2)		SB01 (18-20)		SB04		UH01	
Sampling Date				2/13/2003		2/13/2003		1/31/2003		12/27/2018		12/27/2018		12/27/2018		12/27/2018	
Matrix				Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Compound				Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Volatile Organic Compounds (PPM)																	
1,1-Dichloroethane	0.27	26	240	0.590	U	0.0058	U	0.0023	U	0.130		0.00250	U	0.0220		0.880	D
1,1,1-Trichloroethane	0.680	100	500	1.3		0.0058	U	0.0023	U	NA		NA		NA		NA	
1,2,4-Trimethylbenzene	3.6	52	190	14		0.170		0.0023	U	2.300	D	1.200	D	8.600	D	5.300	D
1,3,5-Trimethylbenzene	8.40	52	190	5.400	U	0.0650		0.0023	U	0.860	D	0.120		4.500	D	1.800	D
Acetone	0.05	100	500	5.900		0.023	U	0.0023	U	0.440	U	0.100		0.590	JD	0.00610	U
2-Butanone	0.12	100	500	5.900	U	0.0058	U	0.0230	U	0.00220	U	0.00250	U	0.110		0.00310	U
2-Hexanone	~	~	~	5.900	U	1.0058	U	1.0230	U	0.00220	U	0.00250	U	0.0700		0.00310	U
cis-1,2-Dichloroethylene	0.25	100	500	0.590	U	0.0058	U	0.0023	U	0.930	D	0.0940		2.700	D	2.800	D
Ethyl Benzene	1	41	390	3.5		0.0070		0.0023	U	0.440	JD	0.0580		1.400	D	0.0420	
Methylene chloride	0.05	100	500	0.590	U	0.0058	U	0.0023	U	0.440	U	0.00500	U	0.0590		0.0100	J
Tetrachloroethylene	1.3	19	150	110.0		0.4500		0.0023	U	94	D	5.600	D	0.510	U	0.0320	
Toluene	0.7	100	500	10.0		0.0058	U	0.0023	U	0.980	D	0.140		2.100	D	1.700	D
Trichloroethylene	0.47	21	200	2.7		0.0058	U	0.0034		0.700	D	0.0670		2.100	D	0.00790	
Chlorobenzene	1.1	100	500	1.3		0.012		0.0023	U	NA		NA		NA		NA	
p-Isopropyltoluene	10	~	~	33		0.110		0.0023	U	NA		NA		NA		NA	
1,2-Dichlorobenzene	1.1	100	500	7.5		1.5		0.0023	U	4.120	D	0.0552	JD	0.295	D	0.112	JD
o-Xylene	~	~	~	5.500		0.0190		0.0023	U	0.780	D	0.120		4.100	D	1.200	D
p- & m- Xylenes	~	~	~	16.000		0.0440		0.0047	U	2.500	D	0.290		6.200	D	0.250	
Vinyl Chloride	0.02	0.9	13	0.590	U	0.0058	U	0.0023	U	0.220	U	0.00250	U	0.00320	J	7.900	D
Xylenes, Total	0.26	100	500	21.5		0.063		0.0070	U	3.300	D	0.410		10	D	0.550	
Semi-Volatiles Organic Compounds (PPM)																	
Chrysene	1	3.9	56	0.440		0.350	U	0.350	U	0.208	D	0.0726	JD	1.010	D	0.292	D
Indeno(1,2,3-cd)pyrene	0.5	0.5	5.6	0.350	U	0.350	U	0.350	U	0.0475	U	0.0487	JD	0.679	D	0.245	D
Phenol	0.33	100	500	NA		NA		NA		1.220	D	0.0455	U	1.810	D	0.0624	U
Metals (PPM)																	
Barium	350	400	400	NA		NA		NA		19.500		62.700		379		168	
Cadmium	2.5	4.3	9.3	0.00059	U	0.00065		0.00078		0.342	U	0.816		6.360		6.530	
Chromium	1/30	110/180	400/1500	0.0052		0.020		0.021		35.400		17.400		59.800		46.700	
Copper	50	270	270	0.0045		0.013		0.033		37.900		26.400		161		113	
Lead	63	400	1000	0.0098		0.0072		0.0079		60.300		68.800		521		263	
Mercury	0.18	0.81	2.8	0.000044		0.00003		0.000017		0.355		0.183		2.990		1.220	
Nickel	30	310	310	0.0024		0.0052		0.0051		15.600		14.800		35.500		37.700	
Zinc	109	10000	10000	0.026		0.074		0.045		63.100		117		705		748	
Polychlorinated Biphenyls (PPM)																	
Aroclor 1254	0.1	1	1	2.7		0.047	U	0.047	U	NA		NA		NA		NA	
Aroclor 1260	0.1	1	1	0.940	U	0.047	U	0.047	U	NA		NA		NA		NA	

NOTES:

Any Regulatory Exceedences are color coded by Regulation

D=result is from an analysis that required a dilution

J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated

U=analyte not detected at or above the level indicated

NA=Not Analyzed

~=this indicates that no regulatory limit has been established for this analyte

TABLE 2
291 Richardson Street, Brooklyn, New York
Groundwater Data Summary

Sample ID Sampling Date Matrix	NYSDEC TOGS 1.1.1 Ambient Groundwater Quality Standards and Guidance Values	GW02 2/13/2003 Groundwater		GW03 2/13/2003 Groundwater	
Compound		**Result**	**Q**	**Result**	**Q**
Volatile Organic Compounds (ug/L)					
1,1-Dichloroethane	5	22		100	
1,2-Dichlorobenzene	3	340		1	U
1,1,1-Trichloroethane	5	51		51	
1,2,3-Trichlorobenzene	5	24		1	U
1,2,4-Trichlorobenzene	5	110		1	U
1,2,4-Trimethylbenzene	5	64		1	U
Acetone	50	2,100		10	U
Benzene	1	43		1	U
cis-1,2-Dichloroethylene	5	94		110	
Chlorobenzene	5	150		1	U
Chloroethane	5	20	U	1	U
Ethyl Benzene	5	49		1	U
p- & m- Xylenes	5	190		2	U
Methylene Chloride	5	200		1	U
Naphthalene (v)	10	32		1	U
o-Xylene	5	81		1	U
Tetrachloroethylene	5	5,100		56	
Toluene	5	700		1	U
Trichloroethylene	5	280		20	

NOTES:

Highlighted denotes the analyte was reported above its respective GWQS.

U=analyte not detected at or above the level indicated

TABLE 3
291 Richardson Street, Brooklyn, NY
Proposed Sampling Frequency, Matrices, and Analyses

								QC Samples					
Matrix	**Analyte**	**USEPA Analytical Method**	**Shallow Soil Screening**	**Sub-Slab and Soil Vapor Investigation**	**Soil and Groundwater Borings**	**Monitoring Well Installation**	**Total Number of Samples**	**MS**	**MSD or MD**	**FD**	**EB**	**TB**	**Grand Total**
Soil													
	TCL VOCs	8260	7		8	8	23	2	2	2	2	3	34
	TCL SVOCs	8270	7		8	8	23	2	2	2	2		31
	TCL Pesticides and PCBs	8080/8082	7		8	8	23	2	2	2	2		31
	TAL Metals	6010/7471	7		8	8	23	2	2	2	2		31
	PFAS (PFAS Analyte List)	537m	7		8	8	23	2	2	2	2		31
	1,4-Dioxane	8270 SIM	7		8	8	23	2	2	2	2		31
Sub-Slab/Soil Vapor and Ambient Air													
	VOCs	TO-15		8			8	1	1	1			11
Groundwater													
	TCL VOCs	8260			8	4	12	1	1	1	1	1	17
	TCL SVOCs	8270			8	4	12	1	1	1	1		16
	TCL Pesticides and PCBs	8080/8082			8	4	12	1	1	1	1		16
	TAL Metals	6010/7471			8	8	16	1	1	1	1		20
	PFAS (PFAS Analyte List)	537m			8	4	12	1	1	1	1		16
	1,4-Dioxane	8270 SIM			8	4	12	1	1	1	1		16
Non-Aqueous Phase Liquids (if necessary)													
	Specifc Gravity	D1298											
	TCL VOCs	8260											
	PCBs	8082											
	Petroleum Product ID	310.13											
	Viscocity @ 15 Deg C.	D455											
	Interfacial Tension @ 15 Deg C.	D791											
Waste Profile/Disposal Samples (if necessary)													
	RCRA Characteristics	1030/9045/SW846											
	Full TCLP	1311/8260/8270/8081/8151/6010/7470											

Notes:

The total number of samples are estimated and may be changed based upon the screening/sampling results.

EB-Equip Blank for Non-Dedicated Equip
FD-Field Duplicate
MD-Matrix Dupicate
MS-Matrix Spike
MSD-Matrix Spike Duplicate
TB-Trip Blank

APPENDIX A – NYSDEC ENVIRONMENTAL DATABASE RECORDS

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Environmental Site Remediation Database Search Details

Site Record

Administrative Information

Site Name: Former Goodman Brothers Steel Drum Co.
Site Code: 224211
Program: State Superfund Program
Classification: 02
EPA ID Number:

Location

DEC Region: 2
Address: 18 Division Place
City: Brooklyn Zip: 11222
County: Kings
Latitude: 40.720108
Longitude: -73.940048
Site Type: STRUCTURE
Estimated Size: 0.67 Acres

Site Owner(s) and Operator(s)

Current Owner Name: Richland Properties, Inc.
Current Owner(s) Address: 275 Richardson Street
Brooklyn,NY, 11222-5641
Current Owner Name: King Tower Properties, Inc.
Current Owner(s) Address: 18 Division Place
Brooklyn,NY, 11222
Current On-Site Operator: Art Furniture Co.
Stated Operator(s) Address: 275 Richardson Street
Brooklyn,NY 11222-5641

Site Document Repository

Name: Brooklyn Public Library - Leonard Branch
Address: 81 Devoe Street
Brooklyn,NY 11211

Site Description

Location: The 0.67 acre site is located in the Greenpoint/East Williamsburg Industrial Area section of Kings County (Borough of Brooklyn, New York City). The site is located on the south side of Division Place between Kingsland and Debevoise Avenues. Site Features: The site is mostly covered with one-story buildings, with a storage yard located on the south side along Richardson Street. Current Zoning and Land Use: The site is zoned for manufacturing. The site is currently used by a furniture manufacturing company. Numerous commercial, industrial, and residential properties surround the site. Past Use of the Site: Goodman Brothers began operations in 1909 as a re-conditioner and recycler of used steel drums for re-use or disposal. The Department's initial involvement with the facility was a RCRA inspection conducted in September 1982, as the company was a large quantity generator of hazardous waste above a sole-source aquifer. The company went out of business in June 2002. During the last 20 years of its operation, Goodman Brothers entered into one consent order with the USEPA (1983), and two consent orders with the Department (1987 and 2003), and agreed to pay penalties in the overall amount of $28,000 for numerous violations. In February 2003 a limited subsurface investigation was performed at the site; a total of nine soil borings were installed with soil samples collected from all nine borings and groundwater samples collected at four locations. The Department began a Site Characterization in this area during the Summer of 2011 as part of a plume trackdown investigation (Meeker Avenue Plume Trackdown, DEC Site ID No. 224121). Site Geology and Hydrogeology: The site is underlain by a sand/silty sand unit (~15-35' thick), a discontinuous sand/gravel unit within the sand/silty sand unit (~5' thick), a discontinuous clayey silt unit within the sand/silty sand unit (~5' thick), and a sand unit below. Groundwater is approximately 15-20' below grade in the immediate vicinity of the site, and appears to be a perched unit. Groundwater below the site flows toward the east in the direction of Newtown Creek (~3,600' away).

Contaminants of Concern (Including Materials Disposed)

Contaminant Name/Type
lead
1,1,1-trichloroethane
toluene
xylene (mixed)
PCB aroclor 1260
tetrachloroethene (PCE)

Site Environmental Assessment

Nature and Extent of Contamination: - Groundwater The primary contaminants of concern at the site are tetrachloroethene (PCE) and its daughter compounds (trichloroethene, cis-1,2 dichloroethene and vinyl chloride); 1,1,1, trichloroethane (1,1,1 TCA); BTEX compounds (benzene, toluene, ethylbenzene, and xylene); and PCBs. These compounds have been found well above their respective Part 703.5 Class GA standards (shown in parenthesis). PCE has been found up to 30,000 ppb (5 ppb); trichloroethene (TCE) up to 2,800 ppb (5 ppb); cis-1,2 dichloroethene (DCE) up to 140,000 ppb (5 ppb); vinyl chloride up to 2,300 ppb (2 ppb); 1,1,1-TCA up to 15,000 ppb (5 ppb); benzene up to 2,400 ppb (1 ppb); toluene up to 54,000 ppb (5 ppb); ethylbenzene up to 2,400 ppb (5 ppb); total xylenes up to 12,100 ppb (5 ppb); and PCBs (Arochlor-1260) up to 940 ppb (0.09 ppb). All the contaminants listed above (except PCBs) have migrated off-site. - Soil Numerous compounds have been found in excess of their unrestricted use soil cleanup objective (shown in parenthesis). PCE has been found up to 260 ppm (1.3 ppm); TCE up to 140 ppm (0.47 ppm); DCE up to 70 ppm (0.25 ppm); 1,1,1-TCA up to 22 ppm (0.68 ppm); benzene up to 13 ppm (0.06 ppm); toluene up to 520 ppm (0.7 ppm); ethylbenzene up to 88 ppm (1 ppm); total xylenes up to 368 ppm (0.26 ppm); PCBs up to 80 ppm (0.1 ppm); lead up to 1,300 ppm (63 ppm); and mercury up to 240 ppm (0.18 ppm). Significant Threat: The site poses a significant environmental threat due to ongoing releases of PCE (and its breakdown products), BTEX compounds, and PCBs from source areas into soil and groundwater.

Site Health Assessment

Direct contact with contaminants in the soil is unlikely because the majority of the site is covered with buildings and pavement. People are not drinking the contaminated groundwater because the area is served by a public water supply that is not affected by this contamination. Volatile organic compounds in the groundwater may move into the soil vapor (air spaces within the soil), which in turn may move into overlying buildings and affect the indoor air quality. This process, which is similar to the movement of radon gas from the subsurface into the indoor air of buildings, is referred to as soil vapor intrusion. The potential for soil vapor intrusion in on-site and off-site structures exists and should be evaluated and may need to be evaluated for off-site structures.

For more Information: E-mail Us

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APPENDIX B – PREVIOUS ENVIRONMENTAL DOCUMENTATION
(LINK to DIGITAL PDF)

APPENDIX C – QUALITY ASSURANCE PROJECT PLAN

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Quality Assurance Project Plan

Former Goodman Brothers Steel Drum Co.
291 Richardson Street
Brooklyn, New York
NYSDEC Site Number: 224292

February 2020

Prepared for:
CR 17 LLC.
1036 Manhattan Avenue
Brooklyn, New York 11222

QUALITY ASSURANCE PROJECT PLAN
FORMER GOODMAN BROTHERS STEEL DRUM CO
291 RICHARDSON STREET, BROOKLYN, NEW YORK
DEC SITE NO: 224292
CASTLETON PROJECT NO: CRLL1902
FEBRUARY 2020

Table of Contents

Figures

Tables

Appendices

1.0 INTRODUCTION

Castleton Environmental Geologic Services, DPC (Castleton), has prepared this Quality Assurance Project Plan (QAPP) for the property located 291 Richardson Street in the Greenpoint/East Williamsburg section of Kings County (Borough of Brooklyn), New York (Figure 1). The site is comprised of a single parcel that is part of the Former Goodman Brothers Steel Drum Co. (Goodman Bros) property. The Goodman Bros property is listed on the New York State Department of Environmental Conservation's (NYSDEC) Environmental Site Remediation Database under site code 224292. A site plan is provided as Figure 2.

The proposed work is being performed on behalf of CR 17 LLC (the Volunteer) as part of their commitment to investigate and to remediate, if and to the extent required, the site under the NYSDEC Brownfield Cleanup Program (BCP).

This QAPP supports the Remedial Investigation Work Plan (RIWP) prepared the site (under separate cover).

This QAPP provides a general overview of the measure to be employed during the field investigation activities at the site. Specific procedures for the various tasks to be performed are included in the Field Activities Plan included in Appendix A.

2.0 PROJECT SCOPE

The scope of this QAPP is to provide Quality Assurance/Quality Control (QA/QC) procedures during the proposed Remedial Investigation (RI). The intent of the RI is to characterize the nature and extent of site contamination identified in previous investigations, including:

- Installation of approximately 14 shallow soil and soil vapor probes/screening points.
- Installation of three sub-slab vapor, one soil vapor, three indoor air, and one outdoor air samples.
- Installation of an estimated six to eight direct push soil and groundwater boring screening/sample probes.
- Installation of three shallow and one deep groundwater monitoring wells.

The purpose and scope of this QAPP is to provide guidance and procedures intended to ensure data derived during the RI activities are of sufficient quality to be relied upon for its intended use. The goals of this QAPP include ensuring QA/QC measures are met and include:

- Accuracy
- Precision
- Sensitivity
- Representation
- Completeness

- Comparability (Where applicable)

Site plans depicting the proposed sampling areas are provided as Figures 3, 4, 5 and 6.

3.0 PROJECT TEAM

The QAPP shall be implemented by several organizations and personnel under contract to the Volunteer as listed below:

- Project Manager – Castleton – Brian Barth (Sr. Project Manager)
- Quality Assurance Officer (QAO) – Castleton – Frank Castellano (Principal)
- Field Staff – Castleton – Sarah Heyne (Staff Scientist)
- Data Validator – Laboratory Data Consultants, Inc. (LDC) of Carlsbad, California.

Personnel resumes are included as Appendix B.

3.1 Environmental Laboratory Accreditation Program

An ELAP-certified laboratory will be used for all sample analyses. The laboratory will follow the following QA/QC protocols. All samples will be delivered to the laboratory within 24 hours of sample collection. Samples will be received by laboratory personnel, who will inspect the sample cooler(s) to check the integrity of the custody seals. The cooler(s) will then be opened, the samples unpackaged, and the information on the chain-of-custody form examined. If the shipped samples match those described on the chain-of-custody form, the laboratory sample custodian will sign and date the form on the next "Received" blank and assume responsibility for the samples. If problems are noted with the sample shipment, the laboratory custodian will sign the form and record problems in the "Remarks" box. The custodian will then immediately notify the Project Manager so appropriate follow-up steps can be implemented on a timely basis.

A record of the information detailing the handling of a particular sample through each stage of analysis will be maintained by the laboratory. The record will include:

- Job reference, sample matrix, sample number, and date sampled;
- Date and time received by laboratory, holding conditions, and analytical parameters;
- Extraction date, time and extractor's initials (if applicable), analysis date, time, and analyst's initials; and
- QA batch number, date reviewed, and reviewer's initials.

The selected ELAP approved lab for this project: York Analytical Laboratories, Inc. (York) of Stratford, Connecticut.

The York Analytical New York State Department of Health (NYSDOH) ELAP Certification is included as Appendix C.

4.0 DATA QUALITY USABILITY OBJECTIVES

The overall data quality objectives of this QAPP is to collect and derive data that is of reliable and documented quality for its intended purpose. Specific to the proposed RI, the specific objectives include collected representative vapor, soil and groundwater samples of sufficient frequency and distribution to characterize the quality of soil and material relative to site specific Soil Cleanup Objectives (SCOs). By implementing appropriate QA/QC procedures for the sample collection, laboratory analysis, and validation will help ensure the analytical results are accurate and of documented quality which can be relied upon for decision making for future investigation and remediation activities.

5.0 SAMPLING AND DECONTAMINATION PROCEDURES

Field QA/QC will include the following procedures:

- Calibration of field equipment, including PID, daily;
- Use of dedicated and/or disposable field sampling equipment;
- Proper decontamination when non-disposable field equipment is utilized;
- Proper sample handling and preservation;
- Proper sample chain of custody documentation; and
- Completion of report logs.

The above procedures will be executed as follows:

- Disposable sampling equipment, including acetate sleeves, latex gloves, and disposable bailers (or sample tubing), will be used to minimize cross-contamination between samples;
- For each of the parameters analyzed, a sufficient sample volume will be collected to adhere to the specific analytical protocol, and provide sufficient sample for reanalysis if necessary;

Samples will be analyzed prior to the expiration of the respective holding time for each analytical parameter to ensure the integrity of the analytical results.

QA/QC procedures will be used to provide performance information regarding field procedures to:

- document that samples are representative of actual conditions at the Site and
- identify possible cross-contamination from field activities or sample transit.

Specific laboratory QA/QC procedures and analyses will be used to:

- demonstrate whether analytical results have been biased either by interfering compounds in the sample matrix, or
- by laboratory techniques that may have introduced systematic or random errors to the analytical process.

A summary of the field and laboratory QA/QC procedures is provided below. Detailed procedures are presented in the Field Activities Plan included as Appendix A.

Sample handling in the field will conform to appropriate sample custody procedures. Field custody procedures include proper sample identification, chain-of-custody forms, and packaging and shipping procedures. Sample labels will be attached to all sampling canisters before field activities begin to ensure proper sample identification. Each label will identify the site and sample location.

5.1 Sampling and Investigation Procedures

The RI is a multi-media investigation which includes sampling of soil, vapor and groundwater. A variety of sampling techniques may be utilized including:

- Surface Soil Sampling
- Hollow Stem Auger Drilling
- Split Spoon Sampling
- Direct Push Soil and Groundwater Sampling
- Vapor Screening
- Soil Vapor Implant and Ambient Air Sampling
- Groundwater Monitoring Well Installation and Sampling

Procedures for each of the above activities are presented in the Field Activities Plan included as Appendix A.

5.2 Decontamination Procedures

To ensure that cross-contamination or outside contamination is not introduced to samples and/or data, the following cleaning procedure will apply for non-dedicated sampling equipment prior to and between sample collection locations.

- Thoroughly clean equipment using a laboratory-grade (Liquinox) solution and scrubbing to remove visual contamination (Liquinox will not be used for the decontamination of 1,4-dioxane sample equipment);
- Rinse with water until soap is removed;
- Allow to dry before next use;
- If equipment is not to be used immediately, wrap in aluminum foil.

5.3 Chain of Custody Procedures

After each sample is collected and appropriately identified, the following information will be recorded on the chain-of-custody form:

- sample identification;
- date and time of sample collection;
- sampling depth;
- identity of samplers;
- sampling methods and devices;

- soil vapor purge volumes;
- volume of soil vapor extracted;
- if canisters used, vacuum of canisters before and after samples collected,
- apparent moisture content (dry, moist, saturated, etc.) of the sampling zone; and
- chain of custody protocols and records used to track samples from sampling point to analysis.

The sampler will sign and date the “Relinquished” blank space prior to removing one copy of the custody form and sealing the remaining copies of the form in a Ziploc plastic bag. The canisters will be picked up by a laboratory representative from the Site or hand delivered to the laboratory.

5.4 Field Logs and Reports

Field logs and borings logs will be completed throughout the course of this investigation. A field log will be completed daily which will describe all field activities including:

- Project number, name, manager, and address;
- The date and time;
- The weather conditions;
- On-site personnel and associated affiliations;
- Description of field activities; and
- Pertinent sample collection information including sample identification numbers, description of samples, location of sampling points, number of samples taken, method of sample collection and any factors that may affect its quality, time of sample collection, name of collector, and field screening results.

6.0 SAMPLING FOR EMERGING CONTAMINANTS UNDER NYSDEC PART 375

As part of the NYSDECs requirement, sampling of the emerging contaminants including 1,4-Dioxane and per and poly-fluoroalkyl substances (PFAS) will be performed during the IRM.

6.1 Specific Guidelines for PFAS

Soil endpoint samples collected will be analyzed by LC-MC/MS for PFAS using methodologies based on EPA method 537.1 and include the 21 PFAS compounds listed below:

Group	**Chemical Name**	**Abbreviation**
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS
	Perfluorohexanesulfonic acid	PFHxS
	Perfluoroheptanesulfonic acid	PFHpS
	Perfluorooctanesulfonic acid	PFOS
	Perfluorodecanesulfonic acid	PFDS
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA
	Perfluoropentanoic acid	PFPeA
	Perfluorohexanoic acid	PFHxA

	Perfluoroheptanoic acid	PFHpA
	Perfluorooctanoic acid	PFOA
	Perfluorononanoic acid	PFNA
	Perfluorodecanoic acid	PFDA
	Perfluoroundecanoic acid	PFUA/PFUdA
	Perfluorododecanoic acid	PFDoA
	Perfluorotridecanoic acid	PFTriA/PFTrDA
	Perfluorotetradecanoic acid	PFTA/PFTeDA
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS
	8:2 Fluorotelomer sulfonate	8:2 FTS
Perfluorooctanesulfonamides	Perfluroroctanesulfonamide	FOSA
Perfluorooctanesulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA

6.2 PFAS Reporting Limits

Reporting limits for PFAS soil are to be 2 ng/L (ppt) and 1 ug/kg (ppb), respectively. If contract labs or work plans submitted by responsible parties indicate that they are not able to achieve these reporting limits for the entire list of 21 PFAS, site-specific decisions will need to be made by the DEC project manager in consultation with the DEC remedial program chemist.

The laboratory SOP for PFAS and method detection limits are included as Appendix C.

6.3 PFAS Specific Sampling Procedures

Sampling for PFAS via EPA Method 537 can be challenging due to the prevalence of these compounds in many consumer and sampling specific products. The following sampling procedures and guidelines are necessary to ensure the usability of PFAS analytical results:

- Clothing or boots should not contain Gore-Tex (wet weather gear made of polyurethane and PVC only);
- All safety boots should be made from polyurethane and PVC;
- No materials containing Tyvek;
- Do not use fabric softener on field clothing;
- Do not use cosmetics, moisturizers, hand cream, or other related products the morning of the sampling event;
- Do not use unauthorized sunscreen or insect repellant;
- All sample containers made of HDPE or polypropylene;
- Caps are unlined and made of HDPE or polypropylene (no Teflon lined caps);
- Equipment decontamination must utilize PFAS-free water onsite for sample equipment;
- Only Alconox and/or Liquinox can be used as decontamination materials;
- Food or drinks must be left in the staging areas;
- Sample for PFAS first, other containers/methods may have PFAS present on containers/equipment;

- Field equipment must not contain Teflon;
- Sampling materials must be made from stainless-steel, HDPE, acetate, silicon, or polypropylene;
- No waterproof field books;
- No plastic clipboards, binders, or spiral notebooks;
- No adhesives
- No sharpies/permanent markers. Must use regular ball point pens;
- No use of aluminum foil;
- Keep PFAS samples in a separate cooler filled with regular ice only (do not use chemical ice packs).
- Sampler must wash hands before wearing nitrile gloves to limit contamination during sampling.

6.4 Specific Guidelines for 1,4-Dioxane

Soil endpoint samples collected will be analyzed for 1,4-Dioxane using EPA Method 8270 SIM in order to achieve the minimum method reporting limit of 0.1 mg/Kg. Liquinox will not be used for decontamination during sampling for 1,4-dioxane.

7.0 ANALYTICAL METHODS/QUALITY ASSURANCE

To assess the adequacy of the samples collected and decontamination procedures performed in the field, QA/QC samples shall be collected and analyzed throughout the field sampling program. In general, QA/QC samples shall confirm that the procedures performed in the field are consistent and acceptable. QA/QC samples must include trip blanks, field (or equipment) blanks, blind (or field) duplicates, matrix spike (MS), and matrix spike duplicate (MSD).

The anticipated sample matrices collected for the purpose of this QAPP include soil, vapor and groundwater samples. The types and frequencies of field QA/QC samples are provided in the table below:

QA/QC Samples	Frequency
Field/Equipment Blanks	1 per day / matrix
Trip Blanks	1 per cooler
Analytical Parameters	In accordance with 6 NYCRR Part 375.
Minimum reporting Limits	In accordance with 6 NYCRR Part 375
MS/MSD Samples to be Collected	1 each per 20 samples/matrix
Duplicate and Blind Duplicate Samples	1 each per 20 samples/matrix

Using the above frequencies and the proposed number of samples per matrix, a complete Sampling Frequency breakdown is presented in Table 1.

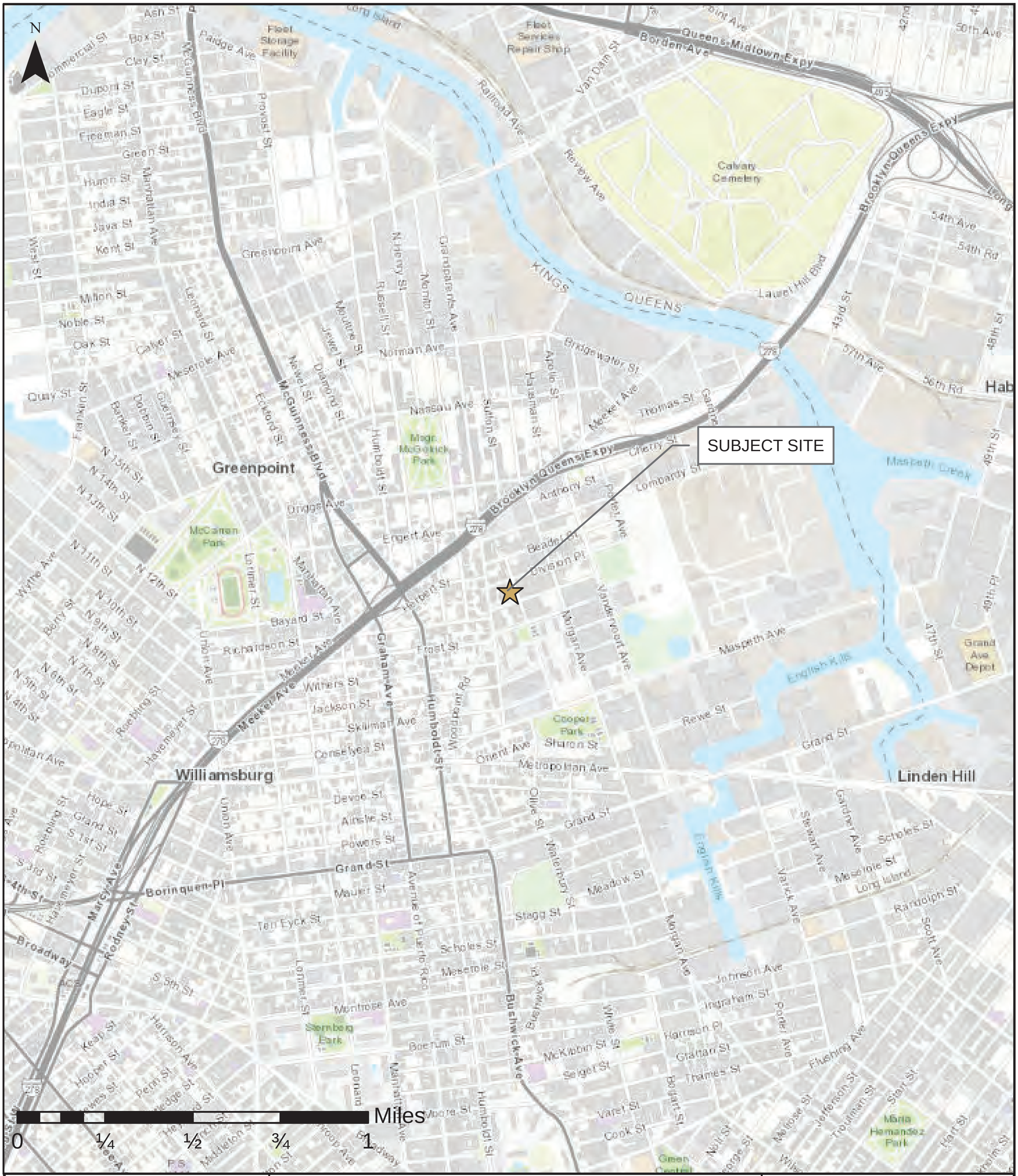
The following table summarizes the sample preservation methods, analytical methods, container volumes and types, and sample holding times per matrix:

Analyte Group	EPA Method(s)	Holding Time	Preservatives	Volume
Volatile Organics	8260	48 hours to freeze 14 days to analysis	Terracore: MeOH DI Water Unpreserved.	 (1) 45ml VOA (2) 45ml VOA (1) 45ml VOA
Semi Volatile Organics	8270	14 days	Ice	4oz jar
Pesticides	8081	14 days	Ice	4oz jar
PCBs	8082	14 days	Ice	4oz jar
Herbicides	8151	14 days	Ice	4oz jar
PFAS	537.1	14 days	Ice	(1) 250ml HDPE
1,4-Dioxane	8270 SIM	48 hours to freeze 14 days to analysis	Terracore: MeOH DI Water Unpreserved.	 (1) 45ml VOA (2) 45ml VOA (1) 45ml VOA
Metals	6010/6020	6 months (total) 28 days (Hg)	Ice	2oz jar

8.0 DATA USABILITY SUMMARY REPORT

A Category B Data Usability Summary Report (DUSR) will be prepared by a third-party contractor. This will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation and chain of custody procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method.

FIGURES



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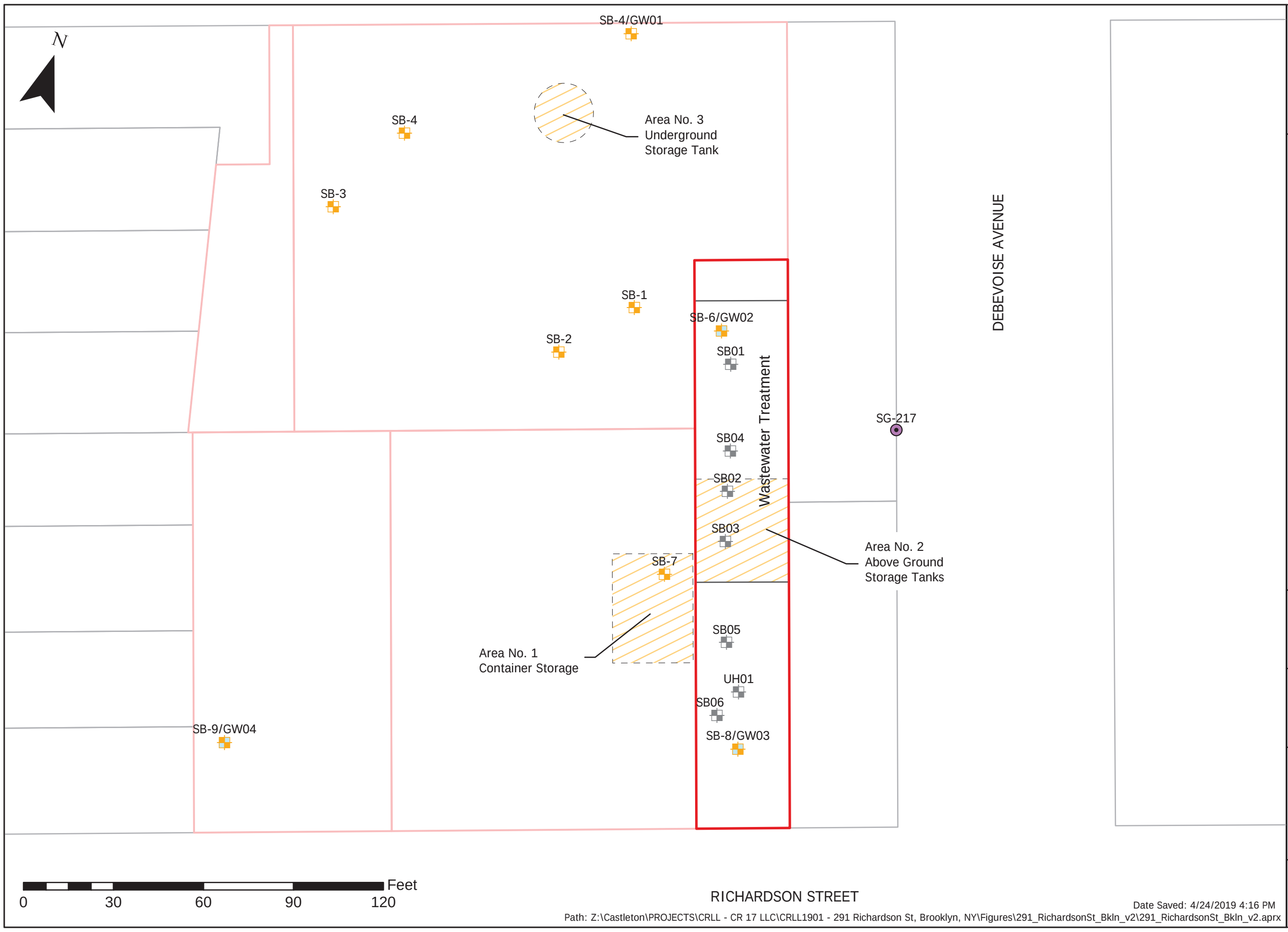
Site Location

291 Richardson Street
Brooklyn, New York

PROJECT:	CRLL1901
DATE:	3/1/2019
DRAWN BY:	BB
APPROVED BY:	FPC

FIGURE:

1



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- ▨ Soil Boring - Gannet Flemming 2003
- ▨ Soil & Groundwater - Gannett 2003
- ▨ AOC - NYSDEC 2005
- 🟥 Site Boundary
- ☐ Former Goodman Site Parcels
- ☐ Surrounding Parcels

PREPARED FOR:
Mr. Marshall Kesten
CR 17 LLC
1036 Manhattan Ave
Brooklyn, NY 11222

PROJECT:	GTJR1508
DATE:	6/14/2019
SCALE:	AS SHOWN
DRAWN BY:	BB
APPROVED BY:	FPC

SITE PLAN

291 RICHARDSON ST
BROOKLYN, NY

FIGURE:

2

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● Proposed Shallow Soil/Vapor Points
▨ AOC - NYSDEC 2005
🟥 Site Boundary
☐ Former Goodman Site Parcels

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SCALE:	AS SHOWN
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RIWP
Proposed Shallow Soil and Soil Vapor Screening Points

291 RICHARDSON ST
BROOKLYN, NY

FIGURE:

3

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⦿ Proposed Sub-Slab and Soil Vapor Point
▨ AOC - NYSDEC 2005
🟥 Site Boundary
□ Former Goodman Site Parcels

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PROJECT:	GTJR1508
DATE:	2/21/2020
SCALE:	AS SHOWN
DRAWN BY:	BB
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RIWP
Proposed Sub-Slab
and Soil Vapor
Sampling Points

291 RICHARDSON ST
BROOKLYN, NY

FIGURE:

4

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- Proposed Soil/Groundwater Boring
- AOC - NYSDEC 2005
- Site Boundary
- Former Goodman Site Parcels

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Brooklyn, NY 11222

PROJECT:	GTJR1508
DATE:	2/21/2020
SCALE:	AS SHOWN
DRAWN BY:	BB
APPROVED BY:	FPC

RIWP
Proposed Soil
and Groundwater
Borings

291 RICHARDSON ST
BROOKLYN, NY

FIGURE:
5

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- ⌖ Proposed Monitoring Well
- ▨ AOC - NYSDEC 2005
- 🟥 Site Boundary
- ☐ Former Goodman Site Parcels

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Brooklyn, NY 11222

PROJECT:	GTJR1508
DATE:	2/21/2020
SCALE:	AS SHOWN
DRAWN BY:	BB
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RIWP
Proposed Shallow
and Deep
Monitoring Wells

291 RICHARDSON ST
BROOKLYN, NY

FIGURE:

6

TABLES

TABLE 2
291 Richardson Street, Brooklyn, NY
Proposed Sampling Frequency, Matrices, and Analyses

Matrix	Analyte	USEPA Analytical Method	Shallow Soil Screening	Sub-Slab and Soil Vapor Investigation	Soil and Groundwater Borings	Monitoring Well Installation	Total Number of Samples	QC Samples					
								MS	MSD or MD	FD	EB	TB	Grand Total
Soil													
	TCL VOCs	8260	7		8	8	23	2	2	2	2	3	34
	TCL SVOCs	8270	7		8	8	23	2	2	2	2		31
	TCL Pesticides and PCBs	8080/8082	7		8	8	23	2	2	2	2		31
	TAL Metals	6010/7471	7		8	8	23	2	2	2	2		31
	PFAS (PFAS Analyte List)	537m	7		8	8	23	2	2	2	2		31
	1,4-Dioxane	8270 SIM	7		8	8	23	2	2	2	2		31
Sub-Slab/Soil Vapor and Ambient Air													
	VOCs	TO-15		8			8	1	1	1			11
Groundwater													
	TCL VOCs	8260			8	4	12	1	1	1	1	1	17
	TCL SVOCs	8270			8	4	12	1	1	1	1		16
	TCL Pesticides and PCBs	8080/8082			8	4	12	1	1	1	1		16
	TAL Metals	6010/7471			8	8	16	1	1	1	1		20
	PFAS (PFAS Analyte List)	537m			8	4	12	1	1	1	1		16
	1,4-Dioxane	8270 SIM			8	4	12	1	1	1	1		16
Non-Aqueous Phase Liquids (if necessary)													
	Specifc Gravity	D1298											
	TCL VOCs	8260											
	PCBs	8082											
	Petroleum Product ID	310.13											
	Viscocity @ 15 Deg C.	D455											
	Interfacial Tension @ 15 Deg C.	D791											
Waste Profile/Disposal Samples (if necessary)													
	RCRA Characteristics	1030/9045/SW846											
	Full TCLP	1311/8260/8270/8081/8151/6010/7470											

Notes:

The total number of samples are estimated and may be changed based upon the screening/sampling results.

EB-Equip Blank for Non-Dedicated Equip
FD-Field Duplicate
MD-Matrix Dupicate
MS-Matrix Spike
MSD-Matrix Spike Duplicate
TB-Trip Blank

APPENDIX A – FIELD ACTIVITIES PLAN

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Field Activities Plan

Former Goodman Brothers Steel Drum Co.
291 Richardson Street
Brooklyn, New York
NYSDEC Site Number: 224292

February 2020

Prepared for:
CR 17 LLC.
1036 Manhattan Avenue
Brooklyn, New York 11222

CASTLETON
ENVIRONMENTAL

FIELD ACTIVITIES PLAN
FOR
REMEDIAL INVESTIGATIONS
CASTLETON PROJECT NO: CRLL1902
FEBRUARY 2020

Table of Contents

Appendices

1.0 INTRODUCTION

Castleton Environmental Geologic Services, DPC (Castleton), has prepared this Field Activity Plan (FAP) which is designed to provide detailed step-by-step procedures for the field activities associated with work activities for Remedial Investigations. It will serve as the field procedures manual to be strictly followed by all Castleton personnel. Adherence to these procedures will ensure the quality and defensibility of the field data collected. In addition to the field procedures outlined in this document, all personnel performing field activities must do so in compliance with: (1) the Quality Assurance/Quality Control measures outlined in the existing Quality Assurance Project Plan; (QAPP); (2) the appropriate Health and Safety guidelines found in the existing Health and Safety Plan (HASP); and (3) the scope of work outlined in the Project Work Plan.

2.0 MOBILIZATION

A mobile decontamination trough or temporary decontamination pad will be available at the site to decontaminate equipment used for the subsurface investigations. The decontamination pad will be of sufficient size to allow equipment and materials to be cleaned as needed for the various tasks.

Prior to each field phase, proposed sampling locations will be staked, labeled and flagged prior to sampling. Utilities in areas designated for intrusive activities will be cleared through Dig Safely New York, at http://www.digsafelynewyork.com. Vehicle access routes to drilling and boring locations shall be determined and cleared prior to field activities.

If overhead electric is nearby, field staff will coordinate with Consolidated Edison Company of New York, Inc. to arrange rubber bumper protection on the overhead wires. The contact for Con Edison is (347) 672-3236; CustC2@coned.com

3.0 SUBSURFACE INVESTIGATION

3.1 General Program

The subsurface investigation programs under the various Project Work Plans will provide information that will assist in geologic, geotechnical, hydrogeological and chemical site interpretation. Proposed investigation locations are described in the Project Work Plans. Typical field procedures for the various activities are described below.

3.2 Surface Soil Sampling

Summary: If areas of exposed surface soil are present, representative soil samples will be collected for chemical analysis of the target compounds.

Procedure:

1. Remove any vegetation and the upper two inches of soil.
2. Using a disposable or decontaminated trowel, excavate soils down to a maximum depth of six inches and place the soil in a decontaminated steel bowl. Collect a sufficient quantity of soil as needed for the intended chemical analyses.
3. Place the desired quantity of soil for the volatile organic compound (VOC) analysis directly into the appropriate laboratory-supplied container.
4. Homogenize the remaining soil and place in the appropriate laboratory-supplied containers.
5. All sample bottles will be labeled in the field using a waterproof permanent marker.
6. Surface soil samples will be placed on ice and shipped overnight to the laboratory under chain of custody (COC) control.

3.3 Test Pit Excavation

Summary: Test pits allow for visual inspection and sample collection directly from the subsurface.

Procedure:

1. Decontaminate backhoe bucket prior to excavation.
2. Maneuver backhoe into position.
3. Remove subsurface materials in 1-foot lifts. Conduct continuous air monitoring with appropriate air monitoring equipment as indicated in the HASP. Screen soil with photoionization detector (PID) and place excavated soil on plastic sheeting adjacent to test pit.
4. Upon completion of test pit, visually inspect the soil horizons for discoloration, perched water zones or staining and photo document the test pit.
5. Record the following information in the fieldbook for each test pit:
    - The total length and width of the excavation
    - The depth and thickness of distinct soil or lithologic units
    - A lithologic description of each unit
    - A description of any man-made materials or apparent impacted soil encountered
    - A Test Pit Log sheet will be completed for each test pit (Appendix A).
6. Collect necessary soil samples. The excavator will collect a sample from a specific horizon and bring the sample to the ground surface. No personnel will enter the excavation to collect samples. The sampler will remove approximately 2 inches of soil from the outside of the soil sample prior to collecting the sample to prevent cross contamination of the sample.
7. Soil samples will be placed on ice and shipped overnight to the laboratory under COC control.
8. The test pit will be backfilled with excavated material immediately after the required information has been recorded and the samples collected. The first soils out should be

the last soils in when filling the test pit. Soils will be compacted in 1-foot lifts using the excavator bucket. No test pits will be left open overnight.

9. Decontaminate sampling equipment and excavator bucket.

3.4 Vac-Tron® Utility Clearance

Summary: Excavation with a Vac-Tron® unit allows for excavation near subsurface utilities with reduced chance of impacting the utilities.

Procedure:

1. Excavate a two-foot square by approximately five-foot deep area manually using post-hole diggers, pry bars, soil knifes, and/or hand digging, along with the Vac-Tron® unit.
2. After the location is cleared for drilling, the hole will be backfilled flush with the sidewalk using the excavated spoils (small rocks and debris removed) and if necessary, temporarily patched with blacktop patch or concrete.
3. Excavated material not returned to the hole will be drummed along with the monitoring well boring spoils for proper disposal.

3.5 Hollow-Stem Auger Drilling Procedures

Summary: A standard method of subsurface drilling which enables the recovery of representative subsurface samples for identification and laboratory testing.

Procedure:

1. Hollow stem augers (HSAs), drill rods, and the drill rig will be thoroughly decontaminated prior to initial borehole installation and between each borehole at the centralized decontamination area. All decontamination liquids will be collected and placed in DOTapproved 55-gallon drums.
2. The drill rig will be inspected for oil leaks and any leaks reported prior to starting drilling operations.
3. Advance the boring by rotating and advancing the HSAs to the desired depth. The borings will be advanced incrementally to permit continuous or intermittent subsurface soil sampling, as required.
4. Remove center plug from the HSAs and collect a split spoon sample per the method stipulated by the project geologist or hydrogeologist.

References: *American Society for Testing and Materials (ASTM) Standard Practice for Soil Exploration and Sampling by Auger Borings D1452/D1452M-16, and Standard Test Method for Standard Penetration Test (SPT) and Split Barrel Sampling of Soils D1586-11*.

3.6 Rotosonic Drilling Procedures

Summary: Rotosonic Drilling (aka. Sonic Drilling, Rotosonic, Rotary Sonic, Sonicore or Resonant Sonic Drilling) is a subsurface drilling method that employs the use of high frequency mechanical vibrations to take continuous core samples of overburden and most bedrock formations using a dual cased drill string. Rotosonic drilling is also used to advance casing in the ground for the installation of monitoring wells and other purposes.

Procedure:

1. Core barrel and outer casing will be decontaminated prior to advancing boreholes.
2. The core barrel (core barrels are typically 5, 10 or 20 feet in length) is attached to the drill head. The boring is advanced by rotating the core barrel incrementally to the desired depth. The borings will be advanced incrementally to permit continuous subsurface soil sampling.
3. Once the core barrel is driven to its incremental depth (i.e., 5, 10 or 20 feet), the drill head is disconnected from the core barrel and connected to the outer casing. The outer casing is then driven down over the core barrel. Note: A small amount of water may be used during the driving of the outer casing to flush materials from the annular space between the core barrel and the outer casing.
4. The drill head is disconnected from the outer casing and reattached to the core barrel. The core barrel is brought to the surface and a clear polyethylene tube is attached to the end of the core barrel. The drive head is vibrated which extrudes the soil sample into the polyethylene tube.
5. The core barrel is reinserted into the outer casing and the boring is advanced to the desired depth by repeating Steps 2 through 4.
6. Split the sample lengthwise and screen the soil with a PID for volatile organic vapors
7. Document all properties and sample locations in the field notebook, and later on the Boring Log form (Appendix A).

Reference: *ASTM Standard Practice for Sonic Drilling for Site Characterization and the Installation of Subsurface Monitoring Devices D6914/D6914M-16*.

3.7 NX-Rock Coring Procedures

Summary: NX-Coring is a standard method of subsurface drilling which enables the recovery of bedrock cores for identification.

Procedure:

1. Advance the boring into the bedrock by core drilling using an NX-size, double-tube, swiveltype core barrel. Continue drilling until core blockage occCastleton or until the net length of the core barrel has been drilled.
2. Remove the core barrel from the hole and disassemble it as necessary to remove the core. Reassemble the core barrel and return it to the hole. Resume coring.
3. Place recovered core in the core box with the upper (surface) end of the core at the upper-left corner of the core box. Fit fractured, bedded, or jointed pieces of core together as they naturally occurred.
4. Label core box with borehole ID, date, time, and depth interval of core.
5. The following observations will be recorded from the rock core:

- Core recovery percent
- Color
- Rock classification
- Rock hardness
- Rock fractures, including descriptions of natural breaks
- Rock Quality Designation (RQD)

RQD = Sum of core lengths > 4”   X 100%   Total length of core run

Reference: *ASTM Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration D2113-14*.

3.8 Wash/Mud Rotary Drilling Procedures

<u>Summary:</u> Wash/mud rotary drilling is a method of subsurface drilling wherein a drilling fluid (water or drill mud) is circulated through the drill string and drill bit, and up through HSAs or casing, if present, to flush cuttings out of the borehole and lubricate drilling tools.

Procedure:

1. Connect drilling water supply pump to drill string.
2. Advance the boring by spinning the drill bit the desired distance into the subsurface.
3. Use a recirculating system to collect and separate cuttings rising out of the borehole.
4. Note rate of drilling and volume of water/mud lost down the borehole.

Reference: *ASTM Standard Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface WaterQuality Monitoring Devices1 D5783-95*.

3.9 Air Rotary Drilling Procedures

<u>Summary:</u> Air rotary drilling is a method of subsurface drilling wherein compressed air is circulated through the drill string and drill bit, and up through HSAs or casing, if present, to flush cuttings out of the borehole and lubricate drilling tools.

Procedure:

1. Connect air compressor discharge hose to drill string.
2. Advance the boring by spinning the drill bit the desired distance into the subsurface.
3. Use a cyclone system to collect and containerize cuttings rising out of the borehole.
4. Note rate of drilling down the borehole.

Reference: *ASTM Standard Guide for Use of Direct Air Rotary Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices1 D5782-95*.

3.10 Split-Spoon Sampling Procedures

Summary: Split-spoon sampling is a standard method of soil sampling to obtain representative samples for identification and laboratory testing as well as to serve as a measure of resistance of soil to sampler penetration. Split-spoon samples will be collected during boring advancement at continuous 2 foot intervals.

Procedure:

1. Measure the sampling equipment lengths to ensure that they conform to specifications. Confirm the weight of the hammer (140 pounds.).
2. Clean out the HSAs to the bottom depth prior to sampling. Select additional components as required (i.e., leaf spring core retainer for clays or a sand trap for non-cohesive sands).
3. Lower the decontaminated 2-inch outside diameter (O.D.) split-spoon to the bottom of the HSAs and check the depth against length of the rods and the split-spoon.
4. Attach the drive head and hammer to the drill rods without the weight of the hammer resting on the rods.
5. Lower the weight and allow the split-spoon to settle up to 6 inches below the bottom of the HSAs. If it settles more, consider use of another type of sampler.
6. Mark four 6-inch intervals on the drill rods relative to a drive reference point on the rig. With the split-spoon resting on the bottom of the hole, drive the split-spoon with the 140-pound hammer falling freely over its 30-inch fall until 24 inches have been penetrated or 50 blows have applied in any 6-inch interval.
7. Record the number of blows required to drive the split-spoon 6 inches into the overburden. Determine the "N" value by adding the blows for the 6-to 12-inch and 12-to 18-inch interval of each sample attempt.
8. After penetration is complete, remove the split-spoon sampler.
9. Open the split-spoon to determine the percent recovery, and describe the soil.
10. Split the sample lengthwise and screen the soil with a PID for volatile organic vapors.
11. Document all properties and sample locations in the field notebook, and later on the Boring Log form (Appendix A).

Reference: *ASTM Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils D1586-11*.

3.10.1 Unified Soil Classification System

Soils are classified for engineering purposes according to the Unified Soil Classification System (USCS) adopted by the U.S. Army Corps of Engineers and U.S. Department of the Interior Bureau of Reclamation. Soil properties that form the basis for the USCS are:

- Percentage of gravel, sand, and fines;
- Shape of the grain-size distribution curve; and
- Plasticity and compressibility characteristics.

According to this system, all soils are divided into three major groups: coarse-grained, fine-grained, and highly-organic (peaty). The boundary between coarse-grained and fine-grained soils is taken to be the 200-mesh sieve (0.074 mm). In the field the distinction is based on whether the individual particles can be seen with the unaided eye. If more than 50% of the soil by weight is judged to consist of grains that can be distinguished separately, the soil is considered to be coarse-grained.

The coarse-grained soils are divided into gravelly (G) or sandy (S) soils, depending on whether more or less than 50% of the visible grains are larger than the No. 4 sieve (3/16 inch).
They are each divided further into four groups:

W: Well graded; fairly clean (<5% finer than 0.074 mm)
P: Poorly graded (gap-graded); fairly clean (<5% finer than 0.074mm)
C: Clayey (>12% finer than 0.074mm); plastic (clayey) fines. Fine fraction above the A- line with plasticity index above 7.
M: Silty (>12% finer than 0.074 mm); non-plastic or silty fines. Fine fraction below the A- line and plasticity index below 4.

The soils are represented by symbols such as GW or SP. Borderline materials are represented by a double symbol, as GW-GC.

The fine-grained soils are divided into three groups: inorganic silts (M), inorganic clays (C), and organic silts and clays (O). The soils are further divided into those having liquid limits lower than 50% (L), or higher than 50% (H).

The distinction between the inorganic clays (C), the inorganic silts (M), and organic soils (O) is made on the basis of a modified plasticity chart. Soils CH and CL are represented by points above the A-line, whereas soils OH, OL, and MH correspond to positions below the Aline. Soils ML, except for a few clayey fine sands, are also represented by points below the Aline. The organic soils O are distinguished from the inorganic soils M and C by their characteristic odor and dark color.

Reference: *ASTM Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) D2487-17*.

3.10.2 Visual Identification

Soil samples collected during boring advancement will be visually identified. Soil properties required to define the USCS classification of a soil and other observed characteristics normally identified in describing a soil are defined below:

- Color

- Moisture conditions
- Grain size
    - Estimated maximum grain size
    - Estimated percent by weight of fines (material passing No. 200 sieve)

- Gradation

- Grain shape

- Plasticity

- Predominant soil type

- Secondary components of soil

- Classification symbol

- Other features such as:
    - organic, chemical, or metallic content;
    - compactness;
    - consistency;
    - cohesiveness near plastic limit;
    - dry strength; and
    - source - residual, or transported (aeolian, water borne, glacial deposit, etc.)

Reference: *ASTM Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) D2488-17*.

3.11 Shelby Tube Sampling Procedures

Summary: Shelby (thin-wall) tube sampling is commonly used in cohesive soils (where splitspoon sampling results in an "N" value less than 15) to obtain relatively undisturbed samples. The thin-walled tube accepts the least frictional resistance as the soil moves up into the sampler. The sampler is advanced in a continuous and rapid motion without twisting on impact.

Procedure:

1. Clean borehole to the required sampling depth, using care not to disturb the material to be sampled during the cleaning process.
2. Prepare the sampler for use, verifying that the tube is round, smooth, not dented or scratched, rust-free, and that the cutting edge has been honed to proper dimensions.

3. Record dimensions of the sampler. Note that the length and diameter of the sampler can be varied depending on soil conditions.
4. Lower the sampler on the drill rods to the bottom of the hole.
5. Make a reference point on the drilling rig and measure a length on the rods equivalent to the sample tube length, minus 10% (this allows for slough in the hole).
6. Raise the water level in the hole to ground surface or above, if practical (this step likely may be omitted).
7. Push the sampler the required distance into the soil with continuous motion of consistent weight.
8. If the sampler cannot be advanced by pushing, note the length advanced and stop sampling.
9. Rotate the rods three revolutions, using a wrench to shear the sample. Allow the sampler to sit undisturbed for five minutes.
10. Withdraw the sampler slowly and pull rods evenly to retrieve the sample. Measure sample length and calculate recovery.
11. Clean out the rod end of the tube and discard disturbed slough. Trim cutting edge of the sampler. Use the cuttings for onsite description and, if required, a moisture content sample.
12. If sample length is recessed from either end, insert plug and seal with wax. If the tube is full, seal ends with caps and/or wax the ends, including the caps if possible.
13. Label the sample container and prepare sample for shipping and/or storage.
14. Store and transport sample(s) in an upright position.

Reference: *ASTM Standard Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes D1587/D1587M-15*.

3.12 Direct Push Groundwater Sampling

Summary: A standard method of subsurface boring which enables the recovery of representative subsurface samples for groundwater screening.

Procedure:

1. A Screen Point Sampler 15 (SP15) groundwater sampler, or an equivalent unit, will be utilized to collect groundwater samples in direct push borings that intercept the groundwater table.
2. To collect groundwater samples, a clean sampler will be threaded onto the leading end of the probe rod and lowered or driven to the desired sampling interval (approximately 1 foot below the top of the water table). While the sampler is driven to depth, O-ring seals at the drive head and expendable drive point will provide a watertight system.
3. Once at the desired sampling depth, chase rods will be sent down-hole until the leading rod contacts the bottom of the sampler screen. The tool string will then be retracted while the screen is held in place by the chase rods. As the tool string is retracted, the expendable point is released from the sampler sheath. An O-ring on the screen head

maintains the seal at the top of the screen. As a result, any liquid entering the sampler during screen deployment must first pass through the screen.

4. The tool string and sheath may be retracted the full length of the screen or as little as a few inches if a small sampling interval is desired. The SP15 Sampler utilizes a screen with a standard slot size of 0.004 inches and an exposed length of 41 inches.
5. A minimum of 1 gallon of water will be purged from the sampler prior to sample collection with dedicated Teflon or polyethylene tubing of laboratory or food grade quality, and a check valve. The groundwater sample will be collected with dedicated Teflon or polyethylene tubing of laboratory or food grade quality, and a check valve.
6. Groundwater samples will be placed on ice and shipped to the laboratory under COC for analysis.
7. Upon the completion of the sampling, the sampler will be removed and the borehole will be backfilled with bentonite pellets and the surface will be repaired with similar material (i.e., concrete, asphalt or topsoil); and marked with spray paint.

Reference: *ASTM Standard Guide for Direct-Push Groundwater Sampling for Environmental Site Characterization D6001-05(2012)*.

3.13 Direct-Push Soil Sampling

Summary: A standard method of subsurface boring using hydraulically powered (static force plus percussion) soil-probing equipment that enables the recovery of representative subsurface samples for identification and laboratory testing.

Procedure:

1. Inspect the sampling equipment to ensure proper working condition.
2. Insert dedicated disposable acetate liner into the sampler and select additional components for the sampler as required (i.e., leaf spring core retainer for clays, or a sand trap for noncohesive sands).
3. Lower the sampler to the ground surface, or bottom of the hole previously made by the sampler, and check the depth against length of the rods and the sampler.
4. Attach the drive head assembly to the sample rods.
5. Push the sampler in increments up to 5 feet into the subsurface up to the desired depth with a hydraulic press.
6. Rotate the sampling rods clockwise and remove the sampler.
7. Split the sample lengthwise and screen the soil with a PID for volatile organic vapors.
8. Document all properties and sample locations in the field notebook, and later on the DirectPush Log form (Appendix A).
9. Abandon the direct-push boring by backfilling with bentonite pellets and hydrate with potable water or use concrete patch in impervious areas.

Reference: *ASTM Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations D6282/D6282M-14*.

3.13.1 Remote Direct-Push Soil Sampling

Summary: Standard equipment used for remote direct push sampling is the 420M Geoprobe® (or similar unit). This is a light weight and durable limited access machine designed to be deployed to hard-to-reach or limited access sampling locations. The machine is powered by a remote hydraulic source which is connected through auxiliary hydraulics.

Procedure:

1. Read and understand all safety, maintenance and operations instructions regarding this machine before beginning operations.
2. Maneuver the probe unit to place the probe foot near the desired probing location.
3. Position the power source near the unit leaving sufficient distance so as not to be in the way of probing activities.
4. The probe unit is intended for operations on level surfaces. Do not use on slopes greater than 2 degrees due to decreased stability.
5. Connect hydraulic hoses to probe unit and power source.
6. Start the engine of the hydraulic power source to allow engine and hydraulics to warm sufficiently and ensure there is adequate ventilation for exhaust fumes.
7. Make sure everyone is clear of any moving parts before engaging the hydraulics of the probe unit. Check the emergency stop button for proper operation. If the emergency stop button doesn't work, cease operations.
8. Anchor the probe derrick to floor or ground surface as needed based on conditions.
9. Insert dedicated disposable acetate liner into the sampler and select additional components for the sampler as required (i.e., leaf spring core retainer for clays, or a sand trap for noncohesive sands).
10. Lower the sampler to the ground surface, or bottom of the hole previously made by the sampler, and check the depth against length of the rods and the sampler.
11. Attach the drive head assembly to the sample rods.
12. Push the sampler in increments up to 5 feet into the subsurface up to the desired depth with a hydraulic press.
13. Rotate the sampling rods clockwise and remove the sampler. Split the sample lengthwise and screen the soil with a PID for volatile organic vapors.
14. Document all properties and sample locations in the field notebook, and later on the DirectPush Log form (Appendix A).
15. Abandon the direct-push boring by backfilling with bentonite pellets and hydrate with potable water or use concrete patch in impervious areas.

Reference: *ASTM Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations D6282/D6282M-14*.

3.14 Bucket Auger Sampling

Summary: A standard method of shallow subsurface boring using a bucket auger that enables the recovery of representative subsurface samples for identification and laboratory testing.

Procedure:

1. Remove stones, vegetation, debris etc. from the ground surface in the sampling area.
2. Lay a section of plastic sheet adjacent to the soil sampling location.
3. Use a clean (decontaminated) bucket auger, required extension rods and “T” handle to collect a soil sample from the desired depth.
4. Monitor VOCs in the ambient air during soil collection.
5. Turn the auger in a clockwise direction with the “T” handle to remove soil until the desired soil sampling depth is reached. Place the excavated soil on the adjacent plastic. If possible lay out the cuttings in stratigraphic order.
6. During auger advancement record observations made of the geologic features of the soil.
7. Stop advancing the auger when the top of the specified sampling depth has been reached. Decontaminate the auger.
8. Insert the auger into the borehole to the sample depth and collect the sample. Place sample on ice and ship overnight to the lab under COC custody.
9. Decontaminate the auger bucket and complete the preceding steps for sample collection from deeper depths.
10. When sampling is complete, place cuttings back in the borehole in the order in which they were removed if possible. Top off with hydrated bentonite pellets.

Reference: *ASTM Standard Practice for Sampling Soils and Contaminated Media with HandOperated Bucket Augers D6907-05(2016).*

3.15 Soil Vapor Implant Installation

Summary: A method for construction of soil vapor implants within unconsolidated material, which enables acquisition of soil vapor samples for laboratory testing. The soil vapor implants will be installed using the procedures described below.

Procedure:

1. Implants shall be 6 inches in length (e. g., Geoprobe® AT86 series) and are to be constructed of double woven stainless steel wire screen. Implants shall have a pore diameter of 0.0057 inch, which is equivalent to a 0.007 slot well screen. The bottom of the implants must have a post run tubing (PRT) style thread; the same fitting style used with Geoprobe® PRT vapor sampling tools. The top connection with the Teflon or polyethylene tubing shall be stainless steel Swagelok® or clamp fitting to prevent leakage during sample collection. The connection to the sampling Summa® canister shall be made through the use of 1/8th inch ID Teflon or polyethylene tubing.

2. Once the rods have been advanced to the desired depth, attach appropriate tubing to the implant to be installed. Allow at least 48 inches of tubing length longer than the required depth of the implant. Cover or plug the end of the tubing.
3. Remove the pull cap from the rods and lower the implant and tubing down inside the diameter of the rods until the implant hits the top of the Anchor/Drive Point. Note the length of the tubing to ensure proper depth has been reached.
4. Rotate tubing counterclockwise while exerting a gentle downward force to engage the PRT threads. Pull up on the tubing lightly to test the connection. DO NOT cut excess tubing.
5. Position a probe rod pull plate or manual probe rod jack on the top of the probe rod. Exert downward pressure on the tubing while pulling the probe rods up. Pull up about 12 inches.
6. Thread excess tubing through the bottom of a funnel and position funnel over top of probe rod. The funnel will be used to facilitate installation of sand into the borehole around the screened portion of the implant.
7. Pour sand into the funnel and down the inside diameter of the probe rods around the outside of the tubing and around the screen of the implant. Use tubing to “stir” sand into place. [NOTE: sand and bentonite can only be installed in the vadose zone (unsaturated zone above the water table)].
8. Lift up an additional 18 to 24 inches and insert a bentonite slurry above beads or sand.
9. Pull remaining rods out of the hole and complete with bentonite slurry.
10. Cut any excess tubing to allow approximately 8 to 12 inches to extend above the ground surface. Plug the tubing with a cap or plug.
11. Install a protective casing (road box) over the tubing and set it into concrete.
12. Document well construction in the field notebook and later on a Soil Vapor Implant Construction Detail diagram (Appendix A).

Reference: *ASTM Standard Practice for Active Soil Gas Sampling in the Vadose Zone for Vapor Intrusion Evaluations. D7663-12*.

3.16 Soil Vapor Implant Sampling

Summary: The soil vapor implants will not be sampled until a minimum of 24-hoCastleton after installation has passed. To collect representative soil vapor samples, soil vapor implant tubing must be adequately sealed to prevent ambient air from being sampled. A helium tracer gas will be used to verify the integrity of the soil vapor implant seal. The soil vapor implants must be purged prior to sampling. Sampling should commence immediately after purging.

Procedure:

1. Inspect the existing tubing. Check for any signs of cracks, clogging or any other characteristics that may impact the collection of a representative sample.
2. Apply a bentonite slurry to the ground surface in an approximate 2-ft diameter circle. Place an approximately 2 ft. by 2 ft. square of plastic sheeting over the bentonite slurry.

Poke a hole, only as large as needed for the sampling tube to penetrate the plastic. Seal the plastic sheeting/tube interface with a small amount of bentonite slurry.

3. Place an enclosure over the well head, run well tubing through in the top outlet. Use plumber's putty to seal the interface between the tubing and the top of the enclosure.
4. Seal enclosure at the ground surface with a bentonite slurry.
5. Connect helium (99.999%) cylinder to side port of enclosure.
6. Release enough helium to displace any ambient air in enclosure. Continue flushing the inside of the enclosure with helium gas.
7. Connect the tubing to the vacuum pump. Use only new Teflon or HDPE tubing if needed for length and new silicone tubing for leak free unions. Do not reuse any tubing between sample locations.
8. Purge the soil vapor implant; remove one to three volumes of soil vapor. Flow rates for purging and sampling must not exceed 0.2 liters per minute (L/min) to minimize outdoor air infiltration during purging/sampling. Record start and stop time on the Summa Canister Sampling Field Data Sheet (Appendix A). Verify air is being drawn from the monitoring well by placing finger on the vacuum pump outlet tube to check for positive pressure. Helium cylinder should be open during the purge time, enough to cause a positive pressure within the enclosure.
9. After purging completed, disconnect the vacuum pump from the tubing.
10. Connect the Mark Helium Detector (Model 9822) to soil vapor implant tubing. Obtain readings. Absence of helium (< 10%) assures that the implant seal is competent and ambient air is not entering the soil vapor implant.

<u>Using Flow Controllers Without a Built in Pressure Gauge:</u>

1. Attach the pressure gauge provided by the laboratory to the Summa® canister, open valve completely, record reading on the Summa Canister Sampling Field Data Sheet (Appendix A), close valve completely, and remove the pressure gauge. If the canister does not show an initial vacuum of approximately 25 inches of mercury (in. Hg), do not use. Record the canister's serial number on the Summa Canister Sampling Field Data Sheet. Assign sample identification to the canister identification tag and record on the COC (Appendix A), and the Summa Canister Sampling Field Data Sheet.
2. Attach flow controller provided by the laboratory to the Summa® canister inlet (one for each Summa® canister). Do not reuse flow controllers between locations. Each flow controller is pre-set by the laboratory to collect the sample over a one hour period.
3. Attach tubing from the soil vapor implant to the flow controller on the Summa® canister. All tubing used in this step should be the same tubing that Project Work Plans used in the purging process.
4. Open canister valve to initiate sample collection and record start time and date on the canister identification tag and on the Summa Canister Sampling Field Data Sheet.
5. The helium cylinder should remain open during sampling set-up to cause a positive pressure in the enclosure. Because of the one-hour sampling time, more than one location may be sampled at the same time (with staggered starting times). When you are

ready to move onto the next location, stop the flow of the helium with the valve on the regulator, and seal ports on the enclosure to maintain the helium atmosphere within the enclosure.

6. After one hour, close the Summa® canister valve completely. Record the time on the Summa Canister Sampling Field Data Sheet.
7. Disconnect tubing.
8. Remove the flow controller, attach the pressure gauge to the Summa® canister, open valve completely, record reading, close valve completely, and remove the pressure gauge. Record the pressure reading on the Summa Canister Sampling Field Data Sheet. There should still be a slight vacuum in the Summa® canister. If no vacuum remains in the canister, do not send the canister for analysis. Retake the sample using the same procedure with a fresh canister.
9. If the canister does not show a significant net loss in vacuum after sampling, evaluate and document the problem. If necessary, use another Summa® canister to recollect the sample and contact the project manager immediately.
10. Connect the helium detector to soil vapor implant tubing. Obtain and record reading. Absence of helium (< 10%) assures that the conduit seal is competent and ambient air is not entering the soil vapor implant.
11. Ship canister standard overnight, with COC to the laboratory for analyses by USEPA Method TO-15 for VOCs with a minimum-reporting limit of 1 µg/m3.

<u>Using Flow Controllers With a Built in Pressure Gauge:</u>

1. Attach the flow controller provided by the laboratory to the Summa® canister inlet (you must have one for each canister). Do not reuse flow controllers between locations. Each flow controller is pre-set by the laboratory to collect the sample over a one hour period. Record the canister's serial number on the Summa Canister Sampling Field Data Sheet. Assign sample identification to the canister identification tag and record on the COC and the Summa Canister Sampling Field Data Sheet.
2. Attach tubing from the soil vapor implant to the flow controller on the Summa® canister. All tubing used in this step should be the same tubing that Project Work Plans used in the purging process.
3. Open Summa® canister valve completely and record the time and pressure on the Summa Canister Sampling Field Data Sheet. If the canister does not show an initial vacuum of approximately 25 in. Hg, do not use.
4. The helium cylinder should remain open during sampling set-up to cause a positive pressure in the enclosure. Because of the one hour sampling time, more than one location may be sampled at the same time (with staggered starting times). When you are ready to move onto the next location, stop the flow of the helium with the valve on the regulator, and seal ports on the enclosure to maintain the helium atmosphere within the enclosure.
5. After one hour, close the Summa® canister valve completely and record the time and pressure on the Summa Canister Sampling Field Data Sheet. There should still be a slight

vacuum in the Summa® canister. If no vacuum remains in the canister, do not send the canister for analysis. Retake the sample using the same procedure with a fresh canister.

6. If the canister does not show a significant net loss in vacuum after sampling, evaluate and document the problem. If necessary, use another Summa® canister to recollect the sample and contact the project manager immediately.
7. Connect the helium detector to soil-gas conduit tubing. Obtain and record readings. Absence of helium (< 10%) assures that the conduit seal is competent and ambient air is not entering the soil-gas conduit.
8. Disconnect tubing.

Reference: *ASTM Standard Practice for Active Soil Gas Sampling in the Vadose Zone for Vapor Intrusion Evaluations. D7663-12*.

3.17 Soil Vapor Implant Decommissioning Procedures

Procedure:
At each location the following will occur:

1. The soil vapor implant will be removed;
2. The flush-mount protective casing will be backfilled with concrete; and,
3. The concrete filled flush-mount protective casing will be removed during sidewalk flag replacement (See Section 3.29).

3.18 Disposal of Drill Cuttings and Soil Boring Spoils

Summary: Disposal of boring spoils will be performed in accordance with New York State Department of Environmental Conservation Technical and Administrative Guidance Memorandum (TAGM) HWR-89-4032, November 21, 1989.

Procedure:

1. Spoils will be stored on site in 1A2 open head 55-gallon steel drums.
2. These drums will be addressed in accordance with the protocols outlined in Section 3.30.

3.19 Groundwater Monitoring Well Construction Procedures

3.19.1 Overburden Monitoring Well Construction Procedures

Summary: A method for construction of groundwater monitoring wells within unconsolidated material, which enables monitoring of groundwater elevation and acquisition of groundwater samples for laboratory testing. The groundwater monitoring wells and piezometers will be installed during this investigation using the procedures described below.

Procedure:

1. Advance subsurface boring to the desired depth by means of hollow-stem auger drilling.
2. While boring, collect split spoon samples on a continuous basis to geologically log the boring.

3. Remove center plug from augers and verify borehole depth using weighted measuring tape.
4. Add washed and graded medium sand as needed to base of borehole.
5. Insert the well screen and riser pipe into borehole through the hollow stem augers. Cap the riser to prevent well construction materials from entering the well.
6. Add sand to screen section of well while slowly removing augers. Sand pack should extend at least two feet above the top of the screen section. Measure with a tape.
7. Slowly add bentonite pellet seal to borehole as augers are slowly removed. The bentonite seal should extend at least two feet above the top of the sand pack section. Measure with tape.
8. Note: The rate of removal of the auger from the borehole should closely follow the rate that the sand pack and bentonite pellets fill the borehole.
9. If bentonite seal is placed above the groundwater level within the borehole, add water to the borehole to hydrate the bentonite pellets. Allow pellets to hydrate for at least 30 minutes.
10. Mix cement/bentonite grout per Manufacturer's specifications.
11. Add grout to borehole through tremie pipe or hose from the top of the bentonite seal to the ground surface.
12. Remove remaining augers from the borehole.
13. Top off grout in borehole. Grout should extend to approximately two feet below ground surface.
14. Cut well-riser pipe to about three feet above the ground surface for stickup type wells. Flush-mount well risers should be cut off just below surface grade.
15. Backfill the remaining two feet of the borehole with concrete.
16. Install a protective casing over the well riser pipe and set it into the concrete backfill.
17. Lock the protective casing cover.
18. Document well construction in the field notebook and later on a Well Construction Detail diagram (Appendix A).

Reference: *ASTM Standard Practice for Design and Installation of Groundwater Monitoring Wells D5092/D5092M-16*.

3.19.2 Bedrock Monitoring Well Construction Procedures

Summary: A method for construction of monitoring wells within bedrock, which enables monitoring of groundwater elevation and acquisition of groundwater samples for laboratory testing.

Procedure:

1. Collect soil samples while advancing to the top of bedrock. Follow the procedures in Sections 3.5 (HSA drilling), 3.6 (Rotosonic drilling), 3.10 (split-spoon sampling), or 3.13 (direct-push sampling) as applicable for field conditions.

2. Measure the depth to the top of bedrock from the ground surface using a weighted measuring tape.
3. At these boring locations collect a 3- to 5-foot NX- rock core sample from the top of rock.
4. Ream the core hole to approximately 8-inches in diameter.
5. Install a 6-inch carbon steel casing into the borehole and set it at least 3 feet into the bedrock. The casing should extend to the ground surface.
6. Remove the HSAs or casing and grout the annular space between the steel casing and borehole wall. Mix grout following procedures in Section 3.19.3. Allow grout to cure for at least 24 hours before continuing the boring.
7. Collect NX-rock core samples to desired depth in 5- or 10-foot increments. After coring, ream the core hole to approximately 6-inches in diameter.
8. Insert a riser cap (J-plug) into the well riser. Install an 8-inch curb box around the well casing by cementing the protective curb box around the well casing. Install lock on Jplug and seal the curb box.
9. Document well construction details in the field notebook and transfer the data onto the Bedrock Monitoring Well Construction Detail form (Appendix A).

Reference: *ASTM Standard Practice for Design and Installation of Groundwater Monitoring Wells D5092/D5092M-16*.

3.19.3 Monitoring Well Abandonment Procedures

Well abandoning will be performed in accordance with New York State Department of Environmental Conservation (NYSDEC) CP-43, using the following steps:

1. Each well will be tremie grouted from the bottom of the well to within five feet of the ground surface to ensure a continuous grout column. Grout slurry composition should be the following:
    - 1.5 to 3.0 percent by weight - Bentonite (Quick Gel)
    - 40 to 60 percent by weight - Cement (Portland Type I)
    - 40 to 60 percent by weight - Water
2. The well casing will be removed at a depth of five feet below grade (if possible) and the outer protective casing "stick-up" and/or flush-mount curb box will be removed only after the well has been properly filled with grout.
3. A metal marker (PK Survey Spike) will be embedded in the top of the grout to indicate the location of the former monitoring well.
4. The uppermost five feet of the borehole will be filled with approved/clean backfill or topsoil.
5. The surface of the borehole will be restored to the condition of the area surrounding the borehole (crushed stone, asphalt, etc.). If the surrounding surface is a concrete sidewalk flag that flag will be replaced in accordance with Section 3.29 of this plan.
6. The solid waste should be handled is accordance with Section 3.30 of this plan.
7. Document well construction details in the field notebook and transfer the data onto the Well Decommissioning Record form (Appendix A).

Reference: *NYSDEC CP-43: Groundwater Monitoring Well Decommissioning Policy, November 3, 2009. ASTM Standard Guide for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities D5299/D5299M-17.*

<u>3.19.4 Plugging/Abandoning Borehole and Grout Mixing Procedures</u>

<u>Summary:</u> Boreholes that are not completed as monitoring wells, will be sealed (plugged) prior to abandonment to prevent downhole contamination. In addition, the annular space in monitoring wells need to be sealed after the installation of the sand pack and bentonite seal to prevent any downward migration of surface water into the well. Sealing can be achieved by backfilling the borehole with bentonite below the water table (hole plug or pellets) and/or with a cement/bentonite grout above the water table. The backfill material will be introduced from bottom to top using either a tremie pipe or the drill rods. Shallow borings will be sealed with bentonite (hole plug or pellets) the entire length of the boring.

Procedure:

1. Determine most suitable seal materials. Grout specifications generally have mixture ratios as follows:
   - Grout Slurry Composition (Percent Weight) 1.5 to 3.0 percent - Bentonite (Quick Gel)
   - 40 to 60 percent - Cement (Portland Type I)
   - 40 to 60 percent - Water

2. Calculate the volume of the borehole based on the bit or auger head diameter plus 10 percent and determine the volume of grout to be emplaced. Generally, the total mixed volume is the borehole volume plus 20 percent.
3. Identify the equipment to be used for preparing and mixing of the grout. Ensure the volume of the tanks to be used for mixing has been measured adequately. Document these volumes.
   - Identify the source of the water to be used for the grout and determine its suitability for use. In particular, water with high sulfate or chloride levels, or heated water, should not be used. These types of waters can cause operational difficulties or modify the set-up for the grout.
4. Identify the equipment to be used for emplacing the grout. Ensure that the pump to be used has adequate pressure to enable complete return to surface.
5. Identify the volumes to be pumped at each stage or in total if only one stage is to be used.
6. Prepare the borehole plugging plan and discuss the plan and activities with the drilling contractor prior to beginning any mixing activities.
7. Begin mixing the grout to be emplaced.
8. Record the type and amount of materials used during the mixing operation. Ensure that the ratios are within specification tolerance.

9. Begin pumping the grout through the return line bypass system to confirm that all pump and surface fittings are secure.
10. Initiate downhole pumping. Record the times and volumes emplaced on the form.
11. Document the borehole is completely filled with grout.
12. Clear and clean the surface near the borehole. Level the ground to about the pre-existing grade. Add grout or cement as necessary to the area near the borehole.

Note: On occasion, there may be some settling of the grout, which takes place over several days. If this settling occurs, the natural soil from the immediate vicinity is used to put the level at grade. A follow-up check at each site should be made within one week to 10 days of completion. Document the visit and describe any action taken.

3.20 Groundwater Monitoring Well Development Procedures

Summary: Following completion of groundwater monitoring well installation, each monitoring well will be developed by pumping until the discharged water is relatively sediment free and the indicator parameters (pH, temperature, and specific conductivity) have reached steady state. Developing the monitoring well not only removes any sediment but also may improve the hydraulic properties of the formation. The effectiveness of the development measures will be closely monitored in order to keep the volume of discharged water to the minimum necessary to obtain sediment-free samples. A portable turbidimeter will be used to monitor effectiveness of development. A turbidity reading of < 50 Nephelometric Turbidity Units (NTU) and steady state pH, temperature, and specific conductivity readings will be used as a guide for discontinuing well development.

Procedure:

1. An appropriate monitoring well development method should be selected, depending on water level depth, well productivity, and sediment content of water. Monitoring well development options include: (a) manual pumping; and (b) powered suction-lift or hydrolift pumping.
2. Equipment should be assembled, decontaminated (if necessary), and installed in the well. Care should be taken not to introduce contaminants to the equipment during installation.
3. Monitoring well development should proceed by repeated removal of water from the well until the discharged water is relatively sediment-free. All development waters will be containerized. Effectiveness of development should be monitored at regular intervals using a portable turbidimeter and water quality meter. Volume of water removed and turbidity, pH, temperature, and conductivity measurements will be recorded on a Well Development/Purging Log form (Appendix A).
4. Monitoring well development will be discontinued when the turbidity of the discharged water is below 50 NTU and the other indicator parameters have stabilized.

Reference: *ASTM Standard Practice for Design and Installation of Groundwater Monitoring Wells D5092/D5092M-16*.

3.21 Monitoring Well and Soil Vapor Implant Inspection and Maintenance

Summary: Periodic inspection and maintenance of monitoring well protective casings are required to keep the wells in good condition. The following procedure should be employed whenever the monitoring wells are opened for gauging and sampling.

Procedure:

1. Use the Monitoring Well Inspection Form or Soil Vapor Implant Inspection Form (Appendix A) to record the conditions of the various components of the monitoring well and protective casing including lock/hasp, hinge/lid, J-plug, gasket seal, and security bolts.
2. Coat security bolts with never seize to prevent seizure in the cast iron flush mount curb boxes.
3. Replace security bolts of the hexagonal head type with bolts that have pentagonal heads (5 sided) at the earliest opportunity. Pentagonal type bolts help prevent unauthorized access to the wells.
4. In wells, record depth to water, depth to bottom, and depths to the top and bottom of any light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL) layers.
5. Record any maintenance performed on the well and stencil as needed.
6. All sections of the inspection form should be completed and photographs taken before and after inspection and maintenance.

3.21.1 Road Box Replacement Procedures

Summary: Often during an inspection, it is determined that a monitoring well's road box is damaged and needs to be replaced. The following procedure should be employed whenever a road box is replaced.

Procedure:

1. Cut the pavement with a jackhammer and hand-excavate the surrounding soil to a depth of approximately 1 ft. below ground surface (bgs). If the surrounding surface is covered with asphalt instead of concrete, then hand cut the asphalt.
2. Any concrete (or asphalt) cuttings will be placed in a 1A2 open head 55-gallon steel drum.
3. Remove the damaged road box and install the new road box. The damaged road box will be placed in a 1A2 open head 55-gallon steel drum.
4. Backfill around the newly installed road box with the excavated soil, leaving enough room for a concrete pad/asphalt patch.
5. Construct a 2 ft. by 2 ft. square concrete pad/asphalt patch surrounding the new road box.
6. If using concrete in freezing temperatures, an anti-freeze agent will be added to the cement mixture and the concrete pad will be covered with a sheet of plastic to prevent the pad from freezing and cracking.

7. An orange cone will be placed near the monitoring well to prevent vehicles from driving over the newly repaired road box.
8. The drums will be addressed in accordance with the protocols outlined in Section 3.30.

3.22 Hydraulic Conductivity Testing

Summary: Hydraulic conductivity tests (slug tests) may be performed in newly installed wells. During any slug testing, gauging of fluid levels will be performed using a data logger/pressure transducer, and stainless steel slugs. Since the water table is shallow, only rising head (slug-out) tests will be performed. This test will consist of inserting a 'slug' of known volume into the well/piezometer, allowing the water level in to return to a steady state, removing the slug allowing the water level to return to static conditions. The transducer/data logger will record changes in water level. This data will be analyzed using the methods of Bouwer and Rice (1976) and Bouwer (1989).

Slug testing is a rapid and inexpensive procedure for estimating the horizontal hydraulic conductivity of an aquifer material screened by a monitoring well. Equipment consists of dedicated/disposable nylon rope, decontaminated stainless steel slug and a data logger/pressure transducer, and a water level indicator.

Procedure:

1. Measure dimensions of the slug to be used to displace water in the monitor and predetermine the volume of water, which will be displaced, and corresponding initial water level change, which will occur by adding or removing the slug.
2. Record initial water level in the wells (static water level).
3. Lower the pre-cleaned data logger/pressure transducer into wells to the wells bottom. Pull transducer up one foot.
4. Insert slug into well, below water table, with nylon rope. Allow water level in well to return to static condition.
5. Simultaneously initiate data logger/pressure transducer and rapidly remove the slug from the wells.
6. Monitor water level recovery in well with data logger/pressure transducer until static water level has been regained.
7. Download data logger/pressure transducer and record data in field notebook. Review data to verify slug test Project Work Plans successful.
8. Remove equipment from well and decontaminate.
9. Analyze data in office using computer.

3.23 Groundwater Sampling

Summary: To collect representative groundwater samples, groundwater wells must be adequately purged prior to sampling. New monitoring wells will not be purged until 72 hours after installation. Purging will require the removal of three to five volumes of standing water in rapidly recharging wells and at least one volume from wells with slow recharge rates. Shallow wells in which the screen intersects the water table should require a minimum amount of purging since the groundwater would flow through the screen and not be entrapped in the casing. Deeper wells should be purged more thoroughly since they may be located in confined aquifers and water may rise up into the casing. A thorough purging would require the removal of several volumes of this trapped water to ensure that representative groundwater is brought into the well for sampling. Sampling should commence immediately after purging as soon as adequate recharge has occurred.

3.23.1 Standard Monitoring Well Purging Procedure

Procedure:

1. The well cover will be unlocked and carefully removed to avoid having any foreign material enter the well. The interior of the riser pipe will be monitored for organic vapors using PID. If a reading of greater than 5 ppm is recorded, the well will be vented until levels are below 5 ppm before purging begins.
2. Using an electronic water level detector, the water level below top of casing will be measured. Knowing the total depth of the well, it will be possible to determine the volume of water in the well. The end of the probe will be soap-and-water-washed and deionized-water rinsed between wells.
3. Calibrate field instruments (e.g., pH, specific conductance, PID, turbidity).
4. Purge the required water volume (i.e., until stabilization of pH, temperature, specific conductivity, and turbidity). New dedicated equipment will be used for each well.
5. Purge well until the water quality parameters have stabilized. The stabilization criteria are: specific conductivity - 3% full scale range; pH - 0.10 pH unit; temperature - 0.2°C, and turbidity <50 NTU.
6. Purging of three well volumes is not necessary if the indicator parameters are stable. However, at least one (1) well volume must be purged before sampling can begin. During purging, it is permissible to by-pass the flow cell until the groundwater has cleared.
7. Indicator parameters of pH, conductivity, dissolved oxygen, oxygen/reduction potential, turbidity, and temperature must be measured continuously using the flow cell.
8. Well purging data are to be recorded in the field notebook and on the Well Purge Log (Appendix A).
9. Dispose of sampling equipment as per Section 3.30.

3.23.2 Low Flow Sampling Procedures

Summary: To collect representative groundwater samples, monitoring wells must be adequately purged prior to sampling. Low volume sampling equipment and procedures will be used to purge the wells and retrieve groundwater samples. Purging will require the removal of one to three volumes of standing water by pumping at a rate of less than one (1) liter per minute. Drawdown must not exceed ten percent of the standing water column. Sampling should commence immediately after purging.

Procedure: Monitoring well purging will be completed using the low-flow purging technique as follows:

1. The well cover will be unlocked and carefully removed to avoid having any foreign material enter the well. The interior of the riser pipe will be monitored for organic vapors using PID. If a reading of greater than 5 ppm is recorded, the well will be vented until levels are below 5 ppm before purging begins.
2. Using an electronic interface probe/water level detector, the water level below top of casing will be measured. The depth of the well will be measured to determine the volume of water in the well. The bottom of the well will also be checked for DNAPL using the interface probe/water level indicator. The end of the probe will be decontaminated between wells.
3. Calibrate field instruments (e.g., pH, specific conductance, PID, turbidity).
4. Purge the required water volume (i.e., until stabilization of pH, temperature, specific conductivity, and turbidity) using a low-flow pump (e.g., Solinst or Geopump) and dedicated HDPE tubing. New dedicated tubing will be used for each well.
5. Purge the well until the water quality parameters have stabilized. The stabilization criteria are: specific conductivity - 3% full-scale range; pH - 0.10 pH unit; dissolved oxygen – 10%, Turbidity – 10% and oxidation/reduction (redox) potential - +/- 10 units.
6. Purging of three well volumes is not necessary if the indicator parameters are stable. However, at least one (1) well volume must be purged before sampling can begin. During purging, it is permissible to by-pass the flow cell until the groundwater has cleared.
7. Indicator parameters of pH, conductivity, dissolved oxygen, oxidation/reduction (redox) potential, turbidity, and temperature must be measured continuously using the flow cell.
8. Well purging data are to be recorded in the field notebook and on the Low Flow Purge Log (Appendix A).

3.23.3 Sample Collection Procedures

Procedure:

1. After well purging is completed, a sample will be collected into the appropriate containers.
2. Direct water flow toward the inside wall of the sample container to minimize volatilization. Fill volatile sample containers so no headspace (air bubbles) is present. If containers are pre-preserved, do not overfill sample containers. Note if effervescence is observed.
3. All sample bottles will be labeled in the field using a waterproof permanent marker (Section 7.0).
4. Samples will be collected into sample bottles (containing required preservatives) and placed on ice in coolers for processing (preservation and packing) prior to shipment to the analytical laboratory. A chain-of-custody record will be initiated. The analytical laboratory will certify that the sample bottles are analyte-free prior to shipping.
5. Remove pump and disconnect valves and tubing, as necessary. If a submersible pump Project Work Plans used, it must be decontaminated prior to and between each use.

Clean pump by flushing 10 gallons of potable water through the pump. Rinse with deionized water after flushing the pump.

6. Well sampling data are to be recorded in the field notebook and on the Well Purging Log (Appendix A).

Reference: *ASTM Standard Practice for Design and Installation of Groundwater Monitoring Wells D5092/D5092M-16*.

3.23.4 Sampling Through LNAPL

Procedure:

1. Measure the depth and thickness of the LNAPL layer per Section 3.25.
2. The groundwater sample from below the product will be collected through a 1-inch ID tremie pipe immersed below the LNAPL layer.
3. Insert a slip cap or similar device (i.e., J-plug) to plug the end of the 1” ID PVC pipe, and attach a tether to the device so it can be retrieved from the well after sampling is complete. The pipe will be lowered into the well and additional sections of 1” ID PVC pipe will be added as necessary.
4. Lower the 1” ID PVC pipe into the well with the slip cap/J-plug inserted in the bottom of the pipe. The bottom of the pipe should be lowered through and at least 2’ below the bottom of the LNAPL layer.
5. Brace the 1” ID pipe at the surface so it cannot fall further into the 2” well casing.
6. Smaller diameter rods or a weighted section of steel pipe attached to a rope will be used to push the slip cap off the end of the 1” ID PVC pipe. The attached tether will allow retrieval of the J-plug when the 1” tubing is retrieved from the well at the conclusion of sampling.
7. Proceed with sampling the well by inserting purging and sampling tubing through the 1” tubing.
8. When sampling is finished remove the 1” tubing and slip cap from the well. The 1” ID PVC pipe will be partially coated with LNAPL and should be discarded. The slip cap can be decontaminated or discarded.

3.23.5 Sampling LNAPL or DNAPL

Summary: When conducting groundwater sampling from monitoring wells, LNAPL and DNAPL may be collected. The following procedure will be used to collect samples of LNAPL and DNAPL.

Procedure:

1. Measure the depth and thickness of the LNAPL/DNAPL layer per Section 3.25.
2. Using a disposable Teflon or Teflon lined bailer attached to disposable poly twine, lower the bailer so the bottom of the bailer is at the same depth as the bottom of the LNAPL/DNAPL layer.
3. Upon reaching its target depth, raise the bailer with the LNAPL/DNAPL product and place the product in the laboratory supplied containers.

4. Repeat steps 2 and 3 until the laboratory supplied containers are full or there is no more product to remove.
5. Upon completion of the sampling, place the used bailer and twine in a 1A2 open head 55gallon steel drum.

3.24 Water Level Monitoring Procedures

Summary: Determination of groundwater depths in monitoring wells is necessary to calculate required purge volumes prior to groundwater sampling. Determination of groundwater depths in piezometers is necessary to determine the direction of groundwater flow.

Water levels in monitoring wells scheduled to be sampled during the field work will be measured using an electronic water level indicator. Initially, measurements will be taken following well development until the well has recovered to anticipated static conditions. Water levels will also be measured in the piezometers as specified in the Project Work Plan. Water level measurement procedures are presented below.

Procedure:

1. Clean the water level probe and the lower portion of cable following standard decontamination procedures (Section 6.0) and test water level meter to ensure that the batteries are charged.
2. Lower the probe slowly into the monitoring well until the audible alarm indicates water.
3. Read the depth to the nearest hundredth of a foot from the graduated cable using the V-notch on the riser pipe as a reference point.
4. Repeat the measurement for confirmation and record the water level.
5. Remove the probe from the well slowly, drying the cable and probe with a clean "Chem Wipe" or paper towel.
6. Replace the well cap and lock protective cap in place.
7. Decontaminate the water level meter (Section 6.0) if additional measurements are to be taken.

Reference: *ASTM Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well) D4750-87(2001)*.

3.25 LNAPL/DNAPL Water Level Monitoring Procedures

Summary: When conducting groundwater measurement from monitoring wells, the presence and thickness of LNAPL and DNAPL will be monitored. The following procedure will be used to determine the presence and thickness of LNAPL and DNAPL. LNAPLs, Light Non-Aqueous Phase Liquids (Lighter than water) are typically measured using an oil/water interface meter.

Procedure:

1. To meet safety requirements and protect electronics from damage, always ground the meter by attaching the ground clamp to the metal well casing.

2. Before beginning any measurement, check the electronics and battery condition by pressing the ‘START/OFF’ button. A brief tone and red light indicates the meter is functional. A flashing green light indicates the meter is on. NOTE: The meter will automatically shut off after 10 min to conserve battery life and will have to be turned back on.
3. Lower the probe end into the well and slowly lower until water or LNAPL is contacted. A steady tone and light indicates a non-conductive liquid (e.g. product). An intermittent tone and light indicates a conductive liquid (e.g. water).
4. For floating product (LNAPL), take the air/product interface measurement on the way into the liquid and the water/product interface on the way up. When passing through product into water, some product may adhere to the probe sensors due to surface tension. Therefore, when water is detected below the product, the probe should be raised and lowered rapidly in a short vertical motion to remove any product that may have been carried down with the probe.
5. The water/product interface should then be measured as the probe is raised very slowly back up. Once the interface is detected the probe can be raised and lowered in small increments to precisely determine the interface.
6. Repeat measurements to confirm water/product interface.
7. To determine the thickness of product, subtract the water/product interface from the product/air interface.
8. To determine if there is any sinking product (DNAPL) in the well, continue lowering the probe slowly. If steady signals activate, determine the top of the sinking layer by reading directly from the tape. Continue lowering the probe slowly until the tape slackens when the well bottom is reached. Read the level directly from the tape and subtract one from the other to determine thickness.
9. Upon completion of readings clean the tape and the probe.

3.26 Indoor Air Investigation

Indoor air investigations will generally include the following tasks at each residence: 1) conducting interviews with homeowners using air quality questionnaires provided by the New York State Department of Health (NYSDOH) (Appendix A); 2) conducting a brief survey of household chemicals present and evaluating their potential to affect air sample results; 3) collecting one indoor air sample each from the breathing zones of the first floor and basement areas, and; (4) collecting one soil vapor sample from beneath the basement concrete slab. In addition, one or two outdoor air samples will be collected from the residential sampling area for each day that sampling is taking place.

3.26.1 Indoor Air Quality Survey and Questionnaire

Once the homeowners have been contacted by the NYSDEC and/or NYSDOH, appointments will be made to conduct homeowner/occupant interviews and building inventory of household chemicals. Questionnaire and Building Inventory forms provided by the NYSDOH (Appendix A) will be used. Once the questionnaires have been completed, a brief inventory of household chemicals stored in the basement area will be prepared. The inventory will consist of a general description of areas where chemicals are stored and the types and approximate numbers of chemicals present. During this inventory, a ppbRAE photo ionization detector (PID) should be used to measure the presence of volatile organic compounds (VOCs) in those areas where the chemicals are found. Also during the inventory, a handout will be provided to the residents that list home activities that should be avoided prior to and during the air sampling. The general procedures to be followed during the surveys are summarized below:

- Identify all areas on the basement level that may be used for storage of chemical containers. Also record the general types and approximate quantities of chemicals stored and VOCs present in the atmosphere in the areas of chemical storage.
- Other potential sources that may influence air quality testing that should be noted and scanned with the PID include: new construction/remodeling/painting, new carpeting, and freshly drycleaned clothing.

3.26.2 Sub-Slab Air Sampling Procedures

One sub-slab air sample will be collected at each sampled residence. As directed by the NYSDEC, additional samples (up to a total of three) may be collected at some of the residences. A minimum of one sub-slab sample at each residence will be tested for an adequate surface seal before and after testing using the helium tracer gas test procedures outlined below.

The sub-slab air sampling procedures are summarized below:

1. Select and prepare the sub-slab sample collection point by observing the condition of the building floor slab for apparent penetrations such as concrete floor cracks, floor drains, or sump holes. The floor conditions will be noted and a potential location of a subsurface probe will be selected. The location will ideally be central to the building, and away from the foundation walls, apparent penetrations and buried pipes. Review all locations with the Homeowner prior to drilling any hole! Photograph and document all sample locations.
2. In locations where bare concrete is available, drill a 5/8-inch diameter hole about one-inch (1”) into the concrete using an electric hammer drill. Extend the hole through the remaining thickness of the slab using a ½ -inch drill bit. Lengthen the hole about three inches (3”) beyond the sub-slab using the drill bit.
3. Remove the concrete dust within the 5/8-inch drilled hole and around the hole using wire brushes and a brush and dust pan, then dabbing the surface with Sculpey brand clay, or equivalent substance (see below).
4. Insert a 5/8-inch outside diameter (OD) by ¼-inch inside diameter (ID) rubber stopper onto and three-inches beyond the end of a 1/4-inch OD by 1/8-inch ID Teflon tube. Insert the Teflon tube into the 5/8-inch hole so the stopper is seated into the top of the ½-inch drilled hole.

5. Seal the annular space between the 5/8-inch hole and the Teflon tubing with white Sculpey Brand modeling clay (or equivalent). Bring the clay above the floor's surface and around the tubing in a volcano-like shape.
6. In locations where only linoleum tile is available, AND THE OWNER AGREES, drill a small (1/4-inch best) hole through the tile and slab. Place the sample tubing into the hole and seal to the floor with clay.
7. Purge the sampling tube by connecting the Teflon tubing to the inlet of an air-sampling pump (GilAir 300 or 500) with 3/8-inch OD silicone tubing, and connecting a 1 liter (L) Tedlar bag to the outlet of the pump with silicone tubing. Purge approximately one liter (1L) of gas from the subsurface probe into the Tedlar bag, using the air-sampling pump. Analyze the 1L Tedlar bag containing the sub-slab purged air with a gas detector that records the concentrations of CH4, CO2 and O2. Record the purge times (start and stop) and the gas concentrations on a Summa Canister Sampling Field Data Sheet (Appendix A). Purging flow rates must not exceed 0.2 L/min.
8. Assign sample identification to the Summa® canister identification tag and record on chain of custody (COC), and the Summa Canister Sampling Field Data Sheet. Also record the Summa® canister's serial number on the Summa Canister Sampling Field Data Sheet.
9. Remove brass plug from canister fitting.
10. Attach a pre-calibrated/certified 24-hour flow controller, and particulate filter to the Summa® canister. Record the regulator serial number on the Summa Canister Sampling Field Data Sheet.
11. Attach the sample tube to the Summa® canister using a ¼-inch Swagelok® nut with appropriate ferrules, via the flow controller/particulate filter assembly.
12. Open canister valve to initiate sample collection and record sample start time, date and initial vacuum on the canister identification tag and on the Summa Canister Sampling Field Data Sheet. If the canister does not show sufficient vacuum (generally less than 25" Hg), do not use. Take a digital photograph of canister setup and surrounding area. Include in the photograph a dry erase board or similar display which presents sample ID and date.
13. After 24 hour, record sample end time and canister pressure on the Summa Canister Sampling Field Data Sheet, and close valve.
14. Disconnect the Teflon tubing and remove flow controller/particulate filter assembly from canister. Seal canister with brass plug.
15. Seal the hole in the basement slab with hydraulic cement patch.
16. Ship samples with COCs, overnight, to a NYSDOH approved laboratory, for TO-15 analysis.

Using Helium Tracer Gas to Test Floor Seals.

1. Drill the concrete floor and attach and seal the Teflon sample tubing to the floor as described above.
2. Place a 2-quart (or similar size) bucket over the floor seal after threading the Teflon sample tube through a hole in the top of the bucket. Seal the tube to the bucket with clay.

3. The bucket should also have a hole in the top for the injection of helium gas. An additional hole should be present in the side, near the bottom, to measure the concentration of helium gas in the bucket.
4. Connect helium (99.999%) cylinder tubing to the top port of bucket enclosure and seal with clay or other sealing material. Insert a helium detector probe to the bottom port of the bucket.
5. Release enough helium to displace any ambient air in the bucket until the concentration of helium reaches a minimum of 90%. Maintain this minimum concentration by testing with a helium detector. The helium cylinder should be open during the purge time to cause a slight positive pressure within the enclosure.
6. Connect the sample tubing to a GilAir vacuum pump or equivalent using 3/8-inch O.D. silicone tubing. Connect a 1-liter Tedlar bag to the outlet of the pump using silicone tubing and collect a 1-liter sample. Analyze the Tedlar bag for helium using a helium detector, and record the results on the Summa Canister Sampling Field Data Sheet. Also analyze the Tedlar bag for the presence of methane, H2S, CO2 and O2 and record the result on the Summa Canister Sampling Field Data Sheet. A concentration of helium 10% or greater indicates a poor seal of the sample tubing to the basement floor. The tubing must be resealed to the floor and another helium test conducted.
7. Purging flow rates must not exceed 0.2 L/min.
8. After purging, remove the bucket enclosure and assign sample identification to the Summa® canister identification tag and record on the COC, and the Summa Canister Sampling Field Data Sheet. Also record the Summa® canister's serial number on the Summa Canister Sampling Field Data Sheet.
9. Connect the 1/4-inch Teflon OD sample tubing to the Summa® canister regulator inlet using a ¼-inch Swagelok® nut with appropriate ferrules. Open the canister valve to initiate sample collection and record the start time and date and beginning vacuum on the canister identification tag and on the Summa Canister Sampling Field Data Sheet. If the canister does not show sufficient vacuum (generally less than 25" Hg), do not use.
10. After 24 hours, record sample end time and final vacuum on the Summa Canister Sampling Field Data Sheet and close the valve.
11. Disconnect the Teflon tubing from the Summa® canister and remove the flow controller/particulate-filter assembly from canister. Seal canister with brass plug.
12. Thread the Teflon sample tubing through the bucket enclosure and conduct a helium tracer gas test as described above. After purging, test the concentration of helium in the 1 liter Tedlar bag and record on the Summa Canister Sampling Field Data Sheet.
13. Remove the sample tubing, stopper and clay from the hole in the basement slab and seal with hydraulic cement patch.
14. Ship the samples, with COCs, overnight to Air Toxics, or other selected lab, for TO-15 analysis.

3.26.3 Indoor Air and Outdoor Air Sampling Procedure

Sampling procedures for the indoor samples and outdoor air sample are summarized below:

1. Place the basement and first floor Summa® canisters at breathing height in a high traffic location. The breathing height is defined as three to six feet above the floor. Place the outdoor air sample at least 2 to three feet above the ground.
2. Record the canister's serial number on the Summa Canister Sampling Field Data Sheet.
3. Assign sample identification to the canister identification tag (see Section 7.0 below) and record on the COC and the Summa Canister Sampling Field Data Sheet.
4. Remove brass plug from canister fitting.
5. Attach a pre-calibrated/certified 24-hour flow controller and particulate filter to the Summa® canister, open valve completely to initiate sampling, and record the sample start time and date, and beginning vacuum reading on the canister identification tag and the Summa Canister Sampling Field Data Sheet. Also record the regulator serial number on the Summa Canister Sampling Field Data Sheet. If the canister does not show sufficient vacuum (generally less than 25" Hg), do not use.
6. Take a digital photograph of canister setup and surrounding area. Include a dry erase board or similar display which presents sample ID and date.
7. After 24 hours, record end time and pressure on the Summa Canister Sampling Field Data Sheet, and close valve.
8. Disconnect flow controller/particulate filter assembly from canister.
9. Seal canister with brass plug.
10. Ship canister standard overnight, with COC, to a NYSDOH approved laboratory, for TO15 analysis.

3.26.4 Quality Control

Field duplicates for structure samples (10 percent) will be collected by attaching the T-fitting supplied by the laboratory to two Summa® canisters with attached regulators. The inlet for the T-fitting will then be attached to the sub-slab sample tubing. Indoor air and outdoor air duplicates will also use T-fittings connected to two Summa® canisters. Tubing will not be required unless needed to the raise the sampling point to the breathing zone. For sampling, both Summa® canister valves are opened and closed simultaneously.

3.26.5 Field Documentation

Field notebooks will be used during all on-site work. A dedicated field notebook will be maintained by the field technician overseeing the site activities. In addition to the notebook, any and all original sampling forms, purge forms and notebooks used during field activities will be submitted to the NYSDEC as part of the final report. Indoor air sampling procedures should be photo-documented.

The field sampling team will maintain sampling records that include the following data:

1. Sample Identification
2. Date and time of sample collection
3. Identity of samplers
4. Sampling methods and devices

5. Purge volumes (soil vapor)
6. Volume of soil vapor sample extracted
7. The Summa® canister vacuum before and after samples collected
8. Chain of Custody and shipping information

The proper completion of the following forms/logs will be considered correct procedure for documentation during the indoor air-sampling program:

1. Field Log Book - weather-proof hand-bound field book
2. Questionnaire and Building Inventory Form (Appendix A)
3. Summa Canister Sampling Field Data Sheet (Appendix A)
4. Chain of Custody Form (Appendix A)

Reference: *NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York*.

3.27 Removal of Underground Storage Tanks

3.27.1 General

The contractor shall furnish all labor, materials, tools and equipment and remove an underground storage tank.

3.27.2 Submittals

The following items shall be submitted to the CASTLETON Project Manager for review and approval.

1. Detailed Work Plan: This plan shall be submitted by the Underground Storage Tank Contractor to CASTLETON and will describe methods, equipment, and sequences of operations including, but not limited to:
   - Tank contents removal
   - Spill Prevention
   - Exploratory excavations
   - Tank purging procedure
   - Interior and exterior tank cleaning procedure
   - Wastewater Collection and Disposal
   - Removal or permanent closure of underground storage tank
   - Transportation and disposal of underground storage tank
   - Anticipated use, recycling or disposal of tank contents
2. Copies of manifests required to transport waste materials. These manifests shall be submitted within 24 hours following their preparation.
3. Documentation of acceptance of waste materials by a facility permitted to treat or dispose of those types of materials. These documentations shall be submitted no later than 7 days following a delivery of waste materials to the permitted facility.

4. Letters of acceptance from the permitted facility and haulers acknowledging agreement to accept the waste materials. These letters shall be submitted not more than 14 days before transporting waste materials.

3.27.3 Permit and License Requirements

1. Prior to the removal of the underground storage tank, all permits and licenses required to perform the work shall be obtained by the Contractor. Determining license and permit requirements shall be the responsibility of the Contractor.
2. The permit and notification requirements for underground storage tank removal or closure shall include, but not be limited to, the following:
    a. Storage tanks greater than 1,100 gallons capacity must be registered with the NYSDEC. If the tank is being closed, and it is not currently registered, the tank must be registered by the contractor before proceeding with his removal or closure activities. Thirty (30) days prior to initiation of closure activities, the contractor shall notify the NYSDEC (Region 2) of the intent to remove or close a storage tank.
    b. Storage tanks of 1,100 gallons or less do not require registration, or notification to the NYSDEC when closed unless a spill has occurred (see below).
    c. The Contractor shall comply with the requirements of 6 NYCRR Part 612, 6 NYCRR Part 613, 6 NYCRR Part 614, NYSDEC Memo #1, and NYSDEC SPOTS No. 14.

3.27.4 Applicable Standards

The publications are referenced by basic designation only and shall be the latest published version.

- American Petroleum Institute (API)
    - API Publ 1628 A Guide to the Assessment and Remediation of Underground Petroleum Releases
    - API Publ 2015 Safe Entry and Cleaning of Petroleum Storage Tanks, Planning and Managing Tank Entry from Decommissioning through Recommissioning
    - API Publ 2217 Guidelines for Confined Space Work in the Petroleum Industry
    - API Publ 2219 Safe Operating Guidelines of Vacuum Trucks in Petroleum Service
      API Publ 2003 Protection Against Ignitions Arising out of Static, Lightning and Stray Currents
- American Society for Testing and Materials (ASTM)
    - ASTM C94/C94M-17 Standard Specifications for Ready-Mixed Concrete

- Code of Federal Regulations (CFR)
    - CFR 40 Part 260 Hazardous Waste Management System: General
    - CFR 50 Part 261 Identification and Listing of Hazardous Waste
    - CFR 40 Part 262 Standards Applicable to Generators of Hazardous Waste
    - CFR 40 Part 263 Standards Applicable to Transporters of Hazardous Waste

  - CFR 40 Part 264 Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
  - CFR 40 Part 265 Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
  - CFR 40 Part 266 Standards for the Management of Specific Hazardous Waste and Specific Types of Hazardous Waste Management Facilities
  - CFR 40 Part 268 Land Disposal Restrictions
  - CFR 40 Part 280 Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks

- USEPA
  - USEPA SW-846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods

- New York City Fire Department
  - FP Directive 3-73 Division of Fire Protection
- NYSDEC
  - 6 NYCRR Part 357.6 Remedial Program Soil Cleanup Objectives
  - 6 NYCRR Part 612 Registration of Petroleum Storage Facilities
  - 6 NYCRR Part 613 Handling and Storage of Petroleum
  - 6 NYCRR Part 614 Standards for New and Substantially Modified Petroleum Storage Facilities
  - NYSDEC CP-51 Soil Cleanup Guidance Policy
  - NYSDEC SPOTS No.14 NYSDEC Spill Prevention Operations Technology Series (SPOTS) Document No. 14: Site Assessments at Bulk Storage Facilities
  - 6 NYCRR Part 372 Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities

<u>3.27.5 Removal or Permanent Closure of Underground Storage Tanks</u>

The procedures for removing the tank shall include, but not be limited to, the following:

1. All product that can be pumped out shall be removed.
2. Products shall be drained and flushed from the piping into the tanks.
3. Remaining liquid shall be removed from the tanks.
4. If the tank does not have manholes; the Contractor shall excavate in accordance with Section 3.3 and provide access to the tank upon completion of purging activities.
5. All piping and gauge lines, with the exception of any vent lines, shall be disconnected and capped.
6. The tank storage systems, including all tanks and piping, shall be purged of flammable vapors in accordance with Section 3.27.8.
7. The interior of the tank shall be cleaned with a high pressure rinse.

8. As shown on the Contract Drawings, tanks shall be removed and disposed corresponding to the New York State Department of Transportation (NYSDOT) Standard Specifications.
9. For method of cutting tanks, see API RP 2015.
10. The vent lines shall be capped at the tanks, cut flush at the roof and capped or removed and disposed of.
11. All openings to the tanks including, but not limited, to fill boxes, manholes and gauge boxes shall be filled with concrete flush with the finished floor.

3.27.6 Site Assessment

1. General: The Contractor shall perform a site assessment to determine if there is any contamination present at the site. The site assessment shall be conducted in accordance with NYSDEC SPOTS No. 14.
2. Equipment: The Contractor shall select the means and methods for performing drilling/sampling operations. The Contractor is solely responsible for determining the adequacy of his equipment to perform the intended work. If the Contractor's equipment is not adequate to perform the work, the Contractor shall replace it with suitable equipment at no additional cost to the NYSDEC.
3. Sampling Procedure-Tank Removed: In general, Castleton will direct the Contractor to collect a minimum of five (5) soil samples in accordance with API Publ 1628 from any area around the removed tank that appears to be visually contaminated. Soil samples from the material surrounding piping will be taken at 20-foot intervals and at dispensers and fill boxes. If there are no visible areas of contaminated soil, then the Contractor shall collect 1 sample from each sidewall of the excavation and 2 samples from the bottom of the excavation. All samples collected for contamination will be screened using a PID. The samples showing the highest PID readings shall be sent to the lab for analysis.
4. If groundwater is within 5 feet of the bottom of the tank excavation, a ground water sample shall be collected.
5. Lab Analysis: Samples collected for analysis shall be sent to the CASTLETON' standby laboratory. For tanks containing gasoline or solvents, the sample shall be analyzed for VOC's via USEPA method 8260C. For tanks containing diesel fuel or heating oil, samples will be analyzed via USEPA method 8270B.

3.27.7 Notification of Spills

1. Petroleum spills and most hazardous materials spills must be reported to DEC Hotline (1800-457-7362) within 2 hours of discovery.
2. Clean closure of excavated Underground Storage Tanks do not require notification to DEC if 1,100 gallons or less in size regardless of contents.
3. Clean closure of tanks of any size that stored motor fuels (gasoline or diesel) must be reported to the NYC Fire Department. The Contractors shall prepare an affidavit of permanent closure for each facility within 7 days of tank closure. The affidavit shall state the Contractor method of tank closure. The affidavit shall be prepared in a form acceptable to the New York City Fire Department and signed by the Contractors licensed

underground storage tank system installer. The affidavit shall be submitted to the New York City Fire Department, Buried Tank Unit, Room 412, and 250 Livingston Street, Brooklyn, New York.

<u>3.27.8 Tank Contents Removal and Disposal</u>

1. General: The Contractor shall furnish all labor, materials, tools and equipment, and remove and dispose all industrial waste, as required by the Contract Documents.
2. Submittals: The following items shall be submitted to the Construction Manager for review and approval in accordance with Section 3.27.2.
    a. A detailed work plan describing the Contractor's proposed methods, equipment and sequence of operations for the removal and disposal of industrial waste from the site. The proposed procedures shall provide for safe conduct of the work and careful removal and disposal of materials.
    b. Copies of the analytical test results performed for disposal within five (5) working days after receipt of the results.
    c. Removal of Industrial waste
        i. Salvageable Fuels: All salvageable fuels shall be transferred by the Contractor to other tanks designated by the Construction manager. If storage capacity is not available, then salvageable fuels become property of the Contractor for beneficial use or disposal.
        ii. B. Sludge Materials and Contaminated Water: Sludge and contaminated water shall be collected in new or reconditioned 55-gallon drums or roll-off containers. Drums or containers shall be sealed (water-tight) to prevent rain infiltration and leakage of sludge or water. Chemical sampling and analyses of sludge and contaminated water shall be conducted by the Contractor in accordance with environmental regulatory requirements, as approved by the Construction Manager. Drums or containers shall be labeled in accordance with federal and state regulations.
3. Excavated and Demolished Materials: Excavated and demolished materials shall be collected in new or reconditioned rolloff containers or similar means as proposed by the Contractor and approved by the Construction Manager. Containers shall be sealed (water-tight) to prevent rain infiltration and leakage. Chemical sampling and analysis of the collected materials shall be conducted by the Contractor in accordance with environmental regulatory requirements, as approved by the Construction manager. Containers shall be labeled in accordance with federal and state regulations.
4. Flammable Vapors: Storage tank systems, including all tanks and piping, shall be purged of flammable vapors. If steam is to be used for either purging or cleaning a tank or other equipment, the steam discharge nozzle and all conductive insulated objects subject to impingement or condensation shall be bonded to the tank or be grounded to prevent static charge build-up on the nozzle of the steam jet. An affidavit of such purging, signed by the Contractor's licensed underground system installer, shall be filed by the

Contractor with the Commissioner of the City's Fire Department, Division of Fire Prevention.

3.27.9 Disposal of Industrial Waste

1. All waste materials shall be disposed of in accordance with the requirements of the USEPA, NYSDEC, and New York City Department of Environmental Protection (NYCDEP).
2. Storage of Waste materials at the site will not be permitted.

3.28 DNAPL Removal/Recovery

Summary: Some monitoring wells have DNAPL. As part of routine site maintenance, DNAPL may be recovered from these wells. Follow all health and safety requirements in the HASP (URS, May 2017). The following procedure will be used to remove DNAPL.

Procedure:

1. Measure the depth and thickness of the DNAPL layer per Section 3.25.
2. Bailer Method:
    a. Using a disposable bailer attached to disposable nylon twine, lower the bailer so the bottom of the bailer is at the same depth as the bottom of the DNAPL layer.
    b. Upon reaching its target depth, raise the bailer with the DNAPL product and place the product in a 1A2 open head 55-gallon steel drum.
    c. Repeat steps a through b until there is no more product to remove.
    d. Upon completion of the removal, place the used bailer and twine in a separate 1A2 open head 55-gallon steel drum.
    e. These drums will be addressed in accordance with the protocols outlined in Section 3.30.
3. Peristaltic Pump Method (to be used if the bottom of the DNAPL layer is less than 25 feet below grade):
    a. Using disposable poly tubing, place one end at the bottom of the DNAPL layer, and the other end in a 1A2 open head 55-gallon steel drum, with a piece of disposable silicone tubing in the middle, attached to the pump head.
    b. Turn on the pump, and keep pumping until there is no more DNAPL product in the pump's effluent.
    c. Upon completion of the removal, place the used tubing in a separate 1A2 open head 55-gallon steel drum.
    d. These drums will be addressed in accordance with the protocols outlined in Section 3.30.
4. Waterra Pump Method:
    a. Attach a foot valve to one end of disposable poly tubing and place that end at the bottom of the DNAPL layer. Connect the remainder of the tubing to the Waterra pump, with the effluent
    b. Turn on the pump, and keep pumping until there is no more DNAPL product in the pump's effluent.

c. Upon completion of the removal, place the used tubing in a separate 1A2 open head 55-gallon steel drum.
d. These drums will be addressed in accordance with the protocols outlined in Section 3.30.

3.28.1 Surfactant Enhanced DNAPL Recovery

Summary: Surfactant Enhanced Product Recovery (SEPR) technology uses a reagent to mobilize DNAPL, typically a surfactant. The surfactant reduces surface tension between the DNAPL and the groundwater and promotes the formation of micelles that emulsifies the DNAPL, making it more mobile. Follow all health and safety requirements in the approved HASP and subsequent addendums (URS, May 2017). The following procedure will be used to remove DNAPL via SEPR technology.

Procedure:

1. Mix the surfactant solution in accordance with the proportions recommended by the Vendor.
2. Inject the solution into an upgradient well using a transfer pump at approximately 1 to 2 gallons per minute.
3. Groundwater and emulsified DNAPL will be recovered in the downgradient well by pumping out the well contents using peristaltic pump or Waterra hydrolift pump methods discussed above, at the rate of 1 to 2 gallons per minute, into a 1A2 open head 55-gallon steel drum.
4. Nearby wells will be closely monitored for the presence of DNAPL. Based on field observations, these wells may also be pumped or bailed for DNAPL recovery.
5. This process will continue as specified in the approved site-specific project work plan.
6. Upon completion of the removal, place the used tubing in a separate 1A2 open head 55gallon steel drum.
7. These drums will be addressed in accordance with the protocols outlined in Section 3.30.

3.29 Sidewalk Flag Replacement

Summary: If a sidewalk flag is damaged during investigation activities (i.e., drilling, etc.), the City of New York requires that it be replaced in accordance with NYSDOT standards.

Procedure:

Prior to removal of a sidewalk flag, the Flag Replacement Contractor will cut the perimeter of each flag to be replaced using a water-cooled pavement saw to reduce fugitive dust. The flags will be demolished, removed and disposed of by the Contractor. New flags will be replaced in kind with the surrounding flags. All work will be performed in accordance with Section 608 of NYSDOT Standard Specifications of May 6, 2010, specifically all sections that pertain to Portland concrete sidewalks and driveways. At locations where expansion joints were installed, the expansion joints will be covered with a non-shrinking/pliable sealant.

Details on each sidewalk flag replacement will be documented in Daily Construction Report forms (Appendix A).

3.30 Investigation Derived Waste Handling

Summary: Investigation Derived Waste (IDW) generated during field activities include, but is not limited to, the following:

- Purge water;
- Poly sheeting;
- Spent macrocore liners;
- PPE; and
- Drill cutting and soil boring spoils.

This IDW must be placed in 1A2 open head 55-gallon steel drums pending shipment off site for disposal.

Procedure:

Segregation

Drummed IDW is to be divided into the following categories:

- Drill cuttings and soil boring spoils (see Section 3.18);
- Purgewater from monitoring well development/sampling and DNAPL product; and,
- Solid waste other than drill cuttings and boring spoils (i.e., spent poly tubing, PPE, etc.).

Generator ID

Any IDW generated is assigned a specific USEPA Generator ID Number based on its origin. The table below identifies the USEPA Generator ID for each Work Assignment (WA).

Site	USEPA Generator ID Number
Former Goodman Brothers Steel Drum Co. Site (WA #41)	TBD

Hazardous/Non-Hazardous Classification

Any liquid waste generated is classified a listed hazardous waste under USEPA waste codes D0039 (DNAPL product – tetrachloroethylene) and/or F002 (spent halogenated solvents). The remaining waste generated from this project is presumed not to be a hazardous waste as defined in 40 CFR Part 261. Therefore, hazardous waste characterization sampling for disposal will only be performed if necessary.

Manifests

Waste manifests must accompany the IDW during shipment off site for disposal. For nonhazardous waste, a non-hazardous waste manifest must be completed. For hazardous waste, a Uniform Hazardous Waste Manifest (USEPA Form 8700-22) must be completed, along with a Land Disposal Restriction Notification Form 1. All IDW manifests must be signed by the generator or their agent.

4.0 FIELD DOCUMENTATION

Field notebooks will be used during all on-site work. A dedicated field notebook will be maintained by the field technician overseeing the site activities. In addition to the notebook, any and all original sampling forms, purge forms and notebooks used during field activities will be submitted as part of the final report.

The field sampling team will maintain a sample log sheet summarizing the following data:

1. Sample Identification
2. Date and time of sample collection
3. Sampling depth
4. Identity of samplers
5. Sampling methods and devices
6. Purge volumes (groundwater)
7. Groundwater purge parameters
8. Chain of custody and shipping information

Each subsurface boring will be logged in a bound field notebook during drilling by the supervising geologist. Field notes will include descriptions of subsurface materials encountered during drilling, sample numbers, and types of samples recovered from the borehole. Additionally, the geologist will note time and material expenditures for later verification of contractor invoices.

Upon completion of daily drilling activities, the geologist will complete the daily drilling record form and initiate chain-of-custody on any samples collected for chemical laboratory testing. Following completion of the drilling program, the geologist will transfer field notes onto standard forms for the Site Characterization Report.

On a weekly basis the project geologist will submit a summary report to the project manager containing at a minimum the following: (1) a summary of the daily drilling records; (2) progress report on field activities; and (3) a record of site visitors.

The supervising geologist will log the time and material expenditures for later verification of contractor invoices. Upon completion of daily drilling activities, the geologist will complete the Daily Drilling Record form. Following completion of the program, the geologist will transfer field notes onto standard forms for the investigation report.

The proper completion of the following forms/logs will be considered correct procedure for documentation during the drilling program:

1. Field Log Book - weather-proof hard-bound field book
2. Daily Drilling Records (Appendix A)
3. Boring Logs (Appendix A)
4. Overburden Monitoring Well Construction Detail Diagrams (Appendix A)

5.0 SURVEYING AND MAPPING

Project surveying will provide data necessary to plot groundwater monitoring wells, piezometers, and soil-gas monitoring well locations on the existing base map. All surveying will be performed under the supervision of a New York State licensed land surveyor, following the requirements of the Work Plan, and the HASP.

Control for this project shall be based upon site control which has been established for prior work. This control is referenced to the New York State plane coordinate System and North American vertical Datum of 1988 (NAVD 88).

6.0 SAMPLING EQUIPMENT CLEANING PROCEDURES

Summary: To assure that no outside contamination will be introduced into the samples/data, thereby invalidating the samples/data, the following cleaning protocols will apply for all equipment used to collect samples/data during the field investigations.

Procedure:

1. Thoroughly clean equipment with laboratory-grade soap and water, until all visible contamination is gone.
2. Rinse with water, until all visible evidence of soap is removed.
3. Rinse several times with deionized water.
4. Air dry before using.
5. If equipment will not be used immediately, wrap in aluminum foil.
6. Geoprobe equipment will be brush cleaned between locations.

7.0 SAMPLE LABELING

Summary: In order to prevent misidentification and to aid in the handling of environmental samples collected during the field investigation, the following procedures will be used:

Soil and Groundwater Sample Procedure:

1. Affixed to each sample container will be a non-removable (when wet) label. The following information will be written on each label with permanent marker:
    - Site name
    - Sample identification
    - Project number
    - Date/time
    - Sampler's initials
    - Sample preservation
    - Analysis required

2. Each sample of each matrix will be assigned a unique identification alpha-numeric code. An example of this code and a description of its components are presented below:

Examples

- MW-1
  MW-1 = Monitoring Well 1

- SG-1
  SG-1 = Soil Gas Monitoring Well 1

List of Abbreviations
Monitor Type

- PZ = Piezometer
- MW = Monitoring Well

Sample Type

SO	=	Soil
GW	=	Groundwater
SG	=	Soil-gas
AB	=	Ambient Blank
TB	=	Trip Blank
RB	=	Rinse Blank
FD	=	Field Duplicate
MS	=	Matrix Spike
MSD	=	Matrix Spike Duplicate

Vapor Intrusion Samples Procedure:
Each indoor air sample will have the following information placed on the laboratory supplied sample label:

- Site name
- Sample identification – see below
- Date/time
- Sampler's initials
- Analysis required – TO-15

The serial number of the canister and regulator used during sampling will also be noted on the Summa® canister identification tag and on the COC.

8.0 SAMPLE SHIPPING

Summary: Proper documentation of sample collection and the methods used to control these documents are referred to as chain-of-custody procedures. Chain-of-custody procedures are essential for presentation of sample analytical chemistry results as evidence in litigation or at administrative hearings held by regulatory agencies. Chain-of-custody procedures also serve to minimize loss or misidentification of samples and to ensure that unauthorized persons do not tamper with collected samples.

The procedures used in this Remedial Design follow the chain-of-custody guidelines outlined in NEIC Policies and Procedures, prepared by the National Enforcement Investigations Center (NEIC) of the U.S. Environmental Protection Agency Office of Enforcement.

Procedure:

1. The chain-of-custody (COC) record (Appendix A) should be completely filled out, with all relevant information.
2. The original COC goes with the samples. It should be placed in a Ziploc bag and taped inside the sample cooler. The sampler should retain a copy of the COC.
3. Place inert cushioning material such as vermiculite or bubble-wrap in the bottom of the cooler.
4. Place the bottles in the cooler in such a way that they do not touch (use cardboard dividers or bubble-wrap).
5. Wrap VOA vials securely in bubble-wrap and tape. Place them in the center of the cooler.
6. With the exception of Summa® canisters, pack the cooler with ice in doubled Ziploc plastic bags.
7. Pack the cooler with cushioning material.
8. Tape the drain shut.
9. Wrap the cooler completely with strapping tape at two locations securing the lid. Do not cover any labels.
10. Place the lab address on top of cooler. For out-of-town laboratory, add the following: Put "This side up" labels on all four sides and "Fragile" labels on at least two sides. Affix numbered custody seals on front right and left of cooler. Cover seals with wide, clear tape.
11. Summa® canisters are shipped in the same boxes the laboratory used for shipping.
12. Ship samples via overnight carrier the same day that they are collected. Samples (except Summa® canisters) must be maintained at 4 degrees Celsius (C) ± 2ºC throughout the shipping duration.

9.0 FIELD SAMPLING INSTRUMENTATION

Rented field sampling equipment will require no maintenance beyond decontamination between sampling locations. Calibration procedures for electronic instruments can be found in the equipment operating manuals.

Maintenance procedures for the common instrumentation that will be used during field investigations are discussed in the equipment operating manuals. A copy of the manufacturer's operating manual for each instrument will be kept with the instrument or the operator. All field sampling equipment will be calibrated as recommended by the manufacturer. The calibration procedures and results will be recorded in the field notebook.

9.1 Preventative Maintenance

Table 9-1 presents the field instrumentation preventative maintenance summary. In case of an emergency, the equipment rental vendor, and/or the instrument manufacturer will be contacted.

TABLE 9-1
FIELD INSTRUMENTATION PREVENTATIVE MAINTENANCE SUMMARY

Instrument	Maintenance Details
Photoionization Detector	Initiate factory checkout and calibration, yearly or when malfunctioning or after changing UV light source. Wipe down readout unit after each use. Clean UV light source window every month or as use and site conditions dictate. Clean the ionization chamber monthly. Recharge battery after each use.
TVA	Initiate factory checkout and calibration, yearly or when malfunctioning or after changing UV light source. Wipe down readout unit after each use. Check probe cable and Teflon tubing prior to and after each use. Inspect H_2 tank prior to filling and recharge battery after each use.
Micropurge Flow Cell	Calibrate the required parameters using appropriate factory-supplied standards and buffers on a daily basis. Store the sonde (probe) in a 2M KCl solution at the end of each work day. Factory calibrate annually.
LaMotte Turbidity Meter	Replace 9 volt battery when necessary. Clean lamp after each days use. Clean turbidity tubes after each reading and replace tubes when discoloration of glass occurs.
TSI DustTrak	Perform a zero check before each use. Clean inlet every 350 hours. Clean 2.5 µm calibration impactor before every use. Replace internal filters every 350 hours at 1 mg/m^3, or when indicated by the main screen filter error indicator. Every year, return to the factory for cleaning and calibration, including the replacement of the internal HEPA filters.

10.0 SAMPLING FOR EMERGING CONTAMINANTS UNDER NYSDEC PART 375

As part of the NYSDECs requirement, sampling of the emerging contaminants including 1,4-Dioxane and per and poly-fluoroalkyl substances (PFAS) will be performed during the RI.

10.1 Specific Guidelines for PFAS

Soil endpoint samples collected will be analyzed by LC-MC/MS for PFAS using methodologies based on EPA method 537.1 and include the 21 PFAS compounds listed below:

Group	Chemical Name	Abbreviation
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS
	Perfluorohexanesulfonic acid	PFHxS
	Perfluoroheptanesulfonic acid	PFHpS
	Perfluorooctanesulfonic acid	PFOS
	Perfluorodecanesulfonic acid	PFDS
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA
	Perfluoropentanoic acid	PFPeA
	Perfluorohexanoic acid	PFHxA
	Perfluoroheptanoic acid	PFHpA
	Perfluorooctanoic acid	PFOA
	Perfluorononanoic acid	PFNA
	Perfluorodecanoic acid	PFDA
	Perfluoroundecanoic acid	PFUA/PFUdA
	Perfluorododecanoic acid	PFDoA
	Perfluorotridecanoic acid	PFTriA/PFTrDA
	Perfluorotetradecanoic acid	PFTA/PFTeDA
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS
	8:2 Fluorotelomer sulfonate	8:2 FTS
Perfluorooctanesulfonamides	Perfluroroctanesulfonamide	FOSA
Perfluorooctanesulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA

10.2 PFAS Reporting Limits

Reporting limits for PFAS soil are to be 2 ng/L (ppt) and 1 ug/kg (ppb), respectively. If contract labs or work plans submitted by responsible parties indicate that they are not able to achieve these reporting limits for the entire list of 21 PFAS, site-specific decisions will need to be made by the DEC project manager in consultation with the DEC remedial program chemist.

The laboratory SOP for PFAS and method detection limits are included as Appendix B.

10.3 PFAS Specific Sampling Procedures

Sampling for PFAS via EPA Method 537 can be challenging due to the prevalence of these compounds in many consumer and sampling specific products. The following sampling procedures and guidelines are necessary to ensure the usability of PFAS analytical results:

- Clothing or boots should not contain Gore-Tex (wet weather gear made of polyurethane and PVC only);
- All safety boots should be made from polyurethane and PVC;
- No materials containing Tyvek;
- Do not use fabric softener on field clothing;
- Do not use cosmetics, moisturizers, hand cream, or other related products the morning of the sampling event;
- Do not use unauthorized sunscreen or insect repellant;
- All sample containers made of HDPE or polypropylene;
- Caps are unlined and made of HDPE or polypropylene (no Teflon lined caps);
- Equipment decontamination must utilize PFAS-free water onsite for sample equipment;
- Only Alconox and/or Liquinox can be used as decontamination materials;
- Food or drinks must be left in the staging areas;
- Sample for PFAS first, other containers/methods may have PFAS present on containers/equipment;
- Field equipment must not contain Teflon;
- Sampling materials must be made from stainless-steel, HDPE, acetate, silicon, or polypropylene;
- No waterproof field books;
- No plastic clipboards, binders, or spiral notebooks;
- No adhesives
- No sharpies/permanent markers. Must use regular ball point pens;
- No use of aluminum foil;
- Keep PFAS samples in a separate cooler filled with regular ice only (do not use chemical ice packs).
- Sampler must wash hands before wearing nitrile gloves to limit contamination during sampling.

10.4 Specific Guidelines for 1,4-Dioxane

Soil endpoint samples collected will be analyzed for 1,4-Dioxane using EPA Method 8270 SIM in order to achieve the minimum method reporting limit of 0.1 mg/Kg. Liquinox will not be used for decontamination during sampling for 1,4-dioxane.

APPENDIX A

FORMS AND LOGS

CASTLETON
ENVIRONMENTAL

Soil Test Pit Field Log Form

Project Number:

Client:

Address:

Castleton Representative:

Date: **Time On-site:** **Time Off-site:**

Contractor:

Weather Conditions: **Date:** **Test Pit ID:**

Method of Excavation: **Time:** **Surface Cover:**

Depth (feet)	Texture / Composition	Consistency	Color	Mottles / Contamination Features	Structure / Fill	Comments

Notes:

Locations are approximate

Boring #		MW#	Page:	of S
PROJECT ADDRESS:				
CASTLETON JOB #				
LOGGED BY:			PRJ. MNGR.:	
CONTRACTOR:				
DRILL METHOD:				
DRILLER:				
Borehole diameter/drill bit type:			total depth	**ft**
			elevation	**NA**
HAMMER WT:	**NA**		DROP:	NA
START TIME:			DATE:	
COMPLETION TIME:			DATE:	
BACKFILL TIME:			DATE:	

Sample Depth (ft)	Advance (ft)	Recovered (ft)	Soil Description Unified Soil Classification System	Notes	Casing depth: NA Screen depth: NA

AIR SAMPLING LOGS

Sample ID	Date	Canister ID	Flow ID	Start (hg)	End (hg)	Start Time	End Time	PID (ppm)
IAQ01								
IAQ02								
IAQ03								
IAQ04								
IAQ05								
IAQ06								
IAQ07								
OAQ01								

Castleton Environmental

Project Number:

Site:

Date:

Weather:

Scope of Work:

Sample ID						
Can ID						
Regulator ID						
Can Size						
Indoor(IN), Background (BK), Sub-Slab (SS)						
Flow Controller readout (ml/min)						
Can Pressure Start ("Hg) - LAB						
Can Pressure Start ("Hg) - FIELD						
Can Pressure End ("Hg)						
Start Time						
End Time						
Temperature Start (°F)						
Temperature End (°F)						
Sub-Slab Sampling						
Slab Thickness (")						
Water present						
PID Readings (PPM)						
Helium in Sub-Slab Sample (ppm)						
Sample Tube Purge, Gillian Pump (min) (1/4" tubing Volume - 5.43 ml/ft)						

Sampling Notes:

Project Number:

Client:

Address:

Castleton Representative:

Date: **Time On-site:** **Time Off-site:**

Contractor:

Site Status:

Current Condition of Site:

APPENDIX C
EXAMPLE (Minimum Requirements)
WELL PURGING-FIELD WATER QUALITY MEASUREMENTS FORM

Location (Site/Facility Name)____________________

Well Number______________ Date______________

Field Personnel____________________

Sampling Organization____________________

Identify MP____________________

Depth to ________/________ of screen
(below MP) top bottom

Pump Intake at (ft. below MP)__________

Purging Device; (pump type)__________

Total Volume Purged __________

Clock Time 24 HR	Water Depth below MP ft	Pump Dial[1]	Purge Rate ml/min	Cum. Volume Purged liters	Temp. °C	Spec. Cond.[2] µS/cm	pH	ORP[3] mv	DO mg/L	Turb-idity NTU	Comments
Stabilization Criteria					3%	3%	±0.1	± 10 mv	10%	10%	

1. Pump dial setting (for example: hertz, cycles/min, etc).
2. µSiemens per cm(same as µmhos/cm)at 25°C.
3. Oxidation reduction potential (ORP)

Soil Vapor Intrusion - Structure Sampling Building Questionnaire **Structure ID :** ______________

Site No. : ______________________ **Site Name** : ____

Date: ______________________ **Time:** ____

Structure Address : ____

Preparer's Name & Affiliation : ____

Residential ? ☐ **Yes** ☐ **No** **Owner Occupied ?** ☐ **Yes** ☐ **No** **Owner Interviewed ?** ☐ **Yes** ☐ **No**

Commercial ? ☐ **Yes** ☐ **No** **Industrial ?** ☐ **Yes** ☐ **No** **Mixed Uses ?** ☐ **Yes** ☐ **No**

Identify all non-residential use(s) : ____

Owner Name : ____ **Owner Phone** : ( ) __________ - ___________

Secondary Owner Phone : ( ) __________ - ___________

Owner Address (if different) : ____

Occupant Name : _______________________________________ **Occupant Phone** : ( ) __________ - __________

Secondary Occupant Phone : ( ) __________ - ___________

Number & Age of All Persons Residing at this Location : ____

Additional Owner/Occupant Information : ____

Describe Structure (style, number floors, size) : ____

____

Approximate **Year Built** : ______________________ Is the building **Insulated**? ☐ Yes ☐ No

Lowest level : ☐ Slab-on-grade ☐ Basement ☐ Crawlspace

Describe Lowest Level (finishing, use, time spent in space) : ____

____

Floor Type: ☐ Concrete Slab ☐ Dirt ☐ Mixed : ____

Floor Condition : ☐ Good (few or no cracks) ☐ Average (some cracks) ☐ Poor (broken concrete or dirt)

Sumps/Drains? ☐ Yes ☐ No Describe : _______________________________________

Identify other floor penetrations & details : ____

____

Wall Construction : ☐ Concrete Block ☐ Poured Concrete ☐ Laid-Up Stone

Identify any wall penetrations : ____

____

Identify water, moisture, or seepage: location & severity (sump, cracks, stains, etc) : ________________________________

____

Heating Fuel : ☐ Oil ☐ Gas ☐ Wood ☐ Electric ☐ Other : ____________________________

Heating System : ☐ Forced Air ☐ Hot Water ☐ Other : ____

Hot Water System : ☐ Combustion ☐ Electric ☐ Boilermate ☐ Other: ____________________________

Clothes Dryer : ☐ Electric ☐ Gas Where is dryer **vented** to? ___________________________

If combustion occurs, describe where air is drawn from (cold air return, basement, external air, etc.) : __________________

____

Fans & Vents (identify where fans/vents pull air from and where they vent/exhaust to) : ___________________________________

____

Describe factors that may affect indoor air quality (chemical use/storage, unvented heaters, smoking, workshop):

Attached garage ? ☐ Yes ☐ No Air fresheners ? ☐ Yes ☐ No

New carpet or furniture ? ☐ Yes ☐ No What/Where ? ____________________

Recent **painting** or **staining** ? ☐ Yes ☐ No Where ? : ____________________

Any **solvent** or **chemical-like** odors ? ☐ Yes ☐ No Describe : ____________________

Last time **Dry Cleaned** fabrics brought in ? __________________ What / Where ? ____________________

Do any building occupants use solvents at work ? ☐ Yes ☐ No Describe : ____________________

Any testing for Radon ? ☐ Yes ☐ No Results : ____________________

Radon System/Soil Vapor Intrusion Mitigation System present ? ☐ Yes ☐ No If yes, describe below

---

Lowest Building Level Layout Sketch

- Identify and label the locations of all sub-slab, indoor air, and outdoor air samples on the layout sketch.
- Measure the distance of all sample locations from identifiable features, and include on the layout sketch.
- Identify room use (bedroom, living room, den, kitchen, etc.) on the layout sketch.
- Identify the locations of the following features on the layout sketch, using the appropriate symbols:

B or **F**	Boiler or Furnace	o	Other floor or wall penetrations (label appropriately)
HW	Hot Water Heater	**xxxxxxx**	Perimeter Drains (draw inside or outside outer walls as appropriate)
FP	Fireplaces	######	Areas of broken-up concrete
WS	Wood Stoves	● SS-1	Location & label of sub-slab vapor samples
W/D	Washer / Dryer	● IA-1	Location & label of indoor air samples
S	Sumps	● OA-1	Location & label of outdoor air samples
@	Floor Drains	● PFET-1	Location and label of any pressure field test holes.

Page _____ of _____

Structure Sampling - Product Inventory

Homeowner Name & Address: ____________________ **Date:** __________

Samplers & Company: ____________________ **Structure ID:** __________

Site Number & Name: ____________________ **Phone Number:** __________

Make & Model of PID: ____________________ **Date of PID Calibration:** __________

Identify any Changes from Original Building Questionnaire : ____________________

Product Name/Description	Quantity	Chemical Ingredients	PID Reading	Location

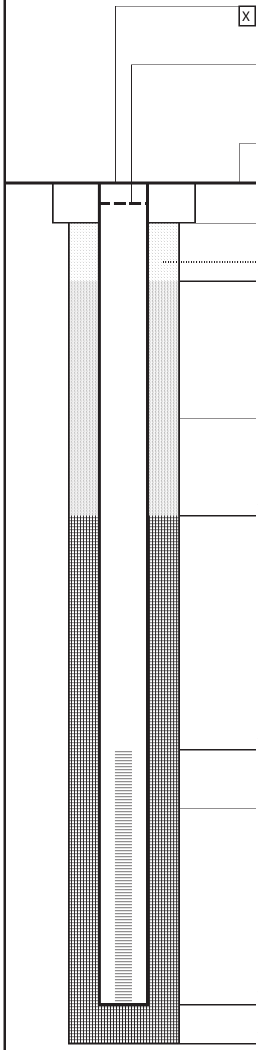
SOIL VAPOR SAMPLING LOGS

Sample ID	Date	Canister ID	Flow ID	Start (hg)	End (hg)	Start Time	End Time	Tracer Test results	PID (ppm)
SSV01									
SSV02									
SSV03									
SSV04									
SSV05									
SSV06									
SSV07									

CASTLETON ENVIRONMENTAL

Monitoring Well

Construction Log



Protective Casing
☒ Flush Mount ☐ Pop-up

Measuring Points

Land Surface

Concrete Pad

Bentonite/Cement Grout
ft.

Sand Seal
Grain Size #00 Sand

ft.

Material PVC

Slot Size. 0.01

Inch Diam. 2

ft. Top of Screen

Gravel Pack
Grain Size #02 Sand

ft. Bottom of Screen

ft.

Note: Drawing is not to scale.
Depths are given in feet below land surface.

Well No. __________

Project __________

Surveyor __________

Measuring Point Elevation __________

Installation Date __________

Pumping Duration __________

Well Purpose __________

Hydrogeologist __________

Company Name __________

Notes __________

APPENDIX B

LAB SOP FOR PFAS/1,4 DIOXANE

York Analytical Laboratories, Inc.

10/30/2019

Analytical Method Information

PFAS Target compounds by LC/MS-MS

Dept.: PFAS

PFAS, NYSDEC Target List in Water (EPA 537m)

Units: ng/L

Preservation: Cool 4°C

Hold Time to Analysis 28 days

Container: 10_250mL Plastic Cool to 4° C

Amount Required: 250 mL

Hold Time to Extr. 14 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
1H,1H,2H,2H-Perfluorodecanesulfonic aci	0.877	2.00 ng/L		30	25 - 150	35	50 - 130	30
1H,1H,2H,2H-Perfluorooctanesulfonic aci	1.16	5.00 ng/L		30	25 - 150	35	50 - 130	30
surr: d3-N-MeFOSAA			25 - 150					
surr: d5-N-EtFOSAA			25 - 150					
surr: M2-6:2 FTS			25 - 150					
surr: M2-8:2 FTS			25 - 150					
surr: M2PFTeDA			10 - 150					
surr: M3PFBS			25 - 150					
surr: M3PFHxS			25 - 150					
surr: M4PFHpA			25 - 150					
surr: M5PFHxA			25 - 150					
surr: M6PFDA			25 - 150					
surr: M7PFUdA			25 - 150					
surr: M9PFNA			25 - 150					
MPFOA		0.100 ng/L						
N-EtFOSAA	0.436	2.00 ng/L		30	25 - 150	35	50 - 130	30
N-MeFOSAA	0.364	2.00 ng/L		30	25 - 150	35	50 - 130	30
surr: Perfluoro-1-[13C8]octanesulfonamid			10 - 150					
surr: Perfluoro-1-[13C8]octanesulfonic aci			25 - 150					
Perfluoro-1-decanesulfonic acid (PFDS)	0.491	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluoro-1-heptanesulfonic acid (PFHpS)	0.418	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluoro-1-octanesulfonamide (FOSA)	0.877	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorobutanesulfonic acid (PFBS)	0.436	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorodecanoic acid (PFDA)	0.493	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorododecanoic acid (PFDoA)	0.611	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluoroheptanoic acid (PFHpA)	0.447	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorohexanesulfonic acid (PFHxS)	0.494	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorohexanoic acid (PFHxA)	0.442	2.00 ng/L		30	25 - 150	35	50 - 130	30
surr: Perfluoro-n-[1,2-13C2]dodecanoic ac			25 - 150					
surr: Perfluoro-n-[13C4]butanoic acid (M			25 - 150					
surr: Perfluoro-n-[13C5]pentanoic acid (M			25 - 150					
surr: Perfluoro-n-[13C8]octanoic acid (M8			25 - 150					
Perfluoro-n-butanoic acid (PFBA)	1.01	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorononanoic acid (PFNA)	0.361	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorooctanesulfonic acid (PFOS)	0.472	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorooctanoic acid (PFOA)	0.360	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluoropentanoic acid (PFPeA)	0.511	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorotetradecanoic acid (PFTA)	0.701	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorotridecanoic acid (PFTrDA)	0.660	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluoroundecanoic acid (PFUnA)	0.534	2.00 ng/L		30	25 - 150	35	50 - 130	30

Analytical Method Information

PFAS Target compounds by LC/MS-MS

Dept.: PFAS

PFAS, NYSDEC Target List in Soil (EPA 537m) Units: ug/kg

Preservation: Cool 4°C **Hold Time to Analysis** 28 days

Container: 10_250mL Plastic Cool to 4° C **Amount Required:** 250 mL **Hold Time to Extr.** 14 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
1H,1H,2H,2H-Perfluorodecanesulfonic aci	0.344	0.750 ug/kg		30	25 - 150	35	50 - 130	30
1H,1H,2H,2H-Perfluorooctanesulfonic aci	0.521	0.750 ug/kg		30	25 - 150	35	50 - 130	30
surr: d3-N-MeFOSAA			25 - 150					
surr: d5-N-EtFOSAA			25 - 150					
surr: M2-6:2 FTS			25 - 150					
surr: M2-8:2 FTS			25 - 150					
surr: M2PFTeDA			10 - 150					
surr: M3PFBS			25 - 150					
surr: M3PFHxS			25 - 150					
surr: M4PFHpA			25 - 150					
surr: M5PFHxA			25 - 150					
surr: M6PFDA			25 - 150					
surr: M7PFUdA			25 - 150					
surr: M9PFNA			25 - 150					
MPFOA								
N-EtFOSAA	0.109	0.750 ug/kg		30	25 - 150	35	50 - 130	30
N-MeFOSAA	0.0910	0.750 ug/kg		30	25 - 150	35	50 - 130	30
surr: Perfluoro-1-[13C8]octanesulfonamid			10 - 150					
surr: Perfluoro-1-[13C8]octanesulfonic aci			25 - 150					
Perfluoro-1-decanesulfonic acid (PFDS)	0.177	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluoro-1-heptanesulfonic acid (PFHpS)	0.198	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluoro-1-octanesulfonamide (FOSA)	0.455	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorobutanesulfonic acid (PFBS)	0.109	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorodecanoic acid (PFDA)	0.123	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorododecanoic acid (PFDoA)	0.110	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluoroheptanoic acid (PFHpA)	0.112	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorohexanesulfonic acid (PFHxS)	0.106	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorohexanoic acid (PFHxA)	0.111	0.750 ug/kg		30	25 - 150	35	50 - 130	30
surr: Perfluoro-n-[1,2-13C2]dodecanoic ac			25 - 150					
surr: Perfluoro-n-[13C4]butanoic acid (M			25 - 150					
surr: Perfluoro-n-[13C5]pentanoic acid (M			25 - 150					
surr: Perfluoro-n-[13C8]octanoic acid (M8			25 - 150					
Perfluoro-n-butanoic acid (PFBA)	0.278	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorononanoic acid (PFNA)	0.0900	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorooctanesulfonic acid (PFOS)	0.118	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorooctanoic acid (PFOA)	0.0900	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluoropentanoic acid (PFPeA)	0.211	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorotetradecanoic acid (PFTA)	0.192	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorotridecanoic acid (PFTrDA)	0.132	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluoroundecanoic acid (PFUnA)	0.133	0.750 ug/kg		30	25 - 150	35	50 - 130	30

Standard Operating Procedure - Summary
PFAS in Groundwater, Surface water and Soils

1.0 Summary

Target PFAS compounds are prepared and analyzed using EPA Method 537.1 modified. Aqueous and Soil samples are fortified with isotopic surrogates of the target PFAS compounds, extracted and concentrated to a known volume. The extracts are then analyzed employing LC-MSMS techniques.

Each preparation batch (per matrix) includes a preparation blank, lab control sample (blank spike), sample matrix spike and matrix spike duplicate and up to 20 samples.

2.0 Sample Preparation

Sample preparation involves extraction/clean-up and final concentration to a known volume before analysis. Isotopic surrogates are added to all preparation batch samples/QC.

2.1 Aqueous Samples

A known volume of sample is spiked with isotopic surrogates and extracted using Solid Phase Extraction (SPE) techniques. The SPE tubes are eluted with solvent and the eluant is then concentrated using nitrogen evaporation to a final volume of 1.0 mL. The final concentrated extract is fortified with Internal Standard and analyzed by LC-MSMS.

2.2 Soil Samples

A known weight of sample is fortified with isotopic surrogates, mixed then extracted in methanolic potassium hydroxide employing vortex mixing, followed by orbital shaking and finally ultrasonic extraction.

The extract is centrifuged and the supernatant solvent is quantitatively poured off and a small volume of PFAS free water is added to the solvent. The solvent mixture is evaporated using nitrogen evaporation and the remaining aqueous extract is brought to a known volume with PFAS free water.

The aqueous extract is then pH adjusted to 6-8 using glacial acetic acid and the resulting aqueous solution is extracted using SPE techniques. The SPE tube is eluted with solvent and the eluant is then concentrated using nitrogen evaporation to a final volume of 2.0 mL. The final concentrated extract is fortified with Internal Standard and analyzed by LC-MSMS.

3.0 **Analysis**

Analysis is conducted utilizing an Agilent Infinity 1290 HPLC system interfaced to an Agilent 6470AAR LC-MSMS with an Agilent Jet Stream-ElectroSpray Ionization (AJS-ESI)interface. The system is operated in the dynamic MRM (multiple reaction monitoring) mode for specific PFAS target isotopes and native analogs.

Where possible, multiple MRM transitions are used for targets and isotopes. Some species only exhibit single MRM transitions. Precursors and product ions are used for Quantitative and Qualitative purposes respectively.

3.1 Initial Calibration

The LC-MSMS is calibrated with 7 standards of a total of 40 isotopes and analog target PFAS compounds. Calibration is conducted from 0.25 to 20 ng/mL. Calibration employs internal standard techniques and either average response factor or quadratic regression is used depending upon the best calibration model based upon accuracy across the calibration range.

3.2 Continuing Calibration Verification

Each analytical sequence includes an opening continuing calibration verification (CCV) and a CCV after every 10 injections and at the end of the analysis sequence.

The CCV acceptance criteria are ± 30% of the expected value. Internal Standard areas are acceptable when -50% to +50% of the average response in the initial calibration.

3.3 Isotopic Surrogates (Isotope Dilution Analytes (IDA)

18 IDAs are utilized for this procedure. These isotopes are used to correct for recovery of detected target analog PFAS compounds through the preparation/analysis processes. The recovery limits currently are 25-150 % recovery and these limits are adjusted based upon laboratory determined control limits when sufficent data points per matrix are available.

3.4 Method Blanks (MBLK)

Each preparation batch includes a laboratory method blank. Any result greater than the Reporting Limit or 2 ng/L (aqueous) or 0.5 ug/kG (soil) is "B" flagged according with the exception of any detection of PFOA, PFOS or PFNA above the RL will require re-extraction of the batch.

3.5 Blank Spike (LCS)

Each preparation batch includes and BS/LCS. Recoveries are calculated and based upon isotope dilution. Recovery acceptance limits are 50-150% with RPD of 30% for a BSD if performed.

3.6 Matrix Spike/Matrix Spike Duplicates (MS/MSD)

Each preparation batch includes and MS/MSD pair. Recoveries are calculated and based upon isotope dilution. Recovery acceptance limits are 25-150% with RPD of 35% for samples.

4.0 Data Review and Reporting

All quantitation reports and LIMS output files are generated using the Agilent Mass Hunter reporting programs. The Quant reports include all Quantitative data and MRM transition data which are reviewed. The LIMS output file is in a format that allows upload to Element LIMS.

Isotope Dilution calculations are performed using our custom PFAS.mdb program which automatically uploads to the LIMS output file for upload to Element LIMS.

Once uploaded to ELEMENT, any exceptions/outliers are noted, flagged and set to reviewed.

All data reported are isotopically corrected for all QC and samples.

5.0 Revision History

May 1, 2019 Revision 1.0 First Issue

6.0 Approvals:

Laboratory Director	Ben Gulizia
Corp. Technical Director	Robert Bradley
Corp. QA Officer	Sarah Widomski

APPENDIX B – PERSONNEL RESUMES

CASTLETON
ENVIRONMENTAL

Brian Barth

1/14/2019

Senior Project Manager

Mr. Barth's ten-years of experience performing a wide variety of environmental projects allows him to effectively support our client's diverse needs and goals. His areas of expertise include conducting environmental site assessments for due diligence, remedial investigations and site characterization, executing federal, state, and local remedial actions, construction support and oversight, treatment system installation and operation, feasibility studies, and environmental mapping and modeling. Mr. Barth has extensive experience implementing geographic information systems, remote sensing, database development, and analysis techniques to better understand complex problems and help derive practical project solutions.

Contact Mr. Barth at bbarth@castletonenv.com

PROFESSIONAL EXPERIENCE

Castleton Environmental, DPC. Babylon, NY	Jan 2018 – Present – Sr. Project Manager
P.W. Grosser Consulting, Inc. Bohemia, NY	Sep 2008 – Jan 2018 – Project Manager
New York Institute of Technology Manhattan, NY	Jan 2012 – Dec 2016 – Adjunct Professor

EDUCATION

New York Institute of Technology
Master of Science – Environmental Technology, May 2012

State University at Albany
Bachelor of Science – Environmental Science, May 2008

CERTIFICATIONS

Environmental Professional per 40 CFR 312.10(b)
Geographic Information Systems and Spatial Analysis
OSHA HAZWOPER 40-Hr; OSHA HAZWOPER 8-Hr
OSHA Construction Site Safety 10-Hr
NYCOER Turbo Training
NYSDEC Endorsed Erosion and Sediment Control

AREAS OF EXERTISE

Environmental Program Management
Site Assessment, Characterization, and Cleanup
Data Management, Analysis, and Interpretation
Environmental & Regulatory Compliance
Multi-Media Sampling

AFFILIATIONS

Long Island Association of Professional Geologists, Member
New York State GIS Association / GISMO
Long Island GIS Association

NOTABLE ASSIGNMENTS

Site Assessments and Investigation

Mr. Barth has performed numerous environmental site investigations supporting real estate transactions and due diligence for a variety of clients. Support included performing Phase I and Phase II Environmental Site Assessments, developing work plans, cost estimates and project schedules, sample collection, documentation, data interpretation and dissemination, and reporting. Based upon the results, Mr. Barth can navigate the project through the myriad of post Phase II actions that may be necessary to ultimately meet the client’s goals and objectives.

Remedial Program Management and Site Development

Mr. Barth has been responsible for and supported the investigation and management of several remedial actions in support of site re-development. Often, these activities are performed under regulatory oversight or as volunteers to ensure compliance with applicable regulations and guidance. Besides navigating the complexity of federal, state, and local programs, voluntary efforts relay heavily on his construction and site re-development experience to develop appropriate site characterization and soil management plans. Mr. Barth has investigated and remediated sites that require soil excavation and disposal, long-term groundwater remediation, soil vapor extraction, and in-situ chemical treatments.

Environmental Studies and Analysis

Mr. Barth has unique experience implementing geographic information systems, database and system development, remote sensing, GPS, and surface and subsurface modeling techniques to a broad range of projects. Using a variety of vector and raster-based toolsets to map, analyze, and visualize complex spatial patters, Mr. Barth has applied these skills to numerous complex projects including largescale superfund and brownfield remediation, groundwater contour and contaminant mapping, fate and transport, nitrogen load to groundwater, sewer feasibility studies, invasive species removal and management, bathymetric surveys, energy siting, and construction and mining support. These skills help our clients better understand the phenomena impacting a site and helps make informed decisions on how to advance a project towards its ultimate goals.

Frank P Castellano

1/1/2019

Principal and Founder

After 23 years leading one of the region's most accomplished and diverse environmental consulting firms, Mr. Castellano has founded Castleton Environmental, Inc. to focus on providing high value environmental consulting services specifically geared to the commercial lending and real estate investment/management industries. Leveraging his many years of experience, Mr. Castellano has earned a reputation for developing strategic approaches to the environmental challenges of complex real estate transactions and portfolio management. These approaches enable the transactions to proceed to closing while managing the risks of the involved stakeholders.

Contact Mr. Castellano at frankc@castletonenv.com

PROFESSIONAL EXPERIENCE

Castleton Environmental, Inc. Babylon, NY	Founded 2015
PW Grosser Consulting, Inc., Bohemia, NY	1992 – 2015 - Last position held – Sr. Vice President/COO
H2M Group Melville, NY	1989-1992 - Last position held – Field Hydrogeologist

EDUCATION

Adelphi University

Master of Science – Hydrogeology, 1993

State University of New York at Oneonta

Bachelor of Science – Water Resources, 1989

CERTIFICATIONS/QUALIFICATIONS

NYS Professional Geologist, (License No. 000705)
Environmental Professional per 40 CFR 312.10(b)
Licensed Professional Geologist, PA
Licensed Real Estate Sales Professional, NY
OSHA Health & Safety HAZWOPER

AREAS OF EXERTISE

Real Property Transactions
Environmental Program Management
Real Estate Portfolio Management
Hazardous Waste Investigation and Cleanup
Environmental Risk Management

AFFILIATIONS

Long Island Association of Professional Geologists, Member
Long Island Business Development Council, Board Member
Long Island Real Estate Group, Member

NOTABLE ASSIGNMENTS

GTJ REIT Portfolio Management

Mr. Castellano serves as the primary environmental consulting resource to a large Real Estate Investment Trust with holdings in suburban New York, New Jersey, Connecticut and Maryland. Working directly alongside the REIT management team, Mr. Castellano provides environmental due diligence guidance beginning at the contract negotiation phase through closing on new acquisitions. Providing Phase I and II Environmental Site Assessment support, Property Condition Assessments and evaluation of potential liabilities, Mr. Castellano works as part of the team to minimize risk while continuing to help the team add assets to their portfolio. Routine management of the portfolio requires Mr. Castellano’s support during tenant lease negotiations, compliance activities and debt re-positioning.

Paramount Assets Portfolio Management

Mr. Castellano serves as a trusted environmental resource to the management team of this real estate company, comprised largely of urban commercial and retail buildings throughout New Jersey. Navigating New Jersey’s complex environmental regulatory framework, Mr. Castellano assists this client with pre-acquisition due diligence as well as compliance with the Industrial Site Recovery Act (ISRA).

Phase II Environmental Assessments

For over 20 years, Mr. Castellano has been performing Phase II Environmental Site Assessments for a variety of private real estate clients and lending institutions. For these projects, Mr. Castellano utilizes his knowledge of various field sampling and testing techniques to meet the desired objective of characterizing potential environmental risks. Based on the Phase II findings, Mr. Castellano develops strategies to remedy identified problems and/or manage risks. The ultimate goal for every Phase II is to develop the appropriate strategy to advance the transaction while protecting the interests of those involved. Based on the quality of his work, Mr. Castellano has established many long-standing client relationships due to his ability to deliver clarity to real estate transactions mired in environmental turbidity.

PUBLICATIONS

Case Studies Using USCG Oil Identification System for Petroleum Spill Source Identification (Petroleum Hydrocarbons & Organic Chemicals in Ground Water, Conference, TX, 1993

Intrusive Investigative Techniques for the Identification of DNAPL (Geology of LI/NY; LIAPG 1996)

Surface Water, Sediment & Fishery Survey, Nassau County Ponds (Geology of LI/NY 1997)

Not Just a Chemical Interaction: Complementary Roles of the Geologist & Engineer on Hazardous Waste Remediation Project (Geology of LI/NY 1997)

MTBE in Ground Water Cleanup Technology and Costs (NYIT – Emerging Problems for the New Century 2002)

DOE Brookhaven National Laboratory Transuranic & Legacy Waste Disposal (Waste Management 05 Conference, Tucson, AZ)

Is Your Real Estate Giving You the Vapors? A Look at Soil Vapor Intrusion Regulations and their Impact on Real Estate Transactions (Society of Chief Appraisers NY Conference, Oct 2018)

Key LDC Staff

Richard M. Amano
Position: Principal Chemist

Experience: Mr. Amano has over 30 years of combined environmental laboratory, QA/QC, laboratory auditing, and data validation experience. Prior to founding LDC in 1991, he directed two major laboratories; Analytical Technologies, Inc. (San Diego) and Brown and Caldwell. His experience includes oversight and direction of major QA/QC and data validation efforts for Superfund sites, DOE sites, Navy RI/FS projects, Army Corps of Engineers investigations, and AFCEE projects. He also has overseen several laboratory audits for major analytical testing programs.

Specifically, Mr. Amano has over 15 years experience with the validation of organic, inorganic, and radiochemical analyses using USEPA CLP (including Region III) functional guidelines and other applicable guidance documents.

Scott Denzer
Position: Technical Director/Principal Chemist

Experience: Mr. Denzer has over 27 years combined experience in environmental sampling, analyses, data validation, quality assurance, laboratory auditing, software design, implementation and training. Mr. Denzer's experience includes sampling, analysis and data validation in support of Federal and State programs, including the Clean Water Act, the Clean Air Act, CERCLA, RCRA, and NIOSH.

Mr. Denzer has performed data verification, review and data validation for numerous Department of Defense projects, commercial projects, and is familiar with program-specific requirements as well as the Uniform Federal Policy for Quality Assurance Project Plans, the EPA Data Quality Objective Process, requirements of the Safe Drinking Water Act, the National Laboratory Accreditation Program, and quality control requirements of various analytical methods.

Prior to his experience at LDC and the Guam Environmental Protection Agency, Mr. Denzer held laboratory positions including GC Pesticides supervisor, GC chemist, and section leader. As Technical Director and Principal Chemist with Laboratory Data Consultants, Inc., Mr. Denzer currently oversees special data validation and software development projects and provides technical support to contractors by performing laboratory audits and technical review of Quality Assurance documents under various programs.

Erlinda Rauto
Position: Senior Chemist/QA Officer, 1993 to present

Experience: Ms. Rauto has over 20 years combined environmental laboratory, QA/QC, and data validation experience. Her experience includes performance of data validation in the GC, trace metals, and wet chemistry areas for major Federal projects. Her laboratory experience includes hands-on CLP and EPA ICP/GFAA analysis, pesticide/PCBs and wet chemistry analysis. Specifically, Ms. Rauto has over 11 years organic data validation and assessment experience using USEPA (including Region III) functional guidelines and other applicable documents.

As a senior chemist with Laboratory Data Consultants, Inc., Ms. Rauto specializes in the data validation and compliance screening of gas chromatography organic analyses. This validation includes EPA CLP, SW-846, and EPA Water and Wastewater methods. Over the past eight years, Ms. Rauto has performed USEPA Level 3 and Level 4 (including NFESC Level C and D) validation for projects including Southwest Division CLEAN 1 (Jacobs Engineering/IT Corporation/CH2M Hill), Southwest Division CLEAN 2 (Bechtel National), Pacific Northwest Division CLEAN (URS Greiner), Southern Division CLEAN (ABB Environmental), Atlantic Division CLEAN (EA Engineering), Southwest Division RAC (OHM Remediation), Pacific Division CLEAN (Earth Tech), DOE Atomic City (Jacobs Engineering Group), Army Corps of Engineers, Travis AFB (CH2M Hill), Army Corps of Engineers, Camp Navajo (Tetra Tech), AFCEE Mather AFB (Montgomery Watson), AFCEE Pease AFB (Bechtel Environmental), AFCEE England AFB (Law Environmental), Army

Corps of Engineers, Hawthorne Army Depot (Tetra Tech), Army Corps of Engineers, Fort Ord (Harding Lawson), Nevada Test Site (IT Corp), and AFCEE Beale AFB (Law/Crandall, Inc.).

Stella V. Cuenco

Position: Senior Chemist, 1996 to present

Experience: Ms. Cuenco has over 14 years combined environmental laboratory and data validation experience. Her experience includes performance of data validation in the GC and GC/MS areas for major Federal projects. Her laboratory experience includes hands-on CLP and EPA analysis of GC and GC/MS volatile organic compounds. Specifically, Ms. Cuenco has over 10 years organic data validation experience using USEPA (including Region III) functional guidelines and other applicable documents.

As senior chemist with Laboratory Data Consultants, Inc., Ms. Cuenco specializes in the data validation and contract compliance screening of gas chromatography-mass spectrometry analyses. She has a thorough knowledge and understanding of gas chromatography-mass spectrometry methods referenced in EPA CLP, SW-846, EPA 500 and 600 series documents. She has performed data validation under EPA Region IX ESAT.

Pei Geng

Position: Senior Chemist, 1996 to Present

Experience: Ms. Geng has over 15 years combined environmental laboratory and data validation experience. Her experience includes performance of data validation in the GC and GC/MS areas for major Federal projects. Her laboratory experience includes hands-on CLP and EPA analysis of GC and GC/MS volatile organic compounds. Specifically, Ms. Geng has over 8 years organic data validation experience using USEPA CLP (including Region III) functional guidelines and other applicable documents.

As a senior chemist with Laboratory Data Consultants, Inc., Ms. Geng specializes in the data validation and contract compliance screening of gas chromatography-mass spectrometry analyses as well as gas chromatography analyses. She has a thorough knowledge and understanding of gas chromatography and gas chromatography-mass spectrometry methods referenced in EPA CLP, SW-846, EPA 500 and 600 series documents. She has performed data validation under EPA Region IX ESAT.

APPENDIX C – YORK ANALYTICAL NYSDOH ELAP CERTIFICATE

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019
Revised April 30, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. KRZYSZTOF TRAFALSKI
YORK ANALYTICAL LABORATORIES, INC. (II)
132-02 89TH AVENUE SUITE 217
RICHMOND HILL, NY 11418

NY Lab Id No: 12058

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Perfluorinated Alkyl Acids

Perfluorooctanesulfonic acid (PFOS)	EPA 537
Perfluorooctanoic acid (PFOA)	EPA 537

Serial No.: 60182

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

APPENDIX D – LABORATORY SOP FOR PFAS/1,4-DIOXANE AND ANALYTICAL METHOD INFORMATION

Standard Operating Procedure - Summary
PFAS in Groundwater, Surface water and Soils

1.0 Summary

Target PFAS compounds are prepared and analyzed using EPA Method 537.1 modified. Aqueous and Soil samples are fortified with isotopic surrogates of the target PFAS compounds, extracted and concentrated to a known volume. The extracts are then analyzed employing LC-MSMS techniques.

Each preparation batch (per matrix) includes a preparation blank, lab control sample (blank spike), sample matrix spike and matrix spike duplicate and up to 20 samples.

2.0 Sample Preparation

Sample preparation involves extraction/clean-up and final concentration to a known volume before analysis. Isotopic surrogates are added to all preparation batch samples/QC.

2.1 Aqueous Samples

A known volume of sample is spiked with isotopic surrogates and extracted using Solid Phase Extraction (SPE) techniques. The SPE tubes are eluted with solvent and the eluant is then concentrated using nitrogen evaporation to a final volume of 1.0 mL. The final concentrated extract is fortified with Internal Standard and analyzed by LC-MSMS.

2.2 Soil Samples

A known weight of sample is fortified with isotopic surrogates, mixed then extracted in methanolic potassium hydroxide employing vortex mixing, followed by orbital shaking and finally ultrasonic extraction.

The extract is centrifuged and the supernatant solvent is quantitatively poured off and a small volume of PFAS free water is added to the solvent. The solvent mixture is evaporated using nitrogen evaporation and the remaining aqueous extract is brought to a known volume with PFAS free water.

The aqueous extract is then pH adjusted to 6-8 using glacial acetic acid and the resulting aqueous solution is extracted using SPE techniques. The SPE tube is eluted with solvent and the eluant is then concentrated using nitrogen evaporation to a final volume of 2.0 mL. The final concentrated extract is fortified with Internal Standard and analyzed by LC-MSMS.

3.0 Analysis

Analysis is conducted utilizing an Agilent Infinity 1290 HPLC system interfaced to an Agilent 6470AAR LC-MSMS with an Agilent Jet Stream-ElectroSpray Ionization (AJS-ESI)interface. The system is operated in the dynamic MRM (multiple reaction monitoring) mode for specific PFAS target isotopes and native analogs.

Where possible, multiple MRM transitions are used for targets and isotopes. Some species only exhibit single MRM transitions. Precursors and product ions are used for Quantitative and Qualitative purposes respectively.

3.1 Initial Calibration

The LC-MSMS is calibrated with 7 standards of a total of 40 isotopes and analog target PFAS compounds. Calibration is conducted from 0.25 to 20 ng/mL. Calibration employs internal standard techniques and either average response factor or quadratic regression is used depending upon the best calibration model based upon accuracy across the calibration range.

3.2 Continuing Calibration Verification

Each analytical sequence includes an opening continuing calibration verification (CCV) and a CCV after every 10 injections and at the end of the analysis sequence.

The CCV acceptance criteria are ± 30% of the expected value. Internal Standard areas are acceptable when -50% to +50% of the average response in the initial calibration.

3.3 Isotopic Surrogates (Isotope Dilution Analytes (IDA)

18 IDAs are utilized for this procedure. These isotopes are used to correct for recovery of detected target analog PFAS compounds through the preparation/analysis processes. The recovery limits currently are 25-150 % recovery and these limits are adjusted based upon laboratory determined control limits when sufficent data points per matrix are available.

3.4 Method Blanks (MBLK)

Each preparation batch includes a laboratory method blank. Any result greater than the Reporting Limit or 2 ng/L (aqueous) or 0.5 ug/kG (soil) is "B" flagged according with the exception of any detection of PFOA, PFOS or PFNA above the RL will require re-extraction of the batch.

3.5 Blank Spike (LCS)

Each preparation batch includes and BS/LCS. Recoveries are calculated and based upon isotope dilution. Recovery acceptance limits are 50-150% with RPD of 30% for a BSD if performed.

3.6 Matrix Spike/Matrix Spike Duplicates (MS/MSD)

Each preparation batch includes and MS/MSD pair. Recoveries are calculated and based upon isotope dilution. Recovery acceptance limits are 25-150% with RPD of 35% for samples.

4.0 Data Review and Reporting

All quantitation reports and LIMS output files are generated using the Agilent Mass Hunter reporting programs. The Quant reports include all Quantitative data and MRM transition data which are reviewed. The LIMS output file is in a format that allows upload to Element LIMS.

Isotope Dilution calculations are performed using our custom PFAS.mdb program which automatically uploads to the LIMS output file for upload to Element LIMS.

Once uploaded to ELEMENT, any exceptions/outliers are noted, flagged and set to reviewed.

All data reported are isotopically corrected for all QC and samples.

5.0 Revision History

May 1, 2019	Revision 1.0	First Issue

6.0 Approvals:

Laboratory Director	Ben Gulizia
Corp. Technical Director	Robert Bradley
Corp. QA Officer	Sarah Widomski

York Analytical Laboratories, Inc.

10/30/2019

Analytical Method Information

PFAS Target compounds by LC/MS-MS

Dept.: PFAS

PFAS, NYSDEC Target List in Water (EPA 537m)

Units: ng/L

Preservation: Cool 4°C

Container: 10_250mL Plastic Cool to 4° C

Amount Required: 250 mL

Hold Time to Analysis 28 days

Hold Time to Extr. 14 days

Analyte	**MDL**	**Reporting Limit**	**Surrogate %R**	**Duplicate RPD**	**Matrix Spike**		**Blank Spike / LCS**	
					%R	**RPD**	**%R**	**RPD**
1H,1H,2H,2H-Perfluorodecanesulfonic aci	0.877	2.00 ng/L		30	25 - 150	35	50 - 130	30
1H,1H,2H,2H-Perfluorooctanesulfonic aci	1.16	5.00 ng/L		30	25 - 150	35	50 - 130	30
surr: d3-N-MeFOSAA			25 - 150					
surr: d5-N-EtFOSAA			25 - 150					
surr: M2-6:2 FTS			25 - 150					
surr: M2-8:2 FTS			25 - 150					
surr: M2PFTeDA			10 - 150					
surr: M3PFBS			25 - 150					
surr: M3PFHxS			25 - 150					
surr: M4PFHpA			25 - 150					
surr: M5PFHxA			25 - 150					
surr: M6PFDA			25 - 150					
surr: M7PFUdA			25 - 150					
surr: M9PFNA			25 - 150					
MPFOA		0.100 ng/L						
N-EtFOSAA	0.436	2.00 ng/L		30	25 - 150	35	50 - 130	30
N-MeFOSAA	0.364	2.00 ng/L		30	25 - 150	35	50 - 130	30
surr: Perfluoro-1-[13C8]octanesulfonamid			10 - 150					
surr: Perfluoro-1-[13C8]octanesulfonic aci			25 - 150					
Perfluoro-1-decanesulfonic acid (PFDS)	0.491	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluoro-1-heptanesulfonic acid (PFHpS)	0.418	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluoro-1-octanesulfonamide (FOSA)	0.877	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorobutanesulfonic acid (PFBS)	0.436	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorodecanoic acid (PFDA)	0.493	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorododecanoic acid (PFDoA)	0.611	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluoroheptanoic acid (PFHpA)	0.447	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorohexanesulfonic acid (PFHxS)	0.494	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorohexanoic acid (PFHxA)	0.442	2.00 ng/L		30	25 - 150	35	50 - 130	30
surr: Perfluoro-n-[1,2-13C2]dodecanoic ac			25 - 150					
surr: Perfluoro-n-[13C4]butanoic acid (MF			25 - 150					
surr: Perfluoro-n-[13C5]pentanoic acid (M			25 - 150					
surr: Perfluoro-n-[13C8]octanoic acid (M8			25 - 150					
Perfluoro-n-butanoic acid (PFBA)	1.01	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorononanoic acid (PFNA)	0.361	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorooctanesulfonic acid (PFOS)	0.472	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorooctanoic acid (PFOA)	0.360	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluoropentanoic acid (PFPeA)	0.511	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorotetradecanoic acid (PFTA)	0.701	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluorotridecanoic acid (PFTrDA)	0.660	2.00 ng/L		30	25 - 150	35	50 - 130	30
Perfluoroundecanoic acid (PFUnA)	0.534	2.00 ng/L		30	25 - 150	35	50 - 130	30

York Analytical Laboratories, Inc.

10/30/2019

Analytical Method Information

PFAS Target compounds by LC/MS-MS

Dept.: PFAS

PFAS, NYSDEC Target List in Soil (EPA 537m)

Units: ug/kg

Preservation: Cool 4°C

Hold Time to Analysis 28 days

Container: 10_250mL Plastic Cool to 4° C

Amount Required: 250 mL

Hold Time to Extr. 14 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
1H,1H,2H,2H-Perfluorodecanesulfonic aci	0.344	0.750 ug/kg		30	25 - 150	35	50 - 130	30
1H,1H,2H,2H-Perfluorooctanesulfonic aci	0.521	0.750 ug/kg		30	25 - 150	35	50 - 130	30
surr: d3-N-MeFOSAA			25 - 150					
surr: d5-N-EtFOSAA			25 - 150					
surr: M2-6:2 FTS			25 - 150					
surr: M2-8:2 FTS			25 - 150					
surr: M2PFTeDA			10 - 150					
surr: M3PFBS			25 - 150					
surr: M3PFHxS			25 - 150					
surr: M4PFHpA			25 - 150					
surr: M5PFHxA			25 - 150					
surr: M6PFDA			25 - 150					
surr: M7PFUdA			25 - 150					
surr: M9PFNA			25 - 150					
MPFOA								
N-EtFOSAA	0.109	0.750 ug/kg		30	25 - 150	35	50 - 130	30
N-MeFOSAA	0.0910	0.750 ug/kg		30	25 - 150	35	50 - 130	30
surr: Perfluoro-1-[13C8]octanesulfonamid			10 - 150					
surr: Perfluoro-1-[13C8]octanesulfonic aci			25 - 150					
Perfluoro-1-decanesulfonic acid (PFDS)	0.177	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluoro-1-heptanesulfonic acid (PFHpS)	0.198	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluoro-1-octanesulfonamide (FOSA)	0.455	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorobutanesulfonic acid (PFBS)	0.109	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorodecanoic acid (PFDA)	0.123	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorododecanoic acid (PFDoA)	0.110	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluoroheptanoic acid (PFHpA)	0.112	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorohexanesulfonic acid (PFHxS)	0.106	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorohexanoic acid (PFHxA)	0.111	0.750 ug/kg		30	25 - 150	35	50 - 130	30
surr: Perfluoro-n-[1,2-13C2]dodecanoic ac			25 - 150					
surr: Perfluoro-n-[13C4]butanoic acid (MF			25 - 150					
surr: Perfluoro-n-[13C5]pentanoic acid (M			25 - 150					
surr: Perfluoro-n-[13C8]octanoic acid (M8			25 - 150					
Perfluoro-n-butanoic acid (PFBA)	0.278	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorononanoic acid (PFNA)	0.0900	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorooctanesulfonic acid (PFOS)	0.118	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorooctanoic acid (PFOA)	0.0900	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluoropentanoic acid (PFPeA)	0.211	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorotetradecanoic acid (PFTA)	0.192	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluorotridecanoic acid (PFTrDA)	0.132	0.750 ug/kg		30	25 - 150	35	50 - 130	30
Perfluoroundecanoic acid (PFUnA)	0.133	0.750 ug/kg		30	25 - 150	35	50 - 130	30

APPENDIX D – HEALTH AND SAFETY PLAN

CASTLETON
ENVIRONMENTAL

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206 West 23rd Street, 4th Floor, New York, NY 10011
631-482-1818 OFFICE
631-482-9042 FAX
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HEALTH AND SAFETY PLAN
FORMER GOODMAN BROTHERS STEEL DRUM CO
291 RICHARDSON STREET
BROOKLYN, NEW YORK
DEC SITE NO: C224292

MAY 2020

Prepared for: CR 17 LLC
1036 Manhattan Ave
Brooklyn, NY 11222

HEALTH AND SAFETY PLAN
FORMER GOODMAN BROTHERS STEEL DRUM CO
291 RICHARDSON STREET, BROOKLYN, NEW YORK
DEC SITE NO: C224292
MAY 2020

Table of Contents

Tables

Table 5-1	Chemical Hazards
Table 7-1	Personal Protective Equipment Section
Table 13-1	Emergency Telephone Numbers

Appendices

Appendix A – Safety Data Sheets
Appendix B – Activity Hazard Analyses
Appendix C – Heat/Cold Stress Protocols
Appendix D – Medical Data Sheet
Appendix E – General Health and Safety Work Practices
Appendix F – Hospital Route Map and Directions
Appendix G – Incident Report Form / Investigation Form
Appendix H – Daily Briefing Sign-In Sheet
Appendix I – COVID-19 Risk Management Spec

1.0 STATEMENT OF COMMITMENT

This Health and Safety Plan (HASP) has been prepared to ensure that workers are not exposed to chemical, biological and physical hazards during the planned environmental work to be performed at 291 Richardson Street, Brooklyn, New York (the site). It is the policy of Castleton Environmental Geologic Services, DPC. (Castleton), to minimize the possibility of work-related exposure through awareness and qualified supervision, health and safety training, medical monitoring, use of appropriate personal protective equipment, and the following activity specific safety protocols contained in this HASP. Castleton has established a guidance program to implement this policy in a manner that protects personnel to the maximum reasonable extent.

This HASP, which applies to persons present at the site actually or potentially exposed to safety or health hazards, describes emergency response procedures for actual and potential physical, biological and chemical hazards. This HASP is also intended to inform and guide personnel entering the work area or exclusion zone. Persons are to acknowledge that they understand the potential hazards and the contents of this Health and Safety policy.

2.0 INTRODUCTION

2.1 Purpose

This HASP addresses the minimum health and safety practices that will be employed by site workers participating in investigation activities at the project site located at 291 Richardson Street, Brooklyn, New York.

The HASP considers the specific hazards inherent to the site and presents the minimum requirements which are to be met by Castleton, their subcontractors, and other on-site personnel in order to avoid and, if necessary, protect against health and/or safety hazards. Contractors will have the option of adopting this HASP or developing their own site-specific document. If a subcontractor chooses to prepare their own HASP, it must meet the minimum requirements as detailed in this HASP and must be made available to Castleton.

Activities performed under this HASP will comply with applicable parts of Occupational Safety and Health Administration (OSHA) Regulations, primarily 29 CFR Parts 1910 and 1926 and all other applicable federal, state, and local regulations. Modifications to the HASP may be made with the approval of the Castleton Health and Safety Manager (HSM) and/or Project Manager (PM). A copy of this HASP will be maintained on-site during all work activities.

Refusal to comply with the HASP or violation of any safety procedures by field personnel may result in their immediate removal from the site following consultation with the HSM and the Field Team Leader (FTL).

2.2 Scope

This HASP addresses the potential hazards related to the environmental investigation activities. The primary environmental investigation activities include the following:

- Site Mobilization/Demobilization;
- Soil, Groundwater, Soil Vapor, and Ambient Air Sampling, and
- Monitoring Well/Vapor Point Installation

The potential hazards associated with this scope are listed below and are discussed in more detail in this HASP after the project organization and responsibilities section.

- Chemical Hazards
- Biological Hazards
- Physical Hazards

2.3 Application

The HASP applies to all personnel involved in the above tasks who wish to gain access to active work areas, including but not limited to:

- Castleton employees and subcontractors;
- Client representatives; and
- Federal, state or local representatives.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section specifies the project organization and responsibilities.

3.1 Project Manager

- Participates in major incident investigations;
- Ensures that the HASP has all the required approvals before site work is conducted; and
- Has the overall project responsibility for project health and safety.

3.2 Field Team Leader (FTL) / Site Health and Safety Officer (SHSO)

- Ensures that the HASP is implemented in conjunction with the Health and Safety Manager (HSM);
- Ensures that field work is scheduled with adequate equipment to complete the job safely;
- Enforces site health and safety rules;
- Ensures that proper personal protective equipment is utilized;
- Ensures that the HSM is informed of project changes that require modifications to the HASP;
- Ensures that the procedure modifications are implemented;
- Investigates incidents;
- Conducts the site safety briefing;
- Reports to HSM to provide summaries of field operations and progress; and
- Acts as Emergency Coordinator.

3.3 Health and Safety Manager

- Provides for the development of the HASP;
- Serves as the primary contact to review health and safety matters that may arise;
- Approves individuals who are assigned SHSO responsibilities;
- Coordinates revisions of this HASP with field personnel; and
- Assists in the investigation of major accidents.

3.4 Site Personnel

- Report any unsafe or potentially hazardous conditions to the FTL/SHSO;
- Maintain knowledge of the information, instructions and emergency response actions contained in this HASP; and
- Comply with rules, regulations and procedures as set forth in this HASP and any revisions.

4.0 SITE HISTORY AND PROJECT DESCRIPTION

4.1 Project Background

This HASP has been prepared by Castleton in response to the environmental investigation and remediation work for the site.

4.2 Site Location and Description

The site is located at 291 Richardson Street, Brooklyn, New York, and is identified as Block 2849 and Lot 120. The site is comprised of one approximately 0.08 acre parcel and is improved with one, single story, 2,375 square foot building. The building was constructed circa 1970 and occupies the majority of the parcel with minimal areas of exposed grounds or landscaped areas.

The 0.08 acre site is part of a larger, New York State Department of Environmental Conservation (NYSDEC) Class 2 Inactive Hazardous Waste Site known as the Former Goodman Brothers Steel Drum Company (Former Goodman Bros.) site. The Former Goodman Bros. site, listed as NYSDEC Site Number 224211, is located on the south side of Division Place between Kingsland and Debevoise Avenues and is identified as 18 Division Place on the NYSDEC Environmental Site Remediation database.

5.0 POTENTIAL HAZARDS OF THE SITE

This section presents an assessment of the chemical, biological, and physical hazards that may be encountered during the tasks specified under Section 1.0. Additional information can be found in Appendix A - Safety Data Sheets or in Appendix B - Activity Hazard Analyses.

5.1 Chemical Hazards

Potential on-site chemicals of concern primarily include petroleum VOCs, chlorinated VOCs, and polychlorinated biphenyls (PCBs).

The chemicals identified may have an effect on the central nervous system, entering the body through the respiratory system and dermal exposure. Acute exposure symptoms may include skin irritation. Specific information on the chemicals can be found in Table 5-1 below.

Table 5-1 Chemical Hazards

COMPOUND	CAS#	OSHA PEL	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS
VOCs (tetrachloroethylene)	127-18-4	TWA 100 ppm	Inhalation Ingestion Skin/Eye	Irritation eyes, nose, throat; headache, dizziness, central nervous system depression; dermatitis	Eyes, skin, respiratory system, central nervous system

Abbreviations:
C = Ceiling limit, not to be exceeded
CNS = Central Nervous System
PEL = Permissible Exposure Limit
OSHA = Occupational Safety and Health Administration
PPM = Parts per million
TWA = Time-weighted average (8 hours)

5.2 Biological Hazards

Work will be performed in a developed urban area of Brooklyn, New York. During the course of the project, there is potential for workers to come into contact with biological hazards such as animals, insects and plants. The Activity Hazard Analyses found in Appendix B includes specific hazards and control measures for each task, if applicable.

5.2.1 Animals

The Site is located in a predominantly developed area. It is possible that dogs, cats, rats and mice may be present. Workers shall use discretion and avoid all contact with animals.

5.2.2 Insects

Insects, such as mosquitoes, ticks, bees and wasps may be present during certain times of the year. Workers will be encouraged to wear repellents and PPE, if deemed necessary, when working in areas where insects are expected to be present.

During the months of April through October, particular caution must be exercised to minimize exposure to deer ticks and the potential for contracting Lyme disease. Specific precautionary work practices that are recommended include the following:

- Cover your body as much as possible. Wear long pants and long-sleeved shirts. Light color clothing makes spotting ticks easier.
- Try to eliminate possible path by which Deer Ticks may reach unprotected skin. For example, tuck bottoms of pants into socks or boots and sleeves into gloves (duct tape may be utilized to help seal cuffs and ankles). If heavy concentrations of ticks or insects are anticipated or encountered, Tyvek coveralls may be utilized for added protection when the potential for heat stress is not a concern.
- Conduct periodic and frequent (e.g. hourly) surveys of your clothing for the presence of ticks. Remove any tick, save it, and report to the clinic with the tick.

- Use insect/tick repellents that contain the chemical DEET (n,n-diethyltoluamide). Apply repellents in accordance with manufacturers recommendations. These repellents are readily available and include such brands as Deep Woods OFF and Maximum Strength OFF.

5.2.3 Plants

Poison ivy, sumac and oak may be present on site. The FTL/SHSO should identify the susceptible individuals. Worker shall avoid all contact with these plants.

5.3 Physical Hazards

Most safety hazards are discussed in the Activity Hazard Analyses (AHA) in Appendix B for the different phases of the project. In addition to the AHAs, general work rules and other safety procedures are described in Section 10 of this HASP.

5.3.1 Temperature Extremes

Heat Stress

Heat stress is a significant potential hazard, which is greatly exacerbated with the use of PPE in hot environments. The potential hazards of working in hot environments include dehydration, cramps, heat rash, heat exhaustion, and heat stroke.

Cold Stress

At certain times of the year, workers may be exposed to the hazards of working in cold environments. Potential hazards in cold environments include frostbite, trench foot or immersion foot, hypothermia as well as slippery surfaces, brittle equipment, and poor judgment.

Castleton's Heat/Cold Stress Protocols are specified in Appendix C.

5.3.2 Steam, Heat, and Splashing

Exposure to steam/heat/splashing hazards can occur during steam cleaning activities. Splashing can also occur during well development and sampling activities. Exposure to steam/heat/splashing can result in scalding/burns, eye injury, and puncture wounds.

5.3.3 Noise

Noise is a potential hazard associated with the operation of heavy equipment, drill rigs, pumps and engines. Workers will wear hearing protection while in the work zone when these types of machinery are operating.

5.3.4 Fire and Explosion

When conducting excavation or drilling activities, the opportunity of encountering fire and explosion hazards may exist from underground utilities, diesel engine equipment, and other potential ignition sources. During dry periods, there is an increased chance of forest and brush fires starting at the job site. If these conditions occur, no smoking will be permitted at the site and all operations involving potential ignition sources will be monitored continuously (fire watch).

5.3.5 Manual Lifting/Material Handling

Manual lifting of heavy objects may be required. Failure to follow proper lifting technique can result in back injuries and strains. Back injuries are a serious concern as they are the most common work-place injury, often resulting in lost or restricted work time, and long treatment and recovery periods.

5.3.6 Slips, Trips, and Falls

Working in and around the site will pose slip, trip and fall hazards due to slippery surfaces that may be oil covered, or from rough terrain, surfaces that are steep inclines, surfaced debris, or surfaces which are wet from rain or ice. Falls may result in twisted ankles, broken bones, head trauma or back injuries.

5.3.7 Heavy Equipment Operation

A Geoprobe/drill rig be used where required. Working with or near heavy equipment poses many potential hazards, including electrocution, fire/explosion, being struck by or against, or pinched/caught/crushed by, and can result in serious physical harm.

5.3.8 Electrocution

Encountering underground utilities may pose electrical hazards to workers. Additionally, overhead electrical lines can be a concern during drilling operations. Potential adverse effects of electrical hazards include burns and electrocution, which could result in death.

6.0 ACTIVITY HAZARD ANALYSIS

The Activity Hazard Analysis (AHA) is a systematic way of identifying the potential health and safety hazards associated with major phases of work on the project and the methods to avoid, control, and mitigate those hazards. The AHAs will be used to train work crews in proper safety procedures during phase preparatory meetings.

AHAs have been developed by Castleton for the following phases of work:

1. Site Mobilization/Demobilization;
2. Excavation and Extraction
3. Soil, Groundwater, Soil Vapor, and Ambient Air Sampling, and
4. Monitoring Well/Vapor point installation

Copies of these AHAs are included in Appendix B of this HASP.

7.0 PERSONAL PROTECTIVE EQUIPMENT

The personal protective equipment (PPE) specified in Table 7-1 represents the hazard analysis and PPE selection required by 29 CFR 1910.132. Specific information on known potential hazards can be found under Section 4.0 and Appendix B - Activity Hazard Analyses. For the purposes of PPE selection, the HSM and FTL/SHSO are considered competent persons. The signatures on the approval page of the HASP constitute certification of the hazard assessment. For activities not covered by Table 7-1, the FTL/SHSO will conduct the hazard assessment, select the PPE, and document changes in the appropriate field logs. PPE selection will be made in consultation with the HSM.

Modifications for initial PPE selection may also be made by the FTL/SHSO in consultation with the HSM and changes documented accordingly. If major modifications occur, the HSM will notify the PM.

7.1 PPE Abbreviations

HEAD PROTECTION
HH = Hard Hat

HEARING PROTECTION
EP = ear plugs
EM = ear muffs

EYE/FACE PROTECTION
APR = Full Face Air Purifying Respirator
MFS = Mesh Face shield
PFS =Plastic Face shield
SG = ANSI approved safety glasses with side shields

FOOT PROTECTION
Neo = Neoprene
OB = Overboot
Poly = polyethylene coated boot
Rub = rubber slush boots
STB = Leather work boots with steel toe

HAND PROTECTION
Cot = cotton
But = Butyl
LWG = Leather Work Gloves
Neo = Neoprene
Nit = Nitrile
Sur = Surgical

BODY PROTECTION
WC = work clothes
Cot Cov = Cotton Coveralls
Poly = Polyethylene coated Tyvek® coveralls
Saran = Saranex coated coveralls
Tyvek® = Uncoated Tyvek® coveralls

RESPIRATORY PROTECTION
APR = Full-face air purifying respirator with organic vapor cartridges
ASR = Full face air supplied respirator with escape bottle
SCBA = Self-contained breathing apparatus

7.2 Hazard Assessment for Selection of Personal Protective Equipment

The initial selectin of personal protective equipment for each task was done by performing a hazard assessment taking into consideration the following:

- Potential chemical and physical hazards present;
- Work operations to be performed;
- Potential routes of exposure;
- Concentrations of contaminants present; and,
- Characteristics, capabilities, and limitations of PPE and any hazards that the PPE presents or magnifies.

A review of the analytical data from previous sampling events indicates that chlorinated VOCs (CVOCs) are the primary contaminants of concern.

The exposure routes for these chemicals are inhalation, skin absorption, skin/eye contact, and ingestion. Chemical protective gloves will be required for all activities that involve sample handling and the likelihood for skin contact. The proper use of PPE and strict adherence to decontamination and personal hygiene procedures will effectively minimize skin contact and ingestion and potential routes of exposure.

Table 7-1 Personal Protective Equipment Selection

TASK	HEAD	EYE/FACE	FEET	HANDS	BODY	HEARING	RESPIRATOR
Mobilization/ Demobilization	HH	SG	STB	WG	WC	None	None
Monitoring Well / Vapor Point Installation	HH	SG	STB	WG, Nit & Sur as needed	WC, Tyvek® as needed	None	None initially APR if action levels exceeded
Soil, groundwater, vapor and ambient air sampling	HH	SG	STB	WG, Nit & Sur as needed	WC, Tyvek® as needed	None	None initially APR if action levels exceeded
Decontamination	HH	SG	STB	Nit + Sur	WC, Tyvek® as needed	None	None initially APR if action levels exceeded

7.3 Respirator Cartridge Change-Out Schedule

A respirator cartridge change-out schedule has been developed in order to comply with 29 CFR. If the use of respirators is necessary, the respirator cartridge change-out schedule for this project will be as follows:

1. Cartridges shall be removed and disposed of at the end of each shift, when cartridges become wet or wearer experiences breakthrough, whichever occurs first; and
2. If the humidity exceeds 85%, then cartridges shall be removed and disposed of after 4 hours of use.

Respirators shall not be stored at the end of the shift with contaminated cartridges left on. Cartridges shall not be worn on the second day, no matter how short of time period they were used the day before.

The schedule was developed based on the following scientific information and assumptions:

- Analytical data that is available regarding site contaminants;
- Using the Rule of Thumb provided by the AIHA;
- All of the chemicals have boiling points greater than 70°C;
- Total airborne concentration of contaminants is anticipated to be less than 200 ppm;
- The humidity is expected to be less than 85%; and

- Desorption of the contaminants (including those with poor warning properties) after partial use of the chemical cartridge can occur after a short period (hours) without use (eg, overnight) and result in a non-use exposure.

The following is a partial list of factors that may affect the usable cartridge service life and/or the degree of respiratory protection attainable under actual workplace conditions. These factors have been considered when developing the cartridge change-out schedule.

Type of contaminant(s);

- Contaminant concentration;
- Relative humidity;
- Breathing rate; temperature; change in contaminant concentration;
- Mixtures of contaminants;
- Accuracy in the determination of the conditions;
- The contaminant concentration in the workplace can vary greatly. Consideration must be given to the quality of the estimate of the workplace concentration;
- Storage conditions between multiple uses of the same respirator cartridges. It is recommended that the chemical cartridges be replaced after each work shift. Contaminants adsorbed on a cartridge can migrate through the carbon bed without airflow;
- Age of the cartridge;
- Condition of the cartridge and respirator;
- Respirator and cartridge selection, respirator fit;
- Respirator assembly, operation, and maintenance;
- User training, experience, and medical fitness;
- Warning properties of the contaminant; and,
- The quality of the warning properties should be considered when establishing the chemical cartridge change schedule. Good warning properties may provide a secondary or back-up indication for cartridge change-out.

8.0 AIR MONITORING

Air monitoring will be performed for protection for on-site workers and the downwind community (i.e., off-site receptors including residences, businesses, and on-site workers not directly involved in the remedial work) from potential airborne contaminant releases resulting from remedial activities at the site. Air monitoring will be used to help to confirm that the remedial work will not spread contamination off-site through the air. Site monitoring with a photoionization detector (PID) will be performed during any invasive activities.

Real-time monitoring for dust and VOCs will be conducted both within the work area, and along the site perimeter, during intrusive activities such as excavation activities.

9.0 ZONES, PROTECTION, AND COMMUNICATION

9.1 Site Control

Site zones are intended to control the potential spread of contamination throughout the site and to assure that only authorized individuals are permitted into potentially hazardous areas. A three-zone approach will be utilized. It shall include an Exclusion Zone (EZ), Contamination Reduction Zone (CRZ) and a Support Zone (SZ). Specific zones shall be established on the work site when operations begin.

This project is a hazardous waste remediation project, and any person working in an area where the potential for exposure to site contaminants exists, will only be allowed access after providing the FTL/SHSO with proper training and medical documentation.

The zones are based upon current knowledge of proposed site activities. It is possible that the zone configurations may be altered due to work plan revisions. Should this occur, the work zone will be adjusted accordingly, and documented through use of a field-change request form.

The following shall be used for guidance in revising these preliminary zone designations, if necessary.

Support Zone - The SZ is an uncontaminated area that will be the field support area for most operations. The SZ provides for field team communications and staging for emergency response. Appropriate safety equipment will be located in this zone. Potentially contaminated personnel/materials are not allowed in this zone. The only exception will be appropriately packaged/decontaminated and labeled samples.

Contamination Reduction Zone - The CRZ is established between the EZ and the SZ. The CRZ contains the contamination reduction corridor and provides for an area for decontamination of personnel and portable hand-held equipment, tools and heavy equipment. A personnel decontamination area will be prepared at each exclusion zone. The CRZ will be used for EZ entry and egress in addition to access for heavy equipment and emergency support services.

Exclusion Zone - All activities, which may involve exposure to site contaminants, hazardous materials and/or conditions, should be considered an EZ. The FTL/SHSO may establish more than one EZ where different levels of protection may be employed, or different hazards exist. The size of the EZ shall be determined by the site HSO allowing adequate space for the activity to be completed, field members and emergency equipment.

9.2 Contamination Control

Decontamination areas will be established for drilling/sampling activities.

9.2.1 Personnel Decontamination Station

All personnel and portable equipment used in the EZ shall be subject to a thorough decontamination process, as deemed necessary by the FTL/SHSO. Sampling equipment shall be decontaminated. As necessary, all boots and gloves will be decontaminated using soap and water solution and scrub brushes or simple removal and disposal. All used respiratory protective equipment will be decontaminated daily and sanitized with appropriate sanitizer solution.

All drums generated as a result of sampling and decontamination activities will be marked and stored at a designated area at the site until the materials can be property disposed of off-site.

All non-expendable sampling equipment will be decontaminated. This usually entails the use of Alconox, solvent and distilled/deionized water rinses to eliminate contaminants.

9.3 Communication

- Each team member will have a cell phone/radio for communication with the PM, HSO and other team members during field activities.
- Hand Signals - Hand signals shall be used by field teams, along with the buddy system. The entire field team shall know them before operations commence and their use covered during site- specific training. Typical hand signals are the following:

SIGNAL	**MEANING**
Hand gripping throat	Out of air, can't breathe
Grip on a partner's wrist or placement of both hands around a partner's waist.	Leave the area immediately, no debate.
Hands on top of head	Need assistance
Thumbs up	Okay, I'm all right, I understand.
Thumbs down	No, negative.

10.0 MEDICAL SURVEILANCE PROCEDURES

All contractor and subcontractor personnel performing field work where potential exposure to contaminants exists at the site are required to have passed a complete medical surveillance examination in accordance with 29 CFR 1910.120(f).

10.1 Medical Surveillance Requirements

A physician's medical release for work will be confirmed by the HSM before an employee can work in the exclusion zone. The examination will be taken annually at a minimum and upon termination of hazardous waste site work if the last examination was not taken within the previous six months.

Additional medical testing may be required by the HSM in consultation with the Corporate Medical Consultant and the FTL/SHSO if an over-exposure or accident occurs, if an employee exhibits symptoms of exposure, or if other site conditions warrant further medical surveillance.

10.2 Medical Data Sheet

A medical data sheet is provided in Appendix D. This medical data sheet is voluntary and should be completed by all on-site personnel and will be maintained at the site. Where possible, this medical data sheet will accompany the personnel needing medical assistance. The medical data sheet will be maintained in a secure location, treated as confidential, and used only on a need- to-know basis.

11.0 SAFETY CONSIDERATIONS

11.1 General Health and Safety Work Practices

A list of general health and safety work practices is included as an included in Appendix E. The work rules will be posted in a conspicuous location at the site.

11.2 The Buddy System

At a minimum, employees shall work in groups of two in such a manner that they can observe each other and maintain line-of-sight for each employee within the work group. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.

11.3 Sample Handling

Personnel responsible for the handling of samples should wear the prescribed level of protection. Samples should be identified as to their hazard and packaged as to prevent spillage or breakage. Sample containers shall be decontaminated in the CRZ or EZ before entering a clean Support Zone area. Any unusual sample conditions, odors, or real-time readings should be noted. Laboratory personnel should be advised personnel should be advised of sample hazard level and the potential contaminants present. This can be accomplished by a phone call to the lab coordinator and/or including a written statement with the samples reviewing lab safety procedures in handling, in order to assure that the practices are appropriate for the suspected contaminants in the sample.

11.4 Excavation

Excavations will be conducted in accordance with the requirements contained in 29 CFR 1926, Subpart P-Excavations. It provides for the designation of a "Competent Person" and general requirements for safe excavating practices. The program also incorporates company standards for the monitoring of potentially hazardous atmospheres; protection from water hazards; analyzing and maintaining the stability of adjacent structures; daily competent person inspections; soil classification; sloping and benching; protective systems; and training.

The Competent Person will be the FTL or other designee with appropriate training and experience. The Competent Person will be assisted in his/her duties by other technical personnel such as the HSM, geologists, structural engineers and soils engineers.

12.0 DISPOSAL PROCEDURES

All discarded materials, waste materials or other objects shall be handled in such a way as to preclude the potential for spreading contamination, creating a sanitary hazard or causing litter to be left on site.

All potentially contaminated materials, e.g., clothing, gloves, etc., will be bagged or drummed as necessary, labeled and segregated for disposal. All non-contaminated materials will be collected and bagged for appropriate disposal as non-hazardous solid waste. Additional waste disposal procedures may be developed as applicable.

13.0 EMERGENCY RESPONSE PLAN

This section establishes procedures and provides information for use during a project emergency. Emergencies happen unexpectedly and quickly, and require an immediate response; therefore, contingency planning and advanced training of staff is essential. Specific elements of emergency support procedures which are addressed in the following subsections include communications, local emergency support units, preparation for medical emergencies, first aid for injuries incurred on site, record keeping, and emergency site evacuation procedures.

13.1 Responsibilities

13.1.1 Health and Safety Manager (HSM)

The HSM oversees and approves the Emergency Response/Contingency Plan and performs audits to determine that the plan is in effect and that all pre-emergency requirements are met. The HSM acts as a liaison to applicable regulatory agencies and notifies OSHA of reportable accidents.

13.1.2 Field Team Leader/Site Health and Safety Officer (FOL/HSO)

The FTL/SHSO is responsible for ensuring that all personnel are evacuated safely and that machinery and processes are shut down or stabilized in the event of a stop work order or evacuation. The FTL/SHSO is required to immediately notify the HSM of any fatalities or catastrophes (three or more workers injured and hospitalized) so that the HSM can ensure that OSHA is notified within the required time frame. The HSM will be notified of all OSHA recordable injuries, fires, spills, releases or equipment damage in excess of $500 within 24 hours.

13.1.3 Emergency Coordinator

The Emergency Coordinator for the project is the FTL/SHSO.

The Emergency Coordinator shall make contact with Local Emergency Response personnel prior to beginning work on site. In these contacts the emergency coordinator will inform interested parties about the nature and duration of work expected on the site and the type of contaminants and possible health or safety effects of emergencies involving these contaminants. The emergency coordinator will locate emergency phone numbers and identify hospital routes prior to beginning work on site. The emergency coordinator shall make necessary arrangements to be prepared for any emergencies that could occur.

The Emergency Coordinator will implement the Emergency Response/Contingency Plan whenever conditions at the site warrant such action.

13.1.4 Site Personnel

Site personnel are responsible for knowing the Emergency Response/Contingency Plan and the procedures contained herein. Personnel are expected to notify the Emergency Coordinator of situations that could constitute a site emergency.

13.2 Communication

A variety of communication systems may be utilized during emergency situations. These are discussed in the following sections.

13.2.1 Hand Signals

Downrange field teams will employ hand signals where necessary for communication during emergency situations. Hand signals are found in Section 8.3.

13.2.2 Field Radios and Cell Phones

Castleton field personnel are provided cellular phones for site communication and emergency use.

13.3 Local Emergency Support Units

A route map from the site to the nearest hospital can be found in Appendix F. This map will be placed with the above emergency telephone numbers in all on-site vehicles.

13.4 Pre-Emergency Planning

Castleton will communicate directly with administrative personnel from the emergency room at the hospital to determine whether the hospital has the facilities and personnel needed to treat cases of trauma resulting from exposure to any of the contaminants expected to be found on the site.

Instructions for finding the hospital will be posted conspicuously in the site office and in each site vehicle.

Before the field activities begin, the local emergency response personnel will be notified of the schedule for field activities and about the materials that are thought to exist on the site so that they will be able to respond quickly and effectively in the event of a fire, explosion, or other emergency. Before fieldwork on the site commences, each person who will be working there or observing the operations will complete a medical data sheet (Appendix D). These data sheets will be filled out during site-specific training and will be kept on the site.

In the event of an incident where a team member becomes exposed or suffers from an acute symptom of exposure to site materials and has to be taken to a hospital, a copy of his/her medical data sheet will be presented to the attending physician.

Table 13-1
Emergency Telephone Numbers

Contact	Firm or Agency	Telephone Number
Police		911
Fire		911
Hospital	NYC Health + Hospitals/Woodhull	(718) 963-8000
Ambulance		911
Project Manager/Health and Safety Manager	Brian Barth Castleton	(631) 482-1818

Health & Safety Officer	Brian Barth Castleton	(631) 482-1818
Poison Control Center		(800) 962-1253
Chemtrec		(800) 424-9300

13.5 Emergency Medical Treatment

The procedures and rules in this HASP are designed to prevent employee injury. However, should an injury occur, no matter how slight, it will be reported to the FTL/SHSO immediately. First aid equipment will be available on site at the following locations:

- First Aid Kit: Support Zone (or designated by FTL/SHSO upon arrival)
- Emergency Eye Wash: Support Zone (or designated by FTL/SHSO upon arrival)

During site-specific training, project personnel will be informed of the location of the first aid station(s) that has been set up. Unless they are in immediate danger, severely injured persons will not be moved until paramedics can attend to them. Some injuries, such as severe cuts and lacerations or burns, may require immediate treatment. Any first aid instructions that can be obtained from doctors or paramedics, before an emergency-response squad arrives at the site or before the injured person can be transported to the hospital, will be followed closely.

There will be at least two people with current First Aid and CPR certification on each active work shift. When personnel are transported to the hospital, the FTL/SHSO will provide a copy of the Medical Data Sheet to the paramedics and treating physician.

Only in non-emergency situations will an injured person be transported to the hospital by means other than an ambulance. A map and directions to the hospital can be found in Appendix F.

13.6 Emergency Site Evacuation Routes and Procedures

In order to mobilize the manpower resources and equipment necessary to cope with a fire or other emergency, a clear chain of authority will be established. The EC will take charge of all emergency response activities and dictate the procedures that will be followed for the duration of the emergency. The EC will report immediately to the scene of the emergency, assess the seriousness of the situation, and direct whatever efforts are necessary until the emergency response units arrive. At his/her discretion, the EC also may order the closure of the site for an indefinite period.

All project personnel will be instructed on proper emergency response procedures and locations of emergency telephone numbers during the initial site safety meeting. If an emergency occurs, including but not limited to fire, explosion or significant release of toxic gas into the atmosphere, an air horn will be sounded on the site. The horn will sound continuously for one blast, signaling that immediate evacuation of all personnel is necessary due to an immediate or impending danger. All heavy equipment will be shut down and all personnel will evacuate the work areas and assemble at the evacuation meeting point, which will be determined upon arrival at the site by the FTL/SHSO, prior to work beginning. This will then be conveyed to all crew members during the site-specific briefing.

The EC will give directions for implementing whatever actions are necessary. Any project team member may be assigned to be in charge of emergency communications during an emergency.

He/she will attend the site telephone specified by the EC from the time the alarm sounds until the emergency has ended.

After sounding the alarm and initiating emergency response procedures, the EC will check and verify that access roads are not obstructed. If traffic control is necessary, as in the event of a fire or explosion, a project team member, who has been trained in these procedures and designated at the site safety meeting, will take over these duties until local police and fire fighters arrive.

The EC will remain at the site to provide any assistance requested by emergency-response squads as they arrive to deal with the situation. A map showing evacuation routes, meeting places and the location of emergency equipment will be posted in all trailers and used during site-specific training.

13.7 Fire Prevention and Protection

In the event of a fire or explosion, procedures will include immediately evacuating the site (air horn will sound for a single continuous blast), and notification of local fire and police departments. No personnel will fight a fire beyond the stage where it can be put out with a portable extinguisher (incipient stage).

13.7.1 Fire Prevention

Adhering to the following precautions will prevent fires:

- Good housekeeping and storage of materials;
- Storage of flammable liquids and gases away from oxidizers;
- No smoking in the exclusion zone or any work area;
- No hot work without a properly executed hot work permit;
- Shutting off engines to refuel;
- Grounding and bonding metal containers during transfer of flammable liquids;
- Use of UL approved flammable storage cans;
- Fire extinguishers rated at least 10 pounds ABC located on all heavy equipment, in all trailers and near all hot work activities; and
- Monthly inspections of all fire extinguishers.

13.8 Overt Chemical Exposure

The following are standard procedures to treat chemical exposures. Other, specific procedures detailed on the Safety Data Sheet or recommended by the Corporate Medical Consultant will be followed, when necessary.

SKIN AND EYE CONTACT: Use copious amounts of soap and water. Wash/rinse affected areas thoroughly, and then provide appropriate medical attention. Eyes should be rinsed for 15 minutes upon chemical contamination. Skin should also be rinsed for 15 minutes if contact with caustics, acids or hydrogen peroxide occurs.

INHALATION: Move to fresh air. Decontaminate and transport to hospital or local medical provider.

INGESTION: Decontaminate and transport to emergency medical facility.

PUNCTURE WOUND OR LACERATION: Decontaminate and transport to emergency medical facility.

13.9 Decontamination during Medical Emergencies

If emergency life-saving first aid and/or medical treatment is required, normal decontamination procedures may need to be abbreviated or postponed. The FTL/SHSO or designee will accompany contaminated victims to the medical facility to advise on matters involving decontamination, when necessary. The outer garments can be removed if they do not cause delays, interfere with treatment or aggravate the problem. Respiratory equipment must always be removed. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed on-site, a plastic barrier placed between the injured individual and clean surfaces should be used to help prevent contamination of the inside of ambulances and/or medical personnel. Outer garments may then be removed at the medical facility. No attempt will be made to wash or rinse the victim if his/her injuries are life threatening, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material which could also cause severe injury or loss of life to emergency response personnel. For minor medical problems or injuries, the normal decontamination procedures will be followed.

13.10 Accident/Incident Reporting

As soon as first aid and/or emergency response needs have been met, the following parties are to be contacted by telephone:

- Health and Safety Manager;
- Project Manager; and
- The employer of any injured worker who is not a Castleton employee

Written confirmation of verbal reports are to be completed by the FTL/SHSO using the Incident Report Form and submitted within 24 hours. The incident report and investigation form are found in Appendix G. If the employee involved is not a Castleton employee, his employer will receive a copy of the report.

13.11 Adverse Weather Conditions

In the event of adverse weather conditions, the FTL/SHSO will determine if work can continue without potentially risking the safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

- Potential for heat stress and heat-related injuries;
- Potential for cold stress and cold-related injuries;

Treacherous weather-related working conditions (hail, rain, snow, ice, high winds);

- Limited visibility (fog);
- Potential for electrical storms;
- Earthquakes; and
- Other major incidents.

Site activities will be limited to daylight hours, or when suitable artificial light is provided, and acceptable weather conditions prevail. The FTL/SHSO will determine the need to cease field operations or observe daily weather reports and evacuate, if necessary, in case of severe inclement weather conditions.

13.12 Spill Control and Response

All small hazardous spills/environmental releases shall be contained as close to the source as possible. Whenever possible, the MSDS will be consulted to assist in determining the best means of containment and cleanup. For small spills, sorbent materials such as sand, sawdust or commercial sorbents should be placed directly on the substance to contain the spill and aid recovery. Any acid spills should be diluted or neutralized carefully prior to attempting recovery. Berms of earthen or sorbent materials can be used to contain the leading edge of the spills. Drains or drainage areas should be blocked. All spill containment materials will be properly disposed. An exclusion zone of 50 to 100 feet around the spill area should be established depending on the size of the spill. The following seven steps should be taken by the Emergency Coordinator:

- Determine the nature, identity and amounts of major spill components;
- Make sure all unnecessary persons are removed from the spill area;
- Notify appropriate response teams and authorities;
- Use proper PPE in consultation with the FTL/SHSO;
- If a flammable liquid, gas or vapor is involved, remove all ignition sources and use non- sparking and/or explosive proof equipment to contain or clean up the spill (diesel only vehicles, air operated pumps, etc.);
- If possible, try to stop the leak with appropriate material; and,

Remove all surrounding materials that can react or compound with the spill.

13.13 Emergency Equipment

The following minimum emergency equipment shall be kept and maintained on-site:

- Industrial first aid kit;
- Burn kit and portable eye washes (one per field team);
- Fire extinguishers (one per work area); and
- Absorbent material /spill kit.

14.0 TRAINING

14.1 General Health and Safety Training

In accordance with Castleton corporate policy, and pursuant to 29 CFR 1910.120, hazardous waste site workers shall, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations unless otherwise noted in the above reference. At a minimum, the training shall have consisted of instruction in the topics outlined in the standard.

Personnel who have not met the requirements for initial training shall not be allowed to work in any site activities in which they may be exposed to hazards (chemical or physical).

14.1.1 Three Day Supervised On the Job Training

In addition to the required initial hazardous waste operations training, each employee shall have received three days of directly supervised on-the-job training. This training will address the duties the employees are expected to perform.

14.2 Annual Eight-Hour Refresher Training

Annual eight-hour refresher training will be required of all hazardous waste site field personnel in order to maintain their qualifications for fieldwork. The training will cover a review of 1910.120 requirements and related company programs and procedures.

14.3 Site-Specific Training

Prior to commencement of field activities, all field personnel assigned to the project will have completed training that will specifically address the activities, procedures, monitoring, and equipment used in the site operations. It will include site and facility layout, hazards and emergency services at the site, and will highlight all provisions contained within this HASP. This training will also allow field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity.

14.4 On-Site Safety Briefings

Project personnel and visitors will be given on-site health and safety briefings daily by the FTL/SHSO to assist site personnel in safely conducting their work activities. A copy of the Daily Briefing Sign-In Sheet is contained in Appendix H. The briefings will include information on new operations to be conducted, changes in work practices or changes in the site's environmental conditions, as well as periodic reinforcement of previously discussed topics. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety inspections. The meetings will also be an opportunity to periodically update the crews on monitoring results. Prior to starting any new activity, a training session using the Activity Hazard Analysis will be held for crew members involved in the activity.

14.5 First Aid and CPR

The HSM will identify those individuals requiring first aid and CPR training to ensure that emergency medical treatment is available during field activities. It is anticipated that a minimum of one field person on-site at any one time will have first aid and CPR training. The training will be consistent with the requirements of the American Red Cross Association or American Heart Association. If none are available on-site, then the HSM shall be notified.

15.0 LOGS, REPORTS, AND RECORDKEEPING

15.1 Medical and Training Records

Copies or verification of training (40-hour, 8-hour, supervisor, site-specific training and documentation of three-day OJT) and medical clearance for hazardous waste site work and respirator use will be maintained on-site. Records for all subcontractor employees will also be kept on-site.

15.2 Incident Report and Investigation Form

The incident report and investigation form are to be completed for all accidents and incidents, including near misses. The form can be found in Appendix G.

15.3 Health and Safety Logbooks

The FTL/SHSO will maintain a logbook during site work. The daily site conditions, personnel, monitoring results and significant events will be recorded. The original logbooks will become part of the exposure records file.

16.0 COVID-19 NOTICE

To provide a safe and healthy workplace and minimize the spread of the COVID-19 virus, Castleton has included the NYSDEC COVID-19 Risk Management Specifications. The Specifications prohibits the assess to work areas by those who pose an elevated risk of spreading COVID-19, and guidance for best practices to minimize the spread and protect themselves and others.

The postings included in the COVID-19 Specifications shall be posted in visible areas at the entrance to work areas and employees shall sign the Entry/Exit Log with COVID-19 Acknowledgement.
The COVID-19 Risk Management Specifications including the Entry/Exit Log and postings are included in Appendix I.

17.0 FIELD PERSONNEL REVIEW

This form serves as documentation that field personnel have read, or have been informed of, and understand the provisions of the HASP. It is maintained on site by the FTL/SHSO as a project record. Each field team member shall sign this section after site-specific training is completed and before being permitted to work on site.

I have read, or have been informed of, the Health and Safety Plan and understand the information presented. I will comply with the provisions contained therein.

Name (Print and Sign)	***Date***

APPENDIX A
SAFETY DATA SHEETS

ThermoFisher
SCIENTIFIC

SAFETY DATA SHEET

Creation Date 10-Dec-2009 **Revision Date** 23-Jan-2018 **Revision Number** 5

1. Identification

Product Name **Tetrachloroethylene**

Cat No. : **AC445690000; ACR445690010; AC445690025; AC445691000**

CAS-No 127-18-4
Synonyms Perchloroethylene

Recommended Use Laboratory chemicals.
Uses advised against Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Skin Sensitization	Category 1
Carcinogenicity	Category 1B
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, Blood.	

Label Elements

Signal Word
Danger

Hazard Statements
Causes skin irritation
Causes serious eye irritation
May cause an allergic skin reaction
May cause drowsiness or dizziness
May cause cancer
May cause damage to organs through prolonged or repeated exposure

Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Contaminated work clothing should not be allowed out of the workplace
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Response
IF exposed or concerned: Get medical attention/advice
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN: Wash with plenty of soap and water
Take off contaminated clothing and wash before reuse
If skin irritation or rash occurs: Get medical advice/attention
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Toxic to aquatic life with long lasting effects
WARNING. Cancer - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Tetrachloroethylene	127-18-4	>95

4. First-aid measures

General Advice	If symptoms persist, call a physician.
Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician.
Inhalation	Move to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur.
Ingestion	Clean mouth with water and drink afterwards plenty of water.

Most important symptoms and effects	None reasonably foreseeable. May cause allergic skin reaction. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical

Thermal decomposition can lead to release of irritating gases and vapors. Containers may explode when heated.

Hazardous Combustion Products

Chlorine Hydrogen chloride gas Phosgene

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	0	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Ensure adequate ventilation.
Environmental Precautions	Do not flush into surface water or sanitary sewer system.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling	Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Ensure adequate ventilation. Avoid ingestion and inhalation.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Protect from sunlight.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Tetrachloroethylene	TWA: 25 ppm STEL: 100 ppm	(Vacated) TWA: 25 ppm (Vacated) TWA: 170 mg/m^3 Ceiling: 200 ppm TWA: 100 ppm	IDLH: 150 ppm	TWA: 100 ppm TWA: 670 mg/m^3 TWA: 200 ppm TWA: 1250 mg/m^3 STEL: 200 ppm STEL: 1340 mg/m^3

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures	Use only under a chemical fume hood. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Long sleeved clothing.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Characteristic, sweet
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-22 °C / -7.6 °F
Boiling Point/Range	120 - 122 °C / 248 - 251.6 °F @ 760 mmHg
Flash Point	No information available
Evaporation Rate	6.0 (Ether = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	18 mbar @ 20 °C
Vapor Density	No information available
Density	1.619
Specific Gravity	1.625
Solubility	0.15 g/L water (20°C)
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	> 150°C
Viscosity	0.89 mPa s at 20 °C
Molecular Formula	C2 Cl4
Molecular Weight	165.83

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products. Excess heat. Exposure to moist air or water.
Incompatible Materials	Strong acids, Strong oxidizing agents, Strong bases, Metals, Zinc, Amines, Aluminium
Hazardous Decomposition Products	Chlorine, Hydrogen chloride gas, Phosgene
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information
Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Tetrachloroethylene	LD50 = 2629 mg/kg (Rat)	LD50 > 10000 mg/kg (Rat)	LC50 = 27.8 mg/L (Rat) 4 h

Toxicologically Synergistic Products	No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation	Irritating to eyes and skin
Sensitization	No information available
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Tetrachloroethylene	127-18-4	Group 2A	Reasonably Anticipated	A3	X	A3

IARC: (International Agency for Research on Cancer)	*IARC: (International Agency for Research on Cancer)* *Group 1 - Carcinogenic to Humans* *Group 2A - Probably Carcinogenic to Humans* *Group 2B - Possibly Carcinogenic to Humans*
NTP: (National Toxicity Program)	*NTP: (National Toxicity Program)* *Known - Known Carcinogen* *Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen*
ACGIH: (American Conference of Governmental Industrial Hygienists)	*A1 - Known Human Carcinogen* *A2 - Suspected Human Carcinogen* *A3 - Animal Carcinogen* *ACGIH: (American Conference of Governmental Industrial Hygienists)*
Mexico - Occupational Exposure Limits - Carcinogens	*Mexico - Occupational Exposure Limits - Carcinogens* *A1 - Confirmed Human Carcinogen* *A2 - Suspected Human Carcinogen* *A3 - Confirmed Animal Carcinogen* *A4 - Not Classifiable as a Human Carcinogen* *A5 - Not Suspected as a Human Carcinogen*

Mutagenic Effects	No information available
Reproductive Effects	No information available.
Developmental Effects	No information available.
Teratogenicity	No information available.
STOT - single exposure	Central nervous system (CNS)

STOT - repeated exposure Kidney Liver Blood

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing

Endocrine Disruptor Information

Component	EU - Endocrine Disrupters Candidate List	EU - Endocrine Disruptors - Evaluated Substances	Japan - Endocrine Disruptor Information
Tetrachloroethylene	Group II Chemical	Not applicable	Not applicable

Other Adverse Effects Tumorigenic effects have been reported in experimental animals.

12. Ecological information

Ecotoxicity

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Tetrachloroethylene	EC50: > 500 mg/L, 96h (Pseudokirchneriella subcapitata)	LC50: 4.73 - 5.27 mg/L, 96h flow-through (Oncorhynchus mykiss) LC50: 11.0 - 15.0 mg/L, 96h static (Lepomis macrochirus) LC50: 8.6 - 13.5 mg/L, 96h static (Pimephales promelas) LC50: 12.4 - 14.4 mg/L, 96h flow-through (Pimephales promelas)	EC50 = 100 mg/L 24 h EC50 = 112 mg/L 24 h EC50 = 120.0 mg/L 30 min	EC50: 6.1 - 9.0 mg/L, 48h Static (Daphnia magna)

Persistence and Degradability Insoluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility . Is not likely mobile in the environment due its low water solubility. Will likely be mobile in the environment due to its volatility.

Component	log Pow
Tetrachloroethylene	2.53 - 2.88

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Tetrachloroethylene - 127-18-4	U210	-

14. Transport information

DOT

UN-No	UN1897
Proper Shipping Name	TETRACHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

TDG

UN-No	UN1897

Proper Shipping Name	TETRACHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

IATA

UN-No	UN1897
Proper Shipping Name	TETRACHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

IMDG/IMO

UN-No	UN1897
Proper Shipping Name	TETRACHLOROETHYLENE
Hazard Class	6.1
Subsidiary Hazard Class	P
Packing Group	III

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Tetrachloroethylene	X	X	-	204-825-9	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Tetrachloroethylene	127-18-4	>95	0.1

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Tetrachloroethylene	-	-	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Tetrachloroethylene	X		-

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Tetrachloroethylene	100 lb 1 lb	-

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Tetrachloroethylene	127-18-4	Carcinogen	14 µg/day	Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Tetrachloroethylene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ):	Y
DOT Marine Pollutant	Y
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security

This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date	10-Dec-2009
Revision Date	23-Jan-2018
Print Date	23-Jan-2018
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

Creation Date 03-Feb-2010 **Revision Date** 14-Jul-2016 **Revision Number** 2

1. Identification

Product Name	**Trichloroethylene**
Cat No. :	**T340-4; T341-4; T341-20; T341-500; T403-4**
Synonyms	Trichloroethene (Stabilized/Technical/Electronic/Certified ACS)
Recommended Use	Laboratory chemicals.
Uses advised against	

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Skin Sensitization	Category 1
Germ Cell Mutagenicity	Category 2
Carcinogenicity	Category 1A
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, Heart, spleen, Blood.	

Label Elements

Signal Word
Danger

Hazard Statements
Causes skin irritation
Causes serious eye irritation
May cause an allergic skin reaction
May cause drowsiness or dizziness
Suspected of causing genetic defects
May cause cancer
May cause damage to organs through prolonged or repeated exposure

Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Contaminated work clothing should not be allowed out of the workplace
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Response
IF exposed or concerned: Get medical attention/advice
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN: Wash with plenty of soap and water
Take off contaminated clothing and wash before reuse
If skin irritation or rash occurs: Get medical advice/attention
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Harmful to aquatic life with long lasting effects
WARNING! This product contains a chemical known in the State of California to cause cancer, birth defects or other reproductive harm.

3. Composition / information on ingredients

Component	CAS-No	Weight %
Trichloroethylene	79-01-6	100

4. First-aid measures

General Advice	Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.
Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.
Inhalation	Move to fresh air. If not breathing, give artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a

	pocket mask equipped with a one-way valve or other proper respiratory medical device. Immediate medical attention is required.
Ingestion	Do not induce vomiting. Call a physician or Poison Control Center immediately.
Most important symptoms/effects	None reasonably foreseeable. May cause allergic skin reaction. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	410 °C / 770 °F
Explosion Limits	
Upper	10.5 vol %
Lower	8 vol %
Oxidizing Properties	Not oxidising
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical

Thermal decomposition can lead to release of irritating gases and vapors. Containers may explode when heated. Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products

Hydrogen chloride gas Chlorine Phosgene Carbon monoxide (CO) Carbon dioxide (CO_2)

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	Flammability	Instability	Physical hazards
2	1	0	N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment. Keep people away from and upwind of spill/leak. Evacuate personnel to safe areas.
Environmental Precautions	Should not be released into the environment. Do not flush into surface water or sanitary sewer system.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling	Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Use only under a chemical fume hood. Do not breathe vapors or spray mist. Do not ingest.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Protect from light. Do not store in aluminum containers.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Trichloroethylene	TWA: 10 ppm STEL: 25 ppm	(Vacated) TWA: 50 ppm (Vacated) TWA: 270 mg/m³ Ceiling: 200 ppm (Vacated) STEL: 200 ppm (Vacated) STEL: 1080 mg/m³ TWA: 100 ppm	IDLH: 1000 ppm	TWA: 100 ppm TWA: 535 mg/m³ STEL: 200 ppm STEL: 1080 mg/m³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures	Use only under a chemical fume hood. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Long sleeved clothing.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Characteristic
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-85 °C / -121 °F
Boiling Point/Range	87 °C / 188.6 °F
Flash Point	No information available
Evaporation Rate	0.69 (Carbon Tetrachloride = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	10.5 vol %
Lower	8 vol %
Vapor Pressure	77.3 mbar @ 20 °C
Vapor Density	4.5 (Air = 1.0)
Specific Gravity	1.460
Solubility	Slightly soluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	410 °C / 770 °F
Decomposition Temperature	> 120°C
Viscosity	0.55 mPa.s (25°C)

Molecular Formula	C2 H Cl3
Molecular Weight	131.39

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Light sensitive.
Conditions to Avoid	Incompatible products. Excess heat. Exposure to light. Exposure to moist air or water.
Incompatible Materials	Strong oxidizing agents, Strong bases, Amines, Alkali metals, Metals,
Hazardous Decomposition Products	Hydrogen chloride gas, Chlorine, Phosgene, Carbon monoxide (CO), Carbon dioxide (CO_2)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

<u>Acute Toxicity</u>

Product Information
Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Trichloroethylene	LD50 = 4290 mg/kg (Rat) LD50 = 4920 mg/kg (Rat)	LD50 > 20 g/kg (Rabbit) LD50 = 29000 mg/kg (Rabbit)	LC50 = 26 mg/L (Rat) 4 h

Toxicologically Synergistic Products	No information available

<u>Delayed and immediate effects as well as chronic effects from short and long-term exposure</u>

Irritation	Irritating to eyes and skin
Sensitization	No information available
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Trichloroethylene	79-01-6	Group 1	Reasonably Anticipated	A2	X	Not listed

IARC: (International Agency for Research on Cancer)	*IARC: (International Agency for Research on Cancer)* *Group 1 - Carcinogenic to Humans* *Group 2A - Probably Carcinogenic to Humans* *Group 2B - Possibly Carcinogenic to Humans*
NTP: (National Toxicity Program)	*NTP: (National Toxicity Program)* *Known - Known Carcinogen* *Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen*
ACGIH: (American Conference of Governmental Industrial Hygienists)	*A1 - Known Human Carcinogen* *A2 - Suspected Human Carcinogen* *A3 - Animal Carcinogen* *ACGIH: (American Conference of Governmental Industrial Hygienists)*

Mutagenic Effects	Mutagenic effects have occurred in humans.
Reproductive Effects	No information available.
Developmental Effects	No information available.
Teratogenicity	No information available.

STOT - single exposure	Central nervous system (CNS)
STOT - repeated exposure	Kidney Liver Heart spleen Blood
Aspiration hazard	No information available
Symptoms / effects,both acute and delayed	Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing
Endocrine Disruptor Information	No information available
Other Adverse Effects	The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment. Do not empty into drains. The product contains following substances which are hazardous for the environment. Contains a substance which is:. Harmful to aquatic organisms. Toxic to aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Trichloroethylene	EC50: = 175 mg/L, 96h (Pseudokirchneriella subcapitata) EC50: = 450 mg/L, 96h (Desmodesmus subspicatus)	LC50: 39 - 54 mg/L, 96h static (Lepomis macrochirus) LC50: 31.4 - 71.8 mg/L, 96h flow-through (Pimephales promelas)	EC50 = 0.81 mg/L 24 h EC50 = 115 mg/L 10 min EC50 = 190 mg/L 15 min EC50 = 235 mg/L 24 h EC50 = 410 mg/L 24 h EC50 = 975 mg/L 5 min	EC50: = 2.2 mg/L, 48h (Daphnia magna)

Persistence and Degradability	Persistence is unlikely based on information available.
Bioaccumulation/ Accumulation	No information available.
Mobility	Will likely be mobile in the environment due to its volatility.

Component	log Pow
Trichloroethylene	2.4

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Trichloroethylene - 79-01-6	U228	-

14. Transport information

DOT

UN-No	UN1710
Proper Shipping Name	TRICHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

TDG

UN-No	UN1710
Proper Shipping Name	TRICHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

IATA

UN-No	UN1710
Proper Shipping Name	TRICHLOROETHYLENE

Hazard Class	6.1
Packing Group	III

IMDG/IMO

UN-No	UN1710
Proper Shipping Name	TRICHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Trichloroethylene	X	X	-	201-167-4	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

Component	TSCA 12(b)
Trichloroethylene	Section 5

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Trichloroethylene	79-01-6	100	0.1

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Trichloroethylene	X	100 lb	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Trichloroethylene	X		-

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Trichloroethylene	100 lb 1 lb	-

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Trichloroethylene	79-01-6	Carcinogen Developmental Male Reproductive	14 µg/day 50 µg/day	Developmental Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Trichloroethylene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ):	Y
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 03-Feb-2010
Revision Date 14-Jul-2016
Print Date 14-Jul-2016
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

APPENDIX B
ACTIVITY HAZARD ANALYSES

Project Identification	**Location** 291 Richardson St, Brooklyn, NY	**Estimated Dates** TBD
Phase of Work Drilling/Excavation	**Page 1 of 1**	**Analysis Approved by** Jessica Ferngren, PM/HSM
TASKS	**HAZARDS**	**CONTROL MEASURES**
	Noise	• Hearing protection mandatory at or above 85dBA. • Instruct personnel how to properly wear heating protective devices. •Disposable ear plugs or other hearing protection required when working near noisy equipment.
	Steam/Heat/Splashing	• Use face shield and safety glasses or goggles; • Stay out of the splash/steam radius; • Do not direct steam at anyone; • Do not hold objects with your foot and steam area near it; • Direct spray to minimize spread of constituents of concern;and • Use shielding as necessary.
	Excavation hazards	• Follow 29 CFR 1926 Subpart P.
	Overhead hazards	• Personnel will be required to wear hard hats that meet ANSI Standard Z89.1; • Ground personnel will stay clear of suspended loads; • Equipment will be provided with guards, canopies or grills to protect the operator from falling or flying objects; and • Overhead hazards will be identified prior to commencing work operations.
	Electrocution	• Equipment will be equipped with GFCI; • A licensed electrician will conduct electrical work; • Equipment will stay a minimum of 15 feet from overhead-energized electrical lines (up to 50 kV). This distance will increase 0.4 inches for each 1 kV above 50kV.

CASTLETON
ENVIRONMENTAL

APPENDIX C
HEAT/COLD STRESS PROTOCOLS

HEAT STRESS

Heat Stress (Hyperthermia)

Heat stress is the body's inability to regulate the core temperature. A worker's susceptibility to heat stress can vary according to his/her physical fitness, degree of acclimation to heat, humidity, age and diet.

1. Prior to site activity, the field team leader may make arrangements for heat stress monitoring (i.e., monitoring heart rate, body temperature, and body water loss) during actual site work if conditions warrant. In addition, the FTL is to ensure that each team member has been acclimatized to the prevailing environmental conditions, that personnel are aware of the signs and symptoms of heat sickness, that they have been adequately trained in first aid procedures, and that there are enough personnel on-site to rotate work assignments and schedule work during hours of reduced temperatures. Personnel should not consume alcoholic or caffeinated beverages but rather drink moderate levels of an electrolyte solution and eat well prior to commencing site work.

2. Although there is no specific test given during a baseline physical that would identify a person's intolerance to heat, some indicators are tobacco or medication use, dietary habits, body weight, and chronic conditions such as high blood pressure or diabetes.

3. *Heat cramps*, caused by profuse perspiration with inadequate fluid intake and salt replacement, most often afflict people in good physical condition who work in high temperature and humidity. Heat cramps usually come on suddenly during vigorous activity. Untreated, heat cramps may progress rapidly to heat exhaustion or heat stroke. First aid treatment: remove victim to a cool place and replace lost fluids with water.

4. Thirst is not an adequate indicator of heat exposure. Drinking fluid by itself does not indicate sufficient water replacement during heat exposure. A general rule, the amount of water administered should replace the amount of water lost, and it should be administered at regular intervals throughout the day. For every half pound of water lost, 8 ounces of water should be ingested. Water should be replaced by drinking 2 – 4 ounce servings during every rest period. A recommended alternative to water is an electrolyte drink split 50/50 with water.

5. *Heat exhaustion* results from salt and water loss along with peripheral pooling of blood. Like heat cramps, heat exhaustion tends to occur in persons in good physical health who are working in high temperatures and humidity. Heat exhaustion may come on suddenly as dizziness and collapse. Untreated, heat exhaustion may progress to heat stroke.

6. *Treatment for heat exhaustion*: Move the victim to a cool environment (e.g. air-conditioned room/car), lay victim down and fan him/her. If the air-conditioning is not available, remove the victim to a shaded area, remove shirt, and fan. If symptoms do not subside within an hour, notify 911 to transport to hospital.

7. *Heat stroke* results from the body's inability to dissipate excess heat. A true medical emergency that requires immediate care, it usually occurs when one ignores the signs of heat exhaustion and continues strenuous activities. Working when the relative humidity exceeds 60% is a particular problem. Workers in the early phase of heat stress may not be coherent of they will be confused, delirious or comatose. Changes in behavior, irritability and combativeness are useful early signs of heat stroke.

8. *Treatment of heat stroke*: Move the victim to a cool, air-conditioned environment. Place victim in a semi-reclined position with head elevated and strip to underclothing. Cool victim as rapidly as possible, applying ice packs to the arms and legs and massaging the neck and torso. Spray victim with tepid water and constantly fan to promote evaporation. Notify 911 to transport to hospital as soon as possible.

TABLE 1

SYMPTOMS OF HEAT STRESS

Heat cramps are caused by heavy sweating with inadequate fluid intake. Symptoms include;

- Muscle cramps
- Cramps in the hands, legs, feet and abdomen

Heat exhaustion occurs when body organs attempt to keep the body cool. Symptoms include;

- Pale, cool moist skin
- Core temperature elevated 1-2°
- Thirst
- Anxiety
- Rapid heart rate
- Heavy sweating
- Dizziness
- Nausea

Heat stroke is the most serious form of heat stress. Immediate action must be taken to cool the body before serious injury and death occur. Symptoms are;

- Red, hot, dry skin
- Lack of perspiration
- Seizures
- Dizziness and confusion
- Strong, rapid pulse
- Core temperature of 104° or above
- Coma

TABLE 2

HEAT STRESS INDICATORS

Heat stress indicator	When to measure	If Exceeds…	Action
Heart rate (pulse)	Beginning of rest period	110 beats per minute	Shorten next work period by 33%
Oral temperature	Beginning of rest period	99°F (after thermometer is under tongue for 3 minutes) 100.6°F	Shorten next work period by 33% Prohibit work in impermeable clothing
Body weight	1. Before workday begins (a.m.) 2. After workday ends (p.m.)		Increase fluid intake

COLD STRESS

Cold stress (Hypothermia)

In hypothermia the core body temperature drops below 95°F. Hypothermia can be attributed to a decrease in heat production, increased heat loss or both.

Prevention

Institute the following steps to prevent overexposure of workers to cold:

1. Maintain body core temperature at 98.6°F or above by encouraging workers to drink warm liquids during breaks (preferably not coffee) and wear several layers of clothing that can keep the body warm even when the clothing is wet.
2. Avoid frostbite by adequately covering hands, feet and other extremities. Clothing such as insulated gloves or mittens, earmuffs and hat liners should be worn. To prevent contact frostbite (from touching metal and cold surfaces below 20°F), workers should wear gloves. Tool handles should be covered with insulating material.
3. Adjust work schedules to provide adequate rest periods. When feasible, rotate personnel and perform work during the warmer hours of the day.
4. Provide heated shelter. Workers should remove their outer layer(s) of clothing while in the shelter to allow sweat to evaporate.
5. In the event that wind barriers are constructed around an intrusive operation (such as drilling), the enclosure must be properly vented to prevent the buildup of toxic or explosive gases or vapors. Care must be taken to keep a heat source away from flammable substances.

Using a wind chill chart such as the one in Table 3, obtain the equivalent chill temperature (ECT) based on actual wind speed and temperature. Refer to the ECT when setting up work warm-up schedules, planning appropriate clothing, etc. Workers should use warming shelters at regular intervals at or below an ECT of 20°F. For exposed skin, continuous exposure should not be permitted at or below an ECT of -25°F.

Frostbite

Personnel should be aware of symptoms of frostbite/hypothermia. If the following symptoms are noticed in any worker, he/she should immediately go to a warm shelter.

Condition	Skin Surface	Tissue Under Skin	Skin Color
Frostnip	Soft	Soft	Initially red, then white
Frostbite	Hard	Soft	White and waxy
Freezing	Hard	Hard	Blotchy, white to yellow-gray to gray

1. *Frostnip* is the incipient stage of frostbite, brought about by direct contact with a cold object or exposure of a body part to cool/cold air. Wind chill or cold water also can be major factors. This condition is not serious. Tissue damage is minor and the response to care is good. The tip of the nose, tips of ears, upper cheeks and fingers (all areas generally exposed) are most susceptible to frostnip.

2. *Treatment of frostnip*: Care for frostnip by warming affected areas. Usually the worker can apply warmth from his/her bare hands, blow warm air on the site, or, if the fingers are involved, hold them in the armpits. During recovery, the worker may complain of tingling or burning sensation, which is normal. If the condition does not respond to this simple care, begin treatment for frostbite.

3. *Frostbite*: The skin and subcutaneous layers become involved. If frostnip goes untreated, it becomes superficial frostbite. This condition is serious. Tissue damage may be serious. The worker must be transported to a medical facility for evaluation. The tip of the nose, tips of ears, upper cheeks and fingers (all areas generally exposed) are most susceptible to frostbite. The affected area will feel frozen, but only on the surface. The tissue below the surface must still be soft and have normal response to touch. *DO NOT* squeeze or poke the tissue. The condition of the deeper tissues can be determined by gently palpating the affected area. The skin will turn mottled or blotchy. It may also be white and then turn grayish-yellow.

4. *Treatment of frostbite*: When practical, transport victim as soon as possible. Get the worker inside and keep him/her warm. Do not allow any smoking or alcohol consumption. Thaw

frozen parts by immersion, re-warming in a 100°F to 106°F water bath. Water temperature will drop rapidly, requiring additional warm water throughout the process. Cover the thawed part with a dry sterile dressing. Do not puncture or drain any blisters.

NOTE: Never listen to myths and folk tales about the care of frostbite. *Never* rub a frostbitten or frozen area. *Never* rub snow on a frostbitten or frozen area. Rubbing the area may cause serious damage to already injured tissues. Do not attempt to thaw a frozen area if there is any chance it will be re-frozen.

5. *General cooling/Hypothermia*: General cooling of the body is known as systemic hypothermia. This condition is not a common problem unless workers are exposed to cold for prolonged periods of time without any shelter.

6. *Treatment of hypothermia*: Keep worker dry. Remove any wet clothing and replace with dry clothes or wrap person in dry blankets. Keep person at rest. Do not allow him/her to move around. Transport the victim to a medical facility as soon as possible.

Body Temperature	°C	Symptoms
99-96	37-35.5	Intense, uncontrollable shivering
95-91	35.5-32.7	Violent shivering persists. If victim is conscious, he has difficulty speaking.
90-86	32-30	Shivering decreases and is replaced by strong muscular rigidity. Muscle coordination is affected. Erratic or jerkey movements are produced. Thinking is less clear. General comprehension is dulled. There may be total amnesia. The worker is generally still able to maintain the appearance of psychological contact with his surroundings.
85-81	29.4-27.2	Victim becomes irrational, loses contact with his environment, and drifts into a stuporous state. Muscular rigidity continues. Pulse and respirations are slow and the worker may develop cardiac arrhythmias.
80-78	26.6-18.5	Victim becomes unconscious. He does not respond to the spoken word. Most reflexes cease to function. Heartbeat becomes erratic
Below 78	25.5	Cardiac and respiratory centers of the brain fail. Ventricular fibrillation occurs; probably edema and hemorrhage in the lungs; death.

TABLE 3(1)

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS AN EQUIVALENT TEMPERATURE (UNDER CALMCONDITIONS)

Estimated wind Speed (in mph)	Actual Temperature Reading (ºF)P											
	50	40	30	20	10	0	10	20	30	40	50	60
	Equivalent Chill Temperature(ºF)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	15	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-146
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER in < hr with dry skin. Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh within one minute			GREAT DANGER Flesh may freeze within 30 seconds.				
	Trench foot and imersion foot mayoccur				at any point on this chart							

Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

(1) Reproduced from American Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1985-1986, p.01.

APPENDIX D

MEDICAL DATA SHEET

Medical Data Sheet

Name:

Date:

Phone:

Emergency contact:

Medical Conditions:

Allergies:

Current Medications:

APPENDIX E

GENERAL HEALTH AND SAFETY WORK PRACTICES

GENERAL HEALTH AND SAFETY WORK PRACTICES

1. Site personnel must attend each day's Daily Briefing and sign the attendance sheet.

2. Any individual taking prescribed drugs shall inform the FTL/HSO of the type of medication. The FTL/HSO will review the matter with the HSM and the Corporate Medical Consultant (CMC), who will decide if the employee can safely work on-site while taking the medication.

3. The personal protective equipment specified by the FTL/HSO and/or associated procedures shall be worn by site personnel. This includes hard hats and safety glasses which must be worn in active work areas.

4. Facial hair (beards, long sideburns or mustaches) which may interfere with a satisfactory fit of a respirator mask is not allowed on any person who may be required to wear a respirator.

5. Personnel must follow proper decontamination procedures and shower as soon as possible upon completion of work shift.

6. Eating, drinking, chewing tobacco or gum, smoking and any other practice that may increase the possibility of hand-to-mouth contact is prohibited in the exclusion zone or the contamination reduction zone. (Exceptions may be permitted by the HSM to allow fluid intake during heat stress conditions).

7. Lighters, matches, cigarettes and other forms of tobacco are prohibited in the Exclusion Zone.

8. Signs and demarcations shall be followed. Such signs and demarcation shall not be removed, except as authorized by the FTL/HSO.

9. No one shall enter a permit-required confined space without a permit and appropriate training. Confined space entry permits shall be implemented as issued.

10. Personnel must follow Hot Work Permits as issued.

11. Personnel must use the Buddy System in the Exclusion Zone.

12. Personnel must follow the work-rest regimens and other practices required by the heat stress program.

13. Personnel must follow lockout/tagout procedures when working on equipment involving moving parts or hazardous energy sources.

14. No person shall operate equipment unless trained and authorized.

15. No one may enter an excavation greater than four feet deep unless authorized by the Competent Person. Excavations must be sloped or shored properly. Safe means of access and egress from excavations must be maintained.

16. Ladders and scaffolds shall be solidly constructed, in good working condition, and inspected prior to use. No one may use defective ladders or scaffolds.

17. Fall protection or fall arrest systems must be in place when working at elevations greater than six feet for temporary working surfaces and four feet for fixed platforms.

18. Safety belts, harnesses and lanyards must be selected by the Supervisor. The user must inspect the equipment prior to use. No defective personal fall protection equipment shall be used. Personal fall protection that has been shock loaded must be discarded.

19. Hand and portable power tools must be inspected prior to use. Defective tools and equipment shall not be used.

20. Ground fault interrupters shall be used for cord and plug equipment used outdoors or in damp locations. Electrical cords shall be kept out walkways and puddles unless protected and rated for the service.

21. Improper use, mishandling, or tampering with health and safety equipment and samples is prohibited.

22. Horseplay of any kind is prohibited.

23. Possession or use of alcoholic beverages, controlled substances, or firearms on any site is forbidden.

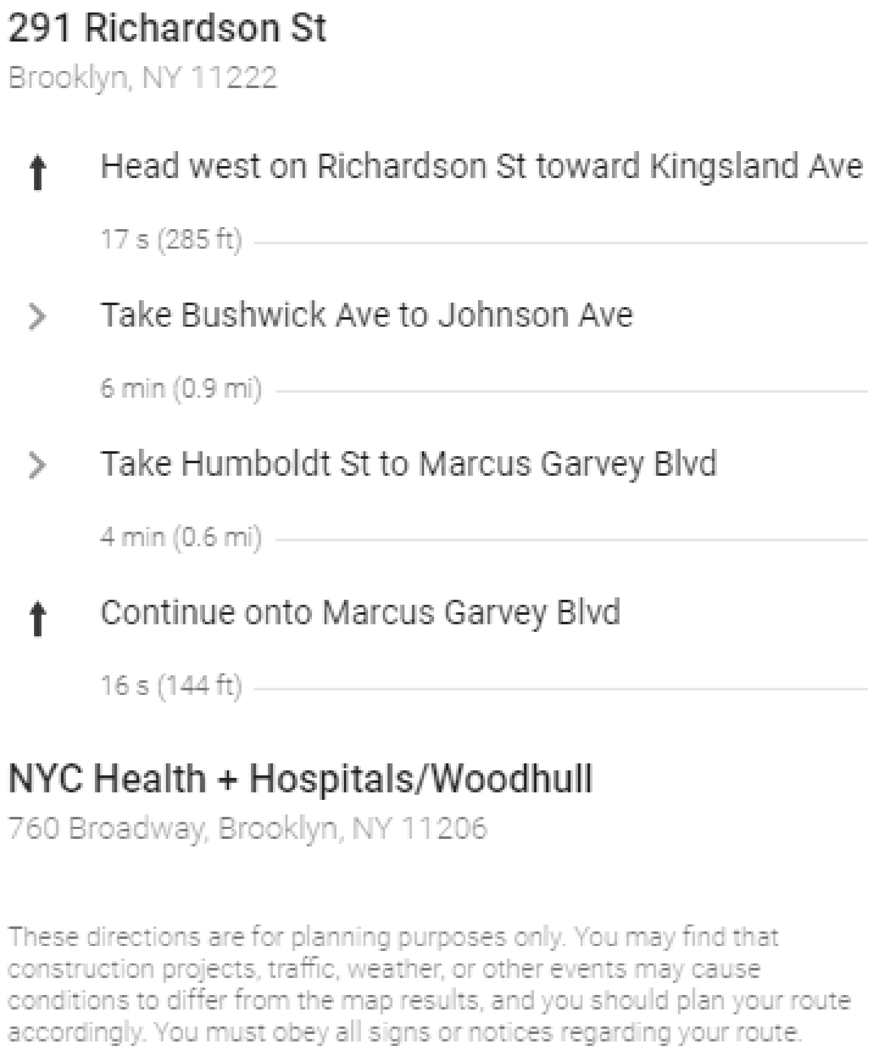
24. Incidents, no matter how minor, must be reported immediately to the Supervisor.

25. Personnel shall be familiar with the Site Emergency Action Plan, which is contained in Section 12 of the HASP/EAP.

The above Health and Safety Rules are not all inclusive and it is your responsibility to comply with regulations set forth by OSHA, the client, Castleton Supervisors, and the FTL/HSO.

APPENDIX F

HOSPITAL ROUTE MAP AND DIRECTIONS



291 Richardson St
Brooklyn, NY 11222

↑ Head west on Richardson St toward Kingsland Ave

17 s (285 ft)

› Take Bushwick Ave to Johnson Ave

6 min (0.9 mi)

› Take Humboldt St to Marcus Garvey Blvd

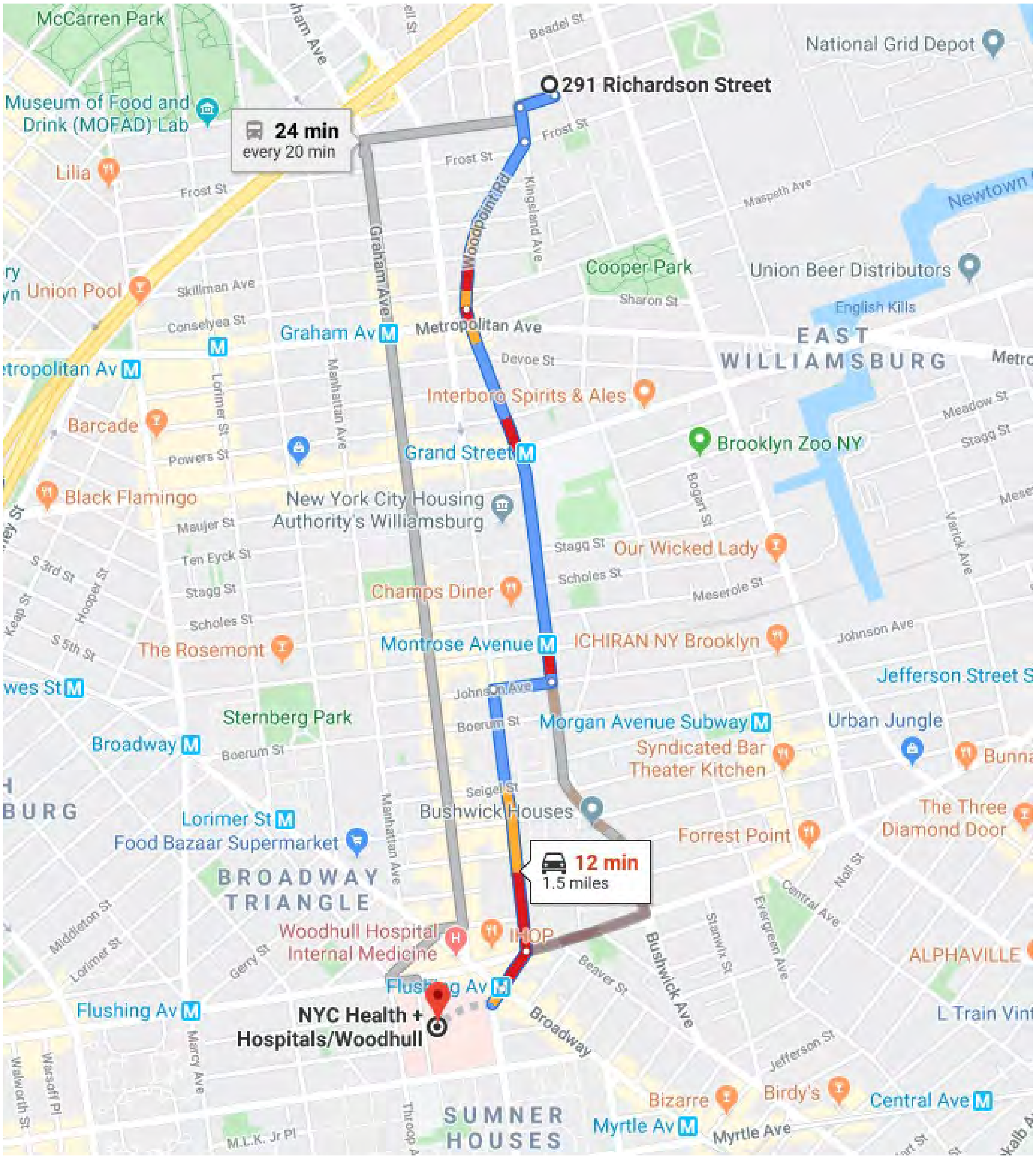
4 min (0.6 mi)

↑ Continue onto Marcus Garvey Blvd

16 s (144 ft)

NYC Health + Hospitals/Woodhull
760 Broadway, Brooklyn, NY 11206

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.


291 Richardson Street
24 min
every 20 min
12 min
1.5 miles
NYC Health + Hospitals/Woodhull
McCarren Park
Museum of Food and Drink (MOFAD) Lab
Lilia
Union Pool
Barcade
Black Flamingo
The Rosemont
Sternberg Park
Graham Av
Metropolitan Av
Metropolitan Ave
Grand Street
Montrose Avenue
Morgan Avenue Subway
Flushing Av
Lorimer St
Broadway
Myrtle Av
Central Ave
Jefferson Street
Interboro Spirits & Ales
Brooklyn Zoo NY
New York City Housing Authority's Williamsburg
Our Wicked Lady
Champs Diner
ICHIRAN NY Brooklyn
Syndicated Bar Theater Kitchen
Bushwick Houses
Forrest Point
Woodhull Hospital Internal Medicine
IHOP
Food Bazaar Supermarket
BROADWAY TRIANGLE
EAST WILLIAMSBURG
SUMNER HOUSES
Cooper Park
National Grid Depot
Union Beer Distributors
English Kills
Newtown
Urban Jungle
The Three Diamond Door
ALPHAVILLE
L Train Vint
Bizarre
Birdy's
Graham Ave
Woodpoint Rd
Kingsland Ave
Manhattan Ave
Lorimer St
Bogart St
Varick Ave
Bushwick Ave
Broadway
Beaver St
Starr St
Evergreen Ave
Central Ave
Noll St
Frost St
Beadel St
Maspeth Ave
Skillman Ave
Conselyea St
Devoe St
Powers St
Maujer St
Ten Eyck St
Stagg St
Scholes St
Meserole St
Johnson Ave
Boerum St
Seigel St
Sharon St
Meadow St
Middleton St
Gerry St
Flushing Av
Marcy Ave
Walworth St
Warsoff Pl
M.L.K. Jr Pl
Throop Av
Jefferson St
Myrtle Ave
Hooper St
Keap St
S 3rd St
S 5th St
Hewes St

APPENDIX G

INCIDENT REPORT FORM/INVESTIGATION FORM

CASTLETON
ENVIRONMENTAL

INCIDENT / NEAR MISS REPORT AND INVESTIGATION - PAGE 1 OF 2

TYPE OF INCIDENT - CHECK ALL THAT APPLY

☐ INJURY/ILLNESS ☐ VEHICLE DAMAGE ☐ PROPERTY DAMAGE ☐ FIRE

☐ SPILL/RELEASE ☐ PERMIT EXCEEDENCE ☐ NEAR MISS ☐ OTHER

GENERAL INFORMATION

PROJECT NAME: DATE OF REPORT: REPORT NO.:

DATE OF INCIDENT: TIME: DAY OF WEEK:

LOCATION OF INCIDENT:

WEATHER CONDITIONS: ADEQUATE LIGHTING AT SCENE? ☐ YES ☐ NO ☐ N/A

DESCRIBE WHAT HAPPENED (STEP BY STEP - USE ADDITIONAL PAGES IF NECESSARY)

AFFECTED EMPLOYEE INFORMATION

NAME: EMPLOYEE: ☐ YES ☐ NO

HOME ADDRESS:

SOCIAL SECURITY NO.: HOME PHONE NO.:

JOB CLASSIFICATION: YEARS IN JOB CLASSIFICATION:

HOURS WORKED ON SHIFT PRIOR TO INCIDENT: AGE:

DID INCIDENT RELATE TO ROUTINE TASK FOR JOB CLASSIFICATION? ☐ YES ☐ NO

INJURY/ILLNESS INFORMATION

NATURE OF INJURY OR ILLNESS:

OBJECT/EQUIPMENT/SUBSTANCE CAUSING HARM:

FIRST AID PROVIDED? ☐ YES ☐ NO

IF YES, WHERE WAS IT GIVEN: ☐ ON-SITE ☐ OFF-SITE

IF YES, WHO PROVIDED FIRST AID:

WILL THE INJURY/ILLNESS RESULT IN: ☐ RESTRICTED DUTY ☐ LOST TIME ☐ UNKNOWN

INCIDENT / NEAR MISS REPORT AND INVESTIGATION - PAGE 2 OF 2	REPORT NO.
MEDICAL TREATMENT INFORMATION	
WAS MEDICAL TREATMENT PROVIDED? ☐YES ☐NO	
IF YES, WAS MEDICAL TREATMENT PROVIDED: ☐ON-SITE ☐DR.'S OFFICE ☐HOSPITAL	
NAME OF PERSON(S) PROVIDING TREATMENT:	
ADDRESS WHERE TREATMENT WAS PROVIDED:	
TYPE OF TREATMENT:	
VEHICLE AND PROPERTY DAMAGE INFORMATION	
VEHICLE/PROPERTY DAMAGED:	
DESCRIPTION OF DAMAGE:	
SPILL AND AIR EMISSIONS INFORMATION:	
SUBSTANCE SPILLED OR RELEASED:	FROM WHERE: TO WHERE:
ESTIMATED QUANTITY/DURATION:	
CERCLA HAZARDOUS SUBSTANCE? ☐YES ☐NO	
REPORTABLE TO AGENCY? ☐YES ☐NO SPECIFY:	
WRITTEN REPORT: ☐YES ☐NO TIME FRAME:	
RESPONSE ACTION TAKEN:	
PERMIT EXCEEDENCE	
TYPE OF PERMIT:	PERMIT #:
DATE OF EXCEEDENCE:	DATE FIRST KNOWLEDGE OF EXCEEDENCE:
PERMITTED LEVEL OR CRITERIA:	
EXCEEDENCE LEVEL OR CRITERIA:	
REPORTABLE TO AGENCY? ☐YES ☐NO SPECIFY:	
WRITTEN REPORT: ☐YES ☐NO TIME FRAME:	
RESPONSE ACTION TAKEN:	
NOTIFICATIONS	
NAMES OF PERSONNEL NOTIFIED:	DATE/TIME:
CLIENT NOTIFIED:	DATE/TIME:
AGENCY NOTIFIED:	DATE/TIME:
CONTACT NAME:	
PERSONS PREPARING REPORT	
EMPLOYEE'S NAME:(PRINT)	SIGN:

SUPERVISOR’S NAME:(PRINT) SIGN:

INVESTIGATIVE REPORT

DATE OF INCIDENT: DATE OF REPORT: REPORT NUMBER:

INCIDENT COST: ESTIMATED: $ ACTUAL: $

OSHA RECORDABLE(S): ☐YES ☐NO # RESTRICTED DAYS # DAYS AWAY FROM WORK

CAUSE ANALYSIS

IMMEDIATE CAUSES - WHAT ACTIONS AND CONDITIONS CONTRIBUTED TO THIS EVENT?

BASIC CAUSES - WHAT SPECIFIC PERSONAL OR JOB FACTORS CONTRIBUTED TO THIS EVENT?

ACTION PLAN

REMEDIAL ACTIONS - WHAT HAS AND OR SHOULD BE DONE TO CONTROL EACH OF THE CAUSES

ACTION	PERSON RESPONSIBLE	TARGET DATE	COMPLETION DATE

PERSONS PERFORMING INVESTIGATION

INVESTIGATOR’S NAME: (PRINT) SIGN: DATE:

INVESTIGATOR’S NAME: (PRINT) SIGN: DATE:

INVESTIGATOR’S NAME: (PRINT) SIGN: DATE:

MANAGEMENT REVIEW

PROJECT MANAGER: (PRINT) SIGN: DATE:

COMMENTS:

H&S MANAGER: (PRINT) SIGN: DATE:

COMMENTS:

EXAMPLES OF IMMEDIATE CAUSES

Substandard Actions

1. Operating equipment without authority
2. Failure to warn
3. Failure to secure
4. Operating at improper speed
5. Making safety devices inoperable
6. Removing safety devices
7. Using defective equipment
8. Failure to use PPE properly
9. Improper loading
10. Improper placement
11. Improper lifting
12. Improper position for task
13. Servicing equipment in operation
14. Under influence of alcohol/drugs
15. Horseplay

Substandard Conditions

1. Guards or barriers
2. Protective equipment
3. Tools, equipment, or materials
4. Congestion
5. Warning system
6. Fire and explosion hazards
7. Poor housekeeping
8. Noise exposure
9. Exposure to hazardous materials
10. Extreme temperature exposure
11. Illumination
12. Ventilation
13. Visibility

EXAMPLES OF BASIC CAUSES

Personal Factors

1. Capability
2. Knowledge
3. Skill
4. Stress
5. Motivation
6. Work Standards
7. Wear and tear
8. Abuse or misuse

Job Factors

1. Supervision
2. Engineering
3. Purchasing
4. Maintenance
5. Tools/equipment

MANAGEMENT PROGRAMS FOR CONTROL OF INCIDENTS

1. Leadership and administration
2. Management training
3. Planned inspections
4. Task analysis and procedures
5. Task observation
6. Emergency preparedness
7. Organizational rules
8. Accident/incident analysis
9. Personal protective equipment
10. Health control
11. Program audits
12. Engineering controls
13. Personal communications
14. Group meetings
15. General promotion
16. Hiring and placement
17. Purchasing controls

CASTLETON
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APPENDIX H

DAILY BRIEFING SIGN-IN SHEET

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ENVIRONMENTAL

DAILY BRIEFING SIGN-IN SHEET

Date:__________________________________
Project Name/Location: ____
Person Conducting Briefing:____

1. AWARENESS (topics discussed, special safety concerns, recent incidents, etc.)

____

____

____

2. OTHER ISSUES (HASP/EAP changes, attendee comments, etc.)

____

____

____

3. ATTENDEES (Print Name):

1.	21.
2.	22.
3.	23.
4.	24.
5.	25.
6.	26.
7.	27.
8.	28.
9.	29.
10.	30.
11.	31.
12.	32.
13.	33.
14.	34.
15.	35.
16.	36.
17.	37.
18.	38.
19.	39.
20.	40.

CASTLETON
ENVIRONMENTAL

APPENDIX I

COVID-19 RISK MANAGEMENT SPECIFICATIONS

Entry/Exit Log with COVID-19 Acknowledgement

Project Name: ____________________________________

Project #: ____

New York State Department of Environmental Conservation's (DEC) objective is to provide a safe and healthy workplace. In response to COVID-19, DEC is prohibiting access to our work areas by those who pose an elevated risk of spreading COVID-19. By completing this site Entry/Exit log, you acknowledge your understanding of this policy and confirm that your health and travel history is NOT in one of the prohibited access groups listed below, and to the best of your knowledge, you do not pose an elevated risk of transmitting COVID-19 to others. Please leave the site immediately and follow recommendations from public health agencies and your healthcare provider if you fall into one of the prohibited access groups listed below:

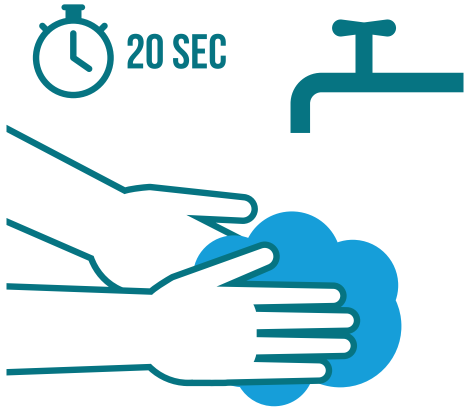
- You are experiencing flu-like symptoms including but not limited to fever, chills, cough, sore throat, diarrhea, vomiting, runny/stuffy nose, muscle or body aches, headaches, fatigue.

- You have traveled to CDC-restricted destinations in the last 2 weeks including China, South Korea, Iran, United Kingdom & Ireland, all European Union countries, Switzerland and regions within the U.S. for which public health agencies have prohibited travel.

- You had direct contact with a person diagnosed with COVID-19 or suspected of having COVID-19 during the last 2 weeks.

Name	Initials	Affiliation	Date	Time In	Time Out

PREVENT INFECTION



Wash your hands and use hand sanitizer

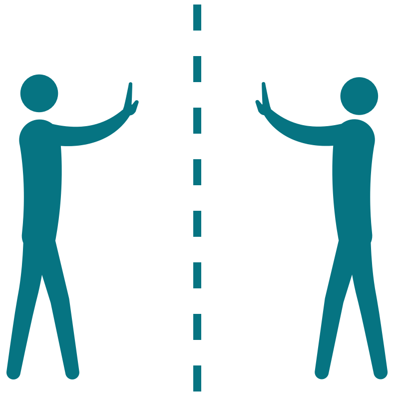
Wash your hands frequently and thoroughly, for a minimum of 20 seconds.

Use hand sanitizer, containing at least 60% alcohol when you are unable to wash you hands with soap and water.

Cover your cough or sneeze

Cover your mouth and nose when coughing or sneezing. Turn your head away from others, if possible, when sneezing.

Use a paper tissue or your sleeve and not your hand. Dispose of used tissues immediately.



Limit physical contact

Avoid handshakes, kisses and hugs.

Maintain at least 6 feet from all others persons when possible.

Keep clean

Regularly sanitize frequently touched and shared surfaces at home as well as at work.

Be considerate

Stay home whenever possible especially if you are experiencing symptoms.

NEW YORK
STATE OF OPPORTUNITY
Department of Environmental Conservation

SITE ACCESS RESTRICTIONS

SITE ACCESS IS PROHIBITED FOR THE FOLLOWING PERSONS DUE TO COVID-19 RISK

- **You are experiencing flu-like symptoms including but not limited to:**

  Fever or feeling feverish/chills, cough, sore throat, diarrhea, vomiting, runny or stuffy nose, muscle or body aches, headaches, fatigue (tiredness)

- **You have traveled to CDC-restricted destinations during the last 2 weeks:**

  China, South Korea, Iran, United Kingdom & Ireland, all European Union countries, Switzerland and regions within the U.S. for which public health agencies have prohibited travel

- **You had direct contact with a person diagnosed with COVID-19 or suspected of having COVID-19 during the last 2 weeks**

  Immediately notify NYSDEC site management.

NEW YORK
STATE OF
OPPORTUNITY
Department of
Environmental
Conservation

APPENDIX E – COMMUNITY AIR MONITORING PLAN

Appendix 1A
New York State Department of Health
Generic Community Air Monitoring Plan

Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. “Periodic” monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

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Appendix 1B
Fugitive Dust and Particulate Monitoring

A program for suppressing fugitive dust and particulate matter monitoring at hazardous waste sites is a responsibility on the remedial party performing the work. These procedures must be incorporated into appropriate intrusive work plans. The following fugitive dust suppression and particulate monitoring program should be employed at sites during construction and other intrusive activities which warrant its use:

1. Reasonable fugitive dust suppression techniques must be employed during all site activities which may generate fugitive dust.

2. Particulate monitoring must be employed during the handling of waste or contaminated soil or when activities on site may generate fugitive dust from exposed waste or contaminated soil. Remedial activities may also include the excavation, grading, or placement of clean fill. These control measures should not be considered necessary for these activities.

3. Particulate monitoring must be performed using real-time particulate monitors and shall monitor particulate matter less than ten microns (PM10) with the following minimum performance standards:

(a) Objects to be measured: Dust, mists or aerosols;
(b) Measurement Ranges: 0.001 to 400 mg/m3 (1 to 400,000 :ug/m3);
(c) Precision (2-sigma) at constant temperature: +/- 10 :g/m3 for one second averaging; and +/- 1.5 g/m3 for sixty second averaging;
(d) Accuracy: +/- 5% of reading +/- precision (Referred to gravimetric calibration with SAE fine test dust (mmd= 2 to 3 :m, g= 2.5, as aerosolized);
(e) Resolution: 0.1% of reading or 1g/m3, whichever is larger;
(f) Particle Size Range of Maximum Response: 0.1-10;
(g) Total Number of Data Points in Memory: 10,000;
(h) Logged Data: Each data point with average concentration, time/date and data point number
(i) Run Summary: overall average, maximum concentrations, time/date of maximum, total number of logged points, start time/date, total elapsed time (run duration), STEL concentration and time/date occurrence, averaging (logging) period, calibration factor, and tag number;
(j) Alarm Averaging Time (user selectable): real-time (1-60 seconds) or STEL (15 minutes), alarms required;
(k) Operating Time: 48 hours (fully charged NiCd battery); continuously with charger;
(l) Operating Temperature: -10 to 50° C (14 to 122° F);
(m) Particulate levels will be monitored upwind and immediately downwind at the working site and integrated over a period not to exceed 15 minutes.

4. In order to ensure the validity of the fugitive dust measurements performed, there must be appropriate Quality Assurance/Quality Control (QA/QC). It is the responsibility of the remedial party to adequately supplement QA/QC Plans to include the following critical features: periodic instrument calibration, operator training, daily instrument performance (span) checks, and a record keeping plan.

5. The action level will be established at 150 ug/m3 (15 minutes average). While conservative,

Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures

When work areas are within 20 feet of potentially exposed populations or occupied structures, the continuous monitoring locations for VOCs and particulates must reflect the nearest potentially exposed individuals and the location of ventilation system intakes for nearby structures. The use of engineering controls such as vapor/dust barriers, temporary negative-pressure enclosures, or special ventilation devices should be considered to prevent exposures related to the work activities and to control dust and odors. Consideration should be given to implementing the planned activities when potentially exposed populations are at a minimum, such as during weekends or evening hours in non-residential settings.

- If total VOC concentrations opposite the walls of occupied structures or next to intake vents exceed 1 ppm, monitoring should occur within the occupied structure(s). Depending upon the nature of contamination, chemical-specific colorimetric tubes of sufficient sensitivity may be necessary for comparing the exposure point concentrations with appropriate pre-determined response levels (response actions should also be pre-determined). Background readings in the occupied spaces must be taken prior to commencement of the planned work. Any unusual background readings should be discussed with NYSDOH prior to commencement of the work.

- If total particulate concentrations opposite the walls of occupied structures or next to intake vents exceed 150 mcg/m^3, work activities should be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 mcg/m^3 or less at the monitoring point.

- Depending upon the nature of contamination and remedial activities, other parameters (e.g., explosivity, oxygen, hydrogen sulfide, carbon monoxide) may also need to be monitored. Response levels and actions should be pre-determined, as necessary, for each site.

Special Requirements for Indoor Work With Co-Located Residences or Facilities

Unless a self-contained, negative-pressure enclosure with proper emission controls will encompass the work area, all individuals not directly involved with the planned work must be absent from the room in which the work will occur. Monitoring requirements shall be as stated above under "Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures" except that in this instance "nearby/occupied structures" would be adjacent occupied rooms. Additionally, the location of all exhaust vents in the room and their discharge points, as well as potential vapor pathways (openings, conduits, etc.) relative to adjoining rooms, should be understood and the monitoring locations established accordingly. In these situations, it is strongly recommended that exhaust fans or other engineering controls be used to create negative air pressure within the work area during remedial activities. Additionally, it is strongly recommended that the planned work be implemented during hours (e.g. weekends or evenings) when building occupancy is at a minimum.