River North
Remedial Investigation Work Plan

178, 194 Richmond Terrace & 8 Stuyvesant Place
Staten Island, NY
Richmond County
Block 13, Lots 82, 92 & 100
BCP Site No. C243045

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau B
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CERTIFICATION

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

____DRAFT______________________ _______________
Alana Carroll, PG Date

1.0 INTRODUCTION

On behalf of Richmond SI Owner LLC (the Volunteer), Tenen Environmental, LLC (Tenen) has prepared this Remedial Investigation Work Plan (RIWP) for the property located at 178 and 194 Richmond Terrace and 8 Stuyvesant Place (Block 13, Lots 82, 92, and 100) in the St. George neighborhood of Staten Island, New York (the Site). The Site location and layout are shown on Figures 1 and 2, respectively. The RIWP has been designed to further investigate and characterize the nature and extent of contamination previously identified on the Site. The scope of work includes investigation of subsurface soils, soil vapor and groundwater in areas where historic operations and/or historic filling potentially impacted the Site or surrounding areas. The results of the investigation will be used to prepare a Remedial Investigation Report (RIR) and qualitative human health exposure assessment (QHHEA) and to support the development of a Remedial Action Work Plan (RAWP). This RIWP has been prepared in accordance with the New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10, May 3, 2010).

1.1 Work Plan Organization

This RIWP includes an introduction (Section 1), background information (Section 2), scope of work (Section 3) and project schedule (Section 4). Quality assurance/quality control, health and safety (including community air monitoring), and project team information are addressed in separate appendices. Supporting tables and figures referenced throughout are included at the end of this RIWP.

1.2 Summary of Previous Investigations

In January 2014, Hydro Tech Environmental, Corp (Hydro Tech) prepared a Phase I Environmental Site Assessment (Phase I ESA) for the Site. Recognized Environmental Conditions (RECs) pertaining to onsite fill material and the suspect presence of heating oil tanks were identified in connection with the Site. Subsequent to the Phase I ESA, Hydro Tech performed a Phase II ESA at the Site in January 2014. The Phase II ESA indicated the presence of metals in exceedance of applicable standards in soil at the Site. In August 2018, a second Phase I ESA was performed for the Site by Environmental Business Consultants (EBC). The EBC Phase I ESA did not identify any RECs in connection with the Site, but did identify one environmental concern pertaining to the potential presence of onsite fill material and the presence of metals in exceedance of applicable standards identified in Hydro Tech's Phase II ESA. In May 2020, Tenen performed a Limited Due Diligence Site Investigation (LDDSI) at the Site. The LDDSI denoted the presence of constituent's characteristic of historic fill material in exceedance of applicable standards in soil at the Site. In addition, the LDDSI indicated the presence of tetrachloroethene (PCE), a chlorinated volatile organic compound (cVOC), and a variety of petroleum-related volatile organic compounds (VOCs) in soil vapor samples collected at the Site. Following the results of the LDDSI, a Phase II Environmental Site Investigation (ESI) was performed at the Site in February 2021 by Tenen. The Phase II ESI indicated the presence of various historic-fill related semivolatile organic compounds (SVOCs) and metals in exceedance of applicable standards in soil. In addition, the Phase II ESI confirmed the presence of PCE, and a variety of petroleum-related VOCs in soil vapor samples collected at the Site. All data from Tenen's 2020 LDDSI and 2021 Phase II ESI will be provided with a Data Usability Summary Report (DUSR) and Electronic Data Deliverables (EDDs). Copies of previous reports are included in Appendix A.

1.3 Regulatory Interaction

A Brownfield Cleanup Program (BCP) application was submitted for the Site in February 2021. Following a 30-day public comment period, a Brownfield Cleanup Agreement (BCA) was executed by the Volunteer and NYSDEC on July 22, 2021 (BCA Index No. C243045-06-21). The work to be performed under this RIWP, as well as, all future remedial work, will be performed in accordance with the requirements set forth in the BCA.

1.4 Work Plan Objectives

This RIWP has been developed to achieve the following BCP objectives:

- To define the nature and extent of contamination onsite;
- To identify if residual contaminant source areas are present on the Site;
- To determine if onsite impacts are migrating offsite;
- To determine whether remedial action is needed to protect human health and the environment; and
- To produce data of sufficient quantity and quality to prepare a Remedial Action Work Plan (including alternatives analysis) to support the remediation of the Site if it is determined that remedial action is needed.

2.0 BACKGROUND

This section includes a description of the Site and surrounding uses, a summary of the proposed Site development, Site characteristics, and information regarding historic operations and regulatory interactions. Summaries of previous Site investigations are also provided.

2.1 Site Description and Surrounding Uses

The Site is located at 178 and 194 Richmond Terrace and 8 Stuyvesant Place in the St. George neighborhood of Staten Island, New York in Staten Island Community Board 1. The Site is an irregularly shaped parcel, identified by the New York City Department of Finance as Block 13, Lots 82, 92, and 100 with an area of approximately 89,298 square feet (SF). Lots 82 and 92 are contiguous, and Lots 92 and 100 are separated by a strip of land identified by the New York City Department of Finance as a portion of Block 13, Lot 8. This portion of Lot 8 has been legally subdivided and is part of the redevelopment site; Lot 8 is not part of the BCP Site.

The Site is located on the northern corner of Stuyvesant Place and extends to the west side of Richmond Terrace. The Site is bounded by Richmond Terrace and residential buildings to the north, Hamilton Avenue to the south, Richmond Terrace and Stuyvesant Avenue to the east, and residential buildings and vacant land to the west. All three Site lots are zoned R6, a designation denoting a built-up, medium density residential area. In addition, all three Site lots have a C2-2 commercial overlay. The area surrounding the Site is predominantly commercial and residential.

Currently, the Site is vacant, heavily vegetated and contains remnants of building foundations associated with prior unfinished construction on the northern portion of the property. The building foundations were constructed in 2006.

2.2 Proposed Development

Proposed Site redevelopment consists of three, new, mixed-use multi-story buildings with full cellars (note that both northern buildings share a cellar) that encompass approximately 50,000-SF of the Site area (as shown on Figure 2). The cellar beneath the Building 1 (Site A) in the southern portion of the Site will extend to an elevation of 30 feet above the NAVD 88 and will require excavation between 15 and 50 ft-bg, due to the varying topography across the Site. The cellar beneath Buildings 2 and 3 (Site B) in the northern portion of the Site will extend to an elevation of ten feet above the 1988 North American Vertical Datum (NAVD 88) and will require excavation between 30 and 60 feet below grade (ft-bg), due to the varying topography across the Site. The entirety of the cellar of Buildings 2 and 3 and the majority of the Building 1 cellar will extend into bedrock. The proposed development will contain approximately 750 residential units, resident amenity spaces, commercial space, and parking. The development will be built in accordance with the City's Mandatory Inclusionary Housing rules, at least 30% of the residential units (225 units) are planned to be affordable housing.

2.3 Site Characteristics

<u>Site Topography</u>

Based on the U.S. Geological Survey (Jersey City-NY USGS 7.5 Minute Topographic Quadrangle) topographic map, the elevation at the Site ranges from approximately 90 feet above mean sea level (ft-msl) along the western Site boundary to 45 ft-msl along the eastern Site boundary. The Site is moderately sloped with the general topographic gradient downward to the east-northeast.

Site Geology and Hydrogeology
A Geotechnical Investigation was conducted at the Site in 2008 by SESI Consulting Engineers, PC (SESI) and identified the presence of fill material across the Site at depths ranging from five to 15 ft-bg. The fill material consists of brown, silty sand with little gravel and varying amounts of boulders, brick, wood, and other small amounts of debris. Beneath the fill layer, a red-brown to olive brown silty sand with little gravel layer was encountered. Some cobbles and fractured weathered rock were also evident in this layer, in particular, the occurrence of fractured rock increased with depth. The depth of this glacial till stratum ranges from 5 feet to greater than 45 ft-bg. Underlying the soils is Serpentinite bedrock, which is classified as massive or schistose, thoroughly sheared and broken by innumerable intersection zones of weak, friable and slippery material of low strength. In addition, Serpentinite is known to contain naturally occurring asbestiform minerals, to which occupational exposure is regulated by OSHA. Weathered rock and Serpentinite bedrock were encountered between approximately 17 feet and 45 ft-bg [Geotechnical Investigation Report, SESI, April 2008].

Groundwater at the Site is highly variable based on the season and is tidally influenced. Groundwater is slow to infiltrate when present and has been documented once during the above-referenced Geotechnical Investigation at 28 ft-bg. Groundwater is assumed to flow east towards the New York Bay. The New York Bay is the nearest surface water body and is located approximately 650 feet to the northeast.

2.4 Historic Operations

The Site was initially developed sometime prior to 1891 with several small structures, most likely residences. Multiple structures were developed and demolished between 1891 and 2005, all residences or garages. The last remaining residence was demolished circa 2005. The foundations present in the northern portion of the Site were constructed in 2006.

2.5 Previous Investigations

Previous assessments and investigations include a 2008 Geotechnical Investigation Report, a 2014 Phase I ESA, a 2014 Phase II ESA, a 2018 Phase I ESA, a 2020 LDDSI, and a 2021 Phase II ESI. The 2020 LDDSI and 2021 Phase II ESI were performed by Tenen; all other investigations were performed by others.

Copies of available environmental records and reports are included in their entirety, as received, in Appendix A. Findings and conclusions from reports prepared by others are summarized in the following sections and are not necessarily representative of Tenen's professional opinion.

2.5.1 Geotechnical Investigation Report for Liberty Towers – Site A and Site B, Richmond

Terrace, Staten Island, NY, SESI Consulting Engineers, PC, April 7, 2008.

A Geotechnical Investigation Report, dated April 7, 2008, was prepared by SESI Consulting Engineers, PC (SESI) for the Site. The Geotechnical Investigation identified the presence of a layer of fill material across the Site at thicknesses ranging from five to 15 ft-bg. Bedrock at the Site was detected at depths ranging from 17 to 45 ft-bg. Bedrock underlying the Site was identified as Serpentinite rock, which is known to contain naturally occurring asbestiform minerals.

2.5.2 Phase I Environmental Site Assessment Report, 178 Richmond Terrace and 24 Stuyvesant Place, Staten Island, NY, Hydro Tech Environmental, Corp, January 3, 2014.

A Phase I ESA, dated January 2014, was prepared by Hydro Tech for the Site. The following RECs were identified in connection with the Site:

- The presence of unknown fill materials; and,
- The suspect presence of heating oil tanks.

2.5.3 Phase II Environmental Site Assessment, 178 Richmond Terrace and 24 Stuyvesant Place, Staten Island, NY, Hydro Tech Environmental, Corp, January 21, 2014.

A Phase II ESA, dated January 2014, was prepared by Hydro tech for the Site to further investigate the RECs identified in their Phase I ESA. The scope of the Phase II ESA included a ground penetrating radar (GPR) survey across the Site, the installation of twelve soil borings across the Site, and the collection of twelve soil samples. All soil samples were analyzed for VOCs, SVOCs, and target analyte list (TAL) metals.

No anomalies indicative of underground storage tanks (USTs) were detected as part of the GPR survey. One metal, selenium, was detected in all twelve soil samples at concentrations exceeding Unrestricted Use Soil Cleanup Objectives (SCOs), but below Restricted-Residential Use SCOs; lead was detected in two soil samples at concentrations exceeding Unrestricted Use SCOs, but below Restricted-Residential Use SCOs; and, mercury was detected in one soil sample in exceedance of its Unrestricted Use and Restricted-Residential Use SCOs. Selenium was detected at a max. concentration of 15.5 milligrams per kilogram (mg/kg); lead was detected at a max. concentration of 99.7 mg/kg; and mercury was detected at a max. concentration of 2.41 mg/kg. VOCs and SVOCs were not detected in exceedance of Unrestricted Use or Restricted-Residential Use SCOs in any soil samples.

2.5.4 Phase I Environmental Site Assessment Report, 170-194 Richmond Terrace and 8-20 Stuyvesant Place, Staten Island, NY, Environmental Business Consultants, August 29, 2018.

A second Phase I ESA, dated August 2018, was prepared by EBC for the Site. EBC did not identify any RECs in association with the Site. However, EBC did identify the following environmental concern:

- Information obtained from various historic sources indicated that the northern and southern portions of the subject property were developed with multiple residences from at least the

1890s. The majority of the residences were demolished in the 1960s and 1970s, with the final building demolished in 2005. As such, there was potential for fill materials to be present (utilized to backfill the foundations and/or basements of the former structures following their demolition). The presence of fill materials was evaluated by Hydro Tech in 2014 as part of a Phase II ESA. No evidence of fill material was identified during the investigation; however, several soil samples contained lead, mercury, and/or selenium at concentrations slightly above applicable regulatory criteria. The presence of these metals alone does not indicate evidence of significant contamination nor do they warrant further investigation/remediation.

2.5.5 *Limited Due Diligence Site Investigation Report, 170-194 Richmond Terrace and 8-20 Stuyvesant Place, Staten Island, NY,* Tenen Environmental, LLC, May 4, 2020.

A LDDSI, dated May 2020, was prepared by Tenen to further evaluate soil in areas of the Site which were not previously investigated and to evaluate soil vapor across the Site which was also not previously investigated. The scope of the LDDSI included the installation of eight soil borings across the Site, the collection of eight soil samples, the installation of six temporary soil vapor points across the Site, the collection of six soil vapor samples, and the installation of one temporary groundwater monitoring well. All soil samples were analyzed for VOCs, SVOCs, and TAL metals and all soil vapor samples were analyzed for VOCs.

The results of the soil sampling conducted as part of the LDDSI indicated the presence of several SVOCs, specifically polycyclic aromatic hydrocarbons (PAHs), in exceedance of Restricted-Residential Use SCOs in one soil sample. Benzo(a)anthracene was detected at a concentration of 2.1 mg/kg; benzo(a)pyrene was detected at a concentration of 1.2 mg/kg; benzo(b)fluoranthene was detected at a concentration of 1.6 mg/kg; and indeno(1,2,3-cd)pyrene was detected at a concentration of 0.76 mg/kg. In addition, various metals were detected in six of eight soil samples at concentrations exceeding Restricted-Residential Use SCOs. Arsenic was detected at a max. concentration of 19.9 mg/kg; barium was detected at a max. concentration of 508 mg/kg; lead was detected at a max. concentration of 2,430 mg/kg; mercury was detected at a max. concentration of 2.07 mg/kg; and nickel was detected at a max. concentration of 753 mg/kg. VOCs were not detected in exceedance of Restricted-Residential Use SCOs in any soil samples.

The results of the soil vapor sampling conducted as part of the LDDSI indicated the presence of one cVOC, PCE, in all six soil vapor samples at concentrations ranging from 11.9 micrograms per cubic meter (ug/m^3) to 86.1 ug/m^3. No other cVOCs were detected in soil vapor samples. Several petroleum-related VOCs were also detected in soil vapor samples across the Site, including the following: benzene [max: 6.07 ug/m^3], toluene [max: 46.7 ug/m^3], ethylbenzene [max: 40.7 ug/m^3], p/m-xylene [max: 160 ug/m^3], o-xylene [max: 236 ug/m^3], 1,2,4-trimethylbenzene [max: 362 ug/m^3], 1,3,5-trimethylbenzene [max: 147 ug/m^3], and 2,2,4-trimethylpentane [max: 2,110 ug/m^3].

Groundwater was not encountered during the LDDSI.

2.5.6 *Phase II Environmental Site Investigation Report, 170-194 Richmond Terrace and 8-20 Stuyvesant Place, Staten Island, NY,* Tenen Environmental, LLC, February 2021.

A Phase II ESI, dated February 2021, was prepared by Tenen to further assess impacts pertaining to chemicals of concern identified in soil and soil vapor at the Site, as well as to investigate the groundwater quality, if present. The scope of the Phase II ESI included the installation of eleven soil borings across the Site, the collection of eleven shallow soil samples from the historic fill layer and eleven deep soil samples from proposed development depth (two foot interval above weathered bedrock), the installation of nine temporary soil vapor points across the Site, and the collection of nine soil vapor samples. All soil samples were analyzed for VOCs, SVOCs, TAL metals, pesticides, herbicides, polychlorinated biphenyls (PCBs) and two shallow soil samples (one from each proposed cellar footprint) were analyzed for per- and polyfluoroalkyl substances (PFAS). All soil vapor samples were analyzed for VOCs.

The results of the soil sampling conducted as part of the Phase II ESI indicated the presence of several SVOCs, specifically PAHs, in exceedance of Restricted-Residential Use SCOs in one shallow soil sample. Benzo(a)anthracene was detected at a concentration of 1.5 mg/kg; benzo(a)pyrene was detected at a concentration of 1.8 mg/kg; benzo(b)fluoranthene was detected at a concentration of 2.3 mg/kg; and indeno(1,2,3-cd)pyrene was detected at a concentration of 1.3 mg/kg. In addition, various metals were detected in nine of eleven shallow soil samples and five of eleven deep soil samples at concentrations exceeding Restricted-Residential Use SCOs. Arsenic was detected at a max. concentration of 17.4 mg/kg; lead was detected at a max. concentration of 1,420 mg/kg; mercury was detected at a max. concentration of 0.81 mg/kg; and nickel was detected at a max. concentration of 310 mg/kg. VOCs, pesticides, herbicides, PCBs, and PFAS were not detected in exceedance of Restricted-Residential Use SCOs in any soil samples.

The results of the soil vapor sampling conducted as part of the Phase II ESI indicated the presence of cVOCs in one or more soil vapor samples. PCE was detected in six of nine soil vapor samples at concentrations ranging from 1.89 ug/m^3 to 2.99 ug/m^3; 1,1,1-trichloroethane (1,1,1-TCA) was detected in one soil vapor sample at a concentration of 1.3 ug/m^3; and chloroform was detected in five of nine soil vapor samples at concentrations ranging from 1.01 ug/m^3 to 3.64 ug/m^3. No other cVOCs were detected in any soil vapor samples. Several petroleum-related VOCs were also detected in soil vapor samples across the Site, including the following: benzene [max: 21.3 ug/m^3], toluene [max: 897 ug/m^3], ethylbenzene [max: 203 ug/m^3], p/m-xylene [max: 634 ug/m^3], o-xylene [max: 175 ug/m^3], 1,2,4-trimethylbenzene [max: 98.3 ug/m^3], 1,3,5-trimethylbenzene [max: 26.2 ug/m^3], and 2,2,4-trimethylpentane [max: 35.7 ug/m^3]. In general, the highest concentrations of petroleum-related VOCs were detected in soil vapor samples collected from the northern portion of Lot 82.

Groundwater was not encountered during the Phase II ESI.

2.6 Summary of Previous Investigations

Based on investigations conducted to date at the Site, the primary contaminants of concern for the Site include SVOCs (PAHs) and metals (arsenic, barium, lead, mercury, and nickel)[1].

Several SVOCs, specifically PAHs, were detected in shallow soil samples collected during the

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[1] A DUSR and EDDs will be provided for data collected during the 2020 LDDSI and 2021 Phase II ESI.

2020 LDDSI and 2021 Phase II ESI in exceedance of Restricted-Residential Use SCOs. In addition, metals, specifically arsenic, barium, lead, mercury, and nickel have been detected in shallow and deep soil across the Site in exceedance of Restricted-Residential Use SCOs.

Soil vapor sampling results indicate the presence of the cVOC, PCE, at low concentrations in soil vapor across the Site. In addition, a variety of petroleum-related VOCs, including benzene, toluene, ethylbenzene, p/m-xylene, o-xylene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, and 2,2,4-trimethylpentane, were detected in soil vapor across the Site, with the highest concentrations generally occurring in soil vapor samples collected from the northern portion of Lot 82. The presence of cVOCs and petroleum may be related to historic uses, particularly residential garages that were located on the Site. Given the limited, seasonal groundwater present at the Site, meaningful transport of contaminants from the Site to offsite surrounding areas is not anticipated.

Analytical results in excess of applicable standards for soil and soil vapor samples are depicted on Figures 3 through 5.

3.0 REMEDIAL INVESTIGATION

The Remedial Investigation (RI) proposed for the Site includes sampling of soil, soil vapor, and groundwater (if present). The objectives of this RI are to define the nature and extent of contamination onsite; to determine if onsite contamination is migrating offsite; and to provide data of sufficient quantity and quality to support development of a Remedial Investigation Report (RIR), Qualitative Human Health Exposure Assessment (QHHEA) and Remedial Action Alternatives Analysis.

This RIWP was developed to meet the following Site-specific objectives:

- Confirm prior investigation results;
- Define the nature and extent of the historic fill material present onsite;
- Identify the extent of onsite soil vapor impacts and the potential for contaminants in soil vapor to migrate offsite;
- Evaluate potential sources of contamination, the migration pathways, and actual or potential receptors of contaminants on or through soil, groundwater and soil vapor;
- Evaluate potential onsite impacts to groundwater;
- Assess potential impacts to human health as a result of the release of contaminants at the Site.

3.1 Scope of Remedial Investigation

The scoping process, for the purpose of identifying and defining the RI tasks described below, included the following:

- Review of current and historic site reports and data;
- Evaluation of DER-10 requirements and relevant State and Federal guidance documents.

The RI will begin after NYSDEC approval of this RIWP and after the 30-day public comment period is satisfied. The RI will include the collection of 90 samples from 45 soil borings, collection of one groundwater sample (if present) from an existing temporary monitoring well, installation of 16 soil vapor points and collection of 16 soil vapor samples, and collection of one ambient air sample from an upgradient, onsite location. Note that if groundwater is observed in soil borings, a temporary groundwater well will be installed and a groundwater sample will be collected. Groundwater analysis will be based on the volume of water recovered and will at a minimum include TCL VOCs.

The type, location, and rationale for each exploration are detailed in the sections below and in summary table included in Section 3.6.

Installation of soil borings, groundwater monitoring wells, and soil vapor and air sampling points will be completed in accordance with the sections below and the standard procedures included in the Quality Assurance Project Plan (QAPP) and Health and Safety Plan (HASP), included as Appendix B and C, respectively. Following the collection of this data, review and evaluation will be performed in order to determine if additional investigation is needed.

Proposed RI sample locations are shown on Figures 5 and 6.

3.2 Soil Sampling

A subsurface investigation will be performed to further characterize soil conditions onsite and to vertically delineate documented historic fill-related impacts onsite.

The following scope of work will be implemented:

- Advance 22 soil borings within the proposed cellar footprints to bedrock to assess historic fill and native soil conditions at the Site;
- Advance 17 soil borings within proposed landscaping portions of the Site to four ft-bg to assess shallow soil conditions at the Site;
- Advance six soil borings onsite to vertically delineate the extent of historic-fill related impacts identified in the 2020 LDDSI and 2021 Phase II ESI. Borings will be advanced proximal to LDDSI soil borings SB-2 and SB-6 and Phase II ESI soil borings SB-8, SB-10, SB-13, and SB-14;
- Within each boring advanced within the proposed cellar footprints, soil samples from the following intervals will be collected: the two-foot interval of historic fill material above the first apparent native layer encountered and the two-foot interval above weathered bedrock or bedrock, whichever is encountered first. If evidence of contamination is observed (PID readings, visual or olfactory), an additional sample will be collected from the two-foot interval of highest suspected contamination. If groundwater is encountered in the boring, an additional sample will be collected from the two-foot interval above the groundwater interface;
- Within each boring advanced within the proposed landscaping areas, soil samples from each of the following intervals will be collected and analyzed: from grade to two ft-bg and from two to four ft-bg;
- Within each delineation boring advanced across the Site, soil samples from each of the following intervals will be collected and analyzed: the two-foot interval directly below the sampling interval that did not meet Restricted-Residential Use SCOs in the nearest LDDSI or Phase II ESI soil boring, and the two-foot interval directly below that sampling interval. The deeper interval sample will be placed on hold to await the results of analysis of the preceding sampling interval. If the preceding sampling interval contains concentrations of analytes in exceedance of Restricted-Residential Use SCOs, the hold sample will be analyzed for those analytes only.
- Analyze all samples (excluding hold samples) for full scan Part 375 SCOs, 1,4-dioxane, and per- and polyfluoroalkyl substances (PFAS).

3.2.1 Soil Sampling Methodology

A total of 45 soil borings will be advanced as part of this RI; proposed soil sample locations are shown in Figure 5. Based on field measurements and observations, boring locations may be moved or added. Prior to modifications being made with regard to the above-described placement, coordination with NYSDEC will take place.

All soil borings will be installed using a direct-push track-mounted Geoprobe® unit. Any soil borings that are inaccessible to Geoprobe® due to Site topography will be advanced with a hand auger. Borings advanced within the proposed cellar footprints will be advanced to weathered bedrock or bedrock, whichever is encountered first. Borings advanced within the proposed landscaping portions of the Site will be advanced to a depth of four ft-bg. Delineation borings will be advanced to various depths depending on previous sampling results. Soil samples will be collected from five-foot macrocores fitted with dedicated acetate liners.

At each location, the liners for each interval will be opened and the soil screened for VOCs using a 10.6 electron-volt (EV) photoionization detector (PID). The soil retrieved from each sampler will be described by Tenen field staff on boring logs using the Unified Soil Classification System. All observations regarding potential contamination such as odors, staining, etc. will be documented. Soil will be screened from grade to the terminal depth of each boring. If evidence of contamination (e.g., elevated PID readings, odor) or staining is observed, the soil boring will be extended, to the extent possible based on the equipment, to delineate the vertical extent of contamination. All descriptions and observations will be documented in a field logbook.

For each soil boring advanced within the proposed cellar footprints, soil samples will be collected from the two-foot interval of historic fill material above the first apparent native layer encountered and the two-foot interval above weathered bedrock or bedrock, whichever is encountered first. If soil screening results in elevated PID readings outside of these intervals, samples will also be collected from the zone of highest PID readings. If groundwater is encountered in the boring, an additional sample will be collected from the two-foot interval above the groundwater interface.

For each soil boring advanced within the proposed landscaping portions of the Site, soil samples will be collected from grade to two ft-bg and from two to four ft-bg.

For each soil delineation boring, soil samples will be collected from the two-foot interval directly below the sampling interval that did not meet Restricted-Residential Use SCOs in the nearest LDDSI or Phase II ESI soil boring, and the two-foot interval below the first sampling interval, to be placed on hold to await the results of analysis of the preceding sampling interval. If the preceding sampling interval contains concentrations of analytes in exceedance of Restricted-Residential Use SCOs, the hold sample will be analyzed for those any analytes only.

Soil samples selected for laboratory analysis will be collected directly from the acetate liner or composite sample, placed in pre-cleaned, pre-preserved laboratory-provided sample bottles or En Core samplers (En Novative Technologies), sealed and labeled, and placed in a cooler and chilled to 4ºC for transport under chain-of custody procedures. Soil samples will be submitted to a New York State Department of Health (NYSDOH) ELAP-certified laboratory via courier service and analyzed for the respective analyte lists included in 6 NYCRR Part 375 SCOs. Laboratory analytical parameters and methods are outlined below. QA/QC procedures to be followed are described in the QAPP included as Appendix B.

All soil samples will be analyzed for the following analytes on the Part 375 list with a Category B deliverable package:

- Target Compound List (TCL) VOCs by EPA Method 8260C;
- TCL SVOCs by EPA Method 8270D;
- Pesticides by EPA Method 8081B;
- Herbicides by EPA Method 8151A;
- Polychlorinated Biphenyls (PCBs) by EPA Method 8082A;
- Target Analyte List (TAL) Metals by EPA Method 6010C/7471B;
- Total Cyanide by EPA Method 9010C;
- Trivalent and Hexavalent Chromium by EPA Method 3060A;
- PFAS by USEPA Method 537 Modified; and
- 1,4-Dioxane by USEPA Method 8270.

A summary table of proposed soil samples and sampling rationale is included in Section 3.6 of this Work Plan.

3.3 Soil Vapor Sampling

The following scope of work is proposed to investigate potential onsite impacts to soil vapor and the potential for contaminants in soil vapor to migrate offsite.

The following scope of work will be implemented:

- Install 16 soil vapor sample points to approximately three ft-bg around the perimeter of the Site to assess onsite soil vapor conditions and the potential for contaminants to migrate offsite;
- One ambient air sample will be collected for each soil vapor sampling event; and,
- Analyze soil vapor and ambient air samples for TO-15 VOCs.

3.3.1 Soil Vapor Sampling Methodology

A total of 16 soil vapor samples and one ambient air sample will be collected as part of this RI. Samples will be collected in accordance with the NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York (Soil Vapor Guidance, October 2006 with updates). All 16 soil vapor samples will be collected from the perimeter of the Site. Soil vapor samples within the proposed building footprints were collected during previous investigations and are not proposed as part of this investigation due to excavation extending into bedrock at both cellar locations.

A Geoprobe® direct push machine will be used to install the soil vapor sampling probes. At locations that are inaccessible by the drill rig due to Site topography, the soil vapor sample probes will be installed with hand tools. At each soil vapor sampling location, a disposable sampling probe consisting of a 1.5-inch long hardened point and a 6-inch long perforated vapor intake will be installed to a depth of three ft-bg.

At the terminal depth of soil vapor locations, the sample probe will be attached to ¼-inch diameter Teflon® tubing and extended to the surface. The borehole above the sampling probe to grade will be sealed using an inert sealant to prevent ambient air mixing with the soil vapor. Ambient air will be purged from the boring hole by attaching the surface end of the ¼-inch diameter Teflon® tube to an air valve and then to a vacuum pump. The vacuum pump will remove three volumes of air (volume of the sample probe and tube) prior to sample collection. The flow rate for both purging and sample collection will not exceed 0.2 liters per minute.

The soil vapor samples will be first screened for VOCs using a PID. A tracer gas (helium) will be used in accordance with the NYSDOH protocols to verify the integrity of the soil vapor probe seal. Helium will be used as the tracer gas and a bucket 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 gas, the probe seals will be adjusted to prevent infiltration.

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

Soil vapor samples will be collected in laboratory-supplied 2.7-liter Summa canisters using two-hour regulators. All samples will be sealed, labeled, and placed in a secure container for delivery to a NYSDOH ELAP-certified analytical laboratory. All soil vapor samples will be analyzed for EPA Method TO-15 VOCs.

3.3.2 Ambient Air Sampling Methodology

All samples will be collected in accordance with the NYSDOH Soil Vapor Guidance. Sample locations may be adjusted based on field observations or conditions.

The ambient air sample will be collected from breathing height (three to five feet above the floor) in a secure, upgradient direction. The sampling flow rate will not exceed 0.2 liters per minute (L/min). Sampling will occur for a duration of 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.

Samples will be collected in laboratory-supplied 6-liter Summa canisters using eight-hour regulators and will be sealed, labeled, and placed in a secure container for delivery to a NYSDOH ELAP-certified analytical laboratory. All samples will be analyzed for EPA Method TO-15 VOCs.

A summary table of proposed soil vapor samples and sampling rationale is included in Section 3.6 of this Work Plan. Proposed RI sample locations are shown on Figure 6.

3.4 Groundwater Sampling

The following scope of work is proposed to further characterize groundwater onsite:

- Gauge and collect a groundwater sample from one existing groundwater monitoring well (TMW-1) installed by Tenen during the 2020 LDDSI if water is present (the well has been historically dry to date since installation). This well was installed in the area where bedrock is present at the lowest elevation onsite; and,
- Groundwater samples will be analyzed for Part 375 VOCs, SVOCs, pesticides, herbicides, PCBs, total and dissolved metals, cyanide, trivalent and hexavalent chromium, 1,4-dioxane, and PFAS based upon volume recovery with a bias toward VOC analysis.

The location of groundwater monitoring well TMW-1 is shown on Figure 5. Note that if groundwater is observed in soil borings, a temporary groundwater well will be installed and a groundwater sample will be collected.

3.4.1 Groundwater Well Sampling

One previously installed temporary monitoring well (TMW-1) will be sampled if water is present. The one-inch diameter temporary groundwater monitoring well was installed as part of Tenen's 2020 LDDSI. All sampling equipment will be decontaminated prior to use. Prior to sampling, water levels will be measured using an electronic product-water level indicator. Sample collection will be accomplished by using low-flow procedures. Samples will not be collected until pH, temperature, and conductivity measurements stabilize and the turbidity reading is 50 Nephelometric Turbidity Units (NTU) or less, or stabilizes above 50 NTU.

Samples will be collected using low-flow techniques in accordance with EPA Region 1 Low-Stress (Low-Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells. (EQASOP-GW 001 Revision 3 dated July 30, 1996 Revised: January 19, 2010). All groundwater samples (subject to recovery) will be analyzed for the following analytes on the Part 375 list and emerging contaminants with a Category B deliverable package:

- TCL VOCs by EPA Method 8260C;
- TCL SVOCs by EPA Method 8270D;
- Pesticides by EPA Method 8081B;
- Herbicides by EPA Method 8151A;
- PCBs by EPA Method 8082A;
- Total and Dissolved TAL Metals by EPA Method 6010C/7471B;
- Total and Dissolved Cyanide by EPA Method 9010C; and
- Total and Dissolved Trivalent and Hexavalent Chromium by EPA Method 3060A;
- 1,4-Dioxane by EPA Method 8270D-SIM Modified; and
- PFAS by EPA Method 537.

Emerging contaminants (e.g., PFAS and 1,4-Dioxane) will be sampled in accordance with the current NYSDEC guidance, *Guidelines for Sampling and Analysis of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs* (January 2021).

3.5 Quality Assurance / Quality Control (QA/QC)

Samples will be collected in accordance with the Quality Assurance Project Plan (QAPP) included as Appendix B.

Sample analysis will be performed by a NYSDOH ELAP-certified laboratory. The laboratory will report sample results on a 5-day turn-around time. An independent sub-consultant will validate sample results and prepare a Data Usability Summary Report (DUSR).

3.6 Summary Table of Proposed Sampling Locations

As required by Section 3.3(b) 3 of DER-10, below is a table describing all proposed sampling locations and QA/QC samples.

Proposed Sampling Locations and Analysis

Soil

Sample Location	Media	Sampling Intervals	Analytical Parameters	Sampling Method / Minimum Reporting Levels	Rationale
SB-2	Soil	From the two-foot interval directly below the sampling interval that did not meet Restricted-Residential Use SCOs in the nearest LDDSI or Phase II ESI soil boring, and the two-foot interval directly below the preceding sampling interval	Part 375 Analytes, PFAS, and 1,4-Dioxane from all samples	EPA 537 Modified / MDL less than 1 ug/kg for PFAS; EPA 8270 / MDL less than 0.1 mg/kg for 1,4-Dioxane; EPA 8260C, 8270D, 8081B, 8082A, 8151A, 7196A, 3050B, 7471B, 9010C/9012B/9014 and 3060A/7196 / MDL less than Unrestricted Use SCOs	Vertical delineation of known historic fill-related impacts
SB-6					
SB-8					
SB-10					
SB-13					
SB-14					

Sample Location	Media	Sampling Intervals	Analytical Parameters	Sampling Method / Minimum Reporting Levels	Rationale
SB-18	Soil	From the two-foot interval of historic fill material above the first apparent native layer encountered and the two-foot interval above weathered bedrock or bedrock, whichever is encountered first; from the zone of highest suspected contamination, if encountered; and, from the two-foot interval above the groundwater interface, if groundwater is encountered	Part 375 Analytes, PFAS, and 1,4-Dioxane from all samples	EPA 537 Modified / MDL less than 1 ug/kg for PFAS; EPA 8270 / MDL less than 0.1 mg/kg for 1,4-Dioxane; EPA 8260C, 8270D, 8081B, 8082A, 8151A, 7196A, 3050B, 7471B, 9010C/9012B/9014 and 3060A/7196 / MDL less than Unrestricted Use SCOs	Assess onsite soil conditions within the proposed cellar footprints
SB-19					
SB-20					
SB-21					
SB-22					
SB-23					
SB-24					
SB-25					
SB-26					
SB-27					
SB-28					

Sample Location	Media	Sampling Intervals	Analytical Parameters	Sampling Method / Minimum Reporting Levels	Rationale
SB-29	Soil	From the two-foot interval of historic fill material above the first apparent native layer encountered and the two-foot interval above weathered bedrock or bedrock, whichever is encountered first; from the zone of highest suspected contamination, if encountered; and, from the two-foot interval above the groundwater interface, if groundwater is encountered	Part 375 Analytes, PFAS, and 1,4-Dioxane from all samples	EPA 537 Modified / MDL less than 1 ug/kg for PFAS; EPA 8270 / MDL less than 0.1 mg/kg for 1,4-Dioxane; EPA 8260C, 8270D, 8081B, 8082A, 8151A, 7196A, 3050B, 7471B, 9010C/9012B/9014 and 3060A/7196 / MDL less than Unrestricted Use SCOs	Assess onsite soil conditions within the proposed cellar footprints
SB-30					
SB-31					
SB-32					
SB-33					
SB-34					
SB-35					
SB-36					
SB-37					
SB-38					
SB-39					

Sample Location	Media	Sampling Intervals	Analytical Parameters	Sampling Method / Minimum Reporting Levels	Rationale
SB-40	Soil	From grade to two ft-bg and from two to four ft-bg	Part 375 Analytes, PFAS, and 1,4-Dioxane from all samples	EPA 537 Modified / MDL less than 1 ug/kg for PFAS; EPA 8270 / MDL less than 0.1 mg/kg for 1,4-Dioxane; EPA 8260C, 8270D, 8081B, 8082A, 8151A, 7196A, 3050B, 7471B, 9010C/9012B/9014 and 3060A/7196 / MDL less than Unrestricted Use SCOs	Assess shallow onsite soil conditions within the proposed landscaping portions of the Site
SB-41					
SB-42					
SB-43					
SB-44					

Sample Location	Media	Sampling Intervals	Analytical Parameters	Sampling Method / Minimum Reporting Levels	Rationale
SB-45	Soil	From grade to two ft-bg and from two to four ft-bg	Part 375 Analytes, PFAS, and 1,4-Dioxane from all samples	EPA 537 Modified / MDL less than 1 ug/kg for PFAS; EPA 8270 / MDL less than 0.1 mg/kg for 1,4-Dioxane; EPA 8260C, 8270D, 8081B, 8082A, 8151A, 7196A, 3050B, 7471B, 9010C/9012B/9014 and 3060A/7196 / MDL less than Unrestricted Use SCOs	Assess shallow onsite soil conditions within the proposed landscaping portions of the Site
SB-46					
SB-47					
SB-48					
SB-49					

Sample Location	Media	Sampling Intervals	Analytical Parameters	Sampling Method / Minimum Reporting Levels	Rationale
SB-50	Soil	From grade to two ft-bg and from two to four ft-bg	Part 375 Analytes, PFAS, and 1,4-Dioxane from all samples	EPA 537 Modified / MDL less than 1 ug/kg for PFAS; EPA 8270 / MDL less than 0.1 mg/kg for 1,4-Dioxane; EPA 8260C, 8270D, 8081B, 8082A, 8151A, 7196A, 3050B, 7471B, 9010C/9012B/9014 and 3060A/7196 / MDL less than Unrestricted Use SCOs	Assess shallow onsite soil conditions within the proposed landscaping portions of the Site
SB-51					
SB-52					
SB-53					
SB-54					

Sample Location	Media	Sampling Intervals	Analytical Parameters	Sampling Method / Minimum Reporting Levels	Rationale
SB-55	Soil	From grade to two ft-bg and from two to four ft-bg	Part 375 Analytes, PFAS, and 1,4-Dioxane from all samples	EPA 537 Modified / MDL less than 1 ug/kg for PFAS; EPA 8270 / MDL less than 0.1 mg/kg for 1,4-Dioxane; EPA 8260C, 8270D, 8081B, 8082A, 8151A, 7196A, 3050B, 7471B, 9010C/9012B/9014 and 3060A/7196 / MDL less than Unrestricted Use SCOs	Assess shallow onsite soil conditions within the proposed landscaping portions of the Site
SB-56					

Groundwater

Sample Location	Media	Sampling Intervals	Analytical Parameters	Sampling Method / Minimum Reporting Levels	Rationale
TMW-1	Groundwater	Screened above bedrock (15-25 ft-bg)	Part 375 analytes including total and dissolved metals; 1,4-dioxane; PFAS	EPA 8260C, 8270D, 8270D-SIM Modified, 8081B, 8151A, 7196A, 3050B, 7471B, 9010C/9012B/9014, 3060A/7196 and 537 / MDL less than Class GA Standards for Part 375 analytes; MDL less than 0.28 ug/L for 1,4-dioxane; MDL less than 2 nanograms per liter (ng/L) for PFAS	Investigate seasonal groundwater conditions onsite

Soil Vapor

Sample Location	Media	Sampling Intervals	Analytical Parameters	Sampling Method / Minimum Reporting Levels	Rationale
SV-16	Soil Vapor	3 ft-bg	TO-15 VOCs	EPA TO-15 / MDL less than 1.00 ug/m3	Assess soil vapor conditions along the Site perimeter and the potential for offsite migration of contaminants, if present
SV-17					
SV-18					
SV-19					
SV-20					
SV-21					
SV-22					
SV-23					
SV-24					
SV-25					
SV-26					
SV-27					
SV-28					
SV-29					
SV-30					
SV-31					
AA-1	Ambient Air	Breathing height (3-5 feet above floor/surface)			Assess ambient air conditions onsite

Quality Assurance / Quality Control

Sample Location	Media	Sampling Intervals	Analytical Parameters	Rationale
Trip Blanks	QA / QC	--	Part 375 analytes and/or 1,4-dioxane and PFAS, as necessary	Quality assurance and quality control
Soil Duplicate				
Soil Blank				
Soil MS/MSD				
Groundwater Duplicate				
Groundwater Blank				
Groundwater MS/MSD				

MDL – Method Detection Limit
Reporting limits are laboratory- and sampling event-specific. The overall objective is to ensure that the minimum reporting levels are such that they can be used to evaluate potential sources, assess risk from detected compounds, and compare detected concentrations against applicable regulatory levels.

3.7 Qualitative Exposure Assessment

Following receipt of the sample results, a QHHEA will be completed in accordance with Section 3.3(c)4 and Appendix B (NYSDOH guidance for preparing a qualitative human health exposure assessment) of DER-10. The QHHEA will utilize the results of the RI to evaluate and document potential exposure routes and identify and characterize potential current and future receptors. The results of the RI will be used to identify potential human exposure scenarios associated with contaminants in sub-slab soil vapor, indoor air, soil, and groundwater. The results of the QHHEA will be included in the RIR.

3.8 Health and Safety Plan (HASP)

All work at the Site will be completed in accordance with the Health and Safety Plan (HASP) included in Appendix C.

3.9 Air Monitoring

The NYSDOH Generic Community Air Monitoring Plan (CAMP), included as Appendix 1A of DER-10 and Appendix D of this Work Plan, will be implemented during all ground-intrusive sampling activities.

Daily CAMP reports will be sent to the NYSDOH and NYSDEC Project Manager via email. Daily reports will include a Site figure depicting Work Zones; activities; wind direction, in addition to CAMP monitor readings and CAMP station locations. Any exceedances of CAMP readings and corrective actions taken will be communicated to the NYSDEC and the NYSDOH Project Managers on the day of occurrence.

3.10 Investigation-Derived Waste (IDW)

Following the completion of sampling, boreholes will be backfilled with clean cuttings or sand. If grossly-contaminated soil cuttings are encountered or if excess soil cuttings are generated, they will be placed in 55-gallon drums. Purge water and other investigation-derived waste (IDW) will be containerized in 55-gallon drums. After the investigation is complete, the drum contents will be characterized for offsite disposal.

3.11 Reporting

A RIR will be prepared in accordance with the requirements of DER-10. The report will include details of the sampling, tabulated sample results and an assessment of the data and conclusions. If warranted, recommendations for additional actions will be included.

Soil sample results will be compared to the Unrestricted Use SCOs and Restricted-Residential Use SCOs as included in Part 375-6.8. Groundwater sample results will be compared to the Class GA Standards. Soil vapor samples will be compared to ambient air concentrations and be used in conjunction with soil and groundwater data to determine the need for additional investigation.

The report will also include the qualitative exposure assessment, CAMP results, laboratory data packages, DUSR, geologic logs, well construction diagrams and well purging/sampling logs. All data will also be submitted electronically to NYSDEC via the Environmental Information Management System (EIMS) in EqUIS format.

4.0 SCHEDULE

Project activities (Tasks 1-3) will be completed within approximately eight weeks after RIWP approval by NYSDEC. The following project schedule has been developed:

Work Plan Implementation Schedule

Task Number	Task	Estimated Task Duration (business days)	Total Duration (business days)
0	Work Plan Approval	0	0
1	Mobilization	25	25
2	Soil Vapor Point Installation / Soil Sampling	10	35
3	Groundwater and Soil Vapor Sampling	1	36
4	Laboratory Analysis	15	51
5	Draft Report and Data Validation	30	81

5.0 REFERENCES

Geotechnical Investigation Report, Liberty Towers – Site A and Site B, Staten Island, NY, SESI Consulting Engineers, PC, April 7, 2008.

Limited Due Diligence Site Investigation Report, 170-194 Richmond Terrace and 8-20 Stuyvesant Place, Staten Island, NY 10301, Tenen Environmental, LLC, May 4, 2020.

New York State Department of Environmental Conservation, Division of Environmental Remediation. DER Technical Guidance for Site Investigation and Remediation (DER-10). NYSDEC 2010.

New York State Department of Environmental Conservation DEC Policy. Commissioner's Policy 51 – Soil Cleanup Guidance. October 21, 2010. NYSDEC 2010.

New York State Department of Environmental Conservation. Guidelines for Sampling and Analysis of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs. January 2021. NYSDEC 2020.

New York State Department of Health. Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH, October 2006 with revisions).

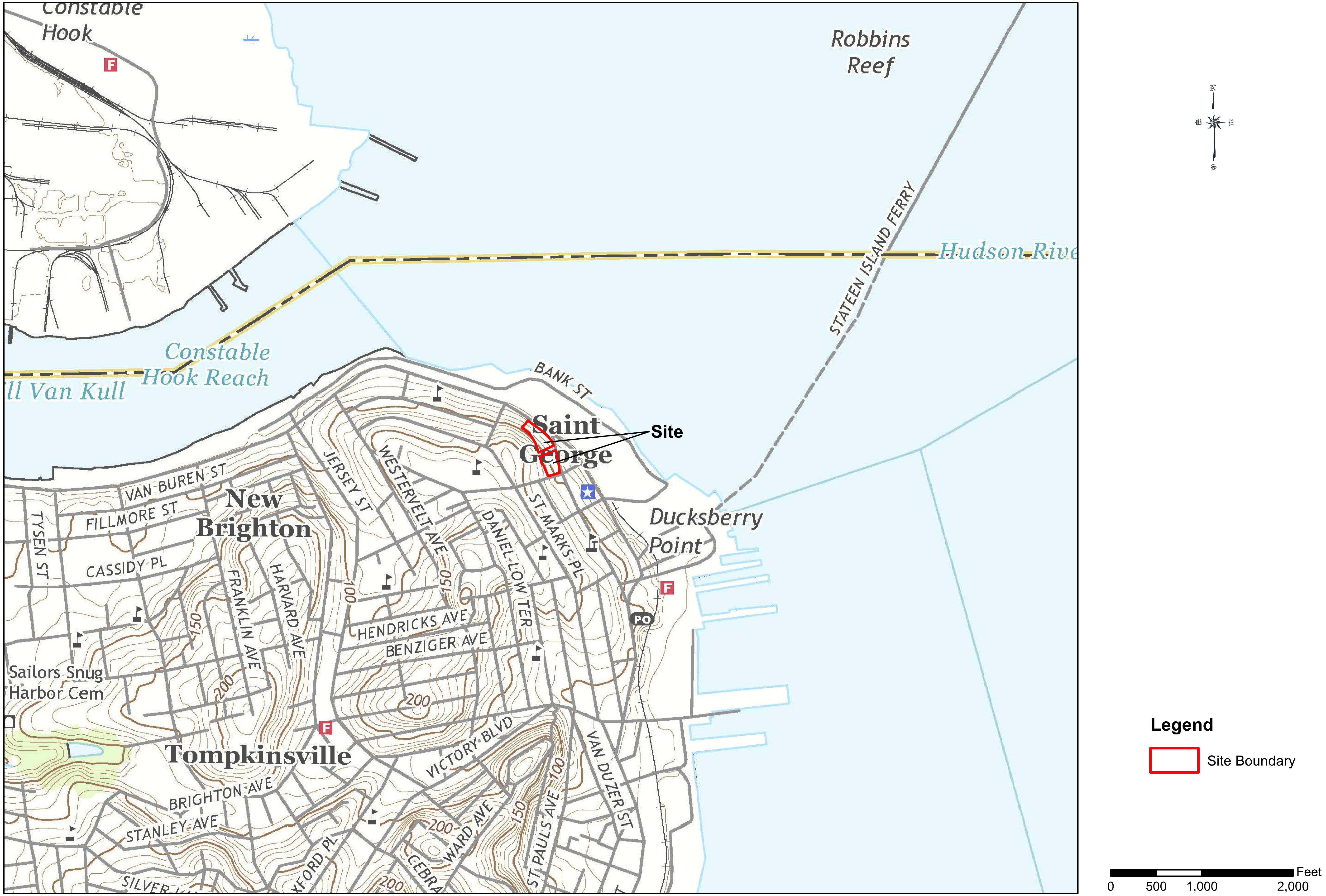
Phase I Environmental Site Assessment Report, 178 Richmond Terrace and 24 Stuyvesant Place, Staten Island, NY, Hydro Tech Environmental, Corp., January 3, 2014.

Phase I Environmental Site Assessment, 170-194 Richmond Terrace and 8-20 Stuyvesant Place, Staten Island, NY 10301, Environmental Business Consultants, August 29, 2018.

Phase II Environmental Site Assessment, 178 Richmond Terrace and 24 Stuyvesant Place, Staten Island, NY, Hydro Tech Environmental, Corp., January 21, 2014.

Phase II Environmental Site Investigation Report, River North, 170-194 Richmond Terrace and 8-20 Stuyvesant Place, Staten Island, NY, Tenen Environmental, LLC, February 2021.

Figures



Basemap: USGS Topographic Map, 7.5 Minute Quadrangle, Jersey City, New Jersey, 2016

Site

River North
Remedial Investigation Work Plan
178, 194 Richmond Terrace &
8 Stuyvesant Place
Staten Island, New York
Block 13, Lots 82, 92 & 100

TENEN ENVIRONMENTAL

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Drawn By	LM
Checked By	AP
Date	August 2021
Scale	As Noted

Drawing Title
Site Location Map

Drawing No
Figure 1

Source: NYC DOF - Digital Tax Map

Site

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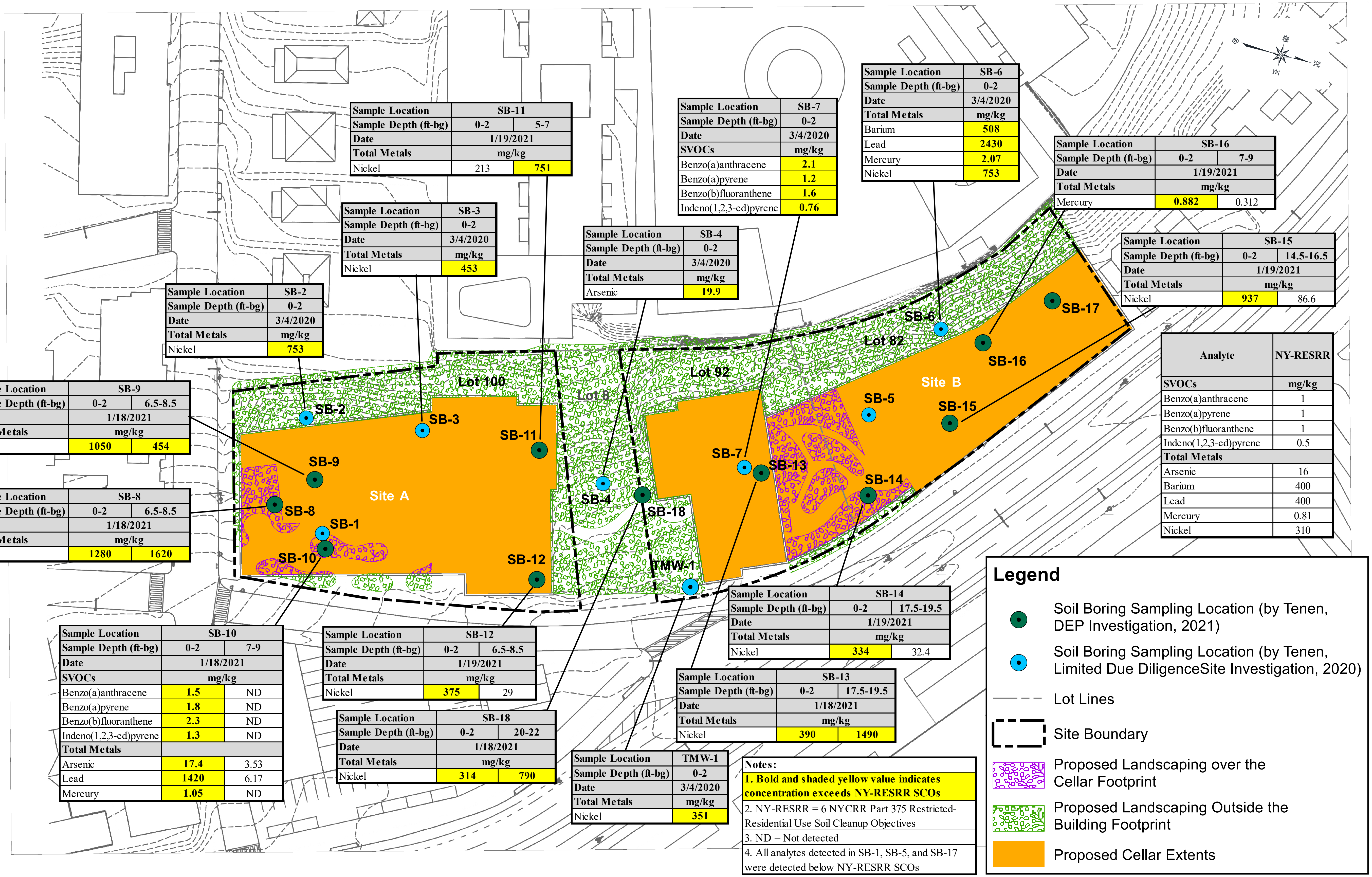
Drawing Title **Site Plan**

Drawing No **Figure 2**



Sample Location	SB-11	
Sample Depth (ft-bg)	0-2	5-7
Date	1/19/2021	
Total Metals	mg/kg	
Nickel	213	**751**

Sample Location	SB-7
Sample Depth (ft-bg)	0-2
Date	3/4/2020
SVOCs	mg/kg
Benzo(a)anthracene	**2.1**
Benzo(a)pyrene	**1.2**
Benzo(b)fluoranthene	**1.6**
Indeno(1,2,3-cd)pyrene	**0.76**

Sample Location	SB-6
Sample Depth (ft-bg)	0-2
Date	3/4/2020
Total Metals	mg/kg
Barium	**508**
Lead	**2430**
Mercury	**2.07**
Nickel	**753**

Sample Location	SB-16	
Sample Depth (ft-bg)	0-2	7-9
Date	1/19/2021	
Total Metals	mg/kg	
Mercury	**0.882**	0.312

Sample Location	SB-3
Sample Depth (ft-bg)	0-2
Date	3/4/2020
Total Metals	mg/kg
Nickel	**453**

Sample Location	SB-4
Sample Depth (ft-bg)	0-2
Date	3/4/2020
Total Metals	mg/kg
Arsenic	**19.9**

Sample Location	SB-15	
Sample Depth (ft-bg)	0-2	14.5-16.5
Date	1/19/2021	
Total Metals	mg/kg	
Nickel	**937**	86.6

Sample Location	SB-2
Sample Depth (ft-bg)	0-2
Date	3/4/2020
Total Metals	mg/kg
Nickel	**753**

Analyte	NY-RESRR
SVOCs	mg/kg
Benzo(a)anthracene	1
Benzo(a)pyrene	1
Benzo(b)fluoranthene	1
Indeno(1,2,3-cd)pyrene	0.5
Total Metals	
Arsenic	16
Barium	400
Lead	400
Mercury	0.81
Nickel	310

Sample Location	SB-9	
Sample Depth (ft-bg)	0-2	6.5-8.5
Date	1/18/2021	
Total Metals	mg/kg	
Nickel	**1050**	**454**

Sample Location	SB-8	
Sample Depth (ft-bg)	0-2	6.5-8.5
Date	1/18/2021	
Total Metals	mg/kg	
Nickel	**1280**	**1620**

Sample Location	SB-14	
Sample Depth (ft-bg)	0-2	17.5-19.5
Date	1/19/2021	
Total Metals	mg/kg	
Nickel	**334**	32.4

Sample Location	SB-10	
Sample Depth (ft-bg)	0-2	7-9
Date	1/18/2021	
SVOCs	mg/kg	
Benzo(a)anthracene	**1.5**	ND
Benzo(a)pyrene	**1.8**	ND
Benzo(b)fluoranthene	**2.3**	ND
Indeno(1,2,3-cd)pyrene	**1.3**	ND
Total Metals		
Arsenic	**17.4**	3.53
Lead	**1420**	6.17
Mercury	**1.05**	ND

Sample Location	SB-12	
Sample Depth (ft-bg)	0-2	6.5-8.5
Date	1/19/2021	
Total Metals	mg/kg	
Nickel	**375**	29

Sample Location	SB-13	
Sample Depth (ft-bg)	0-2	17.5-19.5
Date	1/18/2021	
Total Metals	mg/kg	
Nickel	**390**	**1490**

Sample Location	SB-18	
Sample Depth (ft-bg)	0-2	20-22
Date	1/18/2021	
Total Metals	mg/kg	
Nickel	**314**	**790**

Sample Location	TMW-1
Sample Depth (ft-bg)	0-2
Date	3/4/2020
Total Metals	mg/kg
Nickel	**351**

Notes:

1. Bold and shaded yellow value indicates concentration exceeds NY-RESRR SCOs

2. NY-RESRR = 6 NYCRR Part 375 Restricted-Residential Use Soil Cleanup Objectives

3. ND = Not detected

4. All analytes detected in SB-1, SB-5, and SB-17 were detected below NY-RESRR SCOs

Source: NYC DOF - Digital Tax Map
File: Special Permit-Illustrative Plans.dwg (received 10/26/2020)

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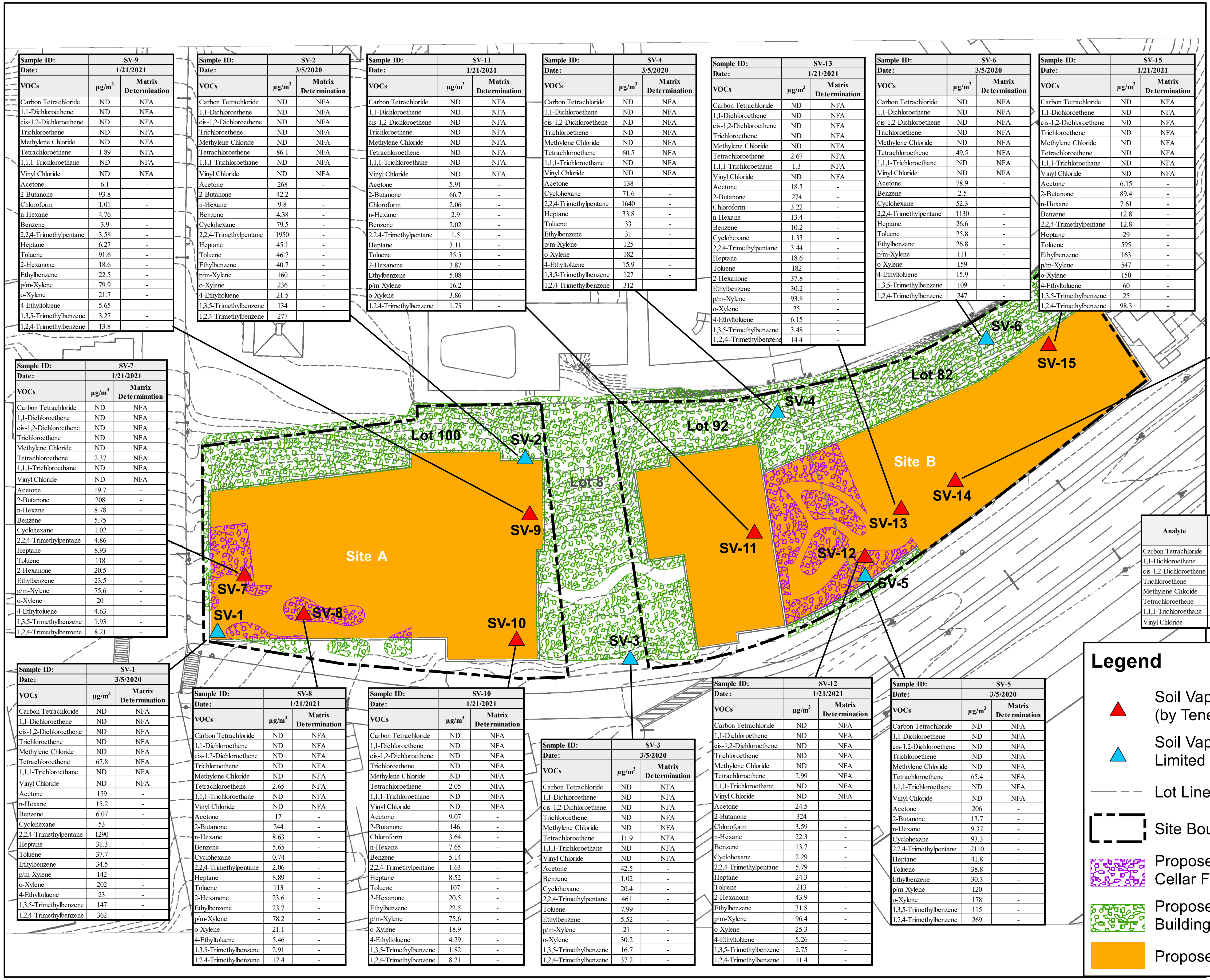
Drawn By	Checked By	Date	Scale
LM	AP	August 2021	As Noted

Drawing Title
Historic Soil Analytical Results

Drawing No
Figure 3



Sample ID:	SV-9	
Date:	1/21/2021	
VOCs	μg/m^3	Matrix Determination
Carbon Tetrachloride	ND	NFA
1,1-Dichloroethene	ND	NFA
cis-1,2-Dichloroethene	ND	NFA
Trichloroethene	ND	NFA
Methylene Chloride	ND	NFA
Tetrachloroethene	1.89	NFA
1,1,1-Trichloroethane	ND	NFA
Vinyl Chloride	ND	NFA
Acetone	6.1	-
2-Butanone	93.8	-
Chloroform	1.01	-
n-Hexane	4.76	-
Benzene	3.9	-
2,2,4-Trimethylpentane	3.58	-
Heptane	6.27	-
Toluene	91.6	-
2-Hexanone	18.6	-
Ethylbenzene	22.5	-
p/m-Xylene	79.9	-
o-Xylene	21.7	-
4-Ethyltoluene	5.65	-
1,3,5-Trimethylbenzene	3.27	-
1,2,4-Trimethylbenzene	13.8	-

Sample ID:	SV-2	
Date:	3/5/2020	
VOCs	μg/m^3	Matrix Determination
Carbon Tetrachloride	ND	NFA
1,1-Dichloroethene	ND	NFA
cis-1,2-Dichloroethene	ND	NFA
Trichloroethene	ND	NFA
Methylene Chloride	ND	NFA
Tetrachloroethene	86.1	NFA
1,1,1-Trichloroethane	ND	NFA
Vinyl Chloride	ND	NFA
Acetone	268	-
2-Butanone	42.2	-
n-Hexane	9.8	-
Benzene	4.38	-
Cyclohexane	79.5	-
2,2,4-Trimethylpentane	1950	-
Heptane	45.1	-
Toluene	46.7	-
Ethylbenzene	40.7	-
p/m-Xylene	160	-
o-Xylene	236	-
4-Ethyltoluene	21.5	-
1,3,5-Trimethylbenzene	134	-
1,2,4-Trimethylbenzene	277	-

Sample ID:	SV-11	
Date:	1/21/2021	
VOCs	μg/m^3	Matrix Determination
Carbon Tetrachloride	ND	NFA
1,1-Dichloroethene	ND	NFA
cis-1,2-Dichloroethene	ND	NFA
Trichloroethene	ND	NFA
Methylene Chloride	ND	NFA
Tetrachloroethene	ND	NFA
1,1,1-Trichloroethane	ND	NFA
Vinyl Chloride	ND	NFA
Acetone	5.91	-
2-Butanone	66.7	-
Chloroform	2.06	-
n-Hexane	2.9	-
Benzene	2.02	-
2,2,4-Trimethylpentane	1.5	-
Heptane	3.11	-
Toluene	35.5	-
2-Hexanone	3.87	-
Ethylbenzene	5.08	-
p/m-Xylene	16.2	-
o-Xylene	3.86	-
1,2,4-Trimethylbenzene	1.75	-

Sample ID:	SV-4	
Date:	3/5/2020	
VOCs	μg/m^3	Matrix Determination
Carbon Tetrachloride	ND	NFA
1,1-Dichloroethene	ND	NFA
cis-1,2-Dichloroethene	ND	NFA
Trichloroethene	ND	NFA
Methylene Chloride	ND	NFA
Tetrachloroethene	60.5	NFA
1,1,1-Trichloroethane	ND	NFA
Vinyl Chloride	ND	NFA
Acetone	138	-
Cyclohexane	71.6	-
2,2,4-Trimethylpentane	1640	-
Heptane	33.8	-
Toluene	33	-
Ethylbenzene	31	-
p/m-Xylene	125	-
o-Xylene	182	-
4-Ethyltoluene	15.9	-
1,3,5-Trimethylbenzene	127	-
1,2,4-Trimethylbenzene	312	-

Sample ID:	SV-13	
Date:	1/21/2021	
VOCs	μg/m^3	Matrix Determination
Carbon Tetrachloride	ND	NFA
1,1-Dichloroethene	ND	NFA
cis-1,2-Dichloroethene	ND	NFA
Trichloroethene	ND	NFA
Methylene Chloride	ND	NFA
Tetrachloroethene	2.67	NFA
1,1,1-Trichloroethane	1.3	NFA
Vinyl Chloride	ND	NFA
Acetone	18.3	-
2-Butanone	274	-
Chloroform	3.22	-
n-Hexane	13.4	-
Benzene	10.2	-
Cyclohexane	1.33	-
2,2,4-Trimethylpentane	3.44	-
Heptane	18.6	-
Toluene	182	-
2-Hexanone	37.8	-
Ethylbenzene	30.2	-
p/m-Xylene	93.8	-
o-Xylene	25	-
4-Ethyltoluene	6.15	-
1,3,5-Trimethylbenzene	3.48	-
1,2,4-Trimethylbenzene	14.4	-

Sample ID:	SV-6	
Date:	3/5/2020	
VOCs	μg/m^3	Matrix Determination
Carbon Tetrachloride	ND	NFA
1,1-Dichloroethene	ND	NFA
cis-1,2-Dichloroethene	ND	NFA
Trichloroethene	ND	NFA
Methylene Chloride	ND	NFA
Tetrachloroethene	49.5	NFA
1,1,1-Trichloroethane	ND	NFA
Vinyl Chloride	ND	NFA
Acetone	78.9	-
Benzene	2.5	-
Cyclohexane	52.3	-
2,2,4-Trimethylpentane	1130	-
Heptane	26.6	-
Toluene	25.8	-
Ethylbenzene	26.8	-
p/m-Xylene	111	-
o-Xylene	159	-
4-Ethyltoluene	15.9	-
1,3,5-Trimethylbenzene	109	-
1,2,4-Trimethylbenzene	247	-

Sample ID:	SV-15	
Date:	1/21/2021	
VOCs	μg/m^3	Matrix Determination
Carbon Tetrachloride	ND	NFA
1,1-Dichloroethene	ND	NFA
cis-1,2-Dichloroethene	ND	NFA
Trichloroethene	ND	NFA
Methylene Chloride	ND	NFA
Tetrachloroethene	ND	NFA
1,1,1-Trichloroethane	ND	NFA
Vinyl Chloride	ND	NFA
Acetone	6.15	-
2-Butanone	89.4	-
n-Hexane	7.61	-
Benzene	12.8	-
2,2,4-Trimethylpentane	12.8	-
Heptane	29	-
Toluene	595	-
Ethylbenzene	163	-
p/m-Xylene	547	-
o-Xylene	150	-
4-Ethyltoluene	60	-
1,3,5-Trimethylbenzene	25	-
1,2,4-Trimethylbenzene	98.3	-

Sample ID:	SV-14	
Date:	1/21/2021	
VOCs	μg/m^3	Matrix Determination
Carbon Tetrachloride	ND	NFA
1,1-Dichloroethene	ND	NFA
cis-1,2-Dichloroethene	ND	NFA
Trichloroethene	ND	NFA
Methylene Chloride	ND	NFA
Tetrachloroethene	ND	NFA
1,1,1-Trichloroethane	ND	NFA
Vinyl Chloride	ND	NFA
2-Butanone	56.6	-
n-Hexane	15.4	-
Benzene	21.3	-
Cyclohexane	3.26	-
2,2,4-Trimethylpentane	35.7	-
Heptane	58.2	-
Toluene	897	-
Ethylbenzene	203	-
p/m-Xylene	634	-
o-Xylene	175	-
4-Ethyltoluene	56.5	-
1,3,5-Trimethylbenzene	26.2	-
1,2,4-Trimethylbenzene	96.8	-

Sample ID:	SV-7	
Date:	1/21/2021	
VOCs	μg/m^3	Matrix Determination
Carbon Tetrachloride	ND	NFA
1,1-Dichloroethene	ND	NFA
cis-1,2-Dichloroethene	ND	NFA
Trichloroethene	ND	NFA
Methylene Chloride	ND	NFA
Tetrachloroethene	2.37	NFA
1,1,1-Trichloroethane	ND	NFA
Vinyl Chloride	ND	NFA
Acetone	19.7	-
2-Butanone	208	-
n-Hexane	8.78	-
Benzene	5.75	-
Cyclohexane	1.02	-
2,2,4-Trimethylpentane	4.86	-
Heptane	8.93	-
Toluene	118	-
2-Hexanone	20.5	-
Ethylbenzene	23.5	-
p/m-Xylene	75.6	-
o-Xylene	20	-
4-Ethyltoluene	4.63	-
1,3,5-Trimethylbenzene	1.93	-
1,2,4-Trimethylbenzene	8.21	-

Sample ID:	SV-1	
Date:	3/5/2020	
VOCs	μg/m^3	Matrix Determination
Carbon Tetrachloride	ND	NFA
1,1-Dichloroethene	ND	NFA
cis-1,2-Dichloroethene	ND	NFA
Trichloroethene	ND	NFA
Methylene Chloride	ND	NFA
Tetrachloroethene	67.8	NFA
1,1,1-Trichloroethane	ND	NFA
Vinyl Chloride	ND	NFA
Acetone	159	-
n-Hexane	15.2	-
Benzene	6.07	-
Cyclohexane	53	-
2,2,4-Trimethylpentane	1290	-
Heptane	31.3	-
Toluene	37.7	-
Ethylbenzene	34.5	-
p/m-Xylene	142	-
o-Xylene	202	-
4-Ethyltoluene	23	-
1,3,5-Trimethylbenzene	147	-
1,2,4-Trimethylbenzene	362	-

Sample ID:	SV-8	
Date:	1/21/2021	
VOCs	μg/m^3	Matrix Determination
Carbon Tetrachloride	ND	NFA
1,1-Dichloroethene	ND	NFA
cis-1,2-Dichloroethene	ND	NFA
Trichloroethene	ND	NFA
Methylene Chloride	ND	NFA
Tetrachloroethene	2.65	NFA
1,1,1-Trichloroethane	ND	NFA
Vinyl Chloride	ND	NFA
Acetone	17	-
2-Butanone	244	-
n-Hexane	8.63	-
Benzene	5.65	-
Cyclohexane	0.74	-
2,2,4-Trimethylpentane	2.06	-
Heptane	8.89	-
Toluene	113	-
2-Hexanone	23.6	-
Ethylbenzene	23.7	-
p/m-Xylene	78.2	-
o-Xylene	21.1	-
4-Ethyltoluene	5.46	-
1,3,5-Trimethylbenzene	2.91	-
1,2,4-Trimethylbenzene	12.4	-

Sample ID:	SV-10	
Date:	1/21/2021	
VOCs	μg/m^3	Matrix Determination
Carbon Tetrachloride	ND	NFA
1,1-Dichloroethene	ND	NFA
cis-1,2-Dichloroethene	ND	NFA
Trichloroethene	ND	NFA
Methylene Chloride	ND	NFA
Tetrachloroethene	2.05	NFA
1,1,1-Trichloroethane	ND	NFA
Vinyl Chloride	ND	NFA
Acetone	9.07	-
2-Butanone	146	-
Chloroform	3.64	-
n-Hexane	7.65	-
Benzene	5.14	-
2,2,4-Trimethylpentane	1.63	-
Heptane	8.52	-
Toluene	107	-
2-Hexanone	20.5	-
Ethylbenzene	22.5	-
p/m-Xylene	75.6	-
o-Xylene	18.9	-
4-Ethyltoluene	4.29	-
1,3,5-Trimethylbenzene	1.82	-
1,2,4-Trimethylbenzene	8.21	-

Sample ID:	SV-3	
Date:	3/5/2020	
VOCs	μg/m^3	Matrix Determination
Carbon Tetrachloride	ND	NFA
1,1-Dichloroethene	ND	NFA
cis-1,2-Dichloroethene	ND	NFA
Trichloroethene	ND	NFA
Methylene Chloride	ND	NFA
Tetrachloroethene	11.9	NFA
1,1,1-Trichloroethane	ND	NFA
Vinyl Chloride	ND	NFA
Acetone	42.5	-
Benzene	1.02	-
Cyclohexane	20.4	-
2,2,4-Trimethylpentane	461	-
Toluene	7.99	-
Ethylbenzene	5.52	-
p/m-Xylene	21	-
o-Xylene	30.2	-
1,3,5-Trimethylbenzene	16.7	-
1,2,4-Trimethylbenzene	37.2	-

Sample ID:	SV-12	
Date:	1/21/2021	
VOCs	μg/m^3	Matrix Determination
Carbon Tetrachloride	ND	NFA
1,1-Dichloroethene	ND	NFA
cis-1,2-Dichloroethene	ND	NFA
Trichloroethene	ND	NFA
Methylene Chloride	ND	NFA
Tetrachloroethene	2.99	NFA
1,1,1-Trichloroethane	ND	NFA
Vinyl Chloride	ND	NFA
Acetone	24.5	-
2-Butanone	324	-
Chloroform	3.59	-
n-Hexane	22.3	-
Benzene	13.7	-
Cyclohexane	2.29	-
2,2,4-Trimethylpentane	5.79	-
Heptane	24.3	-
Toluene	213	-
2-Hexanone	43.9	-
Ethylbenzene	31.8	-
p/m-Xylene	96.4	-
o-Xylene	25.3	-
4-Ethyltoluene	5.26	-
1,3,5-Trimethylbenzene	2.75	-
1,2,4-Trimethylbenzene	11.4	-

Sample ID:	SV-5	
Date:	3/5/2020	
VOCs	μg/m^3	Matrix Determination
Carbon Tetrachloride	ND	NFA
1,1-Dichloroethene	ND	NFA
cis-1,2-Dichloroethene	ND	NFA
Trichloroethene	ND	NFA
Methylene Chloride	ND	NFA
Tetrachloroethene	65.4	NFA
1,1,1-Trichloroethane	ND	NFA
Vinyl Chloride	ND	NFA
Acetone	206	-
2-Butanone	13.7	-
n-Hexane	9.37	-
Cyclohexane	93.3	-
2,2,4-Trimethylpentane	2110	-
Heptane	41.8	-
Toluene	38.8	-
Ethylbenzene	30.3	-
p/m-Xylene	120	-
o-Xylene	178	-
1,3,5-Trimethylbenzene	115	-
1,2,4-Trimethylbenzene	269	-

Notes:
1. NYSDOH Matrix Decisions are described in the NYSDOH Soil Vapor Guidance, October 2006 with May 2017 updates
2. NFA = No Further Action Matrix Decision
3. ND = Not detected
4. NYSDOH Matrix determinations are presented assuming no detections of analytes in indoor air
5. - = No NYSDOH Matrix for this Analyte

Analyte	NYSDOH Matrix	Soil Vapor Concentration for NFA	Soil Vapor Concentration for Monitor	Soil Vapor Concentration for Mitigate
Carbon Tetrachloride 1,1-Dichloroethene cis-1,2-Dichloroethene Trichloroethene	A	<60 μg/m^3	Not Applicable	60 μg/m^3 and above
Methylene Chloride Tetrachloroethene 1,1,1-Trichloroethane	B	<1,000 μg/m^3	Not Applicable	1,000 μg/m^3 and above
Vinyl Chloride	C	<6 μg/m^3	6 μg/m^3 to <60 μg/m^3	60 μg/m^3 and above

Legend

▲	Soil Vapor Sampling Location (by Tenen, DEP Investigation, 2021)
△	Soil Vapor Sampling Location (by Tenen, Limited Due Diligence Site Investigation, 2020)
- - -	Lot Lines
▭	Site Boundary
▨	Proposed Landscaping over the Cellar Footprint
▨	Proposed Landscaping Outside the Building Footprint
🟧	Proposed Cellar Extents

Feet
0 35 70 140

Site
River North
Remedial Investigation Work Plan
178, 194 Richmond Terrace &
8 Stuyvesant Place
Staten Island, New York
Block 13, Lots 82, 92 & 100

TENEN ENVIRONMENTAL

Tenen Environmental, LLC
121 West 27th Street
Suite 702
New York, NY 10001
O: (646) 606-2332
F: (646) 606-2379

Drawn By	LM
Checked By	AP
Date	August 2021
Scale	As Noted

Drawing Title
Historic Soil Vapor Analytical Results

Drawing No
Figure 4

Legend

- ⊕ Proposed Groundwater Sampling Location
- ⊕ Proposed Cellar Soil Boring
- ⊙ Proposed Soil Delineation Boring
- ◐ Proposed Landscaping Soil Boring
- ⊡ Soil Boring Sampling Location (by Tenen, DEP Investigation, 2021)
- ⊙ Soil Boring Sampling Location (by Tenen, Limited Due DiligenceSite Investigation, 2020)
- – – Lot Lines
- ▭ Site Boundary
- ▨ Proposed Landscaping over the Cellar Footprint
- ▨ Proposed Landscaping Outside the Building Footprint
- 🟧 Proposed Cellar Extents

Note:
Temporary Monitoring Well TMW-1 will be sampled if the well is not dry.

Source: NYC DOF - Digital Tax Map
File: Special Permit-Illustrative Plans.dwg (received 10/26/2020)

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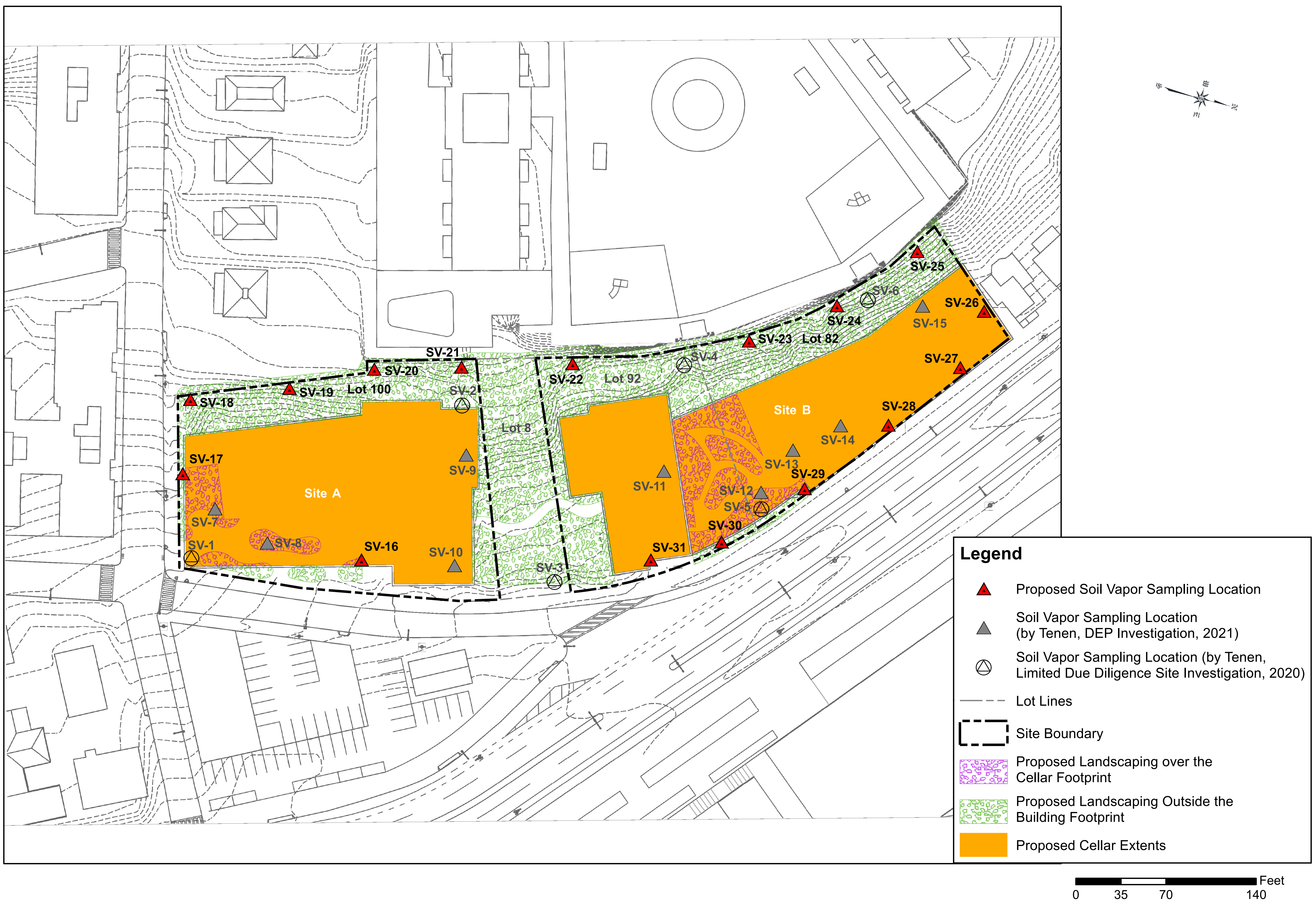
Drawn By	LM
Checked By	AP
Date	August 2021
Scale	As Noted

Drawing Title
Proposed Soil and Groundwater Sampling Locations

Drawing No
Figure 5



Site

River North
Remedial Investigation Work Plan
178, 194 Richmond Terrace &
8 Stuyvesant Place
Staten Island, New York
Block 13, Lots 82, 92 & 100

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Checked By	AP
Date	August 2021
Scale	As Noted

Drawing Title

Proposed Soil Vapor Sampling Locations

Drawing No

Figure 6

Appendix A
Previous Reports (on cd)

Appendix B

Quality Assurance Project Plan

Quality Assurance Project Plan

for
River North
Remedial Investigation Work Plan

178, 194 Richmond Terrace & 8 Stuyvesant Place – Staten Island, NY
Block 13, Lots 82, 92 & 100
BCP Site # C243045

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau B
625 Broadway, 12th Floor
Albany, NY 12233-7016

Prepared for:
Richmond SI Owner LLC
520 Madison Avenue, Suite 3501
New York, New York 10022

Prepared by:
TENEN ENVIRONMENTAL
121 West 27th Street, Suite 702
New York, NY 10001

August 2021

TABLE OF CONTENTS

Appendices

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been developed for the Remedial Investigation Work Plan (RIWP) prepared for the River North property (the Site).

The Site, located at 178 and 194 Richmond Terrace and 8 Stuyvesant Place, is an irregularly-shaped parcel of land located on the northern corner of Stuyvesant Place and extending to the west side of Richmond Terrace in the St. George section of Staten Island, New York.

The Site is vacant, vegetated with trees and overgrowth, and contains remnants of building foundations associated with prior unfinished construction on the northern portion of the property. The Site is an approximate 89,298 square foot parcel located in Staten Island Community Board 1 and is generally identified as Block 13, Lots 82, 92, and 100. Lots 82 and 92 are contiguous, and Lots 92 and 100 are separated by a strip of land generally identified as a portion of Block 13, Lot 8. This portion of Lot 8 is also part of the redevelopment site, but is not part of the Brownfield Cleanup Program (BCP) Site.

1.1 Project Scope and QAPP Objective

The proposed scope of work includes the following:

- advancement of borings for soil and soil vapor sampling on the Site; and,
- collection of soil, groundwater, soil vapor, and ambient air samples from soil borings, existing temporary monitoring wells and temporary soil vapor points.

The objective of the QAPP is to detail the policies, organization, objectives, functional activities and specific quality assurance/quality control activities designed to achieve the data quality goals or objectives of the Remedial Investigation Work Plan. This QAPP addresses how the acquisition and handling of samples and the review and reporting of data will be documented for quality control (QC) purposes. Specifically, this QAPP addresses the following:

- The procedures to be used to collect, preserve, package, and transport samples;
- Field data collection and record keeping;
- Data management;
- Chain-of-custody procedures; and,
- Determination of precision, accuracy, completeness, representativeness, decision rules, comparability and level of quality control effort.

2.0 PROJECT ORGANIZATION

The personnel detailed are responsible for the implementation of the QAPP. Tenen Environmental, LLC (Tenen) will implement the RIWP on behalf of Richmond SI Owner LLC (the Volunteer) once it has been approved by the New York State Department of Environmental Conservation (NYSDEC).

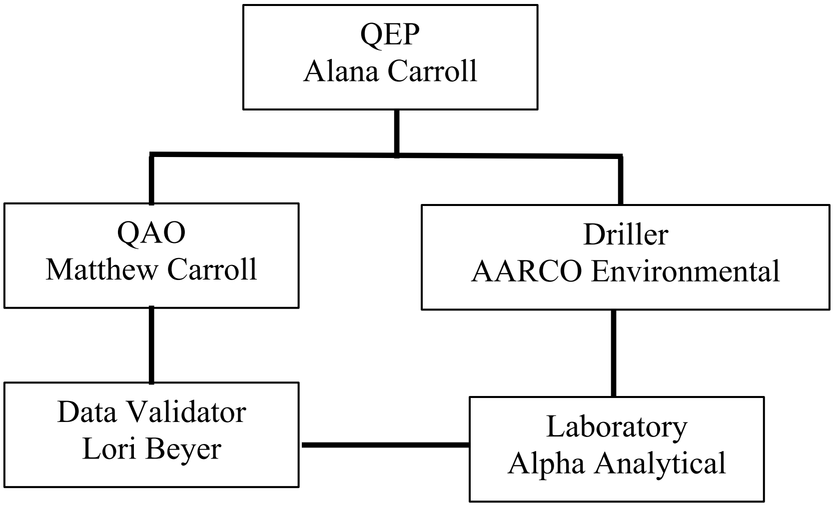
The Project Manager and Qualified Environmental Professional (QEP) will be Mrs. Alana Carroll, CPG, managing scientist at Tenen. Mrs. Carroll is a certified professional geologist with experience in all aspects of site assessment, development and implementation of remedial strategies. Her experience involves projects from inception through investigation, remediation and closure. Her expertise includes soil, soil vapor and groundwater remediation; remedial selection and design; field/health and safety oversight and preparation of work plans and reports to satisfy the requirements of various regulatory agencies. Mrs. Carroll received her BS in Geology from Hofstra University; her resume is included in Appendix A.

The Quality Assurance Officer will be Mr. Matthew Carroll, P.E., principal at Tenen. Mr. Carroll is an environmental engineer experienced in all aspects of site assessment and development and implementation of remedial strategies. His experience involves projects from inception through investigation, remediation and closure. His expertise includes soil, soil vapor and groundwater remediation; remedial selection and design; field/health and safety oversight and preparation of work plans and reports to satisfy the requirements of various regulatory agencies. Mr. Carroll received his Bachelor of Engineering from Stevens Institute of Technology and Bachelor of Science in Chemistry from New York University and is a New York State professional engineer; his resume is included in Appendix A.

In addition, Tenen will utilize subcontractors for drilling (AARCO Environmental Services of Lindenhurst, NY), laboratory services (Alpha Analytical of Westborough, MA) and data validation (L.A.B. Validation Corp. of East Northport, NY). The resume for the DUSR preparer, Ms. Lori Beyer, is included in Appendix A.

Contact Information
Remedial Party (Richmond SI Owner LLC), Zachary Kadden, 646.747.2235
Tenen Environmental, Alana Carroll or Matthew Carroll, 646.606.2332

An organization chart for the implementation of the Remedial Investigation Work Plan and QAPP is below.



3.0 SAMPLING AND DECONTAMINATION PROCEDURES

A detailed description of the procedures to be used during this program for collection of the soil, soil vapor, ambient air and groundwater samples is provided below. Proposed sample locations are shown on Figures 5 and 6 of the Remedial Investigation Work Plan. An Analytical Methods/Quality Assurance Summary is provided in Table 1, included in Section 3.11.

3.1 Level of Effort for QC Samples

Field blank, trip blank, field duplicate and matrix spike (MS) / matrix spike duplicate (MSD) samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs. Each type of QC sample is discussed below.

- Field and trip blanks consisting of distilled water will be submitted to the analytical laboratories to provide the means to assess the quality of the data resulting from the field-sampling program. Field (equipment) blank samples are analyzed to check for procedural chemical constituents that may cause sample contamination. Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage.

- Duplicate samples are analyzed to check for sampling and analytical reproducibility.

- MS/MSD samples provide information about the effect of the sample matrix on the digestion and measurement methodology.

The general level of QC effort will be one field duplicate and one field blank (when non-dedicated equipment is used) for every 20 or fewer investigative samples of a given matrix. Additional sample volume will also be provided to the laboratory to allow one site-specific MS/MSD for every 20 or fewer investigative samples of a given matrix. One trip blank will be included along with each sample delivery group of volatile organic compound (VOC) samples. If non-dedicated sampling equipment is used to collect PFAS samples, one equipment blank will be collected at a frequency of one per day that PFAS samples are collected for a given matrix.

The analytical laboratory, Alpha Analytical, is certified under the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) as Lab IDs 11148 and 11627. NYSDEC Analytical Services Protocol (ASP) Category B deliverables will be prepared by the laboratory.

3.2 Sample Handling

Samples will either be picked up by the laboratory, delivered to the laboratory in person by the sampler, or transported to the laboratory by overnight courier. All samples will be shipped to the laboratory to arrive within 48 hours after collection, and the laboratory will adhere to the analytical holding times for these analyses, as listed in the current version of the New York State ASP.

3.3 Custody Procedures

Sample custody will be controlled and maintained through the chain-of-custody procedures. The chain of custody is the means by which the possession and handling of samples is tracked from the site to the laboratory. Sample containers will be cleaned and preserved at the laboratory before shipment to the Site. The following sections (Sections 3.4 and 3.5) describe procedures for maintaining sample custody from the time samples are collected to the time they are received by the analytical laboratory.

3.4 Sample Storage

Samples will be stored in secure limited-access areas. Walk-in coolers or refrigerators will be maintained at 4°C, +/- 2°C, or as required by the applicable regulatory program. The temperatures of all refrigerated storage areas are monitored and recorded a minimum of once per day. Deviations of temperature from the applicable range require corrective action, including moving samples to another storage location, if necessary.

3.5 Sample Custody

Sample custody is defined by this QAPP as the following:

- The sample is in someone's actual possession;
- The sample is in someone's view after being in his or her physical possession;
- The sample was in someone's possession and then locked, sealed, or secured in a manner that prevents unsuspected tampering; or,
- The sample is placed in a designated and secured area.

Samples will be removed from storage areas by the sample custodian or laboratory personnel and transported to secure laboratory areas for analysis. Access to the laboratory and sample storage areas is restricted to laboratory personnel and escorted visitors only; all areas of the laboratory are therefore considered secure.

Laboratory documentation used to establish chain of custody and sample identification may include the following:

- Field chains of custody or other paperwork that arrives with the sample;
- Laboratory chain of custody;
- Sample labels or tags attached to each sample container;
- Sample custody seals;
- Sample preparation logs (i.e., extraction and digestion information) recorded in hardbound laboratory books, filled out in legible handwriting, and signed and dated by the chemist;
- Sample analysis logs (e.g., metals, GC/MS, etc.) information recorded in hardbound laboratory books that are filled out in legible handwriting, and signed and dated by the chemist;

- Sample storage log (same as the laboratory chain of custody); and,
- Sample disposition log, which documents sample disposal by a contracted waste disposal company.

3.6 Sample Tracking

All samples will be maintained in the appropriate coolers prior to and after analysis. Laboratory analysts will remove and return their samples, as needed. Samples that require internal chain of custody procedures will be relinquished to the analysts by the sample custodians. The analyst and sample custodian will sign the original chain of custody relinquishing custody of the samples from the sample custodian to the analyst. When the samples are returned, the analyst will sign the original chain of custody returning sample custody to the sample custodian. Sample extracts will be relinquished to the instrumentation analysts by the preparatory analysts. Each preparation department will track internal chain of custody through their logbooks/spreadsheets.

Any change in the sample during the time of custody will be noted on the chain of custody (e.g., sample breakage or depletion).

3.7 Soil Sampling

Soil samples from borings will be collected from plastic liners collected by a direct-push Geoprobe® or collected directly from a hand auger. In general, select soil intervals will be screened between grade and the terminal depth of the boring. New, dedicated disposable acetate liners will be used for all soil samples collected using the Geoprobe. All casings and the hand auger will be decontaminated between borings, as described in Section 3.11.

The liner for each sample interval will be opened and the soil within scanned for volatile organic compounds (VOCs) using a photoionization detector (PID) and geologically described using the Unified Soil Classification System, including documentation of observations regarding potential contamination such as odors, staining, etc. All descriptions and observations will be documented in a field notebook.

At all soil boring locations, the collected soil volumes will be screened with a PID and visual (e.g., source areas – sumps, floor drains, stains, sheens, blebs, presence of NAPL, etc.) and olfactory observations will be recorded. If evidence of VOC impacts is detected and drilling conditions allow, the borehole will be extended until no impacts are detected. The full extent of the boring will be screened and samples will be collected based on the field observations and readings. For each boring advanced within the proposed cellar footprints, samples will be collected from the two-foot interval of historic fill material above the first apparent native layer encountered and the two-foot interval above weathered bedrock or bedrock, whichever is encountered first. For each boring advanced within the proposed landscaping areas, samples will be collected from grade to two ft-bg and from two to four ft-bg. For each delineation boring, samples will be collected from the two-foot interval directly below the sampling interval that did not meet Restricted-Residential Use Soil Cleanup Objectives (SCOs) in the nearest LDDSI or Phase II ESI soil boring, and the two-foot interval below the first sampling interval, to be placed on hold to await the results of analysis of the previous sampling interval. Samples will be collected at the intervals detailed above (e.g., based on screening, visual and olfactory indicators) to delineate the vertical and horizontal extent of site contaminants.

Soil samples to be analyzed will be collected directly from the plastic sleeves or hand tools. All collected soil samples will be placed in pre-cleaned, pre-preserved laboratory provided sample bottles or En Core samplers (En Novative Technologies, Inc.), cooled to 4°C in the field, and transported under chain-of-custody command to the designated laboratory for analysis.

All soil samples will be analyzed for the following analytes on the Part 375 list with a Category B deliverable package:

- Target Compound List (TCL) VOCs by EPA Method 8260C;
- TCL Semivolatile Organic Compounds (SVOCs) by EPA Method 8270C;
- Polychlorinated Biphenyls (PCBs) by EPA Method 8082A;
- Pesticides by EPA Method 8081B;
- Herbicides by EPA Method 8151A;
- Target Analyte List (TAL) Metals by EPA Method 6010C / 7471B;
- Trivalent and Hexavalent Chromium by EPA Method 3060A;
- Total Cyanide by EPA Method 9010C;
- PFAS by EPA Method 537 Modified (reporting limit of 0.5 microgram per kilogram [ug/kg]) via liquid chromatography with tandem mass spectrometry (LC-MS/MS) using methodologies based on EPA Method 537.1; and
- 1,4-Dioxane by EPA Method 8270.

Field methods can impact the analysis of PFAS. PFAS samples will be collected using dedicated disposable sampling equipment when possible. If dedicated disposable sampling equipment cannot be used, samples will be collected with stainless steel tools (spoons, bowls, etc.) and decontaminated using detergent (Alconox) and clean, PFAS-free water. Sampling containers for PFAS will be made of high density polyethylene (HDPE) with caps that will not be lined with polytetrafluoroethylene (PTFE). PFAS sampling containers will be kept in separate coolers from all other sampling containers and only regular ice will be used to cool the samples. Field staff conducting the sampling will not wear clothing that contains PTFE material or that has been waterproofed with PFAS material during sampling and all clothing worn will be laundered multiple times. Any bug spray or sunscreen utilized by field staff conducting the sampling will be PFAS free. A sampling guide is included in Appendix B. A list of PFAS compounds to be analyzed and associated method detection limits (MDLs) is included in Appendix C. The laboratory standard operating procedures for PFAS analysis is included in Appendix D.

3.8 Groundwater Sampling

Prior to sample collection, static water levels will be measured and recorded from the monitoring well. The monitoring well will also be gauged for the presence of non-aqueous phase liquid (NAPL). In the event that NAPL is detected, Tenen will record the thickness and will not collect a sample. If NAPL is not detected and the well is not dry, Tenen will purge and sample the monitoring well using low-flow/minimal drawdown purge and sample collection procedures (peristaltic pump system). Prior to sample collection, groundwater will be evacuated from the well at a low-flow rate (typically less than 0.1 L/min). Field measurements for pH, temperature, turbidity, dissolved oxygen, specific conductance, oxidation-reduction potential and water level, as well as visual and olfactory field observations, will be periodically recorded and monitored for stabilization. Purging will be considered complete when pH, specific conductivity, dissolved oxygen and temperature stabilize and when turbidity measurements fall below 50 Nephelometric Turbidity Units (NTU) or become stable above 50 NTU.

Stability is defined as variation between field measurements of 10 percent or less and no overall upward or downward trend in the measurements. Upon stabilization of field parameters, groundwater samples will be collected and analyzed as discussed below.

Field methods can impact the analysis of perfluoroalkyl acids (PFAS). A sampling guide is included in Appendix B.

The well will be purged and sampled using dedicated pump tubing following low-flow/minimal drawdown purge and sample collection procedures, as described above. The pump will be decontaminated between samples.

Groundwater samples will be collected for analysis through dedicated tubing. Prior to, and immediately following collection of groundwater samples, field measurements for pH, specific conductance, temperature, dissolved oxygen, turbidity and depth-to-water, as well as visual and olfactory field observations will be recorded. All collected groundwater samples will be placed in pre-cleaned, pre-preserved laboratory provided sample bottles, cooled to 4°C in the field, and transported under chain-of-custody command to the designated laboratory for analysis.

All groundwater samples will be analyzed for the following analytes on the Part 375 list and emerging contaminants with a Category B deliverable package:

- TCL VOCs by EPA Method 8260C;
- TCL SVOCs by EPA Method 8270C;
- PCBs by EPA Method 8082A;
- Pesticides by EPA Method 8081B;
- Herbicides by EPA Method 8151A;
- Total and Dissolved TAL Metals by EPA Method 6010C / 7471B;
- Total and Dissolved Trivalent and Hexavalent Chromium by EPA Method 3060A;
- Total and Dissolved Cyanide by EPA Method 9010C;
- 1,4-dioxane by EPA Method 8270D-SIM Modified; and
- PFAS by EPA Method 537 Modified (reporting limit of 2 nanograms per liter [ng/l]) via LC-MS/MS using methodologies based on EPA Method 537.1.

Field methods can impact the analysis of PFAS. PFAS samples will be collected using dedicated disposable HDPE tubing. Sampling containers for PFAS will be made of HDPE with caps that will not be lined with PTFE. PFAS sampling containers will be kept in separate coolers from all other sampling containers and only regular ice will be used to cool the samples. Field staff conducting the sampling will not wear clothing that contains PTFE material or that has been waterproofed with PFAS material during sampling and all clothing worn will be laundered multiple times. Any bug spray or sunscreen utilized by field staff conducting the sampling will be PFAS free. A sampling guide is included in Appendix B. A list of PFAS compounds to be analyzed and associated MDLs is included in Appendix C. Alpha Analytical, an ELAP-certified lab for PFOA and PFOS in drinking water by EPA Method 537, will be performing all PFAS analyses of groundwater. The laboratory standard operating procedures for PFAS analysis is included in Appendix D.

3.9 Soil Vapor Installation and Sampling

Soil vapor samples will be collected in accordance with the NYSDOH *Guidance for Evaluating Soil Vapor Intrusion In the State of New York*, dated October 2006.

16 soil vapor points (SV-16 to SV-31) will be installed around the perimeter of the Site to characterize onsite soil vapor conditions and evaluate the potential for contaminants in soil vapor to migrate on- or offsite. The soil vapor points will be advanced to approximately three ft-bg.

Soil vapor samples will be collected using disposable points at a depth of approximately three ft-bg. A Geoprobe® direct-push rig will be used to install the exterior soil vapor sampling probes. For any locations that are inaccessible by Geoprobe due to Site topography, the soil vapor points will be installed with hand tools. Once the soil vapor sampling probe has been driven to the desired depth, it will be attached to disposable tubing for sample collection.

The borehole above the sampling probe to grade will be sealed using an inert sealant to prevent ambient air mixing with the soil vapor. Ambient air will be purged from the boring hole by attaching the surface end of the ¼-inch diameter Teflon® tube to an air valve and then to a vacuum pump. The vacuum pump will remove three volumes of air (volume of the sample probe and tube) prior to sample collection. The flow rate for both purging and sample collection will not exceed 0.2 liter per minute (L/min).

The soil vapor samples will be first screened for organic vapors using a PID. A tracer gas will be used in accordance with NYSDOH protocols to verify the integrity of the soil vapor probe seal. Helium will be used as the tracer gas and a bucket 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.

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.

Soil vapor samples will be collected in laboratory-supplied and batch-certified 2.7-liter Summa canisters using two-hour regulators. All soil vapor samples will be analyzed for VOCs using EPA Method TO-15.

3.10 Ambient Air Sampling Methodology

All samples will be collected in accordance with the NYSDOH Soil Vapor Guidance. Some sample locations may be adjusted based on field observations or conditions.

Ambient air samples will be collected from breathing height (three to five feet above the floor) from an upgradient, secure portion of the Site. The sampling flow rate will not exceed 0.2 L/min. Sampling will occur for a duration of 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 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.

One ambient air sample will be collected in a laboratory-supplied and batch-certified 6-liter canister using an eight-hour regulator during soil vapor sample collection. Ambient air samples will be collected during soil vapor sample collection and will be analyzed for VOCs using EPA Method TO-15.

3.11 Analytical Methods/Quality Assurance Summary Table

A summary of the analytical methods and quality assurance methods are included in Table 1, below.

Table 1
Analytical Methods/Quality Assurance Summary

Matrix	Proposed Samples	QA/QC Samples				Total # Samples	Analytical Parameter	Method	Preservative	Holding Times	Container
		TB	FB	DUP	MS/MSD						
Soil	90	5	5	5	5 / 5	115	VOCs	8260C	Cool to 4°C, No Headspace	14 days	(3) Encore samplers; (1) 2-oz plastic bottle
	90	0	5	5	5 / 5	110	SVOCs	8270D	Cool to 4°C		(1) 4-oz amber glass bottle
	90	0	5	5	5 / 5	110	Pesticides / Herbicides	8081B			
	90	0	5	5	5 / 5	110	PCBs	8082A			
	90	0	5	5	5 / 5	110	TAL Metals (plus Cyanide and Chromium)	8151A, 7196A, 3050B, 7471B, 9010C/9012B/ 9014, 3060A/7196		28 days for mercury; 30 days to extraction for hexavalent chromium (plus 7 days for analysis); 6 months for all others	
	90	0	5	5	5 / 5	110	1,4-Dioxane	8270		14 days	
	90	0	5	5	5 / 5	110	PFAS	537 Modified		14 days to extraction, 28 days following extraction	(1) 8-oz HDPE bottle

Matrix	Proposed Samples	QA/QC Samples				Total # Samples	Analytical Parameter	Method	Preservative	Holding Times	Container
		TB	FB	DUP	MS/MSD						
Groundwater	1	1	1	1	1 / 1	6	VOCs	8260C	Cool to 4°C, HCL	14 days	(3) 40 mL amber glass vials
	1	0	1	1	1 / 1	5	SVOCs	8270D	Cool to 4°C	7 days to extraction, 40 days following extraction	(2) 1 L amber glass bottle
	1	0	1	1	1 / 1	5	Pesticides / Herbicides	8081B			(2) 1 L amber glass bottle
	1	0	1	1	1 / 1	5	PCBs	8082A			
	1	0	1	1	1 / 1	5	Total TAL Metals (plus Cyanide and Chromium)	200.7, 200.8, 245.2, 6010C, 6020A, 7470A, 7472, 9010C/9012B/ 9014, 7196A	Cool to 4°C, HNO3	24 hours for hexavalent chromium, 14 days for cyanide, 28 days for mercury, 180 days for all others	(2) Plastic 500 mL bottles, HNO_3 preserved
	1	0	1	1	1 / 1	5	Dissolved TAL Metals (plus Cyanide and Chromium)	200.7, 200.8, 245.2, 6010C, 6020A, 7470A, 7472, 9010C/9012B/ 9014, 7196A	Cool to 4°C		(1) 500 mL plastic bottle
	1	0	1	1	1 / 1	5	1,4-Dioxane	8270D-SIM Modified		7 days to extraction, 40 days following extraction	(2) 500 mL amber glass bottle
	1	0	1	1	1 / 1	5	PFAS	537	Cool to 4°C	14 days to extraction	(2) 250 mL HDPE bottle

Matrix	Proposed Samples	QA/QC Samples				Total # Samples	Analytical Parameter	Method	Preservative	Holding Times	Container
		TB	FB	DUP	MS/MSD						
Soil Vapor	16	0	0	0	0	16	VOCs	TO-15	None	30 days	(1) 2.7-L Summa
Ambient Air	1	0	0	0	0	1					(1) 6-L Summa

TB – Trip Blank
FB – Field Blank
DUP – Duplicate
°C – degrees Celsius
mL – milliliter
L – liter

3.12 Decontamination

Where possible, samples will be collected using new, dedicated sampling equipment so that decontamination is not required. All non-dedicated drilling tools and equipment will be decontaminated between boring locations using potable tap water and a phosphate-free detergent (e.g., Alconox) and/or a steam cleaner. All non-dedicated sampling equipment will also have a final rinse with deionized water. Decontamination water will be collected and disposed as investigation-derived waste (IDW).

3.13 Data Review and Reporting

The NYSDEC ASP Category B data package will be validated by an independent data validation subconsultant and a DUSR summarizing the results of the data validation process will be prepared. All reported analytical results will be qualified as necessary by the data validation and will be reviewed and compared against background concentrations and/or applicable New York State criteria:

Soil – Unrestricted Use and Restricted-Residential Use Soil Cleanup Objectives (SCOs) as listed in 6NYCRR Part 375 and NYSDEC's January 2021 PFAS Guidelines;
Groundwater – Class GA groundwater standards and guidance values for groundwater as listed in NYSDEC Technical and Operations Guidance Series (TOGS) 1.1.1 and NYSDEC's January 2021 PFAS Guidelines; and,
Soil Vapor – NYSDOH Matrices and ambient air concentrations.

A report documenting the Remedial Investigation will be prepared, and will describe Site conditions and document applicable observations made during the sample collection. In addition, the report will include a description of the sampling procedures, tabulated sample results and an assessment of the data and conclusions. The laboratory data packages, DUSR, geologic logs, well construction diagrams, and field notes will be included in the report as appendices. All data will also be submitted electronically to NYSDEC via the Environmental Information Management System (EIMS) in EqUIS format.

Appendix A

Resumes

Alana M. Carroll, PG
Senior Project Manager

PROFESSIONAL PROFILE

Ms. Alana Carroll is a professional geologist with experience managing a variety of environmental consulting projects in the New York metropolitan area and specializing in remedial investigations, conceptual site modeling, and remedial design and implementation. She provides analytical, technical, and regulatory guidance to clients, including developers and environmental attorneys, on a variety of projects in various stages of investigation, remediation, and redevelopment. Ms. Carroll has managed projects from inception through investigation, remediation, and closure in the New York State Brownfield Cleanup Program, the New York State Department of Environmental Conservation (NYSDEC) Spills and Voluntary Cleanup Programs, the New York State Superfund Program, and the New York City E-Designation Program.

CREDENTIALS AND PROFESSIONAL HONORS

New York State Licensed Professional Geologist #000979
Adjunct Professor, Manhattan College, School of Engineering
M.A., Earth and Environmental Sciences, Brooklyn College, New York
B.S., Geology, Hofstra University, Uniondale, New York

CONTINUING EDUCATION AND TRAINING

OSHA 10-Hour Construction Training (2015)
Hazardous Waste Operations and Emergency Response 40-Hour Certification
    (2004; refreshers 2005, 2006, 2007, 2009, 2010, 2011, 2012, 2013, 2014, and 2015)
First Aid and CPR Certified (2012)
Amtrak Contractor Safety Training (2010 and 2011)

PROFESSIONAL AFFILIATIONS

Member of Geologic Society of America
Member of New Partners for Community Revitalization

RELEVANT EXPERIENCE

New York State Brownfield Cleanup Program, Former West 18th Street MGP Site, Block 690, Lots 20 and 29, West Chelsea, Manhattan, New York—Successfully guided the client into the Brownfield Cleanup Program at the remediation stage. Prepared detailed remedial cost estimates for several redevelopment scenarios. Assisted in negotiating cleanup costs on behalf of the developer with the entity responsible for onsite contamination from former manufactured gas plant (MGP) operations. Designed and managed a pre-design investigation that delineated onsite coal tar impacts and differentiated petroleum impacts. Served on a team that designed an *in situ* stabilization treatability study. Prepared the Remedial Action Work Plan and Alternatives Analysis that included the excavation and removal of coal tar source material within two MGP gas holders and the encapsulation of residual coal tar. Performed an essential role on the construction and design team, coordinating with the structural, foundation, mechanical, and architectural contractors.

New York State Brownfield Cleanup Program, 520 West 28th Street, West Chelsea, Manhattan, New York—Managed several investigations to address New York State Spills, New York City E-Designation, and New York State Brownfield Cleanup programs. Prepared scopes of work to address requirements of both State and City regulatory agencies. Served as an essential member of the construction and design team, coordinating with the structural, foundation, mechanical, and architectural contractors. Managed access with adjacent property owners for full-scale excavation. Coordinated with State and City agencies for the satisfaction of air, noise, and hazardous waste requirements. Coordinated and managed the characterization and disposal of over 35,000 tons of hazardous material and historic fill. Designed and managed the remedial action necessary to obtain a successful Track 1 Cleanup. Assisted in negotiating a nuanced approach to support excavation that allowed for a Track 1 Cleanup. Prepared the final engineering report that expedited the certificate of completion.

New York State Brownfield Cleanup Program, Teitelbaum Dry Cleaner, Long Island City, New York—Designed and managed multiple onsite and offsite investigations to address NYSDEC and New York State Department of Health (NYSDOH) regulatory requirements with respect to chlorinated solvent impacts to groundwater and soil vapor. Designed and managed chlorinated solvent plume delineation and remediation in both groundwater and soil vapor. Prepared a technical memorandum on the fate and transport of the onsite chlorinated solvent groundwater plume that established limited liability for downgradient impacts and identified a secondary source. Coordinated with multiple adjacent parties for access. Designed a remedial approach for the site building that included source removal, groundwater injection, and a retro-fitted sub-slab depressurization system (SSDS).

Confidential Project, Steuben County, NY—Performed a forensic review and analysis of environmental records associated with five parcels of land that the State deemed as illegal solid waste dumps. Prepared and presented two technical arguments to NYSDEC and NYSDOH detailing illegal dumping, historic fill material, human health exposure pathways, bioavailability of historic fill constituents and remedial alternatives. Designed a full-scale remedial investigation of soil, groundwater and sediments for five parcels of historically industrial land.

New York City Voluntary Cleanup Program, Gallery Row, West Chelsea, Manhattan, New York—Managed multiple investigations over five tax lots to address New York City E-Designation and Voluntary Cleanup Program requirements. Designed a remedial action that incorporates a phased and targeted excavation below Highline Park. Coordinated with State and City agencies for the satisfaction of air, noise, and hazardous waste requirements. Served as an integral part of the construction and design team.

New York State Brownfield Cleanup Program, Former Nu-Brite Dry Cleaner, 1299 First Avenue, East Side, Manhattan, New York—Designed and managed multiple investigations to address onsite chlorinated solvent impacts to soil, groundwater, and soil vapor. Site challenges included investigation and remedial action within existing, occupied building sites. Designed and managed a bedrock fracture investigation to address potential impacts to bedrock. Designed and managed offsite delineation of chlorinated solvent plume in soil vapor. Directed multiple offsite soil vapor investigations within adjacent properties; assisted in negotiating several nuanced access agreements. Managed an onsite interim remedial measure including the installation of a retro coat vapor barrier and retro-fitted SSDS within the site building.

New York State Brownfield Cleanup Program, 34th Street and 42nd Street, West Side, Manhattan, New York—Designed and managed multiple investigations to address New York State Spills and Brownfield Cleanup programs. Prepared scopes of work to address requirements of both state regulations and those agreed to by the former owner. Coordinated with NYSDEC to modify scopes based on field observations and limitations, which resulted in not having to mobilize for additional investigations. Coordinated with multiple entities for access to perform investigations, including Javits Convention Center, Amtrak, New York City Department of Transportation, Metropolitan Transit Authority, and their contractors. Developed a three-phase analysis plan with the laboratory to determine the minimum required extent of excavation next to an Amtrak line while limiting analytical costs, decreasing in the extent of excavation, and lowering disposal and structural support requirement costs.

New York State Brownfield Cleanup Program, 388 Bridge Street, Downtown Brooklyn, New York—Designed and managed all onsite and offsite investigations of soil, soil gas, groundwater, and indoor air, including coordination of staff and subcontractors. Prepared investigation reports for submittal to client, project team, NYSDEC, and NYSDOH. Participated in project team decision making with clients, lawyers, construction manager, and other consultants. Managed New York City Transit approvals for subsurface investigations near subway lines. Coordinated offsite access in residences, commercial spaces, and a private school. Participated in soil vapor extraction pilot test implementation and reporting. Assisted with implementation of an offsite SSDS in an existing building; activities included system design/layout, installation oversight, testing, and long-term operation and maintenance. Responsible for NYSDEC/NYSDOH coordination and reporting for all investigations. Tracked project activities for inclusion in NYSDEC/NYSDOH programmatic submittals, including monthly reports and remedial schedules.

New York Department of Environmental Remediation, Class 2 State Superfund, Laurel Hill Site, Queens, New York—Managed multiphase, multiparcel project involving design, installation, and ongoing operation, maintenance, and monitoring of six remedial caps. Site challenges included the division of the site into individual parcels that were independent of one another; subsequently, each parcel had a stormwater management design individual to the surrounding parcels. Other challenges included the site's position in a wetlands area fronting Newtown Creek, and working with the New York City Department of Transportation to facilitate its schedule for the adjacent Kosciusko Bridge restoration.

New York State Brownfield Cleanup Program, Willets Point Development, Queens, New York—Managed the Brownfield Cleanup Program application and Phase I environmental site assessment effort for 45 parcels of industrialized land. Coordinated with multiple interested parties, including New York City Department of Housing Preservation and Development and the Economic Development Corporation for access and contracting.

New York State Brownfield Cleanup Program, Uniforms for Industry, Queens, New York—Designed and managed an alternative approach to the offsite soil vapor intrusion investigation. Utilized soil vapor modeling to evaluate potential human health risks and migration probabilities. Provided support for the design of a retrofitted passive venting system.

New York State Spills Program, Gotham Center, Queens, New York—Responsible for proposal and budget development, subcontractor selection and coordination, negotiation, and preparation of subcontractor terms and agreements, budget, and invoice review for a comprehensive subsurface investigation. Prepared and implemented scope of work for delineation of soil contamination and calculation of contaminant mass estimates. Subsequent to interpretation of site data and subgrade characteristics, developed and presented remedial alternatives and associated costs for internal and client project teams. Prepared remedial investigation report in coordination with the New York City Economic Development Corporation and the client for submittal to state regulators.

Mohamed Ahmed, Ph.D., C.P.G.
Sr. Geologist/Principal

Experience Summary

Mohamed Ahmed is a certified professional geologist with nearly 23 years of experience in the New York City metropolitan area. He has designed and implemented subsurface investigations and is proficient in groundwater modeling, design of groundwater treatment systems and soil remediation. He has managed numerous projects focused on compliance with the New York State Brownfield Cleanup and Spills programs and the New York City "e" designation program. Dr. Ahmed also has extensive experience in conducting regulatory negotiations with the New York State Department of Environmental Conservation, the NYC Office of Housing Preservation and Development, and the Mayor's Office of Environmental Remediation.

Selected Project Experience

Willoughby Square, Downtown Brooklyn
As Project Manager, directs all regulatory interaction and investigation on this joint public-private sector redevelopment that will include a public park and four-level underground parking garage. Prepared the remedial investigation work plan and remedial action work plan, conducted investigation activities and waste characterization, and negotiated with the NYC Department of Environmental Protection and the Mayor's Office of Environmental Remediation to transition the site into the NYC Voluntary Cleanup Program.

School Facility, Borough Park, Brooklyn
Managed all regulatory agency coordination, work plan and report preparation and remedial oversight; worked with OER to determine measures to retroactively address the hazardous materials and air quality E-designations on a previously constructed school building and prepared supporting documentation to justify the use of electrical units rather than natural gas.

LGA Hotel Site, East Elmhurst, Queens
Project manager for all work conducted at this former gasoline service station which is being remediated under the NYS Brownfield Cleanup Program; technical oversight of work plans, reports, and design and implementation of field and soil disposal characterization.

436 10th Avenue, Manhattan
As project manager and technical lead, assisted client in developing remedial cost estimates used for property transaction, developed regulatory strategy to address NYS Spills and NYC E-designation requirements, and currently overseeing remedial activities which include removal and disposal of petroleum-contaminated bedrock and dewatering and disposal of impacted groundwater.

Brownfield Cleanup Program Site, Downtown Brooklyn
Managed investigation and remediation under the BCP program for a proposed mixed-use development; designed the remedial investigation and prepared the remedial action work plan which includes an SVE system monitored natural attenuation. Prepared remedial cost

estimates for several scenarios. The project will include a 53-story mixed-use structure and parking garage.

Queens West Development, Long Island City
Directed project team and subcontractors for soil investigation/remediation studies on multiple properties; provided technical support for negotiations with NYSDEC during investigation and remediation.

Former Creosote Site, Long Island City
Designed and implemented a complex investigation to assess the nature and extent of historic creosote contamination at this former industrial site; conducted studies to optimize recovery of LNAPL and DNAPL and developed strategies using bioremediation and natural attenuation in conjunction with conventional remedial approaches. Performed pilot tests for soil vapor extraction system design and coordinated with NYSDEC and NYSDOH to implement sub-slab soil vapor sampling.

NYSDEC Spill Site – Far West Side, Manhattan
Developed a detailed remedial cost estimate for to support client negotiations with a major oil company. The estimate included costs pertaining to: chipping, removal and disposal of petroleum-impacted bedrock; removal/disposal of recycled concrete; costs for dewatering and disposal of impacted groundwater during construction; and design and installation of a vapor barrier below the redevelopment.

Active Industrial Facility, Newburgh, New York
Designed remedial investigation of soil and groundwater contaminated with trichloroethane; performed soil vapor pilot test and pump test to aid in design of soil and groundwater remediation alternatives; conducted sub-slab vapor sampling in accordance with NYSDOH guidance.

Former Dry Cleaning Facility, New York City
Conducted soil and groundwater investigations, designed and installed a soil vapor extraction system and performed extensive testing of indoor air. Negotiated the scope of the RI and IRM with NYSDEC.

Waterfront Redevelopment, Yonkers, NY
Designed and performed geophysics survey of six parcels to determine locations of subsurface features; supervised test pit excavation to confirm geophysics results and evaluate and classify soil conditions prior to development activities.

Prince's Point, Staten Island, New York
Performed soil, groundwater and sediment sampling to delineate the extent of contamination; used field-screening techniques to control analytical costs and supervised soil excavation and disposal.

Apartment Complex, New York City, New York
Coordinated with Con Edison, the owner of the adjacent property and NYSDEC to determine oil recovery protocol; assessed hydrogeological conditions and conducted pilot tests to design cost-effective recovery system; designed and supervised installation of recovery system.

Publications

“Impact of Toxic Waste Dumping on the Submarine Environment: A Case Study from the New York Bight”. Northeastern Geology and Environmental Sciences, V. 21, No. 12, p. 102-120. (With G. Friedman)

Metals Fluxes Across the Water/Sediment Interface and the Influence of pH. Northeastern Geology and Environmental Sciences, in press. (With G. Friedman)

“Water and Organic Waste Near Dumping Ground in the New York Bight”. International Journal of Coal Geology, volume 43. (With G. Friedman)

Education and Certifications

Ph.D., Earth and Environmental Sciences, Graduate Center of the City of New York (2001)
M.Ph., Earth and Environmental Sciences, City University of New York (1998)
M.A. Geology, Brooklyn College (1993)
B.S. Geology, Alexandria University, Egypt (1982)

American Institute of Professional Geologists, Certified Professional Geologist, 1997-2015

Matthew Carroll, P.E.
Environmental Engineer/Principal

Experience Summary

Matthew Carroll is an environmental engineer experienced in all aspects of site assessment and development and implementation of remedial strategies. He has managed projects from inception through investigation, remediation and closure. His expertise includes soil, soil gas, and groundwater remediation, preparation of cost estimates, remedial alternative selection and design, soil characterization for disposal, field safety oversight, and preparation of work plans and reports to satisfy New York and New Jersey state requirements, and New York City "e" designation and restrictive declarations. Mr. Carroll's project management experience includes past management of a New York City School Construction Authority hazardous materials contract. He is responsible for all engineering work performed by Tenen and is currently the project manager and remedial engineer for several New York State Brownfield Cleanup Program sites.

Selected Project Experience

470 Kent Avenue, Brooklyn

As project manager, supported the client in due diligence and transactional activities, including a Phase I ESA, preliminary site investigation, and remedial cost estimate; preparation of BCP application and remedial investigation work plan. The former manufactured gas plant, sugar refinery and lumberyard will be developed as a mixed-use project with market rate and affordable housing and public waterfront access. As remedial engineer, will be responsible for development of remedial alternatives and oversight and certification of all remedial activities.

500 Exterior Street, Bronx

Designed and implemented the investigation of this former lumberyard and auto repair shop that will be redeveloped as mixed use development with an affordable housing component; prepared BCP application and subsequent work plans and reports. Designed a remedial strategy incorporating both interim remedial measures (IRMs) and remediation during the development phase.

Gateway Elton I and II, Brooklyn

Conducted soil disposal characterization, prepared Remedial Action Work Plans and designed methane mitigation systems for two phases of a nine-building residential development and commercial space; prepared and oversaw implementation of a Stormwater Pollution Prevention Plan during construction and prepared and certified the remedial closure reports for the project.

Affordable Housing Development, Rye, NY

Consultant to the City of Rye on environmental issues pertaining to a county-owned development site slated for an afford senior housing; reviewed environmental documentation for the project and prepared summary memorandum for City Council review; recommended engineering controls to address potential exposure to petroleum constituents, presented report findings at public meetings and currently providing ongoing environmental support during project implementation.

Queens West Development BCP Site, Long Island City, New York
Assistant Project Manager for two developers involved in the site.

- Responsible for oversight of remediation under the New York State Brownfield Cleanup Program
- Technical review of work plans and reports and coordination of the Applicant's investigation and oversight efforts
- Provided input for mass calculations and well placement for an in-situ oxidation remedy implemented on a proposed development parcel and within a City street
- Conducted technical review of work pertaining to a former refinery. Documents reviewed included work plans for characterization and contaminant delineation; pilot test (chemical oxidation); remediation (excavation and groundwater treatment). Managed field personnel conducting full time oversight and prepared progress summaries for distribution to project team
- Following implementation of remedial action, implemented the Site Management Plan and installation/design of engineering controls (SSDS, vapor barrier/concrete slab, NAPL recovery). Also responsible for coordination with NYSDEC

Brownfield Cleanup Program Redevelopment Sites – West Side, New York City
Managed remediation of a development consisting of four parcels being addressed under one or more State and city regulatory programs (NYS Brownfield Cleanup Program, NYS Spills, and NYC "e" designation program). Remediation includes soil removal, screening and disposal; treatment of groundwater during construction dewatering and implementation of a worker health and safety plan and community air monitoring plan (HASP/CAMP)

Managed an additional BCP site, supported the Applicant in coordination with MTA to create station access for the planned No. 7 subway extension; also provided support the client in coordination with Amtrak to obtain access for remedial activities on the portion of the site that is within an Amtrak easement. The site will eventually be used for construction of a mixed-use high-rise building.

BCP Site, Downtown Brooklyn, New York
Performed investigation on off-site properties and designed an SSDS for an adjacent building, retrofitting the system within the constraints of the existing structure; coordinated the installation of the indoor HVAC controls and vapor barrier; provided input to the design of a SVE system to address soil vapor issues on the site.

West Chelsea Brownfield Cleanup Program Site
Designed an in-situ remediation program and sub-slab depressurization system to address contamination remaining under the High Line Viaduct; SSDS design included specification of sub-grade components, fan modeling and selection, identifying exhaust location within building constraints and performance modeling; prepared the Operations Maintenance and Monitoring Plan and Site Management Plan sections pertaining to the SSDS.

Historic Creosote Spill Remediation – Queens, New York – New York State Voluntary Cleanup Program
Modeled contamination volume and extent and prepared mass estimates of historic fill constituents and creosote-related contamination; designed a soil vapor extraction (SVE) and dewatering system to address historic creosote release both above and below static

water table; coordinated with the Metropolitan Transit Authority and prepared drawings to secure approval to drill in the area of MTA subway tunnels.

NYSDEC Spill Site– Far West Side, Manhattan
Provided support to client during negotiations with a major oil company regarding allocation of remedial costs. Worked with client's attorney to develop a regulatory strategy to address the client's obligations under the NYSDEC Spills Program and the New York City "e" designation requirements.

Affordable Housing Site, Brooklyn, New York
Modified prior work plans for soil, soil vapor and groundwater investigation to address requirements for site entry into the New York City Brownfield Cleanup Program. Prepared technical basis for use of prior data previously disallowed by OER. Currently conducting site investigation.

New York City School Construction Authority Hazardous Materials Contract
Provided work scopes and cost estimates, managed and implemented concurrent projects, including Phase I site assessments, Phase II soil, groundwater and soil gas investigations, review of contractor bid documents, preparation of SEQR documents, specifications and field oversight for above- and underground storage tank removal, and emergency response and spill control.

Former Manufacturing Facility, Hoboken, New Jersey
Evaluated site investigation data to support a revision of the current property use to unrestricted; modified the John & Ettinger vapor intrusion model to apply the model to a site-specific, mixed use commercial/residential development; implemented a Remedial Action Work Plan that included the characterization, removal and separation of 9,500 cubic yards of historic fill; designed and implemented a groundwater characterization/delineation program using a real-time Triad approach; designed and implemented an innovative chemical oxidation technology for the property.

F**ormer Varnish Manufacturer – Newark, New Jersey**
Prepared a Phase I environmental site assessment; implemented soil and groundwater sampling to assess presence of petroleum and chlorinated compounds; prepared alternate cost remediation scenarios for settlement purposes and implemented a groundwater investigation plan, including pump tests and piezometer installation to assess the effect of subsurface utilities and unique drainage pathways upon contaminant transport.

Education and Certifications

Professional Engineer, New York
Bachelor of Engineering, Environmental; Stevens Institute of Technology, 2002
Bachelor of Science, Chemistry, New York University, 2002
Technical and Regulatory Training in Underground Storage Tanks, Cook College, Rutgers University, 2006

L.A.B. Validation Corp., 14 West Point Drive, East Northport, New York 11731

Lori A. Beyer

SUMMARY: General Manager/Laboratory Director with a solid technical background combined with Management experience in environmental testing industry. Outstanding organizational, leadership, communication and technical skills. Customer focused, quality oriented professional with consistently high marks in customer/employee satisfaction.

EXPERIENCE:

1998-Present L.A.B. Validation Corporation, 14 West Point Drive, East Northport, NY
President

- Perform Data Validation activities relating to laboratory generated Organic and Inorganic Environmental Data.

1998-Present American Analytical Laboratories, LLC. 56 Toledo Street, Farmingdale, NY
Laboratory Director/Technical Director

- Plan, direct and control the operation, development and implementation of programs for the entire laboratory in order to meet AAL's financial and operational performance standards.
- Ensures that all operations are in compliance with AAL's QA manual and other appropriate regulatory requirements.
- Actively maintains a safe and healthy working environmental that is demanded by local laws/regulations.
- Monitors and manages group's performance with respect to data quality, on time delivery, safety, analyst development/goal achievement and any other key performance indices.
- Reviews work for accuracy and completeness prior to release of results to customers.

1996-1998 Nytest Environmental, Inc. (NEI) Port Washington, New York
General Manager

- Responsible for controlling the operation of an 18,000 square foot facility to meet NEI's financial and operational performance standards.
- Management of 65 FTEs including Sales and Operations
- Ensure that all operations are in compliance with NEI's QA procedures
- Ensures that productivity indicators, staffing levels and other cost factors are held within established guidelines
- Maintains a quantified model of laboratory's capacity and uses this model as the basis for controlling the flow of work into and through the lab so as to ensure that customer requirements and lab's revenue and contribution targets are achieved.

1994-1996 Nytest Environmental, Inc. (NEI) Port Washington, New York
Technical Project Manager

- Responsible for the coordination and implementation of environmental testing programs requirements between NEI and their customers
- Supervise Customer Service Department
- Assist in the development of major proposals
- Complete management of all Federal and State Contracts and assigned commercial contracts
- Provide technical assistance to the customer, including data validation and interpretation
- Review and Implement Project specific QAPP's.

1995-1996 Nytest Environmental, Inc. (NEI) Port Washington, New York
Corporate QA/QC Officer

- Responsible for the implementation of QA practices as required in the NJDEP and EPA Contracts
- Primary contact for NJDEP QA/QC issues including SOP preparation, review and approval
- Responsible for review, verification and adherence to the Contract requirements and NEI QA Plan

1992-1994 Nytest Environmental, Inc. (NEI) Port Washington, New York
Data Review Manager

- Responsible for the accurate compilation, review and delivery of analytical data to the company's customers. Directly and effectively supervised a department of 22 personnel.
- Managed activities of the data processing software including method development, form creation, and production
- Implement new protocol requirements for report and data management formats
- Maintained control of data storage/archival areas as EPA/CLP document control officer

1987-1991 Nytest Environmental, Inc. (NEI) Port Washington, New York
Data Review Specialist

- Responsible for the review of GC, GC/MS, Metals and Wet Chemistry data in accordance with regulatory requirements
- Proficient with USEPA, NYSDEC, NJDEP and NEESA requirements
- Review data generated in accordance with SW846, NYSDEC ASP, EPA/CLP and 40 CFR Methodologies

1986-1987 Nytest Environmental, Inc (NEI) Port Washington, New York
GC/MS VOA Analyst

EDUCATION:

1982-1985 State University of New York at Stony Brook, New York; BS Biology/Biochemistry
1981-1982 University of Delaware; Biology/Chemistry
5/91 Rutgers University; Mass Spectral Data Interpretation Course, GC/MS Training
8/92 Westchester Community College; Organic Data Validation Course
9/93 Westchester Community College; Inorganic Data Validation Course

Westchester Community College
Professional Development Center

Awards this Certificate of Achievement To

LORI BEYER

for Successfully Completing

ORGANIC DATA VALIDATION COURSE (35 HOURS)

Dr. John Samuelian

Date AUGUST 1992

Assistant Dean
Professional Development Center

President

The Professional
Development Center

SUNY
WESTCHESTER COMMUNITY COLLEGE
Valhalla, New York 10595

Westchester Community College
Professional Development Center

Awards this Certificate of Achievement To

LORI BEYER

for Successfully Completing

INORGANIC DATA VALIDATION

Instructor: Dale Boshart

Date **MARCH 1993**

Assistant Dean
Professional Development Center

President

The Professional
Development Center

SUNY
WESTCHESTER COMMUNITY COLLEGE
Valhalla, New York 10595

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Thomas C. Jorling
Commissioner

July 8, 1992

Ms. Elaine Sall
Program Coordinator
Westchester Community College
Valhalla, NY 10595-1698

Dear Elaine,

Thank you for your letter of June 29, 1992. I have reviewed the course outline for organic data validation, qualifications for teachers and qualifications for students. The course that you propose to offer would be deemed equivalent to that which is offered by EPA. The individuals who successfully complete the course and pass the final written exam would be acceptable to perform the task of organic data validation for the Department of Environmental Conservation, Division of Hazardous Waste Remediation.

As we have discussed in our conversation of July 7, 1992, you will forward to me prior to the August course deadline, the differences between the EPA SOW/90 and the NYSDEC ASP 12/91. You stated these differences will be compiled by Mr. John Samulian.

I strongly encourage you to offer an inorganic data validation course. I anticipate the same list of candidates would be interested in an inorganic validation course as well, since most of the data to be validated consists of both organic and inorganic data.

Thank you for you efforts and please contact me if I can be of any further assistance.

Sincerely,

Maureen P. Serafini

Maureen P. Serafini
Environmental Chemist II
Division of Hazardous Waste
Remediation

The Professional Development Center
AT
WESTCHESTER COMMUNITY COLLEGE

914 285-6619

October 2, 1992

Ms. Lori Beyer
3 sparkill Drive
East Northport, NY 11731

Dear Ms. Beyer:

Congratulations upon successful completion of the Organic Data Validation course held August 17 - 21, 1992, through Westchester Community College, Professional Development Center. This course has been deemed by New York State Department of Environmental Conservation as equivalent to EPA's Organic Data Validation Course.

Enclosed is your Certificate. Holders of this Certificate are deemed competent to perform organic data validation for the New York State DEC Division of Hazardous Waste Remediation.

The Professional Development Center at Westchester Community College plans to continue to offer courses and seminars which will be valuable to environmental engineers, chemists and related personnel. Current plans include a TCLP seminar on November 17th and a conference on Environmental Monitoring Regulations on November 18th.

We look forward to seeing you again soon at another environmental program or event. Again, congratulations.

Very truly yours,

Passing Grade is 70%
Your Grade is 99%

Elaine Sall
Program Coordinator

ES/bf

SUNY
WESTCHESTER COMMUNITY COLLEGE
Valhalla, New York 10595

The Professional
Development Center
AT
WESTCHESTER COMMUNITY COLLEGE

914 285-6619

June 21, 1993

Dear Ms. Beyer:

Enclosed is your graded final examination in the Inorganic Data Validation course you completed this past March. A score of 70% was required in order to receive a certificate of satisfactory completion. Persons holding this certificate are deemed acceptable to perform Inorganic Data Validation for the New York State Department of Environmental Conservation, Division of Hazardous Waste Remediation.

I am also enclosing a course evaluation for you to complete if you have not already done so. The information you provide will greatly aid us in structuring further courses. We wish to make these course offerings as relevant, targeted and comprehensive as possible. Your evaluation is vital to that end.

Congratulations on your achievement. I look forward to seeing you again at another professional conference or course. We will be co-sponsoring an environmental monitoring conference on October 21, 1993 with the New York Water Pollution Control Association, Lower Hudson Chapter, at IBM's Yorktown Heights, NY site. Information regarding this event will be going out in August.

Very truly yours,

Elaine Sall

Elaine Sall
Program Coordinator

ES/bf

Enclosures

SUNY
WESTCHESTER COMMUNITY COLLEGE
Valhalla, New York 10595

Appendix B

EPA 537 Field Sampling Guidelines

EPA 537 (PFAS) Field Sampling Guidelines

PLEASE READ INSTRUCTIONS ENTIRELY PRIOR TO SAMPLING EVENT

Sampling for PFAS via EPA 537 can be challenging due to the prevalence of these compounds in consumer products. The following guidelines are strongly recommended when conducting sampling.

Reference-NHDES https://www.des.nh.gov/organization/divisions/waste/hwrb/documents/pfc-stakeholder-notification-20161122.pdf

FIELD CLOTHING and PPE

- No clothing or boots containing Gore-Tex®
- All safety boots made from polyurethane and PVC
- No materials containing Tyvek®
- Do not use fabric softener on clothing to be worn in field
- Do not used cosmetics, moisturizers, hand cream, or other related products the morning of sampling
- Do not use unauthorized sunscreen or insect repellant (see reference above for acceptable products)

SAMPLE CONTAINERS

- All sample containers made of HDPE or polypropylene
- Caps are unlined and made of HDPE or polypropylene (no Teflon® -lined caps)

WET WEATHER (AS APPLICABLE)

Wet weather gear made of polyurethane and PVC only

EQUIPMENT DECONTAMINATION

- "PFAS-free" water on-site for decontamination of sample equipment. No other water sources to be used
- Only Alconox and Liquinox can be used as decontamination materials

FOOD CONSIDERATIONS

No food or drink on-site with exception of bottled water and/or hydration drinks (i.e., Gatorade and Powerade) that is available for consumption only in the staging area

OTHER RECOMMENDATIONS

Sample for PFAS first! Other containers for other methods may have PFAS present on their sampling containers

FIELD EQUIPMENT

- Must not contain Teflon® (aka PTFE) or LDPE materials
- All sampling materials must be made from stainless steel, HDPE, acetate, silicon, or polypropylene
- No waterproof field books can be used
- No plastic clipboards, binders, or spiral hard cover notebooks can be used
- No adhesives (i.e. Post-It® Notes) can be used
- Sharpies and permanent markers not allowed; regular ball point pens are acceptable
- Aluminum foil must not be used
- Keep PFC samples in separate cooler, away from sampling containers that may contain PFAS
- Coolers filled with regular ice only - Do not use chemical (blue) ice packs

EPA 537 (PFAS) Field Sampling Guidelines

PLEASE READ INSTRUCTIONS ENTIRELY PRIOR TO SAMPLING EVENT

Sampler must wash hands before wearing nitrile gloves in order to limit contamination during sampling. Each sample set requires a set of containers to comply with the method as indicated below. **Sample set is composed of samples collected from the same sample site and at the same time.*

Container Count	Container Type	Preservative
3 Sampling Containers - Empty	250 mL container	Pre preserved with 1.25 g Trizma
1 Reagent Water for Field Blank use	250 mL container	Pre preserved with 1.25 g Trizma
P1 Field Blank (FRB) - Empty	250 mL container	Unpreserved

Sampling container must be filled to the neck. For instructional purposes a black line has been drawn to illustrate the required fill level for each of the 3 Sample containers

Field blanks are recommended and the containers have been provided, please follow the instructions below.

Field Blank Instructions:

1. Locate the Reagent Water container from the bottle order. The Reagent Water container will be pre-filled with PFAS-free water and is preserved with Trizma.
2. Locate the empty container labeled "Field Blank".
3. Open both containers and proceed to transfer contents of the "Reagent Water" container into the "Field Blank" container.
4. If field blanks are to be analyzed, they need to be noted on COC, and will be billed accordingly as a sample.

Both the empty Reagent Water container and the filled Field Blank container must be returned to the lab along with the samples taken.

Sampling Instructions:

1. Each sampling event requires 3 containers to be filled to the neck of the provided containers for each sampling location.
2. Before sampling, remove faucet aerator, run water for 5 min, slow water to flow of pencil to avoid splashing and fill sample containers to neck of container (as previously illustrated) and invert 5 times.
3. Do not overfill or rinse the container.
4. Close containers securely. Place containers in sealed ZipLoc® bags, and in a separate cooler (no other container types).
5. Ensure Chain-of-Custody and all labels on containers contain required information. Place sample, Field Blank and empty Reagent Blank containers in ice filled cooler (do not use blue ice) and return to the laboratory. Samples should be kept at 4°C ±2. Samples must not exceed 10°C during first 48 hours after collection. Hold time is 14 days.

Please contact your Alpha Analytical project manager with additional questions or concerns.

Appendix C

PFAS Compounds to be Analyzed and Associated MDLs

Appendix C

PFAS Compounds to be Analyzed and Associated MDLs

Analyte	Soil MDL (ng/g)	Groundwater MDL (ng/l)
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	0.275	0.2908
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	0.198	0.194
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	0.09	0.3728
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	0.103	0.2504
Perfluorobutanesulfonic Acid (PFBS)	0.0635	0.38
Perfluorobutanoic Acid (PFBA)	0.0213	0.3732
Perfluorodecanesulfonic Acid (PFDS)	0.097	0.386
Perfluorodecanoic Acid (PFDA)	0.072	0.62
Perfluorododecanoic Acid (PFDoA)	0.086	0.592
Perfluoroheptanesulfonic Acid (PFHpS)	0.136	0.52
Perfluoroheptanoic Acid (PFHpA)	0.064	0.372
Perfluorohexanesulfonic Acid (PFHxS)	0.057	0.436
Perfluorohexanoic Acid (PFHxA)	0.064	0.492
Perfluorononanoic Acid (PFNA)	0.083	0.436
Perfluorooctanesulfonamide (FOSA)	0.1025	0.556
Perfluorooctanesulfonic Acid (PFOS)	0.1205	0.56
Perfluorooctanoic Acid (PFOA)	0.04105	0.46
Perfluoropentanoic Acid (PFPeA)	0.01035	0.464
Perfluorotetradecanoic Acid (PFTA)	0.07	0.988
Perfluorotridecanoic Acid (PFTrDA)	0.062	0.314
Perfluoroundecanoic Acid (PFUnA)	0.056	0.424

Appendix D

Laboratory Standard Operating Procedures for PFAS Analysis

Determination of Selected Perfluorinated Alkyl Substances by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry Isotope Dilution (LC/MS/MS)

Reference: EPA Method 537, Version 1.1, September 2009, EPA Document #: EPA/600/R-08/09

EPA Method 537.1, Version 1, November 2018, EPA Document #: EPA/600/R-18/352

Department of Defense, Quality Systems Manual for Environmental Laboratories, Version 5.2, .2019

1. Scope and Application

Matrices: Drinking water, Non-potable Water, and Soil Matrices

Definitions: Refer to Alpha Analytical Quality Manual.

1.1 This is a liquid chromatography/tandem mass spectrometry (LC/MS/MS) method for the determination of selected perfluorinated alkyl substances (PFAS) in Non-Drinking Water and soil Matrices. Accuracy and precision data have been generated in reagent water, and finished ground and surface waters for the compounds listed in Table 1.

1.2 The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one or more of the following laboratory personnel before performing the modification: Area Supervisor, Department Supervisor, Laboratory Director, or Quality Assurance Officer.

1.3 This method is restricted to use by or under the supervision of analysts experienced in the operation of the LC/MS/MS and in the interpretation of LC/MS/MS data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability.

2. Summary of Method

2.1 A 250-mL water sample is fortified with extracted internal standards (EIS) and passed through a solid phase extraction (WAX) cartridge containing a mixed mode, Weak Anion Exchange, reversed phase, water-wettable polymer to extract the method analytes and isotopically-labeled compounds. The compounds are eluted from the solid phase in two fractions with methanol followed by a small amount of 2% ammonium hydroxide in methanol solution. The extract is concentrated with nitrogen in a heated water bath, and then adjusted to a 1-mL volume with 80:20% (vol/vol) methanol:water. A 3 µl injection is made into an LC equipped with a C18 column that is interfaced to an MS/MS. The analytes are separated and identified by comparing the acquired mass spectra and retention times to reference spectra and retention times for calibration standards acquired under identical LC/MS/MS conditions. The concentration of each analyte is determined by using the isotope dilution technique. Extracted Internal Standards (EIS) analytes are used to monitor the extraction efficiency of the method analytes.

2.2 Method Modifications from Reference

None.

Table 1

Parameter	Acronym	CAS
PERFLUOROALKYL ETHER CARBOXYLIC ACIDS (PFECAs)		
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid	HFPO-DA	62037-80-3
4,8-dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
PERFLUOROALKYLCARBOXILIC ACIDS (PFCAs)		
Perfluorobutanoic acid	PFBA	375-22-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorohexanoic acid	PFHxA *	307-24-4
Perfluoroheptanoic acid	PFHpA *	375-85-9
Perfluorooctanoic acid	PFOA *	335-67-1
Perfluorononanoic acid	PFNA *	375-95-1
Perfluorodecanoic acid	PFDA *	335-76-2
Perfluoroundecanoic acid	PFUnA *	2058-94-8
Perfluorododecanoic acid	PFDoA *	307-55-1
Perfluorotridecanoic acid	PFTrDA *	72629-94-8
Perfluorotetradecanoic acid	PFTA *	376-06-7
Perfluorohexadecanoic acid	PFHxDA	67905-19-5
Perfluorooctadecanoic acid	PFODA	16517-11-6
PERFLUOROALKYLSULFONATES (PFASs)		
Perfluorobutanesulfonic acid	PFBS *	375-73-5
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluorohexanesulfonic acid	PFHxS *	355-46-4
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorooctanesulfonic acid	PFOS *	1763-23-1
Perfluorononanesulfonic acid	PFNS	68259-12-1
Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluorododecanesulfonic acid	PFDoS	79780-39-5

*** also reportable via the standard 537 method**

Table 1 Cont.

Parameter	Acronym	CAS
CHLORO-PERFLUOROALKYLSULFONATE		
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
PERFLUOROOCTANESULFONAMIDES (FOSAs)		
Perfluorooctanesulfonamide	PFOSA	754-91-6
N-methylperfluoro-1-octanesulfonamide	NMeFOSA	31506-32-8
N-ethylperfluoro-1-octanesulfonamide	NEtFOSA	4151-50-2
TELOMER SULFONATES		
1H,1H,2H,2H-perfluorohexane sulfonate (4:2)	4:2FTS	27619-93-8
1H,1H,2H,2H-perfluorooctane sulfonate (6:2)	6:2FTS	27619-97-2
1H,1H,2H,2H-perfluorodecane sulfonate (8:2)	8:2FTS	39108-34-4
1H,1H,2H,2H-perfluorododecane sulfonate (10:2)	10:2FTS	120226-60-0
PERFLUOROOCTANESULFONAMIDOACETIC ACIDS		
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA *	2355-31-9
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA *	2991-50-6
NATIVE PERFLUOROOCTANESULFONAMIDOETHANOLS (FOSEs)		
2-(N-methylperfluoro-1-octanesulfonamido)-ethanol	NMeFOSE	24448-09-7
2-(N-ethylperfluoro-1-octanesulfonamido)-ethanol	NEtFOSE	1691-99-2

*** also reportable via the standard 537 method**

3. Reporting Limits

The reporting limit for PFAS's is 2 ng/L for aqueous samples (20 ng/L for HFPO-DA) and 1 ng/g (10 ng/g for HFPO-DA) for soil samples.

4. Interferences

4.1 PFAS standards, extracts and samples should not come in contact with any glass containers or pipettes as these analytes can potentially adsorb to glass surfaces. PFAS analyte and EIS standards commercially purchased in glass ampoules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene containers.

4.2 Method interferences may be caused by contaminants in solvents, reagents (including reagent water), sample bottles and caps, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. The method analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) products, LC solvent lines, methanol, aluminum foil, SPE sample transfer lines, etc. All items such as these must be routinely demonstrated to be free from interferences (less than 1/3 the RL for each method analyte) under the conditions of the analysis by analyzing laboratory reagent blanks as described in Section 9.2. **Subtracting blank values from sample results is not permitted.**

4.3 Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature of the water. Humic and/or fulvic material can be co-extracted during SPE and high levels can cause enhancement and/or suppression in the electrospray ionization source or low recoveries on the SPE sorbent. Total organic carbon (TOC) is a good indicator of humic content of the sample.

4.4 SPE cartridges can be a source of interferences. The analysis of field and laboratory reagent blanks can provide important information regarding the presence or absence of such interferences. Brands and lots of SPE devices should be tested to ensure that contamination does not preclude analyte identification and quantitation.

5. Health and Safety

5.1 The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material safety data sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

5.2 All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

5.3 PFOA has been described as “likely to be carcinogenic to humans.” Pure standard materials and stock standard solutions of these method analytes should be handled with suitable protection to skin and eyes, and care should be taken not to breathe the vapors or ingest the materials.

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection for Aqueous Samples

6.1.1 Samples must be collected in two (2) 250-mL high density polyethylene (HDPE) container with an unlined plastic screw cap.

6.1.2 The sample handler must wash their hands before sampling and wear nitrile gloves while filling and sealing the sample bottles. PFAS contamination during sampling can occur from a number of common sources, such as food packaging and certain foods and beverages. Proper hand washing and wearing nitrile gloves will aid in minimizing this type of accidental contamination of the samples.

6.1.3 Open the tap and allow the system to flush until the water temperature has stabilized (approximately 3 to 5 min). Collect samples from the flowing system.

6.1.4 Fill sample bottles. Samples do not need to be collected headspace free.

6.1.5 After collecting the sample and cap the bottle. Keep the sample sealed from time of collection until extraction.

6.1.6 Field Reagent Blank (FRB)

6.1.6.1 A FRB must be handled along with each sample set. The sample set is composed of samples collected from the same sample site and at the same time. At the laboratory, fill the field blank sample bottle with reagent water and preservatives, seal, and ship to the sampling site along with the sample bottles. For each FRB shipped, an empty sample bottle (no preservatives) must also be shipped. At the sampling site, the sampler must open the shipped FRB and pour the reagent water into the empty shipped sample bottle, seal and label this bottle as the FRB. The FRB is shipped back to the laboratory along with the samples and analyzed to ensure that PFAS's were not introduced into the sample during sample collection/handling.

The reagent water used for the FRBs must be initially analyzed for method analytes as a MB and must meet the MB criteria in Section 9.2.1 prior to use. This requirement will ensure samples are not being discarded due to contaminated reagent water rather than contamination during sampling.

6.2 Sample Collection for Soil and Sediment samples.

Grab samples are collected in polypropylene containers. Sample containers and contact surfaces containing PTFE shall be avoided.

6.3 Sample Preservation

Not applicable.

6.4 Sample Shipping

Samples must be chilled during shipment and must not exceed 10 °C during the first 48 hours after collection. Sample temperature must be confirmed to be at or below 10 °C when the samples are received at the laboratory. Samples stored in the lab must be held at or below 6 °C until extraction, but should not be frozen.

NOTE: Samples that are significantly above 10° C, at the time of collection, may need to be iced or refrigerated for a period of time, in order to chill them prior to shipping. This will allow them to be shipped with sufficient ice to meet the above requirements.

6.5 Sample Handling

6.5.1 Holding Times

6.5.1.1 Water samples should be extracted as soon as possible but must be extracted within 14 days. Soil samples should be extracted within 28 days. Extracts are stored at < 10 ° C and analyzed within 28 days after extraction.

7. Equipment and Supplies

7.1 SAMPLE CONTAINERS – 250-mL high density polyethylene (HDPE) bottles fitted with unlined screw caps. Sample bottles must be discarded after use.

7.2 POLYPROPYLENE BOTTLES – 4-mL narrow-mouth polypropylene bottles.

7.3 CENTRIFUGE TUBES – 50-mL conical polypropylene tubes with polypropylene screw caps for storing standard solutions and for collection of the extracts.

7.4 AUTOSAMPLER VIALS – Polypropylene 0.7-mL autosampler vials with polypropylene caps.

7.4.1 NOTE: Polypropylene vials and caps are necessary to prevent contamination of the sample from PTFE coated septa. However, polypropylene caps do not reseal, so evaporation occurs after injection. Thus, multiple injections from the same vial are not possible.

7.5 POLYPROPYLENE GRADUATED CYLINDERS – Suggested sizes include 25, 50, 100 and 1000-mL cylinders.

7.6 Auto Pipets – Suggested sizes include 5, 10, 25, 50, 100, 250, 500, 1000, 5000 and 10,000-µls.

7.7 PLASTIC PIPETS – Polypropylene or polyethylene disposable pipets.

7.8 ANALYTICAL BALANCE – Capable of weighing to the nearest 0.0001 g.

7.9 SOLID PHASE EXTRACTION (SPE) APPARATUS FOR USING CARTRIDGES

7.9.1 SPE CARTRIDGES – 0.5 g SPE cartridges containing a reverse phase copolymer characterized by a weak anion exchanger (WAX) sorbent phase.

7.9.2 VACUUM EXTRACTION MANIFOLD – A manual vacuum manifold with large volume sampler for cartridge extractions, or an automatic/robotic sample preparation system designed for use with SPE cartridges, may be used if all QC requirements discussed in Section 9 are met. Extraction and/or elution steps may not be changed or omitted to accommodate the use of an automated system. Care must be taken with automated SPE systems to ensure the PTFE commonly used in these systems does not contribute to unacceptable analyte concentrations in the MB (Sect. 9.2.1).

7.9.3 SAMPLE DELIVERY SYSTEM – Use of a polypropylene transfer tube system, which transfers the sample directly from the sample container to the SPE cartridge, is recommended, but not mandatory. Standard extraction manifolds come equipped with PTFE transfer tube systems. These can be replaced with 1/8” O.D. x 1/16” I.D. polypropylene or polyethylene tubing cut to an appropriate length to ensure no sample contamination from the sample transfer lines. Other types of non-PTFE tubing may be used provided it meets the MB (Sect. 9.2.1) and LCS (Sect. 9.3) QC requirements. The PTFE transfer tubes may be used, but an MB must be run on each PFTE transfer tube and the QC requirements in Section 13.2.2 must be met. In the case of automated SPE, the removal of PTFE lines may not be feasible; therefore, MBs will need to be rotated among the ports and must meet the QC requirements of Sections 13.2.2 and 9.2.1.

7.10 Extract Clean-up Cartridge – 250 mg 6ml SPE Cartridge containing graphitized polymer carbon

7.11 EXTRACT CONCENTRATION SYSTEM – Extracts are concentrated by evaporation with nitrogen using a water bath set no higher than 65 °C.

7.12 LABORATORY OR ASPIRATOR VACUUM SYSTEM – Sufficient capacity to maintain a vacuum of approximately 10 to 15 inches of mercury for extraction cartridges.

7.13 LIQUID CHROMATOGRAPHY (LC)/TANDEM MASS SPECTROMETER (MS/MS) WITH DATA SYSTEM

7.13.1 LC SYSTEM – Instrument capable of reproducibly injecting up to 10-µL aliquots, and performing binary linear gradients at a constant flow rate near the flow rate used for development of this method (0.4 mL/min). The LC must be capable of pumping the water/methanol mobile phase without the use of a degasser which pulls vacuum on the mobile phase bottle (other types of degassers are acceptable). Degassers which pull vacuum on the mobile phase bottle will volatilize the ammonium acetate mobile phase causing the analyte peaks to shift to earlier retention times over the course of the analysis batch. The usage of a column heater is optional.

NOTE: During the course of method development, it was discovered that while idle for more than one day, PFAS's built up in the PTFE solvent transfer lines. To prevent long delays in purging high levels of PFAS's from the LC solvent lines, they were replaced with PEEK tubing and the PTFE solvent frits were replaced with stainless steel frits. It is not possible to remove all PFAS background contamination, but these measures help to minimize their background levels.

7.13.2 LC/TANDEM MASS SPECTROMETER – The LC/MS/MS must be capable of negative ion electrospray ionization (ESI) near the suggested LC flow rate of 0.4 mL/min. The system must be capable of performing MS/MS to produce unique product ions for the method analytes within specified retention time segments. A minimum of 10 scans across the chromatographic peak is required to ensure adequate precision.

7.13.3 DATA SYSTEM – An interfaced data system is required to acquire, store, reduce, and output mass spectral data. The computer software should have the capability of processing stored LC/MS/MS data by recognizing an LC peak within any given retention time window. The software must allow integration of the ion abundance of any specific ion within specified time or scan number limits. The software must be able to calculate relative response factors, construct linear regressions or quadratic calibration curves, and calculate analyte concentrations.

7.13.4 ANALYTICAL COLUMN – An LC BEH C_{18} column (2.1 x 50 mm) packed with 1.7 µm d_p C_{18} solid phase particles was used. Any column that provides adequate resolution, peak shape, capacity, accuracy, and precision (Sect. 9) may be used.

8. Reagents and Standards

8.1 GASES, REAGENTS, AND SOLVENTS – Reagent grade or better chemicals should be used.

8.1.1 REAGENT WATER – Purified water which does not contain any measurable quantities of any method analytes or interfering compounds greater than 1/3 the RL for each method analyte of interest. Prior to daily use, at least 3 L of reagent water should be flushed from the purification system to rinse out any build-up of analytes in the system's tubing.

8.1.2 METHANOL (CH_3OH, CAS#: 67-56-1) – High purity, demonstrated to be free of analytes and interferences.

8.1.3 AMMONIUM ACETATE ($NH_4C_2H_3O_2$, CAS#: 631-61-8) – High purity, demonstrated to be free of analytes and interferences.

8.1.4 ACETIC ACID (H_3CCOOH, CAS#: 64-19-7) - High purity, demonstrated to be free of analytes and interferences.

8.1.5 1M AMMONIUM ACETATE/REAGENT WATER – High purity, demonstrated to be free of analytes and interferences.

8.1.6 2mM AMMONIUM ACETATE/METHANOL:WATER (5:95) – To prepare, mix 2 ml of 1M AMMONIUM ACETATE,1 ml ACETIC ACID and 50 ml METHANOL into l Liter of REAGENT WATER.

8.1.7 Methanol/Water (80:20) – To prepare a 1 Liter bottle, mix 200 ml of REAGENT WATER with 800 ml of METHANOL.

8.1.8 AMMONIUM HYDROXIDE (NH_3, CAS#: 1336-21-6) – High purity, demonstrated to be free of analytes and interferences.

8.1.9 Sodium Acetate ($NaOOCCH_3$, CAS#: 127-09-3) – High purity, demonstrated to be free of analytes and interferences.

8.1.10 25 mM Sodium Acetate Buffer – To prepare 250mls, dissolve .625 grams of sodium acetate into 100 mls of reagent water. Add 4 mls Acetic Acid and adjust the final volume to 250 mls with reagent water.

8.1.11 NITROGEN – Used for the following purposes: Nitrogen aids in aerosol generation of the ESI liquid spray and is used as collision gas in some MS/MS instruments. The nitrogen used should meet or exceed instrument manufacturer’s specifications. In addition, Nitrogen is used to concentrate sample extracts (Ultra High Purity or equivalent).

8.1.12 ARGON – Used as collision gas in MS/MS instruments. Argon should meet or exceed instrument manufacturer’s specifications. Nitrogen gas may be used as the collision gas provided sufficient sensitivity (product ion formation) is achieved.

8.2 STANDARD SOLUTIONS – When a compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard. PFAS analyte and IS standards commercially purchased in glass ampoules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene containers. Standards for sample fortification generally should be prepared in the smallest volume that can be accurately measured to minimize the addition of excess organic solvent to aqueous samples.

NOTE: Stock standards and diluted stock standards are stored at ≤4 °C.

8.2.1 ISOTOPE DILUTION Extracted Internal Standard (ID EIS) STOCK SOLUTIONS - ID EIS stock standard solutions are stable for at least 6 months when stored at 4 °C. The stock solution is purchased at a concentration of 1000 ng/mL.

8.2.2 ISOTOPE DILUTION Extracted Internal Standard PRIMARY DILUTION STANDARD (ID EIS PDS) – Prepare the ID EIS PDS at a concentration of 500 ng/mL. The ID PDS is prepared in 80:20% (vol/vol) methanol:water. The ID PDS is stable for 6 months when stored at ≤4 °C.

Table 2

Isotope Labeled Standard	Conc. of EIS Stock (ng/mL)	Vol. of EIS Stock (mL)	Final Vol. of EIS PDS (mL)	Final Conc. of EIS PDS (ng/mL)
M4PFBA	1000	1.0	2.0	500
M5PFPeA	1000	1.0	2.0	500
M5PFHxA	1000	1.0	2.0	500
M4PFHpA	1000	1.0	2.0	500
M8PFOA	1000	1.0	2.0	500
M9PFNA	1000	1.0	2.0	500
M6PFDA	1000	1.0	2.0	500
M7PFUdA	1000	1.0	2.0	500
MPFDoA	1000	1.0	2.0	500
M2PFTeDA	1000	1.0	2.0	500
M2PFHxDA	50,000	.02	2.0	500
d3-N-MeFOSA	50,000	.02	2.0	500
d5-N-EtFOSA	50,000	.02	2.0	500
d7-N-MeFOSE	50,000	.02	2.0	500
d9-N-EtFOSE	50,000	.02	2.0	500
M8FOSA	1000	1.0	2.0	500
d3-N-MeFOSAA	1000	1.0	2.0	500
d5-N-EtFOSAA	1000	1.0	2.0	500
M3PFBS	929	1.0	2.0	464.5
M3PFHxS	946	1.0	2.0	473
M8PFOS	957	1.0	2.0	478.5
M2-4:2FTS	935	1.0	2.0	467.5
M2-6:2FTS	949	1.0	2.0	474.5
M2-8:2FTS	958	1.0	2.0	479
M3HFPO-DA	50,000	.4	2.0	10,000

8.2.3 ANALYTE STOCK STANDARD SOLUTION – Analyte stock standards are stable for at least 6 months when stored at 4 °C. When using these stock standards to prepare a PDS, care must be taken to ensure that these standards are at room temperature and adequately vortexed.

8.2.4 Analyte Secondary Spiking Standard Prepare the spiking solution of additional add on components for project specific requirements only. ANALYTE PRIMARY SPIKING STANDARD – Prepare the spiking standard at a concentration of 500 ng/mL in methanol. The spiking standard is stable for at least two months when stored in polypropylene centrifuge tubes at room temperature.

Table 3

Analyte	**Conc. of IS Stock (ng/mL)**	**Vol. of IS Stock (mL)**	**Final Vol. of IS PDS (mL)**	**Final Conc. of IS PDS (ng/mL)**
PFBA	2000	1	4	500
PFPeA	2000	1	4	500
PFHxA	2000	1	4	500
PFHpA	2000	1	4	500
PFOA	2000	1	4	500
PFNA	2000	1	4	500
PFDA	2000	1	4	500
PFUdA	2000	1	4	500
PFDoA	2000	1	4	500
PFTrDA	2000	1	4	500
PFTeDA	2000	1	4	500
FOSA	2000	1	4	500
N-MeFOSAA	2000	1	4	500
N-EtFOSAA	2000	1	4	500
L-PFBS	1770	1	4	442.5
L-PFPeS	1880	1	4	470
L-PFHxSK	1480	1	4	370
Br-PFHxSK	344	1	4	86
L-PFHpS	1900	1	4	475
L-PFOSK	1460	1	4	365
Br-PFOSK	391	1	4	97.75
L-PFNS	1920	1	4	480
L-PFDS	1930	1	4	482.5
4:2FTS	1870	1	4	467.5
6:2FTS	1900	1	4	475
8:2FTS	1920	1	4	480

8.2.5 Analyte Secondary Spiking Standard Prepare the spiking solution of additional add on components for project specific requirements only.

Table 4

Analyte	Conc. of IS Stock (ng/mL)	Vol. of IS Stock (mL)	Final Vol. of IS PDS (mL)	Final Conc. of IS PDS (ng/mL)
ADONA	2000	1	4	500
PFHxDA	2000	1	4	500
PFODA	2000	1	4	500
HFPO-DA	100,000	.4	4	10,000
9ClPF3ONS	50,000	0.04	4	500
11ClPF3OUdS	50,000	0.04	4	500

8.2.6 LOW, MEDIUM AND HIGH LEVEL LCS – The LCS's will be prepared at the following concentrations and rotated per batch; 2 ng/L, 40 ng/L, 500 ng/l for drinking waters. The analyte PDS contains all the method analytes of interest at various concentrations in methanol. The analyte PDS has been shown to be stable for six months when stored at ≤4 °C.

8.2.7 Isotope Dilution Labeled Recovery Stock Solutions (ID REC) – ID REC Stock solutions are stable for at least 6 months when stored at 4 °C. The stock solution is purchased at a concentration of 1000 ng/mL.

8.2.8 Isotope Dilution Labeled Recovery Primary Dilution Standard (ID REC PDS) - Prepare the ID REC PDS at a concentration of 500 ng/mL. The ID REC PDS is prepared in 80:20% (vol/vol) methanol:water. The ID REC PDS is stable for at least six months when stored in polypropylene centrifuge tubes at ≤4 °C.

Table 5

Analyte	Conc. of REC Stock (ng/mL)	Vol. of REC Stock (mL)	Final Vol. of REC PDS (mL)	Final Conc. of REC PDS (ng/mL)
M2PFOA	2000	1	4	500
M2PFDA	2000	1	4	500
M3PFBA	2000	1	4	500
M4PFOS	2000	1	4	500

8.2.9 CALIBRATION STANDARDS (CAL) –

Current Concentrations (ng/mL): 0.5, 1.0, 5.0, 10.0, 50.0, 125, 150, 250, 500

Prepare the CAL standards over the concentration range of interest from dilutions of the analyte PDS in methanol containing 20% reagent water. 20 µl of the EIS PDS and REC PDS are added to the CAL standards to give a constant concentration of 10 ng/ml. The lowest concentration CAL standard must be at or below the RL (2 ng/L), which may depend on system sensitivity. The CAL standards may also be used as CCVs (Sect. 9.8). To make calibration stock standards:

Table 6

Calibration Standard Concentration	Final Aqueous Cal STD Level Concentration	Final Soil Cal STD Level Concentration	24 compound stock added (ul)	PFHxDA Stock added (ul)	500 ng/ml PFHxDA dilution added (ul)	PFODA Stock added (ul)	500 ng/ml PFODA dilution added (ul)	ADONA, HFPO-DA, 11Cl-PF3OUdS, 9Cl-PF3ONS Stock added (ul)	500 ng/ml ADONA dilution added (ul)	Final Volume in MeOH/H_2O (82:20)
.5 ng/ml	2 ng/L	.25 ng/g	6.25		25		25		25	25 mls
1 ng/ml	4 ng/L	.5 ng/g	5		20		20		20	10 mls
5 ng/ml	20 ng/L	1 ng/g	25		100		100		100	10 mls
10 ng/ml	40 ng/L	5 ng/g	125	5		5		5		25 mls

50 ng/ml	200 ng/L	25 ng/g	250	10		10		10		10 mls
125 ng/ml	500 ng/L	62.5 ng/g	625	25		25		25		10 mls
150 ng/ml	600 ng/L	75 ng/g	750	30		30		30		10 mls
250 ng/ml	1000 ng/L	125 ng/g	625							5 mls
500 ng/ml	2000 ng/L	250 ng/g	1250							5 mls

9. Quality Control

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

9.1 MINIMUM REPORTING LIMIT (MRL) CONFIRMATION

9.1.1 Fortify, extract, and analyze seven replicate LCSs at 2 ng/l. Calculate the mean measured concentration (*Mean*) and standard deviation for these replicates. Determine the Half Range for the prediction interval of results (HR_{PIR}) using the equation below

$$HR_{PIR} = 3.963s$$

Where:

s = the standard deviation
3.963 = a constant value for seven replicates.

9.1.2 Confirm that the upper and lower limits for the Prediction Interval of Result ($PIR = Mean \pm HR_{PIR}$) meet the upper and lower recovery limits as shown below

The Upper PIR Limit must be ≤150% recovery.

$$\frac{\underline{Mean + HR_{PIR}}}{\text{Fortified Concentration}} \times 100\% \leq 150\%$$

The Lower PIR Limit must be ≥ 50% recovery.

$$\frac{\underline{Mean - HR_{PIR}}}{\text{Fortified Concentration}} \times 100\% \geq 50\%$$

9.1.3 The RL is validated if both the Upper and Lower PIR Limits meet the criteria described above. If these criteria are not met, the RL has been set too low and must be determined again at a higher concentration.

9.2 Blank(s)

9.2.1 **METHOD BLANK (MB) -** A Method Blank (MB) is required with each extraction batch to confirm that potential background contaminants are not interfering with the identification or quantitation of method analytes. Prep and analyze a MB for every 20 samples. If the MB produces a peak within the retention time window of any analyte that would prevent the determination of that analyte, determine the source of contamination and eliminate the interference before processing samples. Background contamination must be reduced to an acceptable level before proceeding. Background from method analytes or other contaminants that interfere with the measurement of method analytes must be below the RL. If the method analytes are detected in the MB at concentrations equal to or greater than this level, then all data for the problem analyte(s) must be considered invalid for all samples in the extraction batch. Because background contamination is a significant problem for several method analytes, it is highly recommended that the analyst maintain a historical record of MB data.

9.2.2 **FIELD REAGENT BLANK (FRB)** - The purpose of the FRB is to ensure that PFAS's measured in the Field Samples were not inadvertently introduced into the sample during sample collection/handling. Analysis of the FRB is required only if a Field Sample contains a method analyte or analytes at or above the RL. The FRB is processed, extracted and analyzed in exactly the same manner as a Field Sample.

9.3 Laboratory Control Sample (LCS) and Laboratory Control Sample Duplicates (LCSD)

9.3.1 An LCS is required with each extraction batch. The fortified concentration of the LCS may be rotated between low, medium, and high concentrations from batch to batch. Default limits of 50-150% of the true value may be used for analytes until sufficient replicates have been analyzed to generate proper control limits. Calculate the percent recovery (%*R*) for each analyte using the equation

$$\%R = \frac{A \times 100}{B}$$

Where:

A = measured concentration in the fortified sample
B =fortification concentration.

9.3.2 Where applicable, LCSD's are to be extracted and analyzed. The concentration and analyte recovery criteria for the LCSD must be the same as the batch LCS The RSD's must fall within ≤30% of the true value for medium and high level replicates, and ≤50% for low level replicates. Calculate the relative percent difference (RPD) for duplicate MSs (MS and MSD) using the equation

$$RPD = \frac{|LCS - LCSD|}{(LCS + LCSD) / 2} \times 100$$

9.3.3 **If the LCS and or LCSD results do not meet these criteria for method analytes, then all data for the problem analyte(s) must be considered invalid for all samples in the extraction batch.**

9.4 Labeled Recovery Standards (REC)

The analyst must monitor the peak areas of the REC(s) in all injections during each analysis day.

9.5 Extracted Internal Standards (EIS)

9.5.1 The EIS standard is fortified into all samples, CCVs, MBs, LCSs, MSs, MSDs, FD, and FRB prior to extraction. It is also added to the CAL standards. The EIS is a means of assessing method performance from extraction to final chromatographic measurement. Calculate the recovery (%R) for the EIS using the following equation

$$\%R = (A / B) \times 100$$

Where:

A = calculated EIS concentration for the QC or Field Sample
B = fortified concentration of the EIS.

9.5.2 Default limits of 50-150% may be used for analytes until sufficient replicates have been analyzed to generate proper control limits. A low or high percent recovery for a sample, blank, or CCV does not require discarding the analytical data but it may indicate a potential problem with future analytical data. When EIS recovery from a sample, blank, or CCV are outside control limits, check 1) calculations to locate possible errors, 2) standard solutions for degradation, 3) contamination, and 4) instrument performance. For CCVs and QC elements spiked with all target analytes, if the recovery of the corresponding target analytes meet the acceptance criteria for the EIS in question, the data can be used but all potential biases in the recovery of the EIS must be documented in the sample report. If the associated target analytes do not meet the acceptance criteria,the data must be reanalyzed.

9.6 Matrix Spike (MS)

9.6.1 Analysis of an MS is required in each extraction batch and is used to determine that the sample matrix does not adversely affect method accuracy. Assessment of method precision is accomplished by analysis of a Field Duplicate (FD) (Sect. 9.6); however, infrequent occurrence of method analytes would hinder this assessment. If the occurrence of method analytes in the samples is infrequent, or if historical trends are unavailable, a second MS, or MSD, must be prepared, extracted, and analyzed from a duplicate of the Field Sample. Extraction batches that contain MSDs will not require the extraction of a field sample duplicate. If a variety of different sample matrices are analyzed regularly, for example, drinking water from groundwater and surface water sources, method performance should be established for each. Over time, MS data should be documented by the laboratory for all routine sample sources.

9.6.2 Within each extraction batch, a minimum of one Field Sample is fortified as an MS for every 20 Field Samples analyzed. The MS is prepared by spiking a sample with an appropriate amount of the Analyte Stock Standard (Sect. 8.2.3). Use historical data and rotate through the low, mid and high concentrations when selecting a fortifying concentration. Calculate the percent recovery (%*R*) for each analyte using the equation

$$\%R = \frac{(A - B)}{C} \times 100$$

Where:

A = measured concentration in the fortified sample
B = measured concentration in the unfortified sample
C = fortification concentration.

9.6.3 Analyte recoveries may exhibit matrix bias. For samples fortified at or above their native concentration, recoveries should range between 50-150%. If the accuracy of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the LCS, the recovery is judged to be matrix biased. The result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

9.7 Laboratory Duplicate

9.7.1 FIELD DUPLICATE OR LABORATORY FORTIFIED SAMPLE MATRIX DUPLICATE (FD or MSD) – Within each extraction batch (not to exceed 20 Field Samples), a minimum of one FD or MSD must be analyzed. Duplicates check the precision associated with sample collection, preservation, storage, and laboratory procedures. If method analytes are not routinely observed in Field Samples, an MSD should be analyzed rather than an FD.

9.7.2 Calculate the relative percent difference (*RPD*) for duplicate measurements (*FD1* and *FD2*) using the equation

$$\text{RPD} = \frac{|\text{FD1} - \text{FD2}|}{(\text{FD1} + \text{FD2}) / 2} \times 100$$

9.7.3 RPDs for FDs should be ≤30%. Greater variability may be observed when FDs have analyte concentrations that are within a factor of 2 of the RL. At these concentrations, FDs should have RPDs that are ≤50%. If the RPD of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the CCV, the recovery is judged to be matrix biased. The result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

9.7.4 If an MSD is analyzed instead of a FD, calculate the relative percent difference (RPD) for duplicate MSs (MS and MSD) using the equation

$$\text{RPD} = \frac{|\text{MS} - \text{MSD}|}{(\text{MS} + \text{MSD}) / 2} \times 100$$

9.7.5 RPDs for duplicate MSs should be ≤30% for samples fortified at or above their native concentration. Greater variability may be observed when MSs are fortified at analyte concentrations that are within a factor of 2 of the RL. MSs fortified at these concentrations should have RPDs that are ≤50% for samples fortified at or above their native concentration. If the RPD of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the LCSD where applicable, the result is judged to be matrix biased. If no LCSD is present, the associated MS and MSD are to be re-analyzed to determine if any analytical has occurred. If the resulting RPDs are still outside control limits, the result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

9.8 Initial Calibration Verification (ICV)

9.8.1 As part of the IDC (Sect. 13.2), and after each ICAL, analyze a QCS sample from a source different from the source of the CAL standards. If a second vendor is not available, then a different lot of the standard should be used. The QCS should be prepared and analyzed just like a CCV. Acceptance criteria for the QCS are identical to the CCVs; the calculated amount for each analyte must be ±

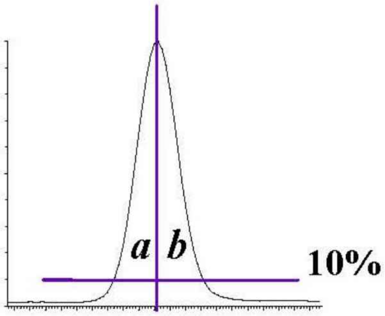
30% of the expected value. If measured analyte concentrations are not of acceptable accuracy, check the entire analytical procedureto locate and correct the problem.

9.9 Continuing Calibration Verification (CCV)

9.9.1 CCV Standards are analyzed at the beginning of each analysis batch, after every 10 Field Samples, and at the end of the analysis batch. See Section 10.7 for concentration requirements and acceptance criteria.

9.10 Method-specific Quality Control Samples

9.10.1 PEAK ASYMMETRY FACTOR – A peak asymmetry factor must be calculated using the equation below during the IDL and every time a calibration curve is generated. The peak asymmetry factor for the first two eluting peaks in a midlevel CAL standard (if only two analytes are being analyzed, both must be evaluated) must fall in the range of 0.8 to 1.5. Modifying the standard or extract composition to more aqueous content to prevent poor shape is not permitted. See guidance in Section 10.6.4.1 if the calculated peak asymmetry factors do not meet the criteria.



$$A_s = b / a$$

Where:

A_s = peak asymmetry factor
b = width of the back half of the peak measured (at 10% peak height) from the trailing edge of the peak to a line dropped perpendicularly from the peak apex
a = the width of the front half of the peak measured (at 10% peak height) from the leading edge of the peak to a line dropped perpendicularly from the apex.

9.11 Method Sequence

- CCV-LOW
- MB
- LCS
- LCSD
- MS
- Duplicate or MSD
- Field Samples (1-10)
- CCV-MID
- Field Samples (11-20)
- CCV-LOW

10. Procedure

10.1 Equipment Set-up

10.1.1 This procedure may be performed manually or in an automated mode using a robotic or automatic sample preparation device. If an automated system is used to prepare samples, follow the manufacturer's operating instructions, but all extraction and elution steps must be the same as in the manual procedure. Extraction and/or elution steps may not be changed or omitted to accommodate the use of an automated system. If an automated system is used, the MBs should be rotated among the ports to ensure that all the valves and tubing meet the MB requirements (Sect. 9.2).

10.1.2 Some of the PFAS's adsorb to surfaces, including polypropylene. Therefore, the aqueous sample bottles must be rinsed with the elution solvent (Sect 10.3.4) whether extractions are performed manually or by automation. The bottle rinse is passed through the cartridge to elute the method analytes and is then collected (Sect. 10.3.4).

10.1.3 **NOTE:** The SPE cartridges and sample bottles described in this section are designed as single use items and should be discarded after use. They may not be refurbished for reuse in subsequent analyses.

10.2 Sample Preparation and Extraction of Aqueous Samples

10.2.1 Samples are preserved, collected and stored as presented in Section 6.

The entire sample that is received must be sent through the SPE cartridge. In addition, the bottle must be solvent rinsed and this rinse must be sent through the SPE cartridge as well. The method blank (MB) and laboratory control sample (LCS) must be extracted in exactly the same manner (i.e., must include the bottle solvent rinse). It should be noted that a water rinse alone is not sufficient. This does not apply to samples with high concentrations of PFAS that are prepared using serial dilution and not SPE.

10.2.2 Determine sample volume. Weigh all samples to the nearest 1g. If visible sediment is present, centrifuge and decant into a new 250mL HDPE bottle and record the weight of the new container.

NOTE: Some of the PFAS's adsorb to surfaces, thus the sample volume may **NOT** be transferred to a graduated cylinder for volume measurement.

10.2.3 The MB, LCS and FRB may be prepared by measuring 250 mL of reagent water with a polypropylene graduated cylinder or filling a 250-mL sample bottle to near the top.

10.2.4 Adjust the QC and sample pH to 3 by adding acetic acid in water dropwise

10.2.5 Add 20 µL of the EIS PDS (Sect. 8.2.2) to each sample and QC, cap and invert to mix.

10.2.6 If the sample is an LCS, LCSD, MS, or MSD, add the necessary amount of analyte PDS (Sect. 8.2.3). Cap and invert each sample to mix.

10.3 Cartridge SPE Procedure

10.3.1 CARTRIDGE CLEAN-UP AND CONDITIONING – DO NOT allow cartridge packing material to go dry during any of the conditioning steps. Rinse each cartridge with 3 X 5 mL of 2% ammonium hydroxide in methanol, followed by 5mls of methanol. Next, rinse each cartridge with 5 mls of the 25 mM acetate buffer, followed by 15 mL of reagent water, without allowing the water to drop below the top edge of the packing. If the cartridge goes dry during the conditioning phase, the conditioning must be started over. Add 4-5 mL of reagent water to each cartridge, attach the sample transfer tubes (Sect. 7.9.3), turn on the vacuum, and begin adding sample to the cartridge.

10.3.2 SAMPLE EXTRACTON – Adjust the vacuum so that the approximate flow rate is approximately 4 mL/min. Do not allow the cartridge to go dry before all the sample has passed through.

10.3.3 SAMPLE BOTTLE AND CARTRIDGE RINSE – After the entire sample has passed through the cartridge, rinse the sample bottles with 4 ml reagent water followed by 4 ml 25 mM acetate buffer at pH 4 and draw the aliquot through the sample transfer tubes and the cartridges. Draw air or nitrogen through the cartridge for 5-10 min at high vacuum (10-15 in. Hg). **NOTE: If empty plastic reservoirs are used in place of the sample transfer tubes to pass the samples through the cartridges, these reservoirs must be treated like the transfer tubes. After the entire sample has passed through the cartridge, the reservoirs must be rinsed to waste with reagent water.**

10.3.4 SAMPLE BOTTLE AND CARTRIDGE ELUTION, Fraction 1 – Turn off and release the vacuum. Lift the extraction manifold top and insert a rack with collection tubes into the extraction tank to collect the extracts as they are eluted from the cartridges. Rinse the sample bottles with 12 mls of methanol and draw the aliquot through the sample transfer tubes and cartridges. Use a low vacuum such that the solvent exits the cartridge in a dropwise fashion.

SAMPLE BOTTLE AND CARTRIDGE ELUTION, Fraction 2 In a separate collection vial, rinse the sample bottles with 12 mL of 2% ammonium hydroxide in methanol and elute the analytes from the cartridges by pulling the 4 mL of methanol through the sample transfer tubes and the cartridges. Use a low vacuum such that the solvent exits the cartridge in a dropwise fashion. To the final extract, add 50 ul of acetic acid.

NOTE: If empty plastic reservoirs are used in place of the sample transfer tubes to pass the samples through the cartridges, these reservoirs must be treated like the transfer tubes. After the reservoirs have been rinsed in Section 10.3.3, the elution solvent used to rinse the sample bottles must be swirled down the sides of the reservoirs while eluting the cartridge to ensure that any method analytes on the surface of the reservoirs are transferred to the extract.

CLEAN-UP CARTRIDGE ELUTION, Elute the clean-up cartridge with 8 additional mls of methanol and draw the aliquot through the cartridge. Use a low vacuum such that the solvent exits the cartridge in a dropwise fashion.

10.3.5 Fractions 1 and 2 are to be combined during the concentration stage (section10.6)

10.4 Sample Prep and Extraction Protocol for Soils

10.4.1 Homogenize and weigh 2 grams of sample (measured to the nearest hundredth of a gram) intoa 50 ml polypropylene centrifuge tube. For laboratory control blanks and spikes, 2 grams of clean sand is used.

10.4.2 Add 20 µL of the EIS PDS (Sect. 8.2.2) to each sample and QC.

10.4.3 If the sample is an LCS, LCSD, MS, or MSD, add the necessary amount of analyte PDS (Sect. 8.2.3). Cap and invert each sample to mix.

10.4.4 To all samples, add 10 mls of methanol, cap, vortex for 25 seconds at 3000RPM and mix for 30 minutes using a shaker table of tumbler at 120RPM.

10.4.5 Following mixing, sonicate each sample for 30 minutes and let samples sit overnight (at least 2 hours is required for RUSH samples).

10.4.6 Centrifuge each sample at 3500RPM for 10 minutes.

10.4.7 Remove supernatant, and reserve for clean-up.

10.5 Extract Clean-up

10.5.1 CARTRIDGE CLEAN-UP AND CONDITIONING –. Rinse each cartridge with 15 mL of methanol and discard. If the cartridge goes dry during the conditioning phase, the conditioning must be started over. Attach the sample transfer tubes (Sect. 7.9.3), turn on the vacuum, and begin adding sample to the cartridge.

10.5.2 Adjust the vacuum so that the approximate flow rate is 1-2 mL/min. Do not allow the cartridge to go dry before all the sample has passed through.

10.5.3 SAMPLE BOTTLE AND CARTRIDGE RINSE – After the entire sample has passed through the cartridge, rinse the sample collection vial with two 1-mL aliquots of methanol and draw each aliquot through the cartridges. Draw air or nitrogen through the cartridge for 5 min at high vacuum (10-15 in. Hg).

10.5.4 If extracts are not to be immediately evaporated, cover collection tubes and store at ambient temperature till concentration.

10.6 Extract Concentration

10.6.1 Concentrate the extract to dryness under a gentle stream of nitrogen in a heated water bath (60-65 °C) to remove all the water/methanol mix. Add the appropriate amount of 80:20% (vol/vol) methanol:water solution and 20 µl of the ID REC PDS (Sect. 8.2.7) to the collection vial to bring the volume to 1 mL and vortex. Transfer two aliquots with a plastic pipet (Sect. 7.6) into 2 polypropylene autosampler vials.

NOTE: It is recommended that the entire 1-mL aliquot not be transferred to the autosampler vial because the polypropylene autosampler caps do not reseal after injection. Therefore, do not store the extracts in the autosampler vials as evaporation losses can occur occasionally in these autosampler vials. Extracts can be split between 2 X 700 µl vials (Sect. 7.4).

10.7 Sample Volume Determination

10.7.1 If the level of the sample was marked on the sample bottle, use a graduated cylinder to measure the volume of water required to fill the original sample bottle to the mark made prior to extraction. Determine to the nearest 10 mL.

10.7.2 If using weight to determine volume, weigh the empty bottle to the nearest 10 g and determine the sample weight by subtraction of the empty bottle weight from the original sample weight (Sect. 10.2.2). Assume a sample density of 1.0 g/mL. In either case, the sample volume will be used in the final calculations of the analyte concentration (Sect. 11.2).

10.8 Initial Calibration

- Demonstration and documentation of acceptable initial calibration is required before any samples are analyzed. After the initial calibration is successful, a CCV is required at the beginning and end of each period in which analyses are performed, and after every tenth Field Sample.

10.8.1 ESI-MS/MS TUNE

10.8.1.1 Calibrate the mass scale of the MS with the calibration compounds and procedures prescribed by the manufacturer.

10.8.1.2 Optimize the [M-H]- for each method analyte by infusing approximately 0.5-1.0 µg/mL of each analyte (prepared in the initial mobile phase conditions) directly into the MS at the chosen LC mobile phase flow rate (approximately 0.4 mL/min). This tune can be done on a mix of the method analytes. The MS parameters (voltages, temperatures, gas flows, etc.) are varied until optimal analyte responses are determined. The method analytes may have different optima requiring some compromise between the optima.

10.8.1.3 Optimize the product ion for each analyte by infusing approximately 0.5-1.0 µg/mL of each analyte (prepared in the initial mobile phase conditions) directly into the MS at the chosen LC mobile phase flow rate (approximately 0.4 mL/min). This tune can be done on a mix of the method analytes. The MS/MS parameters (collision gas pressure, collision energy, etc.) are varied until optimal analyte responses are determined. Typically, the carboxylic acids have very similar MS/MS conditions and the sulfonic acids have similar MS/MS conditions.

10.8.2 Establish LC operating parameters that optimize resolution and peak shape. Modifying the standard or extract composition to more aqueous content to prevent poor shape is not permitted.

Cautions: LC system components, as well as the mobile phase constituents, contain many of the method analytes in this method. Thus, these PFAS's will build up on the head of the LC column during mobile phase equilibration. To minimize the background PFAS peaks and to keep background levels constant, the time the LC column sits at initial conditions must be kept constant and as short as possible (while ensuring reproducible retention times). In addition, prior to daily use, flush the column with 100% methanol for at least 20 min before initiating a sequence. It may be necessary on some systems to flush other LC components such as wash syringes, sample needles or any other system components before daily use.

10.8.3 Inject a mid-level CAL standard under LC/MS conditions to obtain the retention times of each method analyte. If analyzing for PFTA, ensure that the LC conditions are adequate to prevent co-elution of PFTA and the mobile phase interferants. These interferants have the same precursor and products ions as PFTA, and under faster LC conditions may co-elute with PFTA. Divide the chromatogram into retention time windows each of which contains one or more chromatographic peaks. During MS/MS analysis, fragment a small number of selected precursor ions ([M-H]-) for the analytes in each window and choose the most abundant product ion. For maximum sensitivity, small mass windows of ±0.5 daltons around the product ion mass were used for quantitation.

10.8.4 Inject a mid-level CAL standard under optimized LC/MS/MS conditions to ensure that each method analyte is observed in its MS/MS window and that there are at least 10 scans across the peak for optimum precision.

10.8.4.1 If broad, split or fronting peaks are observed for the first two eluting chromatographic peaks (if only two analytes are being analyzed, both must be evaluated), change the initial mobile phase conditions to higher aqueous content until the peak asymmetry ratio for each peak is 0.8 – 1.5. The peak asymmetry factor is calculated as described in Section 9.9.1 on a mid-level CAL standard. The peak asymmetry factor must meet the above criteria for the first two eluting peaks during the IDL and every time a new calibration curve is generated. Modifying the standard or extract composition to more aqueous content to prevent poor shape is not permitted.

NOTE: PFHxS, PFOS, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions in Table 5 due to chromatographic resolution of the linear and branched isomers of these compounds. Most PFAS's are produced by two different processes. One process gives rise to linear PFAS's only while the other process produces both linear and branched isomers. Thus, both branched and linear PFAS's can potentially be found in the environment. For the aforementioned compounds that give rise to more than one peak, all the chromatographic peaks observed in the standard must be integrated and the areas totaled. Chromatographic peaks in a sample must be integrated in the same way as the CAL standard.

10.8.5 Prepare a set of CAL standards as described in Section 8.2.5. The lowest concentration CAL standard must be at or below the RL (2 ng/L), which may depend on system sensitivity.

10.8.6 The LC/MS/MS system is calibrated using the IS technique. Use the LC/MS/MS data system software to generate a linear regression or quadratic calibration curve for each of the analytes. This curve **must always** be forced through zero and may be concentration weighted, if necessary. Forcing zero allows for a better estimate of the background levels of method analytes. A minimum of 5 levels are required for a linear calibration model and a minimum of 6 levels are required for a quadratic calibration model.

10.8.7 **CALIBRATION ACCEPTANCE CRITERIA** – A linear fit is acceptable if the coefficient of determination (r^2) is greater than 0.99. When quantitated using the initial calibration curve, each calibration point, except the lowest point, for each analyte should calculate to be within 70-130% of its true value. The lowest CAL point should calculate to be within 50-150% of its true value. If these criteria cannot be met, the analyst will have difficulty meeting ongoing QC criteria. It is recommended that corrective action is taken to reanalyze the CAL standards, restrict the range of calibration, or select an alternate method of calibration (forcing the curve through zero is still required).

10.8.7.1 **CAUTION:** When acquiring MS/MS data, LC operating conditions must be carefully reproduced for each analysis to provide reproducible retention times. If this is not done, the correct ions will not be monitored at the appropriate times. As a precautionary measure, the chromatographic peaks in each window must not elute too close to the edge of the segment time window.

10.9 CONTINUING CALIBRATION CHECK (CCV) – Minimum daily calibration verification is as follows. Verify the initial calibration at the beginning and end of each group of analyses, and after every tenth sample during analyses. In this context, a “sample” is considered to be a Field Sample. MBs, CCVs, LCSs, MSs, FDs FRBs and MSDs are not counted as samples. The beginning CCV of each analysis batch must be at or below the RL in order to verify instrument sensitivity prior to any analyses. If standards have been prepared such that all low CAL points are not in the same CAL solution, it may be necessary to analyze two CAL standards to meet this requirement. Alternatively, the analyte concentrations in the analyte PDS may be customized to meet these criteria. Subsequent CCVs should alternate between a medium and Low concentration CAL standard.

10.9.1 Inject an aliquot of the appropriate concentration CAL standard and analyze with the same conditions used during the initial calibration.

10.9.2 Calculate the concentration of each analyte and EIS in the CCV. The calculated amount for each analyte for medium level CCVs must be within ± 30% of the true value with an allowance of 10% of the reported analytes to be greater than 30%, but less than 40%. The calculated amount for each EIS must be within ± 50% of the true value. The calculated amount for the lowest calibration point for each analyte must be within ± 50%. If these conditions do not exist, then all data for the problem analyte must be considered invalid, and remedial action should be taken (Sect. 10.7.4) which may require recalibration. Any Field or QC Samples that have been analyzed since the last acceptable calibration verification should be reanalyzed after adequate calibration has been restored, with the following exception. **If the CCV fails because the calculated concentration is greater than 130% (150% for the low-level CCV) for a particular method analyte, and Field Sample extracts show no detection for that method analyte, non-detects may be reported without re-analysis.**

10.9.3 REMEDIAL ACTION – Failure to meet CCV QC performance criteria may require remedial action. Major maintenance, such as cleaning the electrospray probe, atmospheric pressure ionization source, cleaning the mass analyzer, replacing the LC column, etc., requires recalibration (Sect 10.6) and verification of sensitivity by analyzing a CCV at or below the RL (Sect 10.7).

10.10 EXTRACT ANALYSIS

10.10.1 Establish operating conditions equivalent to those summarized in Tables 6-8 of Section 16. Instrument conditions and columns should be optimized prior to the initiation of the IDC.

10.10.2 Establish an appropriate retention time window for each analyte. This should be based on measurements of actual retention time variation for each method analyte in CAL standard solutions analyzed on the LC over the course of time. A value of plus or minus three times the standard deviation of the retention time obtained for each method analyte while establishing the initial calibration and completing the IDC can be used to calculate a suggested window size. However, the experience of the analyst should weigh heavily on the determination of the appropriate retention window size.

10.10.3 Calibrate the system by either the analysis of a calibration curve (Sect. 10.6) or by confirming the initial calibration is still valid by analyzing a CCV as described in Section 10.7. If establishing an initial calibration, complete the IDC as described in Section 13.2.

10.10.4 Begin analyzing Field Samples, including QC samples, at their appropriate frequency by injecting the same size aliquots under the same conditions used to analyze the CAL standards.

10.10.5 At the conclusion of data acquisition, use the same software that was used in the calibration procedure to identify peaks of interest in predetermined retention time windows. Use the data system software to examine the ion abundances of the peaks in the chromatogram. Identify an analyte by comparison of its retention time with that of the corresponding method analyte peak in a reference standard.

10.10.6 The analyst must not extrapolate beyond the established calibration range. If an analyte peak area exceeds the range of the initial calibration curve, the sample should be re-extracted with a reduced sample volume in order to bring the out of range target analytes into the calibration range. If a smaller sample size would not be representative of the entire sample, the following options are recommended. Re-extract an additional aliquot of sufficient size to insure that it is representative of the entire sample. Spike it with a higher concentration of internal standard. Prior to LC/MS analysis, dilute the sample so that it has a concentration of internal standard equivalent to that present in the calibration standard. Then, analyze the diluted extract.

11. Data Evaluation, Calculations and Reporting

11.1 Complete chromatographic resolution is not necessary for accurate and precise measurements of analyte concentrations using MS/MS. In validating this method, concentrations were calculated by measuring the product ions listed in Table 7.

11.2 Calculate analyte concentrations using the multipoint calibration established in Section 10.6. Do not use daily calibration verification data to quantitate analytes in samples. Adjust final analyte concentrations to reflect the actual sample volume determined in Section 10.6 where:

C_{ex} = (Area of target analyte * Concentration of Labeled analog) / (area of labeled analog * CF)

C_s = (C_{ex} / sample volume in ml) * 1000

C_{ex} = The concentration of the analyte in the extract
CF = calibration factor from calibration.

11.3 Prior to reporting the data, the chromatogram should be reviewed for any incorrect peak identification or poor integration.

11.4 PFHxS, PFOS, PFOA, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions in Table 5 due to the linear and branch isomers of these compounds (Sect. 10.6.4.1). The areas of all the linear and branched isomer peaks observed in the CAL standards for each of these analytes must be summed and the concentrations reported as a total for each of these analytes.

11.5 Calculations must utilize all available digits of precision, but final reported concentrations should be rounded to an appropriate number of significant figures (one digit of uncertainty), typically two, and not more than three significant figures.

12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

12.1 Section 9.0 outlines sample batch QC acceptance criteria. If non-compliant organic compound results are to be reported, the Organic Section Head and/or the Laboratory Director, and the Operations Manager must approve the reporting of these results. The laboratory Project Manager shall be notified, and may choose to relay the non-compliance to the client, for approval, or other corrective action, such as re-sampling and re-analysis. The analyst, Data Reviewer, or Department Supervisor performing the secondary review initiates the project narrative, and the narrative must clearly document the non-compliance and provide a reason for acceptance of these results.

12.2 All results for the organic compounds of interest are reportable without qualification if extraction and analytical holding times are met, preservation requirements (including cooler temperatures) are met, all QC criteria are met, and matrix interference is not suspected during extraction or analysis of the samples. If any of the below QC parameters are not met, all associated samples must be evaluated for re-extraction and/or re-analysis.

13. Method Performance

13.1 Detection Limit Study (DL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

13.1.1 The laboratory follows the procedure to determine the DL, LOD, and/or LOQ as outlined in Alpha SOP ID 1732. These studies performed by the laboratory are maintained on file for review.

13.2 Demonstration of Capability Studies

13.2.1 The IDC must be successfully performed prior to analyzing any Field Samples. Prior to conducting the IDC, the analyst must first generate an acceptable Initial Calibration following the procedure outlined in Section 10.6.

13.2.2 INITIAL DEMONSTRATION OF LOW SYSTEM BACKGROUND – Any time a new lot of SPE cartridges, solvents, centrifuge tubes, disposable pipets, and autosampler vials are used, it must be demonstrated that an MB is reasonably free of contamination and that the criteria in Section 9.2.1 are met. If an automated extraction system is used, an MB should be extracted on each port to ensure that all the valves and tubing are free from potential PFAS contamination.

13.2.3 INITIAL DEMONSTRATION OF PRECISION (IDP) – Prepare, extract, and analyze four to seven replicate LCSs fortified near the midrange of the initial calibration curve according to the procedure described in Section 10. Sample preservatives as described in Section 6.2.1 must be added to these samples. The relative standard deviation (RSD) of the results of the replicate analyses must be less than 20%.

13.2.4 INITIAL DEMONSTRATION OF ACCURACY (IDA) – Using the same set of replicate data generated for Section 13.2.3, calculate average recovery. The average recovery of the replicate values must be within ± 30% of the true value.

13.2.5 INITIAL DEMONSTRATION OF PEAK ASYMMETRY FACTOR – Peak asymmetry factors must be calculated using the equation in Section 9.10.1 for the first two eluting peaks (if only two analytes are being analyzed, both must be evaluated) in a mid-level CAL standard. The peak asymmetry factors must fall in the range of 0.8 to 1.5. See guidance in Section 10.6.4.1 if the calculated peak asymmetry factors do not meet the criteria.

13.2.6 Refer to Alpha SOP ID 1739 for further information regarding IDC/DOC Generation.

13.2.7 The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

14. Pollution Prevention and Waste Management

14.1 Refer to Alpha's Chemical Hygiene Plan and Hazardous Waste Management and Disposal SOP for further pollution prevention and waste management information.

14.2 This method utilizes SPE to extract analytes from water. It requires the use of very small volumes of organic solvent and very small quantities of pure analytes, thereby minimizing the potential hazards to both the analyst and the environment as compared to the use of large volumes of organic solvents in conventional liquid-liquid extractions.

14.3 The analytical procedures described in this method generate relatively small amounts of waste since only small amounts of reagents and solvents are used. The matrices of concern are finished drinking water or source water. However, laboratory waste management practices must be conducted consistent with all applicable rules and regulations, and that laboratories protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Also, compliance is required with any sewage discharge permits and regulations, particularly the hazardous waste identification rules and land disposal restrictions.

15. Referenced Documents

Chemical Hygiene Plan – ID 2124

SOP ID 1732 Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ) SOP

SOP ID 1739 Demonstration of Capability (DOC) Generation SOP

SOP ID 1728 Hazardous Waste Management and Disposal SOP

16. Attachments

Table 7: LC Method Conditions

Time (min)	2 mM Ammonium Acetate (5:95 MeOH/H_2O)	100% Methanol
Initial	100.0	0.0
1.0	100.0	0.0
2.2	85.0	15.0
11	20.0	80.0
11.4	0.0	100.0
12.4	100.0	00.0
15.5	100.0	0.0
Waters Aquity UPLC ® BEHC$_{18}$ 2.1 x 50 mm packed with 1.7 µm BEH C$_{18}$ stationary phase Flow rate of 0.4 mL/min 2-5 µL injection		

Table 8: ESI-MS Method Conditions

ESI Conditions	
Polarity	Negative ion
Capillary needle voltage	.5 kV
Cone Gas Flow	25 L/hr
Nitrogen desolvation gas	1000 L/hr
Desolvation gas temp.	500 ºC

Table 9: Method Analyte Source, Retention Times (RTs), and EIS References

#	Analyte	Transition	RT	IS	Type
1	M3PBA	216>171	2.65		REC
2	PFBA	213 > 169	2.65	2: M4PFBA	
3	M4PFBA	217 > 172	2.65	1: M3PBA	EIS
4	PFPeA	263 > 219	5.67	4: M5PFPEA	
5	M5PFPEA	268 > 223	5.66	1: M3PBA	EIS
6	PFBS	299 > 80	6.35	6: M3PFBS	
7	M3PFBS	302 > 80	6.35	29:M4PFOS	EIS
8	FtS 4:2	327 > 307	7.47	9: M2-4:2FTS	

#	Analyte	Transition	RT	IS	Type
9	M2-4:2FTS	329 > 81	7.47	29:M4PFOS	EIS
10	PFHxA	303 > 269	7.57	10: M5PFHxA	
11	M5PFHxA	318 > 273	7.57	19:M2PFOA	EIS
12	PFPeS	349 > 80	7.88	18: M3PFHxS	
13	PFHpA	363 > 319	8.80	14: M4PFHpA	
14	M4PFHpA	367 > 322	8.80	19:M2PFOA	EIS
15	L-PFHxS	399 > 80	8.94	18: M3PFHxS	
16	br-PFHxS	399 > 80	8.72	18: M3PFHxS	
17	PFHxS Total	399 > 80	8.94	18: M3PFHxS	
18	M3PFHxS	402 > 80	8.94	29:M4PFOS	EIS
19	MPFOA	415 > 370	9.7		REC
20	PFOA	413 > 369	9.7	23: M8PFOA	
21	br-PFOA	413 > 369	9.48	23: M8PFOA	
22	PFOA Total	413 > 369	9.7	23: M8PFOA	
23	M8PFOA	421 > 376	9.7	19: M2PFOA	EIS
24	FtS 6:2	427 > 407	9.66	25: M2-6:2FTS	
25	M2-6:2FTS	429 > 409	9.66	29:M4PFOS	EIS
26	PFHpS	449 > 80	9.78	33: M8PFOS	
27	PFNA	463 > 419	10.41	33: M8PFOS	
28	M9PFNA	472 > 427	10.41	19: M2PFOA	EIS
29	M4PFOS	501 > 80	10.45		REC
30	PFOS	499 > 80	10.45	33: M8PFOS	
31	br-PFOS	499 > 80	10.27	33: M8PFOS	
32	PFOS Total	499 > 80	10.45	33: M8PFOS	
33	M8PFOS	507 > 80	10.45	29: M4PFOS	EIS
34	FtS 8:2	527 > 507	10.99	38: M2-8:2FTS	
35	M2-8:2FTS	529 > 509	10.99	29:M4PFOS	EIS
36	M2PFDA	515 > 470	11.00		REC
37	PFDA	513 > 469	11.00	38: M6PFDA	
38	M6PFDA	519 > 474	11.00	36: M2PFDA	EIS
39	PFNS	549 > 80	11.02	33:M8PFOS	
40	NMeFOSAA	570 > 419	11.41	41: D3-NMeFOSAA	
41	d3-NMeFOSAA	573 > 419	11.41	36: M2PFDA	EIS
42	PFOSA	498 > 78	11.48	29: M8FOSA	
43	M8FOSA	506 > 78	11.48	19: M2PFOA	EIS
44	PFUnDA	563 > 519	11.51	41: M7-PFUDA	
45	M7-PFUDA	570 > 525	11.51	36: M2PFDA	EIS
46	PFDS	599 > 80	11.51	33:M8PFOS	
47	NEtFOSAA	584 > 419	11.68	48: d5-NEtFOSAA	

#	Analyte	Transition	RT	IS	Type
48	d5-NEtFOSAA	589 > 419	11.68	36: M2PFDA	EIS
49	PFDoA	613 > 569	11.96	50: MPFDOA	
50	MPFDOA	615 > 570	11.96	36: M2PFDA	EIS
51	PFTriA	663 > 619	12.34	50: MPFDOA	
52	PFTeA	713 > 669	12.6	53: M2PFTEDA	
53	M2PFTEDA	715 > 670	12.6	36: M2PFDA	EIS
54	M3HFPO-DA	329>285	7.97	19: M2PFOA	EIS
55	HFPO-DA	332>287	7.97	54: M3HFPO-DA	
56	ADONA	377>251	8.00	23: M8PFOA	
57	PFHxDA	813>769	13.20	59: M2PFHxDA	
58	PFODA	913>869	13.50	59: M2PFHxDA	
59	M2PFHxDA	815>770	13.20	36:M2PFDA	EIS
60	NEtFOSA	526>169	11.00	61: NMeFOSA	
61	NMeFOSA	512>169	10.50	63: d3-NMeFOSA	
62	d3-NMeFOSA	515>169	10.50	29: M4PFOS	EIS
63	d5-NEtFOSA	531>169	11.00	29: M4PFOS	EIS
64	NMeFOSE	556>122	11.25	66: d7-NMeFOSE	
65	NEtFOSE	570>136	10.75	67: d9-NEtFOSE	
66	d7-NMeFOSE	563>126	11.25	29: M4PFOS	EIS
67	d9-NEtFOSE	579>142	10.75	29: M4PFOS	EIS
68	FtS 10:2	627>607	11.50	25: M2-6:2FTS	
69	PFDoS	699>99	12.50	33: M8PFOS	

Appendix C
Health and Safety Plan

Health and Safety Plan

for
River North
Remedial Investigation Work Plan

178, 194 Richmond Terrace & 8 Stuyvesant Place – Staten Island, NY
Block 13, Lots 82, 92 & 100
BCP Site # C243045

Prepared for:
Richmond SI Owner LLC
c/o Madison Realty Capital
520 Madison Avenue, Suite 3501
New York, NY 10022

Prepared by:
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121 West 27th Street, Suite 702
New York, NY 10001

August 2021

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1.0 INTRODUCTION

This Health and Safety Plan (HASP) has been prepared in conformance with the Occupational Safety and Health Administration (OSHA) standards and guidance that govern site investigation activities, other applicable regulations, and Tenen Environmental LLC (Tenen) health and safety policies and procedures. The purpose of this HASP is the protection of Tenen field personnel and others during the implementation of a Remedial Investigation.

The Site is located on the northern corner of Stuyvesant Place and extends to the west side of Richmond Terrace, in the St. George section of Staten Island, New York.

The Site is identified on the New York City Tax Map as Block 13, 82, 92 and 100. Lots 82 and 92 are contiguous, and Lots 92 and 100 are separated by a strip of land identified on the New York City Tax Map as a portion of Block 13, Lot 8. This portion og Lot 8 is also part of the redevelopment site, but is not part of the Brownfield Cleanup Program (BCP) Site. The Site is currently vacant, vegetated with trees and overgrowth, and contains remnants of building foundations associated with prior unfinished construction on the northern portion of the property.

1.1 Scope of HASP

This HASP includes safety procedures to be used by Tenen staff during the following activities:

- Soil borings and collection of soil samples;
- Collection of groundwater samples; and
- Installation of soil vapor probes and collection of soil vapor samples.

Subcontractors will ensure that performance of the work is in compliance with this HASP and applicable laws and regulations.

2.0 PROJECT SAFETY AUTHORITY

The following personnel are responsible for project health and safety under this HASP.

- Project Manager, Alana Carroll
- Health and Safety Officer (HSO), Matthew Carroll

In addition, each individual working at the Site will be responsible for compliance with this HASP and general safe working practices. All Site workers will have the authority to stop work if a potentially hazardous situation or event is observed.

2.1 Designated Personnel

The Project Manager is responsible for the overall operation of the project, including compliance with the HASP and general safe work practices. The Project Manager may also act as the Health and Safety Officer (HSO) for this project.

Tenen will appoint one of its on-site personnel as the on-site HSO. This individual will be responsible for the implementation of the HASP. The HSO will have a 4-year college degree in occupational safety or a related science/engineering field, and at least two (2) years of experience in implementation of air monitoring and hazardous materials sampling programs. The HSO will have completed a 40-hour training course that meets OSHA requirements of 29 CFR Part 1910, Occupational Safety and Health Standards.

The HSO will be present on-site during all field operations involving drilling or other subsurface disturbance, and will be responsible for all health and safety activities and the delegation of duties to the field crew. The HSO has stop-work authorization, which he/she will execute on his/her determination of an imminent safety hazard, emergency situation, or other potentially dangerous situation. If the HSO must be absent from the field, a replacement who is familiar with the Construction Health and Safety Plan, air monitoring and personnel protective equipment (PPE) will be designated.

3.0 HAZARD ASSESSMENT AND CONTROL MEASURES

Known previous uses of the site include residential dwellings. The following previous investigation summarizes contaminants of concern detected on the site:

Phase I Environmental Site Assessment Report, 170-194 Richmond Terrace & 8-20 Stuyvesant Place, Hydro Tech Environmental Corp. (Hydrotech), January 2014.

Phase II Environmental Site Assessment, 170-194 Richmond Terrace & 8-20 Stuyvesant Place, Hydro Tech Environmental Corp. (Hydrotech), January 2014.

Phase I Environmental Site Assessment Report, 170-194 Richmond Terrace & 8-20 Stuyvesant Place, Environmental Business Consultants (EBC), August 29, 2018.

Limited Due Diligence Site Investigation Report, 170-194 Richmond Terrace & 8-20 Stuyvesant Place, Tenen Environmental, LLC (Tenen), April 29, 2020.

Phase II Environmental Site Investigation Report, 170-194 Richmond Terrace and 8-20 Stuyvesant Place, Tenen Environmental, LLC (Tenen), February 2021.

The findings of the previous investigations are summarized below:

Hydro Tech conducted a Phase I ESA of the property in 2014. The following environmental concerns in relation to the Site were identified in the Phase I ESA:

- The presence of unknown fill material; and,
- The suspect presence of heating oil tanks.

The Phase I conducted by EBC in 2018 did not identify any RECs.

Hydro Tech conducted a Phase II Environmental Site Assessment (ESA) in January 2014. The Phase II ESA consisted of the advancement of twelve soil borings across the Site and the collection of 12 soil samples. The following analytical results were reported in the Phase II ESA:

- One metal (mercury) was detected in exceedance of its Restricted-Residential Use Soil Cleanup Objective (SCO) in one soil sample.

Tenen conducted a Limited Due Diligence Site Investigation (LDDSI) in April 2020. The LDDSI consisted of the advancement of eight soil borings across the Site, collection of eight soil samples, installation of one temporary groundwater monitoring well, installation of six temporary soil vapor sampling probes, and the collection of six soil vapor samples. The following analytical results were reported in the LDDSI:

- Several semivolatile organic compounds (SVOCs), specifically polycyclic aromatic hydrocarbons (PAHs) were detected in exceedance of Restricted-Residential Use SCOs in one soil sample;
- Several metals were detected in six of eight soil samples at concentrations exceeding Restricted-Residential Use SCOs;

- One chlorinated volatile organic compound (cVOC), tetrachloroethene (PCE), was detected in all six soil vapor samples at concentrations ranging from 11.9 micrograms per cubic meter (ug/m^3) to 86.1 ug/m^3; and,
- A variety of petroleum-related VOCs were detected in soil vapor samples across the Site.

Tenen conducted a Phase II Environmental Site Investigation (ESI) in January 2021. The Phase II ESI consisted of the advancement of eleven soil borings across the Site, collection of twenty-two soil samples, installation of nine temporary soil vapor sampling probes, and the collection of nine soil vapor samples. The following analytical results were reported in the Phase II ESI:

- Several SVOCs, specifically PAHs, were detected in exceedance of Restricted-Residential Use SCOs in one shallow soil sample;
- Several metals were detected in nine of eleven shallow soil samples and five of eleven deep soil samples at concentrations exceeding Restricted-Residential Use SCOs;
- cVOCs, including PCE, 1,1,1-trichloroethane (1,1,1-TCA), and chloroform, were detected in one or more soil vapor samples. PCE was detected in six of nine samples, 1,1,1-TCA was detected in one sample, and chloroform was detected in five of nine samples. PCE was detected at a max. concentration of 2.99 ug/m^3, 1,1,1-TCA was detected at a concentration of 1.3 ug/m^3, and chloroform was detected at a max. concentration of 3.64 ug/m^3; and,
- A variety of petroleum-related VOCs were detected in soil vapor samples across the Site.

3.1 Human Exposure Pathways

The media of concern at the Site include potentially-impacted soil, groundwater and soil vapor. Potential exposure pathways include dermal contact, incidental ingestion and inhalation of vapors. The risk of dermal contact and incidental ingestion will be minimized through general safe work practices, a personal hygiene program and the use of PPE.

3.2 Chemical Hazards

Based on historic uses, the following contaminants of concern may be present at the Site:

- VOCs
  - PCE
- Historic Fill
  - SVOCs (PAHs)
  - Pesticides/PCBs
  - Heavy Metals
    - Arsenic
    - Lead
    - Mercury
    - Nickel

Material Safety Data Sheets (MSDSs) for each contaminant of concern are included in Appendix C. All personnel are required to review the MSDSs included in this HASP.

3.3 Physical Hazards

The physical hazards associated with the field activities likely present a greater risk of injury than the chemical constituents at the Site. Activities within the scope of this project shall comply with New York State and Federal OSHA construction safety standards.

Head Trauma
To minimize the potential for head injuries, field personnel will be required to wear National Institutes of Occupational Safety and Health (NIOSH)-approved hard hats during field activities. Hats must be worn properly and not altered in any way that would decrease the degree of protection provided.

Foot Trauma
To avoid foot injuries, field personnel will be required to wear steel-toed safety shoes while field activities are being performed. To afford maximum protection, all safety shoes must meet American National Standards Institute (ANSI) standards.

Eye Trauma
Field personnel will be required to wear eye protection (safety glasses with side shields) while field activities are being performed to prevent eye injuries caused by contact with chemical or physical agents.

Noise Exposure
Field personnel will be required to wear hearing protection (ear plugs or muffs) in high noise areas (noise from heavy equipment) while field activities are being performed.

Buried Utilities and Overhead Power Lines
Boring locations will be cleared by an underground utility locator service. In addition, prior to intrusive activities, the drilling subcontractor will contact the One Call Center to arrange for a utility mark-out, in accordance with New York State requirements. Protection from overhead power lines will be accomplished by maintaining safe distances of at least 15 feet at all times.

Thermal Stress
The effects of ambient temperature can cause physical discomfort, personal injury, and increase the probability of accidents. In addition, heat stress due to lack of body ventilation caused by protective clothing is an important consideration. Heat-related illnesses commonly consist of heat stroke and heat exhaustion.

The symptoms of heat stroke include: sudden onset; change in behavior; confusion; dry, hot and flushed skin; dilated pupils; fast pulse rate; body temperature reaching 105° or more; and/or, deep breathing later followed by shallow breathing.

The symptoms of heat exhaustion include: weak pulse; general weakness and fatigue; rapid shallow breathing; cold, pale and clammy skin; nausea or headache; profuse perspiration; unconsciousness; and/or, appearance of having fainted.

Heat-stress monitoring will be conducted if air temperatures exceed 70 degrees Fahrenheit. The initial work period will be set at 2 hours. Each worker will check his/her pulse at the wrist for 30 seconds early in each rest period. If the pulse rate exceeds 110 beats per minute, the next work period will be shortened by one-third.

One or more of the following precautions will reduce the risk of heat stress on the Site:

- Provide plenty of liquids to replace lost body fluids; water, electrolytic drinks, or both will be made available to minimize the risk of dehydration and heat stress
- Establish a work schedule that will provide appropriate rest periods
- Establish work regimens consistent with the American Conference of Governmental Industrial Hygienists (ACGIH) guidelines
- Provide adequate employee training on the causes of heat stress and preventive measures

In the highly unlikely event of extreme low temperatures, reasonable precautions will be made to avoid risks associated with low temperature exposure.

Traffic

Field activities will occur near public roadways. As a result, vehicular traffic will be a potential hazard during these activities and control of these areas will be established using barricades or traffic cones. Additional staff will be assigned, as warranted, for the sole purpose of coordinating traffic. Personnel will also be required to wear high-visibility traffic vests while working in the vicinity of the public roadways and local requirements for lane closure will be observed as needed. All work in public rights-of-way will be coordinated with local authorities and will adhere to their requirements for working in traffic zones.

Hazardous Weather Conditions

All Site workers will be made aware of hazardous weather conditions, specifically including extreme heat, and will be requested to take the precautions described herein to avoid adverse health risks. All workers are encouraged to take reasonable, common sense precautions to avoid potential injury associated with possible rain or high wind, sleet, snow or freezing.

Slip, Trip and Fall

Areas at the Site may be slippery from mud or water. Care should be taken by all Site workers to avoid slip, trip, and fall hazards. Workers shall not enter areas that do not have adequate lighting. Additional portable lighting will be provided at the discretion of the HSO.

Biological Hazards

Drugs and alcohol are prohibited from the Site. Any on-site personnel violating this requirement will be immediately expelled from the site.

Any worker or oversight personnel with a medical condition that may require attention must inform the HSO of such condition. The HSO will describe appropriate measures to be taken if the individual should become symptomatic.

Due to the Site location in an urban area, it is highly unlikely that poisonous snakes, spiders, plants and insects will be encountered. However, other animals (dogs, cats, etc.) may be encountered and care should be taken to avoid contact.

4.0 COVID-19 HEALTH AND SAFETY

The following requirements apply to all Tenen employees working on project sites for the duration of the COVID-19 pandemic. These guidelines are based on information provided by the Centers for Disease Control, the Occupational Safety and Health Administration and the New York State "New York Forward" Covid-19 management plans. Information regarding the health status of Tenen employees will be kept confidential, with the exception of required notifications to health authorities. The following are guidelines. **As with any potential workplace hazard, employees should report any concerns related to potential Covid-19 exposure to the Project Manager.**

Communication/Reporting:

Employees should not report to work and should notify the Project Manager immediately in the event of the following:

- You are exhibiting flu-like symptoms (fever, body aches, cough, difficulty breathing). Contact your health care provider and follow their instructions.
- You do not exhibit symptoms but have a sick (i.e., diagnosed with Covid-19 or exhibiting flu-like symptoms) family member at home. Remember that the virus can be spread by asymptomatic individuals.
- You have been exposed to someone who has been diagnosed with Covid-19.

In each of the above cases, inform your Project Manager regarding others who may have been exposed in order to facilitate any necessary notification or contact tracing efforts.

Hygiene

- Wash hands frequently with soap and water for at least 20 seconds or use hand sanitizer with at least 60% alcohol if soap and water are not available. Key times for employees to clean their hands include:
    - Before and after work shifts
    - Before and after work breaks
    - After blowing the nose, coughing, or sneezing
    - After using the restroom
    - Before eating or preparing food
    - After putting on, touching, or removing face coverings
- Avoid touching the eyes, nose, and mouth with unwashed hands.
- Practice good respiratory etiquette, including covering coughs and sneezes.
- To the extent possible, avoid sharing tools and sampling equipment. Shared tools and equipment should be regularly disinfected.

Physical Distancing

- Minimize contact with others, maintaining a distance of at least six feet to the extent possible
- Employees should wear masks over their nose and mouth to prevent spread of the virus; this is especially important when a minimum 6-foot distance cannot be maintained.
- Maintain the 6-foot distance to the extent possible during sampling efforts and pickup and delivery of sampling equipment and containers.
- Keep job site meetings to a minimum and of short duration; limit the number of people involved and maintain social distance.

5.0 PERSONAL PROTECTIVE EQUIPMENT

The personal protection equipment required for various kinds of site investigation tasks is based on 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response, “General Description and Discussion of the Levels of Protection and Protective Gear” and the Center for Disease Control (CDC) COVID-19 “Guidelines on How to Protect Yourselves and Others”.

Tenen field personnel and other site personnel will wear Modified Level D-1 personal protective equipment. During activities such as drilling, well installation, or sampling, where there is a chance of contact with contaminated materials, Modified Level D-2 equipment will be worn. The protection will be upgraded to Level C if warranted by the results of the air monitoring. A six-foot minimum distance between individuals (both workers and non-workers) will be maintained at all times. A description of the personnel protective equipment for Levels D and C is provided below.

Modified Level D-1

Respiratory Protection:	Cloth face covering
Protective Clothing:	Hard hat, steel-toed shoes, long pants, nitrile gloves

Modified Level D-2

Respiratory Protection:	Cloth face covering
Protective Clothing:	Hard hat, steel-toed shoes, coveralls/tyvek, nitrile gloves

Level C

Respiratory Protection:	Air purifying respirator with organic vapor cartridges and filters.
Protective Clothing:	Same as modified Level D

6.0 EXPOSURE MONITORING

6.1 Hazardous Materials

Selective monitoring of workers in the exclusion area may be conducted, as determined by the HSO, if sources of hazardous materials are identified. Personal monitoring may be conducted in the breathing zone at the discretion of the Project Manager or HSO. All monitoring will comply with the CDCs Guidance on Social Distancing.

6.2 COVID-19

For any employee that may have come into contact with a person who has COVID-19, a 14-day quarantine will be imposed for that individual and any employee that individual was in contact with.

7.0 SITE ACCESS

Access to the Site during the investigation will be controlled by the Project Manager or HSO. Unauthorized personnel will not be allowed access to the sampling areas.

8.0 WORK AREAS

During any activities involving drilling or other subsurface disturbance, the work area must be divided into various zones to prevent the spread of contamination, clarify the type of protective equipment needed, and provide an area for decontamination.

The Exclusion Zone is defined as the area where potentially contaminated materials are generated as the result of drilling, sampling, or similar activities. The Contamination Reduction Zone (CRZ) is the area where decontamination procedures take place and is located adjacent to the Exclusion Zone. The Support Zone is the area where support facilities such as vehicles, a field phone, fire extinguisher and/or first aid supplies are located. The emergency staging area (part of the Support Zone) is the area where all Site workers will assemble in the event of an emergency. These zones shall be designated daily, depending on that day's activities. All field personnel will be informed of the location of these zones before work begins.

Control measures such as "Caution" tape and traffic cones will be placed around the perimeter of the work area when work is being done in the areas of concern (i.e., areas with exposed soil) to prevent unnecessary access.

9.0 DECONTAMINATION PROCEDURES

Personnel Decontamination

Personnel decontamination (decon), if deemed necessary by the HSO, will take place in the designated decontamination area delineated for each sampling location. Personnel decontamination will consist of the following steps:

- Soap and potable water wash and potable water rinse of gloves;
- Tyvek removal;
- Glove removal;
- Disposable clothing removal; and
- Field wash of hands and face.

Equipment Decontamination

Sampling equipment, such as split-spoons and bailers, will be decontaminated in accordance with U.S. Environmental Protection Agency methodologies, as described in the work plan.

Disposal of Materials

Purged well water, water used to decontaminate any equipment and well cuttings will be containerized and disposed off-site in accordance with federal, state and local regulations.

10.0 GENERAL SAFE WORK PRACTICES

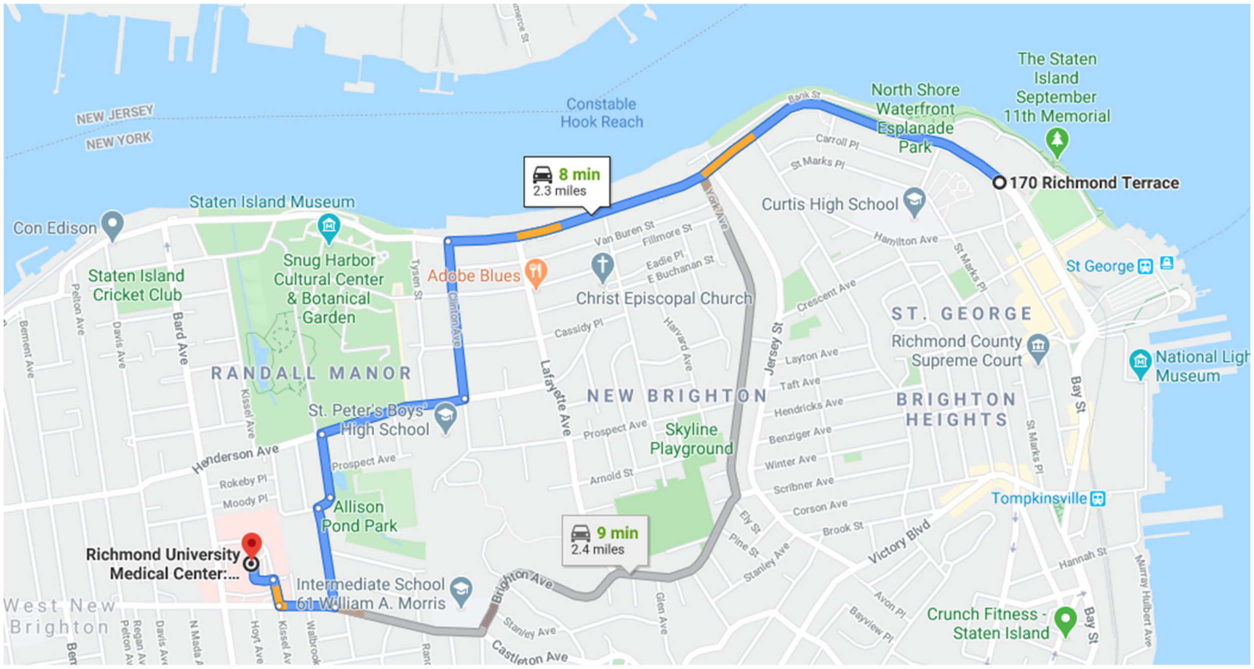
To protect the health and safety of the field personnel, all field personnel will adhere to the guidelines listed below during activities involving subsurface disturbance.

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited, except in designated areas on the site. These areas will be designated by the HSO.
- Workers must wash their hands and face thoroughly on leaving the work area and before eating, drinking, or any other such activity. The workers should shower as soon as possible after leaving the site.
- Removal of potential contamination from PPE and equipment by blowing, shaking or any means that may disperse materials into the air is prohibited.
- Contact with contaminated or suspected surfaces should be avoided.
- The buddy system should always be used; each buddy should watch for signs of fatigue, exposure, and heat stress.
- Personnel will be cautioned to inform each other of symptoms of chemical exposure such as headache, dizziness, nausea, and irritation of the respiratory tract and heat stress.
- No excessive facial hair that interferes with a satisfactory fit of the face-piece of the respirator to the face will be allowed on personnel required to wear respiratory protective equipment.
- On-site personnel will be thoroughly briefed about the anticipated hazards, equipment requirements, safety practices, emergency procedures, and communications methods.

11.0 EMERGENCY PROCEDURES

The field crew will be equipped with emergency equipment, such as a first aid kit and disposable eye washes. In the case of a medical emergency, the HSO will determine the nature of the emergency and will have someone call for an ambulance, if needed. If the nature of the injury is not serious—i.e., the person can be moved without expert emergency medical personnel—onsite personnel should drive injured person to a hospital. **The nearest emergency room is located at Richmond Medical Center located at 355 Bard Avenue, Staten Island, NY 10310. The emergency room entrance is on Bard Avenue. The phone number is (718) 818-1234.** The route to the hospital is shown and detailed on the next page.

11.1 Route to Hospital



Driving directions to **Richmond Medical Center** from **170-194 Richmond Terrace, Staten Island, NY.**

Driving Directions

1. Head northwest on Richmond Terrace toward Richmond Terrace
2. Turn left onto Clinton Ave
3. Turn right onto Henderson Ave
4. Follow Brentwood Ave and Conyingham Ave to Castleton Ave
5. Turn right onto Castleton Ave

11.2 Emergency Contacts

There will be an on-site field phone. Emergency and contact telephone numbers are listed below:

Table 1 – Emergency Contacts

Ambulance	911
Emergency Room	(718) 818-1234
NYSDEC Spill Hotline	(800) 457-7362
NYSDEC	(518) 402-8013
Tenen HSO, Matt Carroll	(917) 510-6767
Project Manager, Alana Carroll	(646) 248-6795
On-site Personnel, Ashley Platt	(908) 892-1354
Client representative	(516) 698-9547

12.0 TRAINING

All personnel performing the field activities described in this HASP will have received the initial safety training required by 29 CFR, 1910.120. Current refresher training status also will be required for all personnel engaged in field activities.

All those who enter the work area while intrusive activities are being performed must recognize and understand the potential hazards to health and safety. All field personnel must attend a training program covering the following areas:

- potential hazards that may be encountered;
- the knowledge and skills necessary for them to perform the work with minimal risk to health and safety;
- the purpose and limitations of safety equipment; and
- protocols to enable field personnel to safely avoid or escape from emergencies.

Each member of the field crew will be instructed in the above objectives before he/she goes onto the site. The HSO will be responsible for conducting the training program.

13.0 MEDICAL SURVEILLANCE

All Tenen and subcontractor personnel performing field work involving drilling or other subsurface disturbance at the site are required to have passed a complete medical surveillance examination in accordance with 29 CFR 1910.120 (f). The medical examination for Tenen employees will, at a minimum, be provided annually and upon termination of hazardous waste site work.

Appendix A

Acknowledgement of HASP

ACKNOWLEDGMENT OF HASP

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

AFFIDAVIT

I have read the Construction Health and Safety Plan (HASP) for the River North site in Staten Island, NY. I agree to conduct all on-site work in accordance with the requirements set forth in this HASP and understand that failure to comply with this HASP could lead to my removal from the site.

Signature: ______________________________ Date: ________________
Signature: ______________________________ Date: ________________
Signature: ______________________________ Date: ________________
Signature: ______________________________ Date: ________________
Signature: ______________________________ Date: ________________

Appendix B

Injury Reporting Form (OSHA Form 300)

OSHA's Form 300 (Rev. 01/2004)

Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

Year 20__ __

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

You must record information about every work-related death and about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR Part 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an Injury and Illness Incident Report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Establishment name ______________________

City ______________ State __________

Identify the person			**Describe the case**			**Classify the case** *CHECK ONLY ONE box for each case based on the most serious outcome for that case:*				*Enter the number of days the injured or ill worker was:*		*Check the "Injury" column or choose one type of illness:*					
								Remained at Work									
(A) Case no.	(B) Employee's name	(C) Job title (*e.g., Welder*)	(D) Date of injury or onset of illness	(E) Where the event occurred (*e.g., Loading dock north end*)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (*e.g., Second degree burns on right forearm from acetylene torch*)	Death (G)	Days away from work (H)	Job transfer or restriction (I)	Other record-able cases (J)	Away from work (K)	On job transfer or restriction (L)	(M) Injury (1)	Skin disorder (2)	Respiratory condition (3)	Poisoning (4)	Hearing loss (5)	All other illnesses (6)
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					Page totals➤	____	____	____	____	____	____	____	____	____	____	____	____
												Injury (1)	Skin disorder (2)	Respiratory condition (3)	Poisoning (4)	Hearing loss (5)	All other illnesses (6)

Be sure to transfer these totals to the Summary page (Form 300A) before you post it.

Public reporting burden for this collection of information is estimated to average 14 minutes per response, including time to review the instructions, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any other aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistical Analysis, Room N-3644, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office.

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Appendix C

Material Safety Data Sheets

Safety Data Sheet

Revision Date: 07/31/19
www.restek.com

2 Letter ISO country code/language code: US/EN

1. IDENTIFICATION

Catalog Number / Product Name:	**32201 / 4,4'-DDD Standard**
Company:	Restek Corporation
Address:	110 Benner Circle Bellefonte, Pa. 16823
Phone#:	814-353-1300
Fax#:	814-353-1309
Emergency#:	800-424-9300 (CHEMTREC) 703-527-3887 (Outside the US)
Email:	www.restek.com
Revision Number:	9
Intended use:	For Laboratory use only

2. HAZARD(S)IDENTIFICATION

Emergency Overview:

GHS Hazard Symbols:

GHS Classification:
Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 1
Flammable Liquid Category 2
Acute Toxicity - Dermal Category 3
Acute Toxicity - Oral Category 3

GHS Signal Word:
Danger

GHS Hazard:
Highly flammable liquid and vapour.
Toxic if swallowed or in contact with skin.
Causes damage to organs.

GHS Precautions:

Safety Precautions:
Keep away from heat/sparks/open flames/hot surfaces. – No smoking.
Keep container tightly closed.
Ground/bond container and receiving equipment.
Use explosion-proof electrical/ventilation and lighting equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Do not breathe dust/fume/gas/mist/vapours/spray.
Wash hands and skin thoroughly after handling.
Do not eat, drink or smoke when using this product.
Wear protective gloves/protective clothing/eye protection/face protection.

First Aid Measures:
IF SWALLOWED: Immediately call a POISON CENTER/doctor/....
IF ON SKIN: Wash with plenty of soap and water.
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
IF exposed: Call a POISON CENTER or doctor/physician.
Call a POISON CENTER or doctor/physician if you feel unwell.
Specific treatment see section 4.
Rinse mouth.
Take off immediately all contaminated clothing and wash it before reuse.
In case of fire: Use extinguishing media in section 5 for extinction.

Storage:
Keep container tightly closed.

Store in a well-ventilated place. Keep cool.
Store locked up.

Disposal: Dispose of contents/container according to section 13 of the SDS.

Single Exposure Target Organs: Specific target organ toxicity - Single exposure - STOT SE 1: H370 Causes damage to organs. (C >= 10 %; No information to prove exclusion of certain routes of exposure); Specific target organ toxicity - Single exposure - STOT SE 2: H371 May cause damage to organs. (3 % <= C <10 %; Concentration limits for acute toxicity cannot be translated into GHS from the DSD especially when minimum classifications are given)

Repeated Exposure Target Organs: No data available

3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
methanol	67-56-1	200-659-6	99.9
4,4'-DDD	72-54-8	200-783-0	0.1

4. FIRST-AID MEASURES

Inhalation: Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately

Eyes: Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.

Skin Contact: Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.

Ingestion: Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.

5. FIRE- FIGHTING MEASURES

Extinguishing Media: Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water may be ineffective but water spray can be used extinguish a fire if swept across the base of the flames. Water can absorb heat and keep exposed material from being damaged by fire.

Fire and/or Explosion Hazards: Vapors may be ignited by sparks, flames or other sources of ignition if material is above the flash point giving rise to a fire (Class B). Vapors are heavier than air and may travel to a source of ignition and flash back.

Fire Fighting Methods and Protection: Do not enter fire area without proper protection including self-contained breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions and Equipment: Exposure to the spilled material may be severely irritating or toxic. Follow personal protective equipment recommendations found in Section 8 of this SDS. Personal protective equipment needs must be evaluated based on information provided on this sheet and the special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred, and the expertise of employees in the area responding to the spill. Never exceed any occupational exposure limits.

Methods for Clean-up: Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal evaluation.

7. HANDLING AND STORAGE

Handling Technical Measures and Precautions: Toxic or severely irritating material. Avoid contacting and avoid

	breathing the material. Use only in a well ventilated area. Use spark-proof tools and explosion-proof equipment
Storage Technical Measures and Conditions:	Store in a cool dry ventilated location. Isolate from incompatible materials and conditions. Keep container(s) closed. Keep away from sources of ignition

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

United States:

Chemical Name	CAS No.	IDLH	ACGIH STEL	ACGIH TLV-TWA	OSHA Exposure Limit
methanol	67-56-1	6000 ppm IDLH	250 ppm STEL	200 ppm TWA	200 ppm TWA; 260 mg/m3 TWA

Personal Protection:

Engineering Measures:	Local exhaust ventilation is recommended when generating excessive levels of vapours from handling or thermal processing.
Respiratory Protection:	Respiratory protection may be required to avoid overexposure when handling this product. General or local exhaust ventilation is the preferred means of protection. Use a respirator if general room ventilation is not available or sufficient to eliminate symptoms.If an exposure limit is exceeded or if an operator is experiencing symptoms of inhalation overexposure as explained in Section 3, provide respiratory protection.
Eye Protection:	Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.
Skin Protection:	Wear protective gloves. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance, color:	No data available
Odor:	Mild
Physical State:	No data available
pH:	Not applicable
Vapor Pressure:	No data available
Vapor Density:	1.1 (air = 1)
Boiling Point (°C):	64.7 °C at 760 mmHg (HSDB)
Melting Point (°C):	-98 °C
Flash Point (°F):	52
Flammability:	Highly Flammable
Upper Flammable/Explosive Limit, % in air:	36
Lower Flammable/Explosive Limit, % in air:	6
Autoignition Temperature (°C):	464 deg C
Decomposition Temperature (°C):	No data available
Specific Gravity:	0.791 - 0.792 g/cm3 at 20 °C
Evaporation Rate:	No data available
Odor Threshold:	No data available
Solubility:	Moderate; 50-99%
Partition Coefficient: n-octanol in water:	No data available
VOC % by weight:	99.9
Molecular Weight:	32.04

10. STABILITY AND REACTIVITY

Stability:	Stable under normal conditions.
Conditions to Avoid:	None known.
Materials to Avoid / Chemical Incompatiability:	Strong oxidizing agents
Hazardous Decomposition Products:	Carbon dioxide Carbon monoxide

11. TOXICOLOGICAL INFORMATION

Routes of Entry:	Inhalation, Skin Contact, Eye Contact, Ingestion
Target Organs Potentially Affected By Exposure:	Eyes, Central nervous system stimulation, Skin, GI Tract, Respiratory Tract
Chemical Interactions That Change Toxicity:	None Known

Immediate (Acute) Health Effects by Route of Exposure:

Inhalation Irritation:	Can cause moderate respiratory irritation, dizziness, weakness, fatigue, nausea and headache.
Inhalation Toxicity:	Harmful! Can cause systemic damage (see "Target Organs)Methanol can cause central nervous system depression and overexposure can cause damage to the optic nerve resulting in visual impairment or blindness.
Skin Contact:	Can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.
Eye Contact:	Can cause moderate irritation, tearing and reddening, but not likely to permanently injure eye tissue.
Ingestion Irritation:	Irritating to mouth, throat, and stomach. Can cause abdominal discomfort, nausea, vomiting and diarrhea.Highly toxic and may be fatal if swallowed.
Ingestion Toxicity:	Toxic if swallowed. May cause target organ failure and/or death.May be fatal if swallowed.

Long-Term (Chronic) Health Effects:

Carcinogenicity:	Contains a probable or known human carcinogen.
Reproductive and Developmental Toxicity:	No data available to indicate product or any components present at greater than 0.1% may cause birth defects.
Inhalation:	Upon prolonged and/or repeated exposure, can cause moderate respiratory irritation, dizziness, weakness, fatigue, nausea and headache.Harmful! Can cause systemic damage upon prolonged and/or repeated exposure (see "Target Organs)
Skin Contact:	Upon prolonged or repeated contact, can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.
Ingestion:	Toxic if swallowed. May cause target organ failure and/or death.

Component Toxicological Data:

NIOSH:

Chemical Name	CAS No.	LD50/LC50
Methanol	67-56-1	Inhalation LC50 Rat 22500 ppm 8 h

Component Carcinogenic Data:

OSHA:

Chemical Name	CAS No.
No data available	

ACGIH:

Chemical Name	CAS No.
No data available	

NIOSH:

Chemical Name	CAS No.
No data available	

NTP:

Chemical Name	CAS No.
No data available	

IARC:

Chemical Name	CAS No.	Group No.
Monograph 53 [1991] (listed under DDT and associated compounds)	72-54-8	Group 2B

12. ECOLOGICAL INFORMATION

Overview:	Moderate ecological hazard. This product may be dangerous to plants and/or wildlife.
Mobility:	No data
Persistence:	No data
Bioaccumulation:	No data
Degradability:	Biodegrades slowly.
Ecological Toxicity Data:	No data available

13. DISPOSAL CONSIDERATIONS

Waste Description of Spent Product:	Spent or discarded material is a hazardous waste.Mixing spent or discarded material with other materials may render the mixture hazardous. Perform a hazardous waste determination on mixtures.
Disposal Methods:	Dispose of by incineration following Federal, State, Local, or Provincial regulations.
Waste Disposal of Packaging:	Comply with all Local, State, Federal, and Provincial Environmental Regulations.

14. TRANSPORTATION INFORMATION

United States:

DOT Proper Shipping Name:	Methanol
UN Number:	UN1230
Hazard Class:	3
Packing Group:	II

International:

IATA Proper Shipping Name:	Methanol
UN Number:	UN1230
Hazard Class:	3(6.1)
Packing Group:	II

Marine Pollutant: No

Chemical Name	CAS#	Marine Pollutant	Severe Marine Pollutant
No data available			

15. REGULATORY INFORMATION

United States:

Chemical Name	CAS#	CERCLA	SARA 313	SARA EHS 313	TSCA
methanol	67-56-1	X	X	-	X

The following chemicals are listed on CA Prop 65:

Chemical Name	CAS #	Regulation
DDD	72-54-8	Prop 65 Cancer
Methanol	67-56-1	Prop 65 Devolop Tox

State Right To Know Listing:

Chemical Name	CAS#	New Jersey	Massachusetts	Pennsylvania	California
methanol	67-56-1	X	X	X	X
4,4'-DDD	72-54-8	X	X	X	X

16. OTHER INFORMATION

Prior Version Date:	07/31/18
Other Information:	Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.
References:	No data available
Disclaimer:	Restek Corporation provides the descriptions, data and information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. It is provided for your guidance only. Because many factors may affect processing or application/use, Restek Corporation recommends you perform an assessment to determine the suitability of a product for your particular purpose prior to use. No warranties of any kind, either expressed or implied, including fitness for a particular purpose, are made regarding products described, data or information set forth. In no case shall the descriptions, information, or data provided be considered a part of our terms and conditions of sale. Further, the descriptions, data and information furnished hereunder are given gratis. No obligation or liability for the description, data and information given are assumed. All such being given and accepted at your risk.

Safety Data Sheet

Revision Date: 11/08/19
www.restek.com

2 Letter ISO country code/language code: US/EN

1. IDENTIFICATION

Catalog Number / Product Name:	**32202 / 4,4'-DDE Standard**
Company:	Restek Corporation
Address:	110 Benner Circle Bellefonte, Pa. 16823
Phone#:	814-353-1300
Fax#:	814-353-1309
Emergency#:	800-424-9300 (CHEMTREC) 703-527-3887 (Outside the US)
Email:	www.restek.com
Revision Number:	11
Intended use:	For Laboratory use only

2. HAZARD(S)IDENTIFICATION

Emergency Overview:

GHS Hazard Symbols:

GHS Classification:
Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 1
Flammable Liquid Category 2
Acute Toxicity - Inhalation Dust / Mist Category 3
Acute Toxicity - Dermal Category 3
Acute Toxicity - Oral Category 3

GHS Signal Word: Danger

GHS Hazard:
Highly flammable liquid and vapour.
Toxic if swallowed, in contact with skin or if inhaled.
Causes damage to organs.

GHS Precautions:

Safety Precautions:
Keep away from heat/sparks/open flames/hot surfaces. – No smoking.
Ground/bond container and receiving equipment.
Use explosion-proof electrical/ventilation and lighting equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Do not breathe dust/fume/gas/mist/vapours/spray.
Wash hands and skin thoroughly after handling.
Do not eat, drink or smoke when using this product.
Use only outdoors or in a well-ventilated area.
Wear protective gloves/protective clothing/eye protection/face protection.

First Aid Measures:
IF SWALLOWED: Immediately call a POISON CENTER/doctor/....
IF ON SKIN: Wash with plenty of soap and water.
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
Specific treatment see section 4.
Rinse mouth.
Take off immediately all contaminated clothing and wash it before reuse.
In case of fire: Use extinguishing media in section 5 for extinction.

Storage: Store in a well-ventilated place. Keep container tightly closed.

Store in a well-ventilated place. Keep cool.
Store locked up.

Disposal: Dispose of contents/container according to section 13 of the SDS.

Single Exposure Target Organs: Specific target organ toxicity - Single exposure - STOT SE 1: H370 Causes damage to organs. (C >= 10 %; No information to prove exclusion of certain routes of exposure); Specific target organ toxicity - Single exposure - STOT SE 2: H371 May cause damage to organs. (3 % <= C <10 %; Concentration limits for acute toxicity cannot be translated into GHS from the DSD especially when minimum classifications are given)

Repeated Exposure Target Organs: No data available

3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
methanol	67-56-1	200-659-6	99.9
4,4'-DDE	72-55-9	200-784-6	0.1

4. FIRST-AID MEASURES

Inhalation: Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately

Eyes: Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.

Skin Contact: Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.

Ingestion: Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.

5. FIRE- FIGHTING MEASURES

Extinguishing Media: Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water may be ineffective but water spray can be used extinguish a fire if swept across the base of the flames. Water can absorb heat and keep exposed material from being damaged by fire.

Fire and/or Explosion Hazards: Vapors may be ignited by sparks, flames or other sources of ignition if material is above the flash point giving rise to a fire (Class B). Vapors are heavier than air and may travel to a source of ignition and flash back.

Fire Fighting Methods and Protection: Do not enter fire area without proper protection including self-contained breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions and Equipment: Exposure to the spilled material may be severely irritating or toxic. Follow personal protective equipment recommendations found in Section 8 of this SDS. Personal protective equipment needs must be evaluated based on information provided on this sheet and the special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred, and the expertise of employees in the area responding to the spill. Never exceed any occupational exposure limits.

Methods for Clean-up: Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal evaluation.

7. HANDLING AND STORAGE

Handling Technical Measures and Precautions: Toxic or severely irritating material. Avoid contacting and avoid

	breathing the material. Use only in a well ventilated area. Use spark-proof tools and explosion-proof equipment
Storage Technical Measures and Conditions:	Store in a cool dry ventilated location. Isolate from incompatible materials and conditions. Keep container(s) closed. Keep away from sources of ignition

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

United States:

Chemical Name	CAS No.	IDLH	ACGIH STEL	ACGIH TLV-TWA	OSHA Exposure Limit
methanol	67-56-1	6000 ppm IDLH	250 ppm STEL	200 ppm TWA	200 ppm TWA; 260 mg/m3 TWA

Personal Protection:

Engineering Measures:	Local exhaust ventilation is recommended when generating excessive levels of vapours from handling or thermal processing.
Respiratory Protection:	Respiratory protection may be required to avoid overexposure when handling this product. General or local exhaust ventilation is the preferred means of protection. Use a respirator if general room ventilation is not available or sufficient to eliminate symptoms.If an exposure limit is exceeded or if an operator is experiencing symptoms of inhalation overexposure as explained in Section 3, provide respiratory protection.
Eye Protection:	Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.
Skin Protection:	Wear protective gloves. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance, color:	No data available
Odor:	Mild
Physical State:	Liquid
pH:	Not applicable
Vapor Pressure:	No data available
Vapor Density:	1.1 (air = 1)
Boiling Point (°C):	64.7 °C at 760 mmHg (HSDB)
Melting Point (°C):	-98 °C
Flash Point (°F):	52
Flammability:	Highly Flammable
Upper Flammable/Explosive Limit, % in air:	36
Lower Flammable/Explosive Limit, % in air:	6
Autoignition Temperature (°C):	464 deg C
Decomposition Temperature (°C):	No data available
Specific Gravity:	0.791 - 0.792 g/cm3 at 20 °C
Evaporation Rate:	No data available
Odor Threshold:	No data available
Solubility:	Moderate; 50-99%
Partition Coefficient: n-octanol in water:	No data available
VOC % by weight:	99.9
Molecular Weight:	32.04

10. STABILITY AND REACTIVITY

Stability:	Stable under normal conditions.
Conditions to Avoid:	None known.
Materials to Avoid / Chemical Incompatiability:	Strong oxidizing agents
Hazardous Decomposition Products:	Carbon dioxide Carbon monoxide

11. TOXICOLOGICAL INFORMATION

Routes of Entry:	Inhalation, Skin Contact, Eye Contact, Ingestion
Target Organs Potentially Affected By Exposure:	Eyes, Central nervous system stimulation, Skin, GI Tract, Respiratory Tract
Chemical Interactions That Change Toxicity:	None Known

Immediate (Acute) Health Effects by Route of Exposure:

Inhalation Irritation:	Can cause moderate respiratory irritation, dizziness, weakness, fatigue, nausea and headache.
Inhalation Toxicity:	Harmful! Can cause systemic damage (see "Target Organs)Methanol can cause central nervous system depression and overexposure can cause damage to the optic nerve resulting in visual impairment or blindness.
Skin Contact:	Can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.
Eye Contact:	Can cause moderate irritation, tearing and reddening, but not likely to permanently injure eye tissue.
Ingestion Irritation:	Irritating to mouth, throat, and stomach. Can cause abdominal discomfort, nausea, vomiting and diarrhea.Highly toxic and may be fatal if swallowed.
Ingestion Toxicity:	Toxic if swallowed. May cause target organ failure and/or death.May be fatal if swallowed.

Long-Term (Chronic) Health Effects:

Carcinogenicity:	Contains a probable or known human carcinogen.
Reproductive and Developmental Toxicity:	Contains a known human reproductive and/or developmental hazard.
Inhalation:	Upon prolonged and/or repeated exposure, can cause moderate respiratory irritation, dizziness, weakness, fatigue, nausea and headache.Harmful! Can cause systemic damage upon prolonged and/or repeated exposure (see "Target Organs)
Skin Contact:	Upon prolonged or repeated contact, can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.
Ingestion:	Toxic if swallowed. May cause target organ failure and/or death.

Component Toxicological Data:
NIOSH:

Chemical Name	CAS No.	LD50/LC50
Methanol	67-56-1	Inhalation LC50 Rat 22500 ppm 8 h

Component Carcinogenic Data:
OSHA:

Chemical Name	CAS No.
No data available	

ACGIH:

Chemical Name	CAS No.
No data available	

NIOSH:

Chemical Name	CAS No.
No data available	

NTP:

Chemical Name	CAS No.
No data available	

IARC:

Chemical Name	CAS No.	Group No.
Monograph 53 [1991] (listed under DDT and associated compounds)	72-55-9	Group 2B

12. ECOLOGICAL INFORMATION

Overview:	Moderate ecological hazard. This product may be dangerous to plants and/or wildlife.
Mobility:	No data
Persistence:	No data
Bioaccumulation:	No data
Degradability:	Biodegrades slowly.
Ecological Toxicity Data:	No data available

13. DISPOSAL CONSIDERATIONS

Waste Description of Spent Product:	Spent or discarded material is a hazardous waste.Mixing spent or discarded material with other materials may render the mixture hazardous. Perform a hazardous waste determination on mixtures.
Disposal Methods:	Dispose of by incineration following Federal, State, Local, or Provincial regulations.
Waste Disposal of Packaging:	Comply with all Local, State, Federal, and Provincial Environmental Regulations.

14. TRANSPORTATION INFORMATION

United States:

DOT Proper Shipping Name:	Methanol
UN Number:	UN1230
Hazard Class:	3
Packing Group:	II

International:

IATA Proper Shipping Name:	Methanol
UN Number:	UN1230
Hazard Class:	3(6.1)
Packing Group:	II

Marine Pollutant: No

Chemical Name	CAS#	Marine Pollutant	Severe Marine Pollutant
No data available			

15. REGULATORY INFORMATION

United States:

Chemical Name	CAS#	CERCLA	SARA 313	SARA EHS 313	TSCA
methanol	67-56-1	X	X	-	X

The following chemicals are listed on CA Prop 65:

Chemical Name	CAS #	Regulation
DDE	72-55-9	Prop 65 Cancer
1,1-Dichloro-2,2-bis(p-chlorophenyl)ethylene	72-55-9	Prop 65 Devolop Tox
Methanol	67-56-1	Prop 65 Devolop Tox
1,1-Dichloro-2,2-bis(p-chlorophenyl)ethylene	72-55-9	Prop 65 Rep Male

State Right To Know Listing:

Chemical Name	CAS#	New Jersey	Massachusetts	Pennsylvania	California
methanol	67-56-1	X	X	X	X
4,4'-DDE	72-55-9	X	X	X	X

16. OTHER INFORMATION

Prior Version Date:	03/23/18
Other Information:	Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.
References:	No data available
Disclaimer:	Restek Corporation provides the descriptions, data and information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. It is provided for your guidance only. Because many factors may affect processing or application/use, Restek Corporation recommends you perform an assessment to determine the suitability of a product for your particular purpose prior to use. No warranties of any kind, either expressed or implied, including fitness for a particular purpose, are made regarding products described, data or information set forth. In no case shall the descriptions, information, or data provided be considered a part of our terms and conditions of sale. Further, the descriptions,

Safety Data Sheet

Revision Date: 10/04/19
www.restek.com

2 Letter ISO country code/language code: US/EN

1. IDENTIFICATION

Catalog Number / Product Name:	**32203 / 4,4'-DDT Standard**
Company:	Restek Corporation
Address:	110 Benner Circle Bellefonte, Pa. 16823
Phone#:	814-353-1300
Fax#:	814-353-1309
Emergency#:	800-424-9300 (CHEMTREC) 703-527-3887 (Outside the US)
Email:	www.restek.com
Revision Number:	10
Intended use:	For Laboratory use only

2. HAZARD(S)IDENTIFICATION

Emergency Overview:

GHS Hazard Symbols:

GHS Classification:
Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 1
Flammable Liquid Category 2
Carcinogenicity Category 2
Acute Toxicity - Dermal Category 3
Acute Toxicity - Oral Category 3

GHS Signal Word: Danger

GHS Hazard:
Highly flammable liquid and vapour.
Toxic if swallowed or in contact with skin.
Suspected of causing cancer.
Causes damage to organs.

GHS Precautions:

Safety Precautions:
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Keep away from heat/sparks/open flames/hot surfaces. – No smoking.
Keep container tightly closed.
Ground/bond container and receiving equipment.
Use explosion-proof electrical/ventilation and lighting equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Do not breathe dust/fume/gas/mist/vapours/spray.
Wash hands and skin thoroughly after handling.
Do not eat, drink or smoke when using this product.
Wear protective gloves/protective clothing/eye protection/face protection.

First Aid Measures:
IF SWALLOWED: Immediately call a POISON CENTER/doctor/....
IF ON SKIN: Wash with plenty of soap and water.
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
IF exposed: Call a POISON CENTER or doctor/physician.
IF exposed or concerned: Get medical advice/attention.
Call a POISON CENTER or doctor/physician if you feel unwell.
Specific treatment see section 4.

Rinse mouth.
Take off immediately all contaminated clothing and wash it before reuse.
In case of fire: Use extinguishing media in section 5 for extinction.

Storage: Keep container tightly closed.
Store in a well-ventilated place. Keep cool.
Store locked up.

Disposal: Dispose of contents/container according to section 13 of the SDS.

Single Exposure Target Organs: Specific target organ toxicity - Single exposure - STOT SE 1: H370 Causes damage to organs. (C >= 10 %; No information to prove exclusion of certain routes of exposure); Specific target organ toxicity - Single exposure - STOT SE 2: H371 May cause damage to organs. (3 % <= C <10 %; Concentration limits for acute toxicity cannot be translated into GHS from the DSD especially when minimum classifications are given)

Repeated Exposure Target Organs: Specific target organ toxicity - Repeated exposure - STOT RE 1: H372 Causes damage to organs through prolonged or repeated exposure. (No information to prove exclusion of certain routes of exposure)

3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
methanol	67-56-1	200-659-6	99.9
4,4'-DDT	50-29-3	200-024-3	0.1

4. FIRST-AID MEASURES

Inhalation: Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately

Eyes: Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.

Skin Contact: Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.

Ingestion: Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.

5. FIRE- FIGHTING MEASURES

Extinguishing Media: Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water may be ineffective but water spray can be used extinguish a fire if swept across the base of the flames. Water can absorb heat and keep exposed material from being damaged by fire.

Fire and/or Explosion Hazards: Vapors may be ignited by sparks, flames or other sources of ignition if material is above the flash point giving rise to a fire (Class B). Vapors are heavier than air and may travel to a source of ignition and flash back.

Fire Fighting Methods and Protection: Do not enter fire area without proper protection including self-contained breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions and Equipment: Exposure to the spilled material may be severely irritating or toxic. Follow personal protective equipment recommendations found in Section 8 of this SDS. Personal protective equipment needs must be evaluated based on information provided on this sheet and the special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred, and the expertise of employees in the area responding to the spill. Never exceed any occupational exposure limits.

Methods for Clean-up: Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay.

Gather and store in a sealed container pending a waste disposal evaluation.

7. HANDLING AND STORAGE

Handling Technical Measures and Precautions:	Toxic or severely irritating material. Avoid contacting and avoid breathing the material. Use only in a well ventilated area. Use spark-proof tools and explosion-proof equipment
Storage Technical Measures and Conditions:	Store in a cool dry ventilated location. Isolate from incompatible materials and conditions. Keep container(s) closed. Keep away from sources of ignition

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

United States:

Chemical Name	CAS No.	IDLH	ACGIH STEL	ACGIH TLV-TWA	OSHA Exposure Limit
methanol	67-56-1	6000 ppm IDLH	250 ppm STEL	200 ppm TWA	200 ppm TWA; 260 mg/m3 TWA
4,4'-DDT	50-29-3	500 mg/m3 IDLH	None Known	1 mg/m3 TWA	1 mg/m3 TWA (listed under Dichlorodiphenyltrichloroethane)

Personal Protection:

Engineering Measures:	Local exhaust ventilation is recommended when generating excessive levels of vapours from handling or thermal processing.
Respiratory Protection:	Respiratory protection may be required to avoid overexposure when handling this product. General or local exhaust ventilation is the preferred means of protection. Use a respirator if general room ventilation is not available or sufficient to eliminate symptoms.If an exposure limit is exceeded or if an operator is experiencing symptoms of inhalation overexposure as explained in Section 3, provide respiratory protection.
Eye Protection:	Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.
Skin Protection:	Wear protective gloves. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance, color:	No data available
Odor:	Mild
Physical State:	No data available
pH:	Not applicable
Vapor Pressure:	No data available
Vapor Density:	1.1 (air = 1)
Boiling Point (°C):	260 °C 64.7 °C at 760 mmHg (HSDB)
Melting Point (°C):	-98 °C
Flash Point (°F):	52
Flammability:	Highly Flammable
Upper Flammable/Explosive Limit, % in air:	36
Lower Flammable/Explosive Limit, % in air:	6
Autoignition Temperature (°C):	464 deg C
Decomposition Temperature (°C):	No data available
Specific Gravity:	0.791 - 0.792 g/cm3 at 20 °C
Evaporation Rate:	No data available
Odor Threshold:	No data available
Solubility:	Moderate; 50-99%
Partition Coefficient: n-octanol in water:	No data available
VOC % by weight:	99.9
Molecular Weight:	32.04

10. STABILITY AND REACTIVITY

Stability:	Stable under normal conditions.
Conditions to Avoid:	None known.
Materials to Avoid / Chemical Incompatiability:	Strong oxidizing agents

Hazardous Decomposition Products:	Carbon dioxide Carbon monoxide

11. TOXICOLOGICAL INFORMATION

Routes of Entry:	Inhalation, Skin Contact, Eye Contact, Ingestion
Target Organs Potentially Affected By Exposure:	Eyes, Central nervous system stimulation, Skin, GI Tract, Respiratory Tract
Chemical Interactions That Change Toxicity:	None Known

Immediate (Acute) Health Effects by Route of Exposure:

Inhalation Irritation:	Can cause moderate respiratory irritation, dizziness, weakness, fatigue, nausea and headache.
Inhalation Toxicity:	Harmful! Can cause systemic damage (see "Target Organs)Methanol can cause central nervous system depression and overexposure can cause damage to the optic nerve resulting in visual impairment or blindness.
Skin Contact:	Can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.
Eye Contact:	Can cause moderate irritation, tearing and reddening, but not likely to permanently injure eye tissue.
Ingestion Irritation:	Irritating to mouth, throat, and stomach. Can cause abdominal discomfort, nausea, vomiting and diarrhea.Highly toxic and may be fatal if swallowed.
Ingestion Toxicity:	Toxic if swallowed. May cause target organ failure and/or death.May be fatal if swallowed.

Long-Term (Chronic) Health Effects:

Carcinogenicity:	Contains a probable or known human carcinogen.
Reproductive and Developmental Toxicity:	Contains a known human reproductive and/or developmental hazard.
Inhalation:	Upon prolonged and/or repeated exposure, can cause moderate respiratory irritation, dizziness, weakness, fatigue, nausea and headache.Harmful! Can cause systemic damage upon prolonged and/or repeated exposure (see "Target Organs)
Skin Contact:	Upon prolonged or repeated contact, can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.
Ingestion:	Toxic if swallowed. May cause target organ failure and/or death.

Component Toxicological Data:
NIOSH:

Chemical Name	CAS No.	LD50/LC50
DDT	50-29-3	Dermal LD50 Rabbit 300 - 2820 mg/kg
Methanol	67-56-1	Inhalation LC50 Rat 22500 ppm 8 h

Component Carcinogenic Data:
OSHA:

Chemical Name	CAS No.	
DDT	50-29-3	Present

ACGIH:

Chemical Name	CAS No.	
DDT	50-29-3	A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans

NIOSH:

Chemical Name	CAS No.	
DDT	50-29-3	potential occupational carcinogen

NTP:

Chemical Name	CAS No.
No data available	

IARC:

Chemical Name	CAS No.	Group No.
Monograph 113 [in preparation]; Monograph 53 [1991]; Supplement 7 [1987]	50-29-3	Group 2A

12. ECOLOGICAL INFORMATION

Overview:	Moderate ecological hazard. This product may be dangerous to plants and/or wildlife.
Mobility:	No data
Persistence:	No data
Bioaccumulation:	No data
Degradability:	Biodegrades slowly.
Ecological Toxicity Data:	No data available

13. DISPOSAL CONSIDERATIONS

Waste Description of Spent Product:	Spent or discarded material is a hazardous waste.Mixing spent or discarded material with other materials may render the mixture hazardous. Perform a hazardous waste determination on mixtures.
Disposal Methods:	Dispose of by incineration following Federal, State, Local, or Provincial regulations.
Waste Disposal of Packaging:	Comply with all Local, State, Federal, and Provincial Environmental Regulations.

14. TRANSPORTATION INFORMATION

United States:

DOT Proper Shipping Name:	Methanol
UN Number:	No data available
Hazard Class:	3
Packing Group:	II

International:

IATA Proper Shipping Name:	Methanol
UN Number:	UN1230
Hazard Class:	3(6.1)
Packing Group:	II

Marine Pollutant: No

Chemical Name	CAS#	Marine Pollutant	Severe Marine Pollutant
No data available			

15. REGULATORY INFORMATION

United States:

Chemical Name	CAS#	CERCLA	SARA 313	SARA EHS 313	TSCA
methanol	67-56-1	X	X	-	X
4,4'-DDT	50-29-3	X	-	-	X

The following chemicals are listed on CA Prop 65:

Chemical Name	CAS #	Regulation
DDT	50-29-3	Prop 65 Cancer
p,p''-DDT	50-29-3	Prop 65 Devolop Tox
Methanol	67-56-1	Prop 65 Devolop Tox
p,p''-DDT	50-29-3	Prop 65 Rep Female
p,p''-DDT	50-29-3	Prop 65 Rep Male

State Right To Know Listing:

Chemical Name	CAS#	New Jersey	Massachusetts	Pennsylvania	California
methanol	67-56-1	X	X	X	X
4,4'-DDT	50-29-3	X	X	X	X

16. OTHER INFORMATION

Prior Version Date: 09/13/18

Other Information: Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.

References:	No data available
Disclaimer:	Restek Corporation provides the descriptions, data and information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. It is provided for your guidance only. Because many factors may affect processing or application/use, Restek Corporation recommends you perform an assessment to determine the suitability of a product for your particular purpose prior to use. No warranties of any kind, either expressed or implied, including fitness for a particular purpose, are made regarding products described, data or information set forth. In no case shall the descriptions, information, or data provided be considered a part of our terms and conditions of sale. Further, the descriptions, data and information furnished hereunder are given gratis. No obligation or liability for the description, data and information given are assumed. All such being given and accepted at your risk.

RESTEK

Safety Data Sheet

Revision Date: 09/16/20
www.restek.com

2 Letter ISO country code/language code: US/EN

1. IDENTIFICATION

Catalog Number / Product Name:	**32011 / Aroclor® 1254 Standard**
Company:	Restek Corporation
Address:	110 Benner Circle Bellefonte, Pa. 16823
Phone#:	814-353-1300
Fax#:	814-353-1309
Emergency#:	800-424-9300 (CHEMTREC) 703-527-3887 (Outside the US)
Email:	www.restek.com
Revision Number:	13
Intended use:	For Laboratory use only

2. HAZARD(S)IDENTIFICATION

Emergency Overview:

GHS Hazard Symbols:

GHS Classification:
Flammable Liquid Category 2
Skin Corrosion/Irritation Category 2
Specific Target Organ Systemic Toxicity (STOT) - Repeated Exposure Category 2
Hazardous to the aquatic environment - Chronic Category 2
Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 3

GHS Signal Word: Danger

GHS Hazard:
Highly flammable liquid and vapour.
Causes skin irritation.
May cause drowsiness or dizziness.
May cause damage to organs through prolonged or repeated exposure.
Toxic to aquatic life with long lasting effects.

GHS Precautions:

Safety Precautions:
Keep away from heat/sparks/open flames/hot surfaces. – No smoking.
Ground/bond container and receiving equipment.
Use explosion-proof electrical/ventilation and lighting equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Do not breathe dust/fume/gas/mist/vapours/spray.
Wash hands and skin thoroughly after handling.
Use only outdoors or in a well-ventilated area.
Avoid release to the environment.
Wear protective gloves/protective clothing/eye protection/face protection.

First Aid Measures:
IF ON SKIN: Wash with plenty of soap and water.
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
Call a POISON CENTER or doctor/physician if you feel unwell.
Specific treatment see section 4.
If skin irritation occurs: Get medical advice/attention.
Take off contaminated clothing and wash it before reuse.
In case of fire: Use extinguishing media in section 5 for extinction.

Collect spillage.

Storage: Store in a well-ventilated place. Keep container tightly closed.
Store in a well-ventilated place. Keep cool.
Store locked up.

Disposal: Dispose of contents/container according to section 13 of the SDS.

Single Exposure Target Organs: Specific target organ toxicity - Single exposure - STOT SE 3: H336 May cause drowsiness or dizziness.

Repeated Exposure Target Organs: Specific target organ toxicity - Repeated exposure - STOT RE 2: H373 May cause damage to organs through prolonged or repeated exposure. (C >= 5 %; Minimum classification, No information to prove exclusion of certain routes of exposure)

3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
hexane	110-54-3	203-777-6	99.9
aroclor® 1254	11097-69-1		0.1

4. FIRST-AID MEASURES

Inhalation: Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen.

Eyes: Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.

Skin Contact: Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.

Ingestion: Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.

5. FIRE- FIGHTING MEASURES

Extinguishing Media: Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water spray or fog may also be effective for extinguishing if swept across the base of the fire. Water can also be used to absorb heat and keep exposed material from being damaged by fire.

Fire and/or Explosion Hazards: Vapors may be ignited by heat, sparks, flames or other sources of ignition at or above the low flash point giving rise to a Class B fire. Vapors are heavier than air and may travel to a source of ignition and flash back

Fire Fighting Methods and Protection: Do not enter fire area without proper protection including self-contained toxic breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface. Use water spray/fog for cooling. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions and Equipment: Exposure to the spilled material may be irritating or harmful. Follow personal protective equipment recommendations found in Section 8 of this SDS. Additional precautions may be necessary based on special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred. Also consider the expertise of employees in the area responding to the spill.

Methods for Clean-up: Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal evaluation.

7. HANDLING AND STORAGE

Handling Technical Measures and Precautions:	Harmful or irritating material. Avoid contacting and avoid breathing the material. Use only in a well ventilated area. Use spark-proof tools and explosion-proof equipment
Storage Technical Measures and Conditions:	Store in a cool dry ventilated location. Isolate from incompatible materials and conditions. Keep container(s) closed. Keep away from sources of ignition

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

United States:

Chemical Name	CAS No.	IDLH	ACGIH STEL	ACGIH TLV-TWA	OSHA Exposure Limit
hexane	110-54-3	1100 ppm IDLH (10% LEL)	1000 ppm	50 ppm TWA	500 ppm TWA; 1800 mg/m3 TWA
aroclor® 1254	11097-69-1	5 mg/m3 IDLH	None Known	0.5 mg/m3 TWA	0.5 mg/m3 TWA

Personal Protection:

Engineering Measures:	Local exhaust ventilation is recommended when generating excessive levels of vapours from handling or thermal processing.
Respiratory Protection:	Respiratory protection may be required to avoid overexposure when handling this product. General or local exhaust ventilation is the preferred means of protection. Use a respirator if general room ventilation is not available or sufficient to eliminate symptoms.
Eye Protection:	Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.
Skin Protection:	Wear protective gloves. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance, color:	No data available
Odor:	Mild
Physical State:	Liquid
pH:	Not applicable
Vapor Pressure:	No data available
Vapor Density:	2.97 (air = 1)
Boiling Point (°C):	68.73 °C (HSDB)
Melting Point (°C):	-95 °C Melting Point
Flash Point (°F):	-8
Flammability:	Highly Flammable Extremely Flammable
Upper Flammable/Explosive Limit, % in air:	No data available
Lower Flammable/Explosive Limit, % in air:	No data available
Autoignition Temperature (°C):	No data available deg C
Decomposition Temperature (°C):	No data available
Specific Gravity:	0.672 g/cm3 at 15 °C
Evaporation Rate:	No data available
Odor Threshold:	No data available
Solubility:	Negligible; 0-1%
Partition Coefficient: n-octanol in water:	No data available
VOC % by weight:	0
Molecular Weight:	No data available

10. STABILITY AND REACTIVITY

Stability:	Stable under normal conditions.
Conditions to Avoid:	None known.
Materials to Avoid / Chemical Incompatiability:	Strong oxidizing agents
Hazardous Decomposition Products:	No data available

11. TOXICOLOGICAL INFORMATION

Routes of Entry:	Inhalation Contact Absorption Ingestion
Target Organs Potentially Affected By Exposure:	Eyes, Central nervous system stimulation,

	Respiratory Tract, Skin, Peripheral Nervous System
Chemical Interactions That Change Toxicity:	None Known

Immediate (Acute) Health Effects by Route of Exposure:

Inhalation Irritation:	Can cause severe respiratory irritation, dizziness, weakness, fatigue, nausea, headache and possible unconsciousness.
Skin Contact:	Can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.
Skin Absorption:	May cause irritation and minor systemic damage.Harmful if absorbed through the skin.
Eye Contact:	Can cause moderate irritation, tearing and reddening, but not likely to permanently injure eye tissue.
Ingestion Irritation:	Irritating to mouth, throat, and stomach. Can cause abdominal discomfort, nausea, vomiting and diarrhea.Harmful if swallowed.
Ingestion Toxicity:	Toxic if swallowed. May cause target organ failure and/or death.

Long-Term (Chronic) Health Effects:

Carcinogenicity:	No data.
Reproductive and Developmental Toxicity:	No data available to indicate product or any components present at greater than 0.1% may cause birth defects.
Inhalation:	Upon prolonged and/or repeated exposure, can cause severe respiratory irritation, dizziness, weakness, fatigue, nausea, headache and possible unconsciousness.
Skin Contact:	Upon prolonged or repeated contact, can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.
Skin Absorption:	Upon prolonged or repeated exposure, harmful if absorbed through the skin. May cause minor systemic damage.

Component Toxicological Data:

NIOSH:

Chemical Name	CAS No.	LD50/LC50
Aroclor 1254	11097-69-1	Oral LD50 Rat 1010 mg/kg
n-Hexane	110-54-3	Dermal LD50 Rabbit 3000 mg/kg; Inhalation LC50 Rat 48000 ppm 4 h; Oral LD50 Rat 25 g/kg

Component Carcinogenic Data:

OSHA:

Chemical Name	CAS No.	
Aroclor 1254	11097-69-1	Present

ACGIH:

Chemical Name	CAS No.	
Chlorodiphenyl (54% chlorine)	11097-69-1	A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans

NIOSH:

Chemical Name	CAS No.	
Chlorodiphenyl (54% chlorine)	11097-69-1	potential occupational carcinogen

NTP:

Chemical Name	CAS No.
No data available	

IARC:

Chemical Name	CAS No.	Group No.

12. ECOLOGICAL INFORMATION

Overview:	Moderate ecological hazard. This product may be dangerous to plants and/or wildlife.
Mobility:	No data
Persistence:	No data
Bioaccumulation:	No data
Degradability:	No data
Ecological Toxicity Data:	No data available

13. DISPOSAL CONSIDERATIONS

Waste Description of Spent Product:	Spent or discarded material is a hazardous waste.Mixing spent or discarded material with other materials may render the mixture hazardous. Perform a hazardous waste determination on mixtures.
Disposal Methods:	Dispose of by incineration following Federal, State, Local, or Provincial regulations.
Waste Disposal of Packaging:	Comply with all Local, State, Federal, and Provincial Environmental Regulations.

14. TRANSPORTATION INFORMATION

United States:

DOT Proper Shipping Name:	Hexanes
UN Number:	UN1208
Hazard Class:	3
Packing Group:	II

International:

IATA Proper Shipping Name:	Hexanes
UN Number:	UN1208
Hazard Class:	3
Packing Group:	II

Marine Pollutant: Yes

Chemical Name	CAS#	Marine Pollutant	Severe Marine Pollutant
hexane	110-54-3	Y	N

15. REGULATORY INFORMATION

United States:

Chemical Name	CAS#	CERCLA	SARA 313	SARA EHS 313	TSCA
hexane	110-54-3	X	X	-	X
aroclor® 1254	11097-69-1	X	-	-	-

The following chemicals are listed on CA Prop 65:

Chemical Name	CAS #	Regulation

State Right To Know Listing:

Chemical Name	CAS#	New Jersey	Massachusetts	Pennsylvania	California
hexane	110-54-3	X	X	X	-
aroclor® 1254	11097-69-1	-	X	X	X

16. OTHER INFORMATION

Prior Version Date:	03/05/18
Other Information:	Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.
References:	No data available
Disclaimer:	Restek Corporation provides the descriptions, data and information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. It is provided for your guidance only. Because many factors may affect processing or application/use, Restek Corporation recommends you perform an assessment to determine the suitability of a product for your particular purpose prior to use. No warranties of any kind, either expressed or implied, including fitness for a particular purpose, are made regarding products described, data or information set forth. In no case shall the descriptions, information, or data provided be considered a part of our terms and conditions of sale. Further, the descriptions, data and information furnished hereunder are given gratis. No obligation or liability for the description, data and information given are assumed. All such being given and accepted at your risk.

SIGMA-ALDRICH sigma-aldrich.com

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006
Version 5.0 Revision Date 29.10.2012
Print Date 19.04.2017
GENERIC EU MSDS - NO COUNTRY SPECIFIC DATA - NO OEL DATA

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1 Product identifiers

Product name : Arsenic

Product Number : 267961
Brand : Aldrich
Index-No. : 033-001-00-X
CAS-No. : 7440-38-2

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Israel Ltd.
3 PARK RABIN, PLAUT
7670603 REHOVOT
ISRAEL

Telephone : +972 8948-4222
Fax : +972 8948-4200

1.4 Emergency telephone number

Emergency Phone # : +972 (8) 948-4222

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008 [EU-GHS/CLP]
Acute aquatic toxicity (Category 1)
Chronic aquatic toxicity (Category 1)
Acute toxicity, Inhalation (Category 3)
Acute toxicity, Oral (Category 3)

Classification according to EU Directives 67/548/EEC or 1999/45/EC
Toxic by inhalation and if swallowed. Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

2.2 Label elements

Labelling according Regulation (EC) No 1272/2008 [CLP]
Pictogram

Signal word Danger

Hazard statement(s)

H301	Toxic if swallowed.
H331	Toxic if inhaled.
H410	Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P273	Avoid release to the environment.
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTER or doctor/

	physician.
P311	Call a POISON CENTER or doctor/ physician.
P501	Dispose of contents/ container to an approved waste disposal plant.

Supplemental Hazard Statements	none

According to European Directive 67/548/EEC as amended.

Hazard symbol(s)

R-phrase(s)	
R23/25	Toxic by inhalation and if swallowed.
R50/53	Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

S-phrase(s)	
S20/21	When using do not eat, drink or smoke.
S28	After contact with skin, wash immediately with plenty of soap and water.
S45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S60	This material and its container must be disposed of as hazardous waste.
S61	Avoid release to the environment. Refer to special instructions/ Safety data sheets.

2.3 Other hazards - none

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3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula : As

Molecular Weight : 74,92 g/mol

Component		Concentration
Arsenic		
CAS-No.	7440-38-2	-
EC-No.	231-148-6	
Index-No.	033-001-00-X	

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4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact

Flush eyes with water as a precaution.

If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

Absorption into the body leads to the formation of methemoglobin which in sufficient concentration causes cyanosis. Onset may be delayed 2 to 4 hours or longer.

4.3 Indication of any immediate medical attention and special treatment needed

no data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Arsenic oxides

5.3 Advice for firefighters
Wear self contained breathing apparatus for fire fighting if necessary.

5.4 Further information
no data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear respiratory protection. Avoid dust formation. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up
Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid formation of dust and aerosols.
Provide appropriate exhaust ventilation at places where dust is formed.

7.2 Conditions for safe storage, including any incompatibilities
Store in cool place. Keep container tightly closed in a dry and well-ventilated place.

7.3 Specific end uses
no data available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

8.2 Exposure controls

Appropriate engineering controls
Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

Personal protective equipment

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Immersion protection
Material: Nitrile rubber
Minimum layer thickness: 0,11 mm
Break through time: > 480 min
Material tested:Dermatril® (Aldrich Z677272, Size M)

Splash protection
Material: Nitrile rubber
Minimum layer thickness: 0,11 mm
Break through time: > 30 min
Material tested:Dermatril® (Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 873000, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an Industrial Hygienist familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N99 (US) or type P2 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

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9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: powder Colour: grey
b)	Odour	no data available
c)	Odour Threshold	no data available
d)	pH	no data available
e)	Melting point/freezing point	Melting point/range: 817 °C - lit.
f)	Initial boiling point and boiling range	613 °C - lit.
g)	Flash point	not applicable
h)	Evaporation rate	no data available
i)	Flammability (solid, gas)	no data available
j)	Upper/lower flammability or explosive limits	no data available
k)	Vapour pressure	no data available
l)	Vapour density	no data available
m)	Relative density	5,727 g/mL at 25 °C
n)	Water solubility	no data available
o)	Partition coefficient: n-octanol/water	no data available

p)	Autoignition temperature	no data available
q)	Decomposition temperature	no data available
r)	Viscosity	no data available
s)	Explosive properties	no data available
t)	Oxidizing properties	no data available

9.2 Other safety information

no data available

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10. STABILITY AND REACTIVITY

10.1 Reactivity

no data available

10.2 Chemical stability

no data available

10.3 Possibility of hazardous reactions

no data available

10.4 Conditions to avoid

Heat. Exposure to air may affect product quality.

10.5 Incompatible materials

Oxidizing agents, Halogens, Palladium undergoes a violent reaction with arsenic, Zinc, Platinum oxide, Nitrogen trichloride, Bromine azide

10.6 Hazardous decomposition products

Other decomposition products - no data available

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11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity

LD50 Oral - rat - 763 mg/kg
Remarks: Behavioral:Ataxia. Diarrhoea

LD50 Oral - mouse - 145 mg/kg
Remarks: Behavioral:Ataxia. Diarrhoea

Inhalation: no data available

Skin corrosion/irritation

no data available

Serious eye damage/eye irritation

no data available

Respiratory or skin sensitization

no data available

Germ cell mutagenicity

no data available

Carcinogenicity

This is or contains a component that has been reported to be carcinogenic based on its IARC, OSHA, ACGIH, NTP, or EPA classification.

IARC: 1 - Group 1: Carcinogenic to humans (Arsenic)

Reproductive toxicity

no data available

Specific target organ toxicity - single exposure
no data available

Specific target organ toxicity - repeated exposure
no data available

Aspiration hazard
no data available

Potential health effects

Inhalation	Toxic if inhaled. May cause respiratory tract irritation.
Ingestion	Harmful if swallowed.
Skin	May be harmful if absorbed through skin. May cause skin irritation.
Eyes	May cause eye irritation.

Signs and Symptoms of Exposure
Absorption into the body leads to the formation of methemoglobin which in sufficient concentration causes cyanosis. Onset may be delayed 2 to 4 hours or longer.

Additional Information
RTECS: CG0525000

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Pimephales promelas (fathead minnow) - 9,9 mg/l - 96,0 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 3,8 mg/l - 48 h

12.2 Persistence and degradability
no data available

12.3 Bioaccumulative potential
no data available

12.4 Mobility in soil
no data available

12.5 Results of PBT and vPvB assessment
no data available

12.6 Other adverse effects
Very toxic to aquatic life with long lasting effects.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

14.1 UN number

ADR/RID: 1558	IMDG: 1558	IATA: 1558

14.2 UN proper shipping name
ADR/RID: ARSENIC
IMDG: ARSENIC
IATA: Arsenic

14.3 Transport hazard class(es)

ADR/RID: 6.1	IMDG: 6.1	IATA: 6.1

14.4 Packaging group

ADR/RID: II	IMDG: II	IATA: II

14.5 Environmental hazards

ADR/RID: yes	IMDG Marine pollutant: yes	IATA: no

14.6 Special precautions for user

no data available

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15. REGULATORY INFORMATION

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

no data available

15.2 Chemical Safety Assessment

no data available

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16. OTHER INFORMATION

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

SAFETY DATA SHEET

Revision Date 19-Jan-2018 **Revision Number** 3

1. Identification

Product Name	**1,2-Benzanthracene**
Cat No. :	**AC105250000; AC105250010; AC105252500**
Synonyms	Benzóa!anthracene; Tetraphene
Recommended Use	Laboratory chemicals.
Uses advised against	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)

Carcinogenicity	Category 1B

Label Elements

Signal Word
Danger

Hazard Statements
May cause cancer

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
Response
IF exposed or concerned: Get medical attention/advice
Storage
Store locked up
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Very toxic to aquatic life with long lasting effects
WARNING. Cancer - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Benz[a]anthracene	56-55-3	99

4. First-aid measures

Eye Contact	Immediate medical attention is required. Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.
Skin Contact	Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Immediate medical attention is required.
Inhalation	Remove from exposure, lie down. Remove to fresh air. If not breathing, give artificial respiration. Immediate medical attention is required.
Ingestion	Call a physician immediately. Clean mouth with water.
Most important symptoms and effects	No information available.
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Water spray. Carbon dioxide (CO_2). Dry chemical. Chemical foam.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	Not applicable
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
Do not allow run-off from fire-fighting to enter drains or water courses.

Hazardous Combustion Products
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.

NFPA

Health	Flammability	Instability	Physical hazards
0	1	0	N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment as required.
Environmental Precautions	Do not flush into surface water or sanitary sewer system. Do not allow material to contaminate ground water system. Prevent product from entering drains. Local authorities should be advised if significant spillages cannot be contained.
Methods for Containment and Clean Up	Sweep up and shovel into suitable containers for disposal.

7. Handling and storage

Handling	Do not breathe dust. Do not get in eyes, on skin, or on clothing. Handle product only in closed system or provide appropriate exhaust ventilation.
Storage	Keep in a dry, cool and well-ventilated place. Refer product specification and/or product label for specific storage temperature requirement. Keep container tightly closed.

8. Exposure controls / personal protection

Exposure Guidelines	This product does not contain any hazardous materials with occupational exposure limitsestablished by the region specific regulatory bodies.
Engineering Measures	Ensure adequate ventilation, especially in confined areas.

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	Wear appropriate protective gloves and clothing to prevent skin exposure.
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	Powder Solid

Appearance	Beige
Odor	Odorless
Odor Threshold	No information available
pH	No information available
Melting Point/Range	158 - 161 °C / 316.4 - 321.8 °F
Boiling Point/Range	437.6 °C / 819.7 °F
Flash Point	No information available
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	Not applicable
Specific Gravity	No information available
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	Not applicable
Decomposition Temperature	No information available
Viscosity	Not applicable
Molecular Formula	C18 H12
Molecular Weight	228.29

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products.
Incompatible Materials	Strong oxidizing agents
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO_2)
Hazardous Polymerization	No information available.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information	No acute toxicity information is available for this product
Component Information	
Toxicologically Synergistic Products	No information available

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

Irritation	No information available
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
Benz[a]anthracene	56-55-3	Group 2B	Reasonably Anticipated	A2	X	A2

Mutagenic Effects	Ames test: positive.
Reproductive Effects	No information available.

Developmental Effects	No information available.
Teratogenicity	No information available.
STOT - single exposure	None known
STOT - repeated exposure	None known
Aspiration hazard	No information available
Symptoms / effects,both acute and delayed	No information available

Endocrine Disruptor Information

Component	EU - Endocrine Disrupters Candidate List	EU - Endocrine Disruptors - Evaluated Substances	Japan - Endocrine Disruptor Information
Benz[a]anthracene	Group III Chemical	Not applicable	Not applicable

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

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

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Benz[a]anthracene	Not listed	Not listed	EC50 = 0.26 mg/L 15 min	LC50: = 0.01 mg/L, 96h Static (Daphnia magna) EC50: = 0.0042 mg/L, 48h (Daphnia magna)

Persistence and Degradability	May persist
Bioaccumulation/ Accumulation	No information available.
Mobility	. Is not likely mobile in the environment due its low water solubility.

Component	log Pow
Benz[a]anthracene	5.61

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
Benz[a]anthracene - 56-55-3	U018	-

14. Transport information

DOT	Not regulated
TDG	Not regulated
IATA	
UN-No	UN3077
Proper Shipping Name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.*
Hazard Class	9
Packing Group	III
IMDG/IMO	
UN-No	UN3077
Proper Shipping Name	Environmentally hazardous substances, solid, n.o.s.

Hazard Class	9
Packing Group	III

15. Regulatory information

United States of America Inventory

Component	CAS-No	TSCA	TSCA Inventory notification - Active/Inactive	TSCA - EPA Regulatory Flags
Benz[a]anthracene	56-55-3	X	ACTIVE	-

Legend:
TSCA - Toxic Substances Control Act, (40 CFR Part 710)
X - Listed
'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories
Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Australia (AICS), China (IECSC), Korea (ECL).

Component	CAS-No	DSL	NDSL	EINECS	PICCS	ENCS	AICS	IECSC	KECL
Benz[a]anthracene	56-55-3	-	X	200-280-6	-	-	-	X	-

U.S. Federal Regulations

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Benz[a]anthracene	56-55-3	99	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
Benz[a]anthracene	-	-	-	X

Clean Air Act Not applicable

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
Benz[a]anthracene	10 lb	-

California Proposition 65 This product contains the following Proposition 65 chemicals.

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Benz[a]anthracene	56-55-3	Carcinogen	0.033 µg/day	Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Benz[a]anthracene	X	X	X	X	X

U.S. Department of Transportation
Reportable Quantity (RQ): N

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

Revision Date	19-Jan-2018
Print Date	19-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

Revision Date 14-Feb-2020 **Revision Number** 2

1. Identification

Product Name	**Benzo[a]pyrene**
Cat No. :	**15856**
CAS-No	50-32-8
Synonyms	Benzo[def]chrysene.; 3,4-Benzopyrene; 3,4-Benzpyrene
Recommended Use	Laboratory chemicals.
Uses advised against	Food, drug, pesticide or biocidal product use.

Details of the supplier of the safety data sheet

Company
Alfa Aesar
Thermo Fisher Scientific Chemicals, Inc.
30 Bond Street
Ward Hill, MA 01835-8099
Tel: 800-343-0660
Fax: 800-322-4757
Email: tech@alfa.com
www.alfa.com

Emergency Telephone Number
During normal business hours (Monday-Friday, 8am-7pm EST), call (800) 343-0660.
After normal business hours, call Carechem 24 at (866) 928-0789.

2. Hazard(s) identification

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

Skin Sensitization	Category 1
Germ Cell Mutagenicity	Category 1B
Carcinogenicity	Category 1A
Reproductive Toxicity	Category 1B

Label Elements

Signal Word
Danger

Hazard Statements
May cause an allergic skin reaction
May cause genetic defects
May cause cancer
May damage fertility. May damage the unborn child

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
Avoid breathing dust/fume/gas/mist/vapors/spray
Contaminated work clothing should not be allowed out of the workplace
Wear protective gloves
Response
IF exposed or concerned: Get medical attention/advice
Skin
IF ON SKIN: Wash with plenty of soap and water
If skin irritation or rash occurs: Get medical advice/attention
Wash contaminated clothing before reuse
Storage
Store locked up
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Very toxic to aquatic life with long lasting effects
WARNING. Cancer - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Benzo[a]pyrene	50-32-8	> 96

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	Remove 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. Get medical attention if symptoms occur.
Most important symptoms and effects	None reasonably foreseeable. . May cause allergic skin reaction. 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

Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	Not applicable
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
Do not allow run-off from fire-fighting to enter drains or water courses.

Hazardous Combustion Products
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.

NFPA

Health	Flammability	Instability	Physical hazards
2	1	0	N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment as required. Avoid dust formation.
Environmental Precautions	Do not flush into surface water or sanitary sewer system. Do not allow material to contaminate ground water system. Prevent product from entering drains. Local authorities should be advised if significant spillages cannot be contained.
Methods for Containment and Clean Up	Sweep up and shovel into suitable containers for disposal. Keep in suitable, closed containers for disposal.

7. Handling and storage

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

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Benzo[a]pyrene		TWA: 0.2 mg/m^3		

Legend

OSHA - Occupational Safety and Health Administration

Engineering Measures Ensure adequate ventilation, especially in confined areas.

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	Wear appropriate protective gloves and clothing to prevent skin exposure.
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	Powder Solid
Appearance	Dark yellow
Odor	aromatic
Odor Threshold	No information available
pH	Not applicable
Melting Point/Range	175 - 179 °C / 347 - 354.2 °F
Boiling Point/Range	495 °C / 923 °F @ 760 mmHg
Flash Point	No information available
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	Not applicable
Specific Gravity	No information available
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	Not applicable
Decomposition Temperature	No information available
Viscosity	Not applicable
Molecular Formula	C20H12
Molecular Weight	252.31

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products.
Incompatible Materials	Oxidizing agent
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO_2)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information	
Component Information	
Toxicologically Synergistic Products	No information available

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

Irritation No information available

Sensitization May cause sensitization by skin contact

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Benzo[a]pyrene	50-32-8	Group 1	Reasonably Anticipated	A2	X	A2

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 No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed 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
Benzo[a]pyrene	Group III Chemical	Not applicable	Not applicable

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Very 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.

Persistence and Degradability May persist

Bioaccumulation/ Accumulation No information available.

Mobility Is not likely mobile in the environment due its low water solubility.

Component	log Pow
Benzo[a]pyrene	6.06

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
Benzo[a]pyrene - 50-32-8	U022	-

14. Transport information

DOT

UN-No	UN3077
Proper Shipping Name	Environmentally hazardous substances, solid, n.o.s.
Technical Name	Benzo[a]pyrene
Hazard Class	9
Packing Group	III

TDG

UN-No	UN3077
Proper Shipping Name	Environmentally hazardous substances, solid, n.o.s.
Hazard Class	9
Packing Group	III

IATA

UN-No	UN3077
Proper Shipping Name	Environmentally hazardous substances, solid, n.o.s.
Hazard Class	9
Packing Group	III

IMDG/IMO

UN-No	UN3077
Proper Shipping Name	Environmentally hazardous substances, solid, n.o.s.
Hazard Class	9
Packing Group	III

15. Regulatory information

United States of America Inventory

Component	CAS-No	TSCA	TSCA Inventory notification - Active/Inactive	TSCA - EPA Regulatory Flags
Benzo[a]pyrene	50-32-8	X	ACTIVE	-

Legend:
TSCA - Toxic Substances Control Act, (40 CFR Part 710)
X - Listed
'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories
Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Australia (AICS), China (IECSC), Korea (ECL).

Component	CAS-No	DSL	NDSL	EINECS	PICCS	ENCS	AICS	IECSC	KECL
Benzo[a]pyrene	50-32-8	X	-	200-028-5	X	-	-	X	KE-05-0184

U.S. Federal Regulations

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Benzo[a]pyrene	50-32-8	> 96	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
Benzo[a]pyrene	-	-	X	X

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration Not applicable

CERCLA Not applicable

Component	Hazardous Substances RQs	CERCLA EHS RQs
Benzo[a]pyrene	1 lb	-

California Proposition 65 This product contains the following Proposition 65 chemicals.

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Benzo[a]pyrene	50-32-8	Carcinogen	0.06 µg/day	Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Benzo[a]pyrene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ):	N
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 Health, Safety and Environmental Department
Email: tech@alfa.com
www.alfa.com

Revision Date	14-Feb-2020
Print Date	14-Feb-2020
Revision Summary	SDS authoring systems update, replaces ChemGes SDS No. 50-32-8/1.

Disclaimer

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End of SDS

RESTEK

Safety Data Sheet

Revision Date: 07/31/19
www.restek.com

2 Letter ISO country code/language code: US/EN

1. IDENTIFICATION

Catalog Number / Product Name:	**31272 / Benzo(b)fluoranthene Standard**
Company:	Restek Corporation
Address:	110 Benner Circle Bellefonte, Pa. 16823
Phone#:	814-353-1300
Fax#:	814-353-1309
Emergency#:	800-424-9300 (CHEMTREC) 703-527-3887 (Outside the US)
Email:	www.restek.com
Revision Number:	11
Intended use:	For Laboratory use only

2. HAZARD(S)IDENTIFICATION

Emergency Overview:

GHS Hazard Symbols:

GHS Classification:
Carcinogenicity Category 1B
Flammable Liquid Category 2
Serious Eye Damage/Eye Irritation Category 2
Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 3

GHS Signal Word: Danger

GHS Hazard:
Highly flammable liquid and vapour.
Causes serious eye irritation.
May cause drowsiness or dizziness.
May cause cancer.

GHS Precautions:

Safety Precautions:
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Keep away from heat/sparks/open flames/hot surfaces. – No smoking.
Ground/bond container and receiving equipment.
Use explosion-proof electrical/ventilation and lighting equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Avoid breathing dust/fume/gas/mist/vapours/spray.
Wash hands and skin thoroughly after handling.
Use only outdoors or in a well-ventilated area.
Wear protective gloves/protective clothing/eye protection/face protection.

First Aid Measures:
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
IF exposed or concerned: Get medical advice/attention.
Call a POISON CENTER or doctor/physician if you feel unwell.
If eye irritation persists: Get medical advice/attention.
In case of fire: Use extinguishing media in section 5 for extinction.

Storage: Store in a well-ventilated place. Keep container tightly closed.
Store in a well-ventilated place. Keep cool.
Store locked up.

Disposal: Dispose of contents/container according to section 13 of the SDS.

Single Exposure Target Organs: Specific target organ toxicity - Single exposure - STOT SE 3: H336 May cause drowsiness or dizziness.

Repeated Exposure Target Organs: No data available

3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
Acetone	67-64-1	200-662-2	99.9
benzo (b) fluoranthene	205-99-2	205-911-9	0.1

4. FIRST-AID MEASURES

Inhalation: Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately

Eyes: Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.

Skin Contact: Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.

Ingestion: Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.

5. FIRE- FIGHTING MEASURES

Extinguishing Media: Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water spray or fog may also be effective for extinguishing if swept across the base of the fire. Water can also be used to absorb heat and keep exposed material from being damaged by fire. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

Fire and/or Explosion Hazards: Vapors may be ignited by heat, sparks, flames or other sources of ignition at or above the low flash point giving rise to a Class B fire. Vapors are heavier than air and may travel to a source of ignition and flash back

Fire Fighting Methods and Protection: Do not enter fire area without proper protection including self-contained toxic breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface. Use water spray/fog for cooling. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions and Equipment: Exposure to the spilled material may be irritating or harmful. Follow personal protective equipment recommendations found in Section 8 of this SDS. Additional precautions may be necessary based on special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred. Also consider the expertise of employees in the area responding to the spill.

Methods for Clean-up: Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal evaluation.

7. HANDLING AND STORAGE

Handling Technical Measures and Precautions:	Harmful or irritating material. Avoid contacting and avoid breathing the material. Use only in a well ventilated area. Use spark-proof tools and explosion-proof equipment
Storage Technical Measures and Conditions:	Store in a cool dry ventilated location. Isolate from incompatible materials and conditions. Keep container(s) closed. Keep away from sources of ignition

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

United States:

Chemical Name	**CAS No.**	**IDLH**	**ACGIH STEL**	**ACGIH TLV-TWA**	**OSHA Exposure Limit**
Acetone	67-64-1	2500 ppm IDLH (10% LEL)	750 ppm STEL; 1782 mg/m3 STEL	500 ppm TWA; 1188 mg/m3 TWA	1000 ppm TWA; 2400 mg/m3 TWA
benzo (b) fluoranthene	205-99-2	Not established	None Known	Not established	No data available

Personal Protection:

Engineering Measures:	Local exhaust ventilation is recommended when generating excessive levels of vapours from handling or thermal processing.
Respiratory Protection:	No respiratory protection required under normal conditions of use. Provide general room exhaust ventilation if symptoms of overexposure occur as explained Section 3. A respirator is not normally required.
Eye Protection:	Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.
Skin Protection:	Wear protective gloves. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work
Medical Conditions Aggravated By Exposure:	Respiratory disease including asthma and bronchitis

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance, color:	Depends upon product selection
Odor:	Strong
Physical State:	No data available
pH:	Not applicable
Vapor Pressure:	No data available
Vapor Density:	2.0 (air = 1)
Boiling Point (°C):	56.05 °C at 1013.25 hPa
Melting Point (°C):	-95.4 °C Melting Point
Flash Point (°F):	39
Flammability:	Highly Flammable
Upper Flammable/Explosive Limit, % in air:	No data available
Lower Flammable/Explosive Limit, % in air:	No data available
Autoignition Temperature (°C):	465 deg C
Decomposition Temperature (°C):	No data available
Specific Gravity:	0.7845 g/cm3 at 25 °C
Evaporation Rate:	No data available
Odor Threshold:	ND
Solubility:	Complete; 100%
Partition Coefficient: n-octanol in water:	No data available
VOC % by weight:	99.9
Molecular Weight:	58.08

10. STABILITY AND REACTIVITY

Stability:	Stable under normal conditions.
Conditions to Avoid:	None known.
Materials to Avoid / Chemical Incompatiability:	Strong oxidizing agents Strong acids
Hazardous Decomposition Products:	Carbon dioxide Carbon monoxide

11. TOXICOLOGICAL INFORMATION

Routes of Entry:	Inhalation, Skin Contact, Eye Contact, Ingestion

Target Organs Potentially Affected By Exposure:	Eyes, Central nervous system stimulation, Respiratory Tract, Skin
Chemical Interactions That Change Toxicity:	None Known

Immediate (Acute) Health Effects by Route of Exposure:

Inhalation Irritation:	Can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.
Skin Contact:	Can cause minor skin irritation, defatting, and dermatitis.
Eye Contact:	Can cause minor irritation, tearing and reddening.
Ingestion Irritation:	May be harmful if swallowed.
Ingestion Toxicity:	Harmful if swallowed. May cause systemic poisoning.

Long-Term (Chronic) Health Effects:

Carcinogenicity:	Contains a probable or known human carcinogen.
Reproductive and Developmental Toxicity:	No data available to indicate product or any components present at greater than 0.1% may cause birth defects.
Inhalation:	Upon prolonged and/or repeated exposure, can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.
Skin Contact:	Upon prolonged or repeated contact, can cause minor skin irritation, defatting, and dermatitis.

Component Toxicological Data:

NIOSH:

Chemical Name	CAS No.	LD50/LC50
Acetone	67-64-1	Dermal LD50 Rabbit >15700 mg/kg; Inhalation LC50 Rat 50100 mg/m3 8 h; Oral LD50 Rat 5800 mg/kg

Component Carcinogenic Data:

OSHA:

Chemical Name	CAS No.	
Benzo(b)fluoranthene	205-99-2	Present

ACGIH:

Chemical Name	CAS No.	
Benzo[b]fluoranthene	205-99-2	A2 - Suspected Human Carcinogen
Acetone	67-64-1	A4 - Not Classifiable as a Human Carcinogen

NIOSH:

Chemical Name	CAS No.
No data available	

NTP:

Chemical Name	CAS No.
No data available	

IARC:

Chemical Name	CAS No.	Group No.
Monograph 92 [2010]; Supplement 7 [1987]; Monograph 32 [1983]	205-99-2	Group 2B

12. ECOLOGICAL INFORMATION

Overview:	This material is not expected to be harmful to the ecology.
Mobility:	No data
Persistence:	No data
Bioaccumulation:	No data
Degradability:	No data
Ecological Toxicity Data:	No data available

13. DISPOSAL CONSIDERATIONS

Waste Description of Spent Product:	Spent or discarded material is a hazardous waste.Mixing spent or discarded material with other materials may render the mixture hazardous. Perform a hazardous waste determination on mixtures.

Disposal Methods:	Dispose of by incineration following Federal, State, Local, or Provincial regulations.
Waste Disposal of Packaging:	Comply with all Local, State, Federal, and Provincial Environmental Regulations.

14. TRANSPORTATION INFORMATION

United States:

DOT Proper Shipping Name:	Acetone
UN Number:	UN1090
Hazard Class:	3
Packing Group:	II

International:

IATA Proper Shipping Name:	Acetone
UN Number:	UN1090
Hazard Class:	3
Packing Group:	II

Marine Pollutant: No

Chemical Name	CAS#	Marine Pollutant	Severe Marine Pollutant
No data available			

15. REGULATORY INFORMATION

United States:

Chemical Name	CAS#	CERCLA	SARA 313	SARA EHS 313	TSCA
Acetone	67-64-1	X	-	-	X
benzo (b) fluoranthene	205-99-2	X	X	-	-

The following chemicals are listed on CA Prop 65:

Chemical Name	CAS #	Regulation
Benzo[b]fluoranthene	205-99-2	Prop 65 Cancer

State Right To Know Listing:

Chemical Name	CAS#	New Jersey	Massachusetts	Pennsylvania	California
Acetone	67-64-1	X	X	X	X
benzo (b) fluoranthene	205-99-2	X	X	X	X

16. OTHER INFORMATION

Prior Version Date:	08/13/18
Other Information:	Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.
References:	No data available
Disclaimer:	Restek Corporation provides the descriptions, data and information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. It is provided for your guidance only. Because many factors may affect processing or application/use, Restek Corporation recommends you perform an assessment to determine the suitability of a product for your particular purpose prior to use. No warranties of any kind, either expressed or implied, including fitness for a particular purpose, are made regarding products described, data or information set forth. In no case shall the descriptions, information, or data provided be considered a part of our terms and conditions of sale. Further, the descriptions, data and information furnished hereunder are given gratis. No obligation or liability for the description, data and information given are assumed. All such being given and accepted at your risk.

Safety Data Sheet

Revision Date: 07/15/19
www.restek.com

2 Letter ISO country code/language code: US/EN

1. IDENTIFICATION

Catalog Number / Product Name:	**32218 / Dieldrin Standard**
Company:	Restek Corporation
Address:	110 Benner Circle Bellefonte, Pa. 16823
Phone#:	814-353-1300
Fax#:	814-353-1309
Emergency#:	800-424-9300 (CHEMTREC) 703-527-3887 (Outside the US)
Email:	www.restek.com
Revision Number:	8
Intended use:	For Laboratory use only

2. HAZARD(S)IDENTIFICATION

Emergency Overview:

GHS Hazard Symbols:

GHS Classification:
Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 1
Flammable Liquid Category 2
Carcinogenicity Category 2
Acute Toxicity - Dermal Category 3
Acute Toxicity - Oral Category 3

GHS Signal Word: Danger

GHS Hazard:
Highly flammable liquid and vapour.
Toxic if swallowed or in contact with skin.
Suspected of causing cancer.
Causes damage to organs.

GHS Precautions:

Safety Precautions:
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Keep away from heat/sparks/open flames/hot surfaces. – No smoking.
Keep container tightly closed.
Ground/bond container and receiving equipment.
Use explosion-proof electrical/ventilation and lighting equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Do not breathe dust/fume/gas/mist/vapours/spray.
Wash hands and skin thoroughly after handling.
Do not eat, drink or smoke when using this product.
Wear protective gloves/protective clothing/eye protection/face protection.

First Aid Measures:
IF SWALLOWED: Immediately call a POISON CENTER/doctor/....
IF ON SKIN: Wash with plenty of soap and water.
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
IF exposed: Call a POISON CENTER or doctor/physician.
IF exposed or concerned: Get medical advice/attention.
Call a POISON CENTER or doctor/physician if you feel unwell.
Specific treatment see section 4.

Rinse mouth.
Take off immediately all contaminated clothing and wash it before reuse.
In case of fire: Use extinguishing media in section 5 for extinction.

Storage: Keep container tightly closed.
Store in a well-ventilated place. Keep cool.
Store locked up.

Disposal: Dispose of contents/container according to section 13 of the SDS.

Single Exposure Target Organs: Specific target organ toxicity - Single exposure - STOT SE 1: H370 Causes damage to organs. (C >= 10 %; No information to prove exclusion of certain routes of exposure); Specific target organ toxicity - Single exposure - STOT SE 2: H371 May cause damage to organs. (3 % <= C <10 %; Concentration limits for acute toxicity cannot be translated into GHS from the DSD especially when minimum classifications are given)

Repeated Exposure Target Organs: Specific target organ toxicity - Repeated exposure - STOT RE 1: H372 Causes damage to organs through prolonged or repeated exposure. (No information to prove exclusion of certain routes of exposure)

3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
methanol	67-56-1	200-659-6	99.9
dieldrin	60-57-1	200-484-5	0.1

4. FIRST-AID MEASURES

Inhalation: Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately

Eyes: Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.

Skin Contact: Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.

Ingestion: Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.

5. FIRE- FIGHTING MEASURES

Extinguishing Media: Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water may be ineffective but water spray can be used extinguish a fire if swept across the base of the flames. Water can absorb heat and keep exposed material from being damaged by fire.

Fire and/or Explosion Hazards: Vapors may be ignited by sparks, flames or other sources of ignition if material is above the flash point giving rise to a fire (Class B). Vapors are heavier than air and may travel to a source of ignition and flash back.

Fire Fighting Methods and Protection: Do not enter fire area without proper protection including self-contained breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions and Equipment: Exposure to the spilled material may be severely irritating or toxic. Follow personal protective equipment recommendations found in Section 8 of this SDS. Personal protective equipment needs must be evaluated based on information provided on this sheet and the special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred, and the expertise of employees in the area responding to the spill. Never exceed any occupational exposure limits.

Methods for Clean-up: Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay.

Gather and store in a sealed container pending a waste disposal evaluation.

7. HANDLING AND STORAGE

Handling Technical Measures and Precautions:	Toxic or severely irritating material. Avoid contacting and avoid breathing the material. Use only in a well ventilated area. Use spark-proof tools and explosion-proof equipment
Storage Technical Measures and Conditions:	Store in a cool dry ventilated location. Isolate from incompatible materials and conditions. Keep container(s) closed. Keep away from sources of ignition

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

United States:

Chemical Name	CAS No.	IDLH	ACGIH STEL	ACGIH TLV-TWA	OSHA Exposure Limit
methanol	67-56-1	6000 ppm IDLH	250 ppm STEL	200 ppm TWA	200 ppm TWA; 260 mg/m3 TWA

Personal Protection:

Engineering Measures:	Local exhaust ventilation is recommended when generating excessive levels of vapours from handling or thermal processing.
Respiratory Protection:	Respiratory protection may be required to avoid overexposure when handling this product. General or local exhaust ventilation is the preferred means of protection. Use a respirator if general room ventilation is not available or sufficient to eliminate symptoms.If an exposure limit is exceeded or if an operator is experiencing symptoms of inhalation overexposure as explained in Section 3, provide respiratory protection.
Eye Protection:	Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.
Skin Protection:	Wear protective gloves. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance, color:	No data available
Odor:	Mild
Physical State:	No data available
pH:	Not applicable
Vapor Pressure:	No data available
Vapor Density:	1.1 (air = 1)
Boiling Point (°C):	64.7 °C at 760 mmHg (HSDB)
Melting Point (°C):	-98 °C
Flash Point (°F):	52
Flammability:	Highly Flammable
Upper Flammable/Explosive Limit, % in air:	36
Lower Flammable/Explosive Limit, % in air:	6
Autoignition Temperature (°C):	464 deg C
Decomposition Temperature (°C):	No data available
Specific Gravity:	0.791 - 0.792 g/cm3 at 20 °C
Evaporation Rate:	No data available
Odor Threshold:	No data available
Solubility:	Moderate; 50-99%
Partition Coefficient: n-octanol in water:	No data available
VOC % by weight:	99.9
Molecular Weight:	32.04

10. STABILITY AND REACTIVITY

Stability:	Stable under normal conditions.
Conditions to Avoid:	None known.
Materials to Avoid / Chemical Incompatiability:	Strong oxidizing agents
Hazardous Decomposition Products:	Carbon dioxide Carbon monoxide

11. TOXICOLOGICAL INFORMATION

Routes of Entry:	Inhalation, Skin Contact, Eye Contact, Ingestion

Target Organs Potentially Affected By Exposure:	Eyes, Central nervous system stimulation, Skin, GI Tract, Respiratory Tract
Chemical Interactions That Change Toxicity:	None Known

Immediate (Acute) Health Effects by Route of Exposure:

Inhalation Irritation:	Can cause moderate respiratory irritation, dizziness, weakness, fatigue, nausea and headache.
Inhalation Toxicity:	Harmful! Can cause systemic damage (see "Target Organs)Methanol can cause central nervous system depression and overexposure can cause damage to the optic nerve resulting in visual impairment or blindness.
Skin Contact:	Can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.
Eye Contact:	Can cause moderate irritation, tearing and reddening, but not likely to permanently injure eye tissue.
Ingestion Irritation:	Irritating to mouth, throat, and stomach. Can cause abdominal discomfort, nausea, vomiting and diarrhea.Highly toxic and may be fatal if swallowed.
Ingestion Toxicity:	Toxic if swallowed. May cause target organ failure and/or death.May be fatal if swallowed.

Long-Term (Chronic) Health Effects:

Carcinogenicity:	Contains a probable or known human carcinogen.
Reproductive and Developmental Toxicity:	No data available to indicate product or any components present at greater than 0.1% may cause birth defects.
Inhalation:	Upon prolonged and/or repeated exposure, can cause moderate respiratory irritation, dizziness, weakness, fatigue, nausea and headache.Harmful! Can cause systemic damage upon prolonged and/or repeated exposure (see "Target Organs)
Skin Contact:	Upon prolonged or repeated contact, can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.
Ingestion:	Toxic if swallowed. May cause target organ failure and/or death.

Component Toxicological Data:
NIOSH:

Chemical Name	CAS No.	LD50/LC50
Methanol	67-56-1	Inhalation LC50 Rat 22500 ppm 8 h

Component Carcinogenic Data:
OSHA:

Chemical Name	CAS No.
No data available	

ACGIH:

Chemical Name	CAS No.
No data available	

NIOSH:

Chemical Name	CAS No.
No data available	

NTP:

Chemical Name	CAS No.
No data available	

IARC:

Chemical Name	CAS No.	Group No.
Monograph 117 [in preparation]; Supplement 7 [1987]; Monograph 5 [1974]	60-57-1	Group 2A

12. ECOLOGICAL INFORMATION

Overview:	Moderate ecological hazard. This product may be dangerous to plants and/or wildlife.
Mobility:	No data
Persistence:	No data

Bioaccumulation:	No data
Degradability:	Biodegrades slowly.
Ecological Toxicity Data:	No data available

13. DISPOSAL CONSIDERATIONS

Waste Description of Spent Product:	Spent or discarded material is a hazardous waste.Mixing spent or discarded material with other materials may render the mixture hazardous. Perform a hazardous waste determination on mixtures.
Disposal Methods:	Dispose of by incineration following Federal, State, Local, or Provincial regulations.
Waste Disposal of Packaging:	Comply with all Local, State, Federal, and Provincial Environmental Regulations.

14. TRANSPORTATION INFORMATION

United States:	
DOT Proper Shipping Name:	Methanol
UN Number:	UN1230
Hazard Class:	3
Packing Group:	II

International:	
IATA Proper Shipping Name:	Methanol
UN Number:	UN1230
Hazard Class:	3(6.1)
Packing Group:	II

Marine Pollutant: No

Chemical Name	CAS#	Marine Pollutant	Severe Marine Pollutant
No data available			

15. REGULATORY INFORMATION

United States:

Chemical Name	CAS#	CERCLA	SARA 313	SARA EHS 313	TSCA
methanol	67-56-1	X	X	-	X

The following chemicals are listed on CA Prop 65:

Chemical Name	CAS #	Regulation
Dieldrin	60-57-1	Prop 65 Cancer
Methanol	67-56-1	Prop 65 Devolop Tox

State Right To Know Listing:

Chemical Name	CAS#	New Jersey	Massachusetts	Pennsylvania	California
methanol	67-56-1	X	X	X	X
dieldrin	60-57-1	X	X	X	X

16. OTHER INFORMATION

Prior Version Date:	09/13/18
Other Information:	Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.
References:	No data available
Disclaimer:	Restek Corporation provides the descriptions, data and information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. It is provided for your guidance only. Because many factors may affect processing or application/use, Restek Corporation recommends you perform an assessment to determine the suitability of a product for your particular purpose prior to use. No warranties of any kind, either expressed or implied, including fitness for a particular purpose, are made regarding products described, data or information set forth. In no case shall the descriptions, information, or data provided be considered a part of our terms and conditions of sale. Further, the descriptions,

data and information furnished hereunder are given gratis. No obligation or liability for the description, data and information given are assumed. All such being given and accepted at your risk.

RESTEK

Safety Data Sheet

Revision Date: 06/04/19
www.restek.com

2 Letter ISO country code/language code: US/EN

1. IDENTIFICATION

Catalog Number / Product Name: **31279 / Indeno(1,2,3-c,d)pyrene Standard**
Company: Restek Corporation
Address: 110 Benner Circle
Bellefonte, Pa. 16823
Phone#: 814-353-1300
Fax#: 814-353-1309
Emergency#: 800-424-9300 (CHEMTREC)
703-527-3887 (Outside the US)
Email: www.restek.com
Revision Number: 11
Intended use: For Laboratory use only

2. HAZARD(S)IDENTIFICATION

Emergency Overview:

GHS Hazard Symbols:

GHS Classification: Carcinogenicity Category 2

GHS Signal Word: Warning
GHS Hazard: Suspected of causing cancer.
GHS Precautions:

Safety Precautions: Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Wear protective gloves/protective clothing/eye protection/face protection.

First Aid Measures: IF exposed or concerned: Get medical advice/attention.
Storage: Store locked up.

Disposal: Dispose of contents/container according to section 13 of the SDS.

Single Exposure Target Organs: No data available

Repeated Exposure Target Organs: No data available

3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
Dichloromethane	75-09-2	200-838-9	99.9
indeno (1,2,3-c,d) pyrene	193-39-5	205-893-2	0.1

4. FIRST-AID MEASURES

Inhalation:	Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately
Eyes:	Immediately flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention and monitor the eye daily as advised by your physician. Serious harm (damage) may result if treatment is delayed. Continue to flush eyes while awaiting medical attention
Skin Contact:	Wash with soap and water. Remove contaminated clothing, launder immediately, and discard contaminated leather goods. Get medical attention immediately.
Ingestion:	Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS. Never give anything by mouth to an unconscious person

5. FIRE- FIGHTING MEASURES

Extinguishing Media:	Use alcohol resistant foam, carbon dioxide, or dry chemical when fighting fires. Water or foam may cause frothing if liquid is burning but it still may be a useful extinguishing agent if carefully applied to the surface of the fire. Do Not direct a stream of water into the hot burning liquid. Use methods suitable to fight surrounding fire.
Fire and/or Explosion Hazards:	No data.
Fire Fighting Methods and Protection:	Use methods for the surrounding fire.
Hazardous Combustion Products:	Carbon dioxide, Carbon monoxide

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions and Equipment:	Exposure to the spilled material may be severely irritating or toxic. Follow personal protective equipment recommendations found in Section 8 of this SDS. Personal protective equipment needs must be evaluated based on information provided on this sheet and the special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred, and the expertise of employees in the area responding to the spill. Never exceed any occupational exposure limits.
Methods for Clean-up:	Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal evaluation.

7. HANDLING AND STORAGE

Handling Technical Measures and Precautions:	Toxic or severely irritating material. Avoid contacting and avoid breathing the material. Use only in a well ventilated area. As with all chemicals, good industrial hygiene practices should be followed when handling this material.
Storage Technical Measures and Conditions:	Store in a cool dry place. Isolate from incompatible materials. Keep container closed when not in use

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

United States:

Chemical Name	CAS No.	IDLH	ACGIH STEL	ACGIH TLV-TWA	OSHA Exposure Limit
Dichloromethane	75-09-2	2300 ppm IDLH	None Known	50 ppm TWA	25 ppm TWA; 125 ppm STEL (15 min. TWA)
indeno (1,2,3-c,d) pyrene	193-39-5	Not established	None Known	Not established	No data available

Personal Protection:

Engineering Measures:	Local exhaust ventilation or other engineering controls are normally required when handling or using this product to avoid overexposure.
Respiratory Protection:	Respiratory protection may be required to avoid overexposure when handling this product. General or local exhaust ventilation is the preferred means of protection. Use a respirator if general room ventilation is not available or sufficient to

	eliminate symptoms.
Eye Protection:	Wear chemically resistant safety glasses with side shields when handling this product. Wear additional eye protection such as chemical splash goggles and/or face shield when the possibility exists for eye contact with splashing or spraying liquid, or airborne material. Do not wear contact lenses. Have an eye wash station available.
Skin Protection:	Avoid skin contact by wearing chemically resistant gloves, an apron and other protective equipment depending upon conditions of use. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work.
Medical Conditions Aggravated By Exposure:	Eye disease Skin disease including eczema and sensitization Respiratory disease including asthma and bronchitis

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance, color:	Colorless
Odor:	Strong
Physical State:	No data available
pH:	Not applicable
Vapor Pressure:	No data available
Vapor Density:	2.93 (air = 1)
Boiling Point (°C):	530 °C
Melting Point (°C):	-96.7 °C
Flash Point (°F):	No data available
Upper Flammable/Explosive Limit, % in air:	No data available
Lower Flammable/Explosive Limit, % in air:	No data available
Autoignition Temperature (°C):	556 deg C
Decomposition Temperature (°C):	No data available
Specific Gravity:	1.3254 - 1.3258 g/cm3 at 20 °C
Evaporation Rate:	No data available
Odor Threshold:	ND
Solubility:	Moderate; 50-99%
Partition Coefficient: n-octanol in water:	No data available
VOC % by weight:	99.9
Molecular Weight:	No data available

10. STABILITY AND REACTIVITY

Stability:	Stable under normal conditions.
Conditions to Avoid:	None known.Contamination High temperatures
Materials to Avoid / Chemical Incompatiability:	Strong oxidizing agents Caustics (bases)
Hazardous Decomposition Products:	Carbon dioxide Carbon monoxide

11. TOXICOLOGICAL INFORMATION

Routes of Entry:	Inhalation Absorption Ingestion Skin contact Eye contact
Target Organs Potentially Affected By Exposure:	Skin, Cardiovascular System, Eyes, Liver
Chemical Interactions That Change Toxicity:	None Known

Immediate (Acute) Health Effects by Route of Exposure:

Inhalation Irritation:	Can cause moderate respiratory irritation, dizziness, weakness, fatigue, nausea and headache.
Inhalation Toxicity:	Harmful! Can cause systemic damage (see "Target Organs)Inhalation may cause severe central nervous system depression (including unconsciousness).
Skin Contact:	Contact causes severe skin irritation and possible burns.
Skin Absorption:	Harmful if absorbed through the skin. May cause severe irritation and systemic damage.
Eye Contact:	Contact with the eyes may cause moderate to severe eye injury. Eye contact may result in tearing and reddening, but not likely to permanently injure eye tissue. Temporary vision impairment (cloudy or blurred vision) is possible.
Ingestion Irritation:	Irritating to mouth, throat, and stomach. Can cause abdominal discomfort, nausea, vomiting and diarrhea.
Ingestion Toxicity:	Harmful if swallowed. May cause systemic poisoning.

Long-Term (Chronic) Health Effects:

Carcinogenicity:	Contains a probable or known human carcinogen.
Reproductive and Developmental Toxicity:	No data available to indicate product or any components

	present at greater than 0.1% may cause birth defects.
Inhalation:	Upon prolonged and/or repeated exposure, can cause moderate respiratory irritation, dizziness, weakness, fatigue, nausea and headache.Harmful! Can cause systemic damage upon prolonged and/or repeated exposure (see "Target Organs)
Skin Absorption:	Upon prolonged or repeated exposure, harmful if absorbed through the skin. May cause severe irritation and systemic damage

Component Toxicological Data:
NIOSH:

Chemical Name	CAS No.	LD50/LC50
Methane, dichloro-	75-09-2	Inhalation LC50 Rat 53 mg/L 6 h

Component Carcinogenic Data:
OSHA:

Chemical Name	CAS No.	
Indeno[1,2,3-cd]pyrene	193-39-5	Present
Methylene chloride	75-09-2	25 ppm TWA (8 hr.); 125 ppm STEL (15 min.); 12.5 ppm Action Level (see 29 CFR 1910.1051); effective date for respiratory protection for certain employers to acheive the 8-hour TWA PEL is August 31, 1998; the start up date to install engineering controls is December 10, 1998.; {OSHA - 29 CFR 1910 Specifically Regulate

ACGIH:

Chemical Name	CAS No.	
Dichloromethane	75-09-2	A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans

NIOSH:

Chemical Name	CAS No.	
Methylene chloride	75-09-2	potential occupational carcinogen

NTP:

Chemical Name	CAS No.
No data available	

IARC:

Chemical Name	CAS No.	Group No.
Monograph 110 [in preparation]; Monograph 71 [1999]	75-09-2	Group 2A
Monograph 92 [2010]; Supplement 7 [1987]; Monograph 32 [1983]	193-39-5	Group 2B

12. ECOLOGICAL INFORMATION

Overview:	Moderate ecological hazard. This product may be dangerous to plants and/or wildlife. Keep out of waterways.
Mobility:	No data
Persistence:	No data
Bioaccumulation:	No data
Degradability:	No data
Ecological Toxicity Data:	No data available

13. DISPOSAL CONSIDERATIONS

Waste Description of Spent Product:	Spent or discarded material is a hazardous waste.Mixing spent or discarded material with other materials may render the mixture hazardous. Perform a hazardous waste determination on mixtures.
Disposal Methods:	Incinerate spent or discarded material a permitted hazardous waste facility.
Waste Disposal of Packaging:	Comply with all Local, State, Federal, and Provincial

Environmental Regulations.

14. TRANSPORTATION INFORMATION

United States:	
DOT Proper Shipping Name:	Dichloromethane
UN Number:	UN1593
Hazard Class:	6.1
Packing Group:	III
International:	
IATA Proper Shipping Name:	Dichloromethane
UN Number:	UN1593
Hazard Class:	6.1
Packing Group:	III

Marine Pollutant: No

Chemical Name	CAS#	Marine Pollutant	Severe Marine Pollutant
No data available			

15. REGULATORY INFORMATION

United States:

Chemical Name	CAS#	CERCLA	SARA 313	SARA EHS 313	TSCA
Dichloromethane	75-09-2	X	X	-	X
indeno (1,2,3-c,d) pyrene	193-39-5	X	X	-	X

The following chemicals are listed on CA Prop 65:

Chemical Name	CAS #	Regulation
Indeno[1,2,3-cd]pyrene	193-39-5	Prop 65 Cancer
Dichloromethane Dichloromethane (Methylene chloride)	75-09-2	Prop 65 Cancer

State Right To Know Listing:

Chemical Name	CAS#	New Jersey	Massachusetts	Pennsylvania	California
Dichloromethane	75-09-2	X	X	X	X
indeno (1,2,3-c,d) pyrene	193-39-5	X	X	X	X

16. OTHER INFORMATION

Prior Version Date:	03/22/18
Other Information:	Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.
References:	No data available
Disclaimer:	Restek Corporation provides the descriptions, data and information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. It is provided for your guidance only. Because many factors may affect processing or application/use, Restek Corporation recommends you perform an assessment to determine the suitability of a product for your particular purpose prior to use. No warranties of any kind, either expressed or implied, including fitness for a particular purpose, are made regarding products described, data or information set forth. In no case shall the descriptions, information, or data provided be considered a part of our terms and conditions of sale. Further, the descriptions, data and information furnished hereunder are given gratis. No obligation or liability for the description, data and information given are assumed. All such being given and accepted at your risk.

Material Safety Data Sheet
Lead

ACC# 12510

Section 1 - Chemical Product and Company Identification

MSDS Name: Lead
Catalog Numbers: S71957, S719571, S75257, S80049, L18-500, L246-500, L27-1LB, L27-1RL, NC9657609, NC9888945, XXL24625KG
Synonyms: Lead metal.
Company Identification:

Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410

For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
7439-92-1	Lead	99.8	231-100-4

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: bluish white, silvery gray solid.

Warning! Possible cancer hazard. May cause cancer based on animal data. Causes eye and skin irritation. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. May be absorbed through intact skin. May cause central nervous system depression. May cause kidney damage. May cause adverse reproductive effects. May cause fetal effects.
Target Organs: Kidneys, central nervous system, blood forming organs.

Potential Health Effects

Eye: Causes eye irritation.
Skin: Causes skin irritation. May be absorbed through the skin.
Ingestion: Causes gastrointestinal irritation with nausea, vomiting and diarrhea. Ingestion of lead compounds can cause toxic effects in the blood-forming organs, kidneys and central nervous system. Symptoms of lead poisoning or plumbism include weakness, weight loss, lassitude, insomnia, and hypotension. It also includes constipation, anorexia, abdominal discomfort and colic.
Inhalation: May cause respiratory tract irritation. Inhalation of fumes may cause metal fume fever, which is characterized by flu-like symptoms with metallic taste, fever, chills, cough, weakness, chest pain, muscle pain and increased white blood cell count. May cause effects similar to those described for ingestion.
Chronic: Possible cancer hazard based on tests with laboratory animals. Chronic exposure may cause reproductive disorders and teratogenic effects. Chronic exposure to lead may result in plumbism which is characterized by lead line in gum, headache, muscle weakness, mental changes.

Section 4 - First Aid Measures

Eyes: Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin: Get medical aid. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Discard contaminated clothing in a manner which limits further exposure.
Ingestion: Get medical aid immediately. Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water.
Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically and supportively.
Antidote: The use of Dimercaprol or BAL (British Anti-Lewisite) as a chelating agent should be determined by qualified medical personnel. The use of d-Penicillamine as a chelating agent should be determined by qualified medical personnel. The use of Calcium disodium EDTA as a chelating agent should be determined by qualified medical personnel.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Use extinguishing media appropriate to the surrounding fire. Substance is noncombustible. Dust can be an explosion hazard when exposed to heat or flame.
Extinguishing Media: For small fires, use water spray, dry chemical, carbon dioxide or chemical foam. Substance is noncombustible; use agent most appropriate to extinguish surrounding fire.
Flash Point: Not available.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 2; Flammability: 0; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Vacuum or sweep up material and place into a suitable disposal container. Clean up spills immediately, observing precautions in the Protective Equipment section. Avoid generating dusty conditions. Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Avoid ingestion and inhalation. Wash clothing before reuse.
Storage: Store in a cool, dry place. Keep from contact with oxidizing materials. Keep containers tightly closed.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Lead	0.05 mg/m3 TWA	0.050 mg/m3 TWA 100 mg/m3 IDLH	50 æg/m3 TWA; 50 æg/m3 TWA (as Pb); 30 æg/m3 Action Level (as Pb. Poison - see 29 CFR 1910.10 25)

OSHA Vacated PELs: Lead: No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes: 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: Wear appropriate protective gloves and clothing to prevent skin exposure.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: 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.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance: bluish white, silvery gray
Odor: none reported
pH: Not applicable.
Vapor Pressure: 1.3 mm Hg @ 970C
Vapor Density: Not available.
Evaporation Rate: Not applicable.
Viscosity: Not applicable.
Boiling Point: 1740 deg C
Freezing/Melting Point:327.4 deg C
Decomposition Temperature: Not available.
Solubility: Insoluble in water.
Specific Gravity/Density:11.3
Molecular Formula: Pb
Molecular Weight:207.2

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Dust generation, excess heat.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Lead/lead oxides.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 7439-92-1: OF7525000
LD50/LC50:
Not available.

Carcinogenicity:
CAS# 7439-92-1:

- **ACGIH:** A3 - Confirmed animal carcinogen with unknown relevance to humans
- **California:** carcinogen, initial date 10/1/92
- **NTP:** Suspect carcinogen
- **IARC:** Group 2A carcinogen

Epidemiology: There are several reports that certain lead compounds administered to animals in high doses are carcinogenic, primarily producing renal tumors. Salts demonstrating carcinogenicity in animals are usually soluble salts. Epidemiological studies have not shown a relationship between lead exposure and the incidence of cancer in lead workers. However, one study of lead-exposed workers demonstrated a statistically significant elevation in the standardized mortality ratio for gastric and lung cancer in battery plant workers only.
Teratogenicity: Lead penetrates the placental barrier and has caused fetal abnormalities in animals. Excesssive exposure to lead during pregnancy has caused neurological disorders in infants.
Reproductive Effects: Reproductive effects from lead have been documented in animals and human beings of both sexes. In battery workmen with a mean exposure of 8.5 years to lead, there was an increased frequency of sperm abnormalities as compared with a control group.
Mutagenicity: Mutagenic effects have occurred in humans.
Neurotoxicity: Subtle neurologic effects have been demonstrated with relatively low blood levels of lead. The performance of lead workers on various neurophysiological tests was mildly reduced when compared with a control group. Anxiety, depression, poor concentration, forgetfulness, mild reductions in motor and sensory nerve conduction velociities have been documented in lead-exposed workers.
Other Studies:

Section 12 - Ecological Information

Ecotoxicity: No data available. LC50 Japanese quail (Coturnix japonica), males or females, 14 days old, oral (5-day adlibitum in diet) >5,000 ppm; at 1000, 2236 & 5000 onset of toxic signs began at 7, 7 & 7 days and remissed at 11, 11 & 12 days, respectively, no mortality was observed; control references were dieldrin & dicrotophos; corn oil diluent was added to diet at ratio of 2:98 by wt; (extreme concentrations: 1,000-5,000 ppm) /Lead metal, 100%.
Environmental: Terrestrial: Extremely stable metal. While some corrosion may be expected in soil, generally an inert coat of an insoluble salt will form and limit further corrosion. Aquatic: Lead will simply sink into the sediment. Atmospheric: Will be in particulate matter and be subject to washout and gravitational settling. Will biodegrade and bioconcentrate.
Physical: No information available.
Other: For more information, see "HANDBOOK OF ENVIRONMENTAL FATE AND EXPOSURE DATA."

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	**Canada TDG**
Shipping Name:	Not regulated	Not Regulated
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA

CAS# 7439-92-1 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 7439-92-1: 10 lb final RQ (no reporting of releases of this hazardous substance is required

SARA Section 302 Extremely Hazardous Substances

None of the chemicals in this product have a TPQ.

SARA Codes

CAS # 7439-92-1: immediate, delayed.

Section 313

This material contains Lead (CAS# 7439-92-1, 99.8%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA. CAS# 7439-92-1 is listed as a Priority Pollutant under the Clean Water Act. CAS# 7439-92-1 is listed as a Toxic Pollutant under the Clean Water Act.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 7439-92-1 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California Prop 65
The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act:

WARNING: This product contains Lead, a chemical known to the state of California to cause cancer.
WARNING: This product contains Lead, a chemical known to the state of California to cause male reproductive toxicity.
California No Significant Risk Level: CAS# 7439-92-1: 15 æg/day NSRL (oral)

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

T N

Risk Phrases:

R 20/22 Harmful by inhalation and if swallowed.
R 33 Danger of cumulative effects.
R 61 May cause harm to the unborn child.
R 62 Possible risk of impaired fertility.
R 50/53 Very toxic to aquatic organisms, may cause long-term
adverse effects in the aquatic environment.

Safety Phrases:

S 45 In case of accident or if you feel unwell, seek medical advice

immediately (show the label where possible).
S 53 Avoid exposure - obtain special instructions before use.
S 60 This material and its container must be disposed of as hazardous waste.
S 61 Avoid release to the environment. Refer to special instructions /safety data sheets.

WGK (Water Danger/Protection)
CAS# 7439-92-1: No information available.
Canada - DSL/NDSL
CAS# 7439-92-1 is listed on Canada's DSL List.
Canada - WHMIS
This product has a WHMIS classification of D2A.
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.
Canadian Ingredient Disclosure List
CAS# 7439-92-1 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 4/29/1999
Revision #5 Date: 5/22/2007

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

Safety Data Sheet
Mercury (Metallic)

SDS Revision Date: **05/01/2015**

1. Identification

1.1. Product identifier

Product Identity	Mercury (Metallic)
Alternate Names	Quicksilver; Hydrargyrum; Liquid Silver

1.2. Relevant identified uses of the substance or mixture and uses advised against

Intended use	See Technical Data Sheet.
Application Method	See Technical Data Sheet.

1.3. Details of the supplier of the safety data sheet

Company Name

WM Mercury Waste Inc.
21211 Durand Avenue
Union Grove, WI 53182

Emergency

CHEMTREC (USA)	(800) 424-9300
Customer Service: WM Mercury Waste Inc.	(800) 741-3343

2. Hazard(s) identification

2.1. Classification of the substance or mixture

Acute Tox. 2;H330	Fatal if inhaled.
Repr. 1B;H360D	May damage the unborn child.
STOT RE 1;H372	Causes damage to organs through prolonged or repeated exposure. Specific Target Organs: (Central Nervous System)
Aquatic Chronic 1;H410	Very toxic to aquatic life with long lasting effects.

2.2. Label elements

Using the Toxicity Data listed in section 11 and 12 the product is labeled as follows.

Danger

H330 Fatal if inhaled.

H360D May damage the unborn child.

H372 Causes damage to organs through prolonged or repeated exposure.

H410 Very toxic to aquatic life with long lasting effects.

[Prevention]:
P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and understood.
P260 Do not breathe mist / vapors / spray.
P264 Wash thoroughly after handling.
P270 Do not eat, drink or smoke when using this product.
P271 Use only outdoors or in a well-ventilated area.
P273 Avoid release to the environment.
P281 Use personal protective equipment as required.
P284 Wear respiratory protection.
[Response]:
P304+340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P308+313 IF exposed or concerned: Get medical advice / attention.
P310 Immediately call a POISON CENTER or doctor / physician.
P314 Get Medical advice / attention if you feel unwell.
P320 Specific treatment is urgent (see information on this label).
P391 Collect spillage.
[Storage]:
P403+233 Store in a well ventilated place. Keep container tightly closed.
P405 Store locked up.
[Disposal]:
P501 Dispose of contents / container in accordance with local / national regulations.

3. Composition/information on ingredients

This product contains the following substances that present a hazard within the meaning of the relevant State and Federal Hazardous Substances regulations.

Ingredient/Chemical Designations	Weight %	GHS Classification	Notes
Mercury **CAS Number: 0007439-97-6**	**100**	**Repr. 1B;H360D** **Acute tox. 2;H330** **STOT RE 1;H372** **Aquatic Acute 1;H400** **Aquatic Chronic 1;H410**	**[1][2]**

In accordance with paragraph (i) of §1910.1200, the specific chemical identity and/or exact percentage (concentration) of composition has been withheld as a trade secret.
[1] Substance classified with a health or environmental hazard.
[2] Substance with a workplace exposure limit.
[3] PBT-substance or vPvB-substance.
*The full texts of the phrases are shown in Section 16.

4. First aid measures

4.1. Description of first aid measures

General	In all cases of doubt, or when symptoms persist, seek medical attention. Never give anything by mouth to an unconscious person.
Inhalation	Remove to fresh air, keep patient warm and at rest. If breathing is irregular or stopped, give artificial respiration. If unconscious place in the recovery position and obtain immediate medical attention. Give nothing by mouth.
Eyes	Irrigate copiously with clean water for at least 15 minutes, holding the eyelids apart and seek medical attention.
Skin	Remove contaminated clothing. Wash skin thoroughly with soap and water or use a recognized skin cleanser.
Ingestion	If swallowed, wash out mouth with water, obtain immediate medical attention. Keep at rest. Do NOT induce vomiting.

4.2. Most important symptoms and effects, both acute and delayed

Overview	**Eye:** Contact with eyes may cause severe irritation, and possible eye burns. Vapors may cause eye irritation. **Skin:** May cause skin irritation. May be absorbed through the skin in harmful amounts. May cause skin sensitization, an allergic reaction, which becomes evident upon re-exposure to this material. Chronic exposure to mercury may cause permanent central nervous system damage, fatigue, weight loss, tremors, and personality changes. **Ingestion:** May cause gastrointestinal irritation with nausea, vomiting and diarrhea. May cause effects similar to those for inhalation exposure. **Inhalation:** Causes respiratory tract irritation. Inhalation of fumes may cause metal fume fever, which is characterized by flu-like symptoms with metallic taste, fever, chills, cough, weakness, chest pain, muscle pain and increased white blood cell count. May cause central nervous system effects including vertigo, anxiety, depression, muscle incoordination, and emotional instability. May cause severe respiratory tract irritation. **Chronic:** Chronic exposure to mercury may cause permanent central nervous system damage, fatigue, weight loss, tremors, and personality changes. **Notes to Physician:** Treat symptomatically and supportively. **Antidote:** The use of Dimercaprol or BAL (British Anti-Lewisite) as a chelating agent should be determined by qualified medical personnel. The use of d-Penicillamine as a chelating agent should be determined by qualified medical personnel. See section 2 for further details.
Inhalation	Fatal if inhaled.

5. Fire-fighting measures

5.1. Extinguishing media

Substance is nonflammable; use agent most appropriate to extinguish surrounding fire.

5.2. Special hazards arising from the substance or mixture

Hazardous decomposition: Mercury/mercury oxides.

Do not breathe mist / vapors / spray.

5.3. Advice for fire-fighters

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

ERG Guide No. 172

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Put on appropriate personal protective equipment (see section 8).

6.2. Environmental precautions

Do not allow spills to enter drains or waterways.

Use good personal hygiene practices. Wash hands before eating, drinking, smoking or using toilet. Promptly remove soiled clothing and wash thoroughly before reuse.

6.3. Methods and material for containment and cleaning up

Vacuum or sweep up material and place into a suitable disposal container. Wear a self contained breathing apparatus and appropriate personal protection. (See Exposure Controls, Personal Protection section).

7. Handling and storage

7.1. Precautions for safe handling

Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Minimize dust generation and accumulation. Avoid breathing dust, vapor, mist, or gas. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation.

See section 2 for further details. - [Prevention]:

7.2. Conditions for safe storage, including any incompatibilities

Handle containers carefully to prevent damage and spillage.

Incompatible materials: Acetylene, ammonia, boron phosphodiiodide, chlorine, chlorine dioxide, methyl azide, sodium carbide, halogens, strong oxidizers.

Store in a cool, dry, well-ventilated area away from incompatible substances. Keep away from metals. Poison room locked.

See section 2 for further details. - [Storage]:

7.3. Specific end use(s)

No data available.

8. Exposure controls and personal protection

8.1. Control parameters

Exposure

CAS No.	Ingredient	Source	Value
0007439-97-6	Mercury	OSHA	TWA 0.1 mg/m3
		ACGIH	Alkyl compounds TWA: 0.01 mg/m3 STEL 0.03 mg/m3 Skin Aryl compounds TWA: 0.05 mg/m3 C 0.1 mg/m3 Skin Elemental/Inorganic 0.025mg/m3 Skin
		NIOSH	No Established Limit
		Supplier	No Established Limit

Carcinogen Data

CAS No.	Ingredient	Source	Value
0007439-97-6	Mercury	OSHA	Select Carcinogen: No
		NTP	Known: No; Suspected: No
		IARC	Group 1: No; Group 2a: No; Group 2b: No; Group 3: Yes; Group 4: No;

8.2. Exposure controls

Respiratory	Follow the OSHA respirator regulations found in 29CFR §1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.
Eyes	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin	Wear appropriate protective clothing to prevent skin exposure. Wear appropriate gloves to prevent skin exposure.
Engineering Controls	Provide adequate ventilation. Where reasonably practicable this should be achieved by the use of local exhaust ventilation and good general extraction. If these are not sufficient to maintain concentrations of particulates and any vapor below occupational exposure limits suitable respiratory protection must be worn.
Other Work Practices	Use good personal hygiene practices. Wash hands before eating, drinking, smoking or using toilet. Promptly remove soiled clothing and wash thoroughly before reuse.

See section 2 for further details. - [Prevention]:

9. Physical and chemical properties

Appearance	Silver Liquid
Odor	Odorless
Odor threshold	Not Measured
pH	Not Applicable
Melting point / freezing point	-38.87 deg C

Initial boiling point and boiling range	356.5 deg C @ 760.00mmHg
Flash Point	Not Measured
Evaporation rate (Ether = 1)	Not Available
Flammability (solid, gas)	Not Applicable
Upper/lower flammability or explosive limits	**Lower Explosive Limit:** Not Measured **Upper Explosive Limit:** Not Measured
Vapor pressure (Pa)	0.002 mmHg @ 25C
Vapor Density	7 (Air=1)
Specific Gravity	13.5400g/cm3 (Water=1)
Solubility in Water	Insoluble
Partition coefficient n-octanol/water (Log Kow)	Not Measured
Auto-ignition temperature	Not Measured
Decomposition temperature	Not Available
Viscosity (cSt)	1.554 cP 20.00
Molecular Formula	Hg
Molecular Weight	200.59

9.2. Other information

No other relevant information.

10. Stability and reactivity

10.1. Reactivity

Hazardous Polymerization will not occur.

10.2. Chemical stability

Stable under normal circumstances.

10.3. Possibility of hazardous reactions

No data available.

10.4. Conditions to avoid

High temperatures, incompatible materials, metals.

10.5. Incompatible materials

Acetylene, ammonia, boron phosphodiiodide, chlorine, chlorine dioxide, methyl azide, sodium carbide, halogens, strong oxidizers.

10.6. Hazardous decomposition products

Mercury/mercury oxides.

11. Toxicological information

Acute toxicity

Ingredient	Oral LD50, mg/kg	Skin LD50, mg/kg	Inhalation Vapor LC50, mg/L/4hr	Inhalation Dust/Mist LC50, mg/L/4hr	Inhalation Gas LC50, ppm

Mercury - (7439-97-6)	37.00, Rat - Category: 2	No data available	No data available	No data available	No data available

Note: When no route specific LD50 data is available for an acute toxin, the converted acute toxicity point estimate was used in the calculation of the product's ATE (Acute Toxicity Estimate).

Classification	Category	Hazard Description
Acute toxicity (oral)	2	Fatal if swallowed.
Acute toxicity (dermal)	---	Not Applicable
Acute toxicity (inhalation)	2	Fatal if inhaled.
Skin corrosion/irritation	---	Not Applicable
Serious eye damage/irritation	---	Not Applicable
Respiratory sensitization	---	Not Applicable
Skin sensitization	---	Not Applicable
Germ cell mutagenicity	---	Not Applicable
Carcinogenicity	---	Not Applicable
Reproductive toxicity	1B	May damage the unborn child.
STOT-single exposure	---	Not Applicable
STOT-repeated exposure	1	Causes damage to organs through prolonged or repeated exposure.
Aspiration hazard	---	Not Applicable

12. Ecological information

12.1. Toxicity

Very toxic to aquatic life with long lasting effects.

No additional information provided for this product. See Section 3 for chemical specific data.

Aquatic Ecotoxicity

Ingredient	96 hr LC50 fish, mg/l	48 hr EC50 crustacea, mg/l	ErC50 algae, mg/l
Mercury - (7439-97-6)	Not Available	0.0052, Daphnia magna	Not Available

12.2. Persistence and degradability

There is no data available on the preparation itself.

12.3. Bioaccumulative potential

Not Measured

12.4. Mobility in soil

No data available.

12.5. Results of PBT and vPvB assessment

This product contains no PBT/vPvB chemicals.

12.6. Other adverse effects

No data available.

13. Disposal considerations

13.1. Waste treatment methods

Observe all federal, state and local regulations when disposing of this substance.

14. Transport information

	DOT (Domestic Surface Transportation)	IMO / IMDG (Ocean Transportation)	ICAO/IATA
14.1. UN number	UN2809	UN2809	UN2809
14.2. UN proper shipping name	UN2809, Mercury, 8, III	Mercury	Mercury
14.3. Transport hazard class(es)	**DOT Hazard Class:** 8 (6.1)	**IMDG:** 8 **Sub Class:** 6.1	**Air Class:** 8
14.4. Packing group	III	III	III

14.5. Environmental hazards

IMDG Marine Pollutant: Yes (Mercury)

14.6. Special precautions for user

No further information

15. Regulatory information

Regulatory Overview	The regulatory data in Section 15 is not intended to be all-inclusive, only selected regulations are represented.
Toxic Substance Control Act (TSCA)	All components of this material are either listed or exempt from listing on the TSCA Inventory.
WHMIS Classification	D1A

US EPA Tier II Hazards

Fire: No
Sudden Release of Pressure: No
Reactive: No
Immediate (Acute): Yes
Delayed (Chronic): Yes

EPCRA 311/312 Chemicals and RQs (lbs):

Mercury (1.00)

EPCRA 302 Extremely Hazardous:
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

EPCRA 313 Toxic Chemicals:

Mercury

Proposition 65 - Carcinogens (>0.0%):
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

Proposition 65 - Developmental Toxins (>0.0%):
Mercury

Proposition 65 - Female Repro Toxins (>0.0%):
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

Proposition 65 - Male Repro Toxins (>0.0%):
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

New Jersey RTK Substances (>1%):

Mercury

Pennsylvania RTK Substances (>1%):

Mercury

16. Other information

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein. We accept no responsibility and disclaim all liability for any harmful effects which may be caused by exposure to our products. Customers/users of this product must comply with all applicable health and safety laws, regulations, and orders.

The full text of the phrases appearing in section 3 is:

H330 Fatal if inhaled.

H360D May damage the unborn child.

H372 Causes damage to organs through prolonged or repeated exposure.

H400 Very toxic to aquatic life.

H410 Very toxic to aquatic life with long lasting effects.

This is the first version in the GHS SDS format. Listings of changes from previous versions in other formats are not applicable.

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall WM Mercury Waste Inc. be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages.

End of Document

SIGMA-ALDRICH

sigma-aldrich.com

Material Safety Data Sheet

Version 4.2
Revision Date 11/16/2012
Print Date 03/19/2014

1. PRODUCT AND COMPANY IDENTIFICATION

Product name : Nickel

Product Number : 577995
Brand : Aldrich

Supplier : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA
Telephone : +1 800-325-5832
Fax : +1 800-325-5052
Emergency Phone # (For both supplier and manufacturer) : (314) 776-6555
Preparation Information : Sigma-Aldrich Corporation
Product Safety - Americas Region
1-800-521-8956

2. HAZARDS IDENTIFICATION

Emergency Overview

OSHA Hazards
Flammable solid, Carcinogen, Target Organ Effect, Skin sensitiser

Target Organs

Lungs

GHS Classification
Flammable solids (Category 2)
Skin sensitization (Category 1)
Carcinogenicity (Category 2)
Specific target organ toxicity - repeated exposure, Inhalation (Category 1)
Acute aquatic toxicity (Category 1)

GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)

H228	Flammable solid.
H317	May cause an allergic skin reaction.
H351	Suspected of causing cancer.
H372	Causes damage to organs through prolonged or repeated exposure if inhaled.
H400	Very toxic to aquatic life.

Precautionary statement(s)

P210	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P273	Avoid release to the environment.
P280	Wear protective gloves.
P314	Get medical advice/ attention if you feel unwell.

HMIS Classification

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical hazards:	3

NFPA Rating

Health hazard:	2
Fire:	0
Reactivity Hazard:	3

Potential Health Effects

Inhalation	May be harmful if inhaled. May cause respiratory tract irritation.
Skin	May be harmful if absorbed through skin. May cause skin irritation.
Eyes	May cause eye irritation.
Ingestion	May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Formula : Ni
Molecular Weight : 58.69 g/mol

Component		Concentration
Nickel, powder [particle diameter < 1 mm]		
CAS-No.	7440-02-0	-
EC-No.	231-111-4	
Index-No.	028-002-01-4	

4. FIRST AID MEASURES

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact

Flush eyes with water as a precaution.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Special protective equipment for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products

Hazardous decomposition products formed under fire conditions. - Nickel/nickel oxides

Further information

Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Use personal protective equipment. Avoid dust formation. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Avoid breathing dust.

Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

Methods and materials for containment and cleaning up
Sweep up and shovel. Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13). Keep in suitable, closed containers for disposal. Contain spillage, pick up with an electrically protected vacuum cleaner or by wet-brushing and transfer to a container for disposal according to local regulations (see section 13).

7. HANDLING AND STORAGE

Precautions for safe handling
Avoid contact with skin and eyes. Avoid formation of dust and aerosols.
Provide appropriate exhaust ventilation at places where dust is formed. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

Conditions for safe storage
Store in cool place. Keep container tightly closed in a dry and well-ventilated place.

Handle and store under inert gas. Keep in a dry place.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Value	Control parameters	Basis
Nickel, powder [particle diameter < 1 mm]	7440-02-0	TWA	1.5 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
Remarks	Dermatitis Pneumoconiosis Not suspected as a human carcinogen			
		TWA	1 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	1 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		TWA	0.015 mg/m3	USA. NIOSH Recommended Exposure Limits
	Potential Occupational Carcinogen See Appendix A			

Personal protective equipment

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Eye protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection
Complete suit protecting against chemicals, Flame retardant antistatic protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	powder
Colour	white, silver, metallic

Safety data

pH	no data available
Melting point/freezing point	Melting point/range: 1,453 °C (2,647 °F) - lit.
Boiling point	2,732 °C (4,950 °F) - lit.
Flash point	not applicable
Flammability (solid, gas)	The substance or mixture is a flammable solid with the category 2.
Ignition temperature	no data available
Autoignition temperature	no data available
Lower explosion limit	no data available
Upper explosion limit	no data available
Vapour pressure	1 hPa (1 mmHg) at 1,810 °C (3,290 °F)
Density	8.9 g/cm3 at 25 °C (77 °F)
Water solubility	insoluble
Partition coefficient: n-octanol/water	no data available
Relative vapour density	no data available
Odour	no data available
Odour Threshold	no data available
Evaporation rate	no data available

10. STABILITY AND REACTIVITY

Chemical stability
Stable under recommended storage conditions.

Possibility of hazardous reactions
no data available

Conditions to avoid
Heat, flames and sparks. Extremes of temperature and direct sunlight.

Materials to avoid
acids, Oxidizing agents, Sulphur compounds, Hydrogen gas, Oxygen, Methanol, organic solvents, Aluminium, Fluorine, Ammonia

Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Nickel/nickel oxides
Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral LD50
no data available

Inhalation LC50
no data available

Dermal LD50
no data available

Other information on acute toxicity
no data available

Skin corrosion/irritation
no data available

Serious eye damage/eye irritation
no data available

Respiratory or skin sensitization
May cause allergic skin reaction.

Germ cell mutagenicity

no data available

Carcinogenicity

This product is or contains a component that has been reported to be possibly carcinogenic based on its IARC, ACGIH, NTP, or EPA classification.

Limited evidence of carcinogenicity in animal studies

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Nickel, powder [particle diameter < 1 mm])

NTP: Reasonably anticipated to be a human carcinogen (Nickel, powder [particle diameter < 1 mm])

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity

no data available

Teratogenicity

no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)
no data available

Specific target organ toxicity - repeated exposure (Globally Harmonized System)
Inhalation - Causes damage to organs through prolonged or repeated exposure.

Aspiration hazard
no data available

Potential health effects

Inhalation	May be harmful if inhaled. May cause respiratory tract irritation.
Ingestion	May be harmful if swallowed.
Skin	May be harmful if absorbed through skin. May cause skin irritation.
Eyes	May cause eye irritation.

Synergistic effects
no data available

Additional Information
RTECS: Not available

12. ECOLOGICAL INFORMATION

Toxicity

Toxicity to fish	LC50 - Cyprinus carpio (Carp) - 1.3 mg/l - 96 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 1 mg/l - 48 h

Persistence and degradability
no data available

Bioaccumulative potential
no data available

Mobility in soil
no data available

PBT and vPvB assessment
no data available

Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Very toxic to aquatic life.

13. DISPOSAL CONSIDERATIONS

Product
Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 3089 Class: 4.1 Packing group: II
Proper shipping name: Metal powders, flammable, n.o.s.
Reportable Quantity (RQ): 100 lbs
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG
UN number: 3089 Class: 4.1 Packing group: II EMS-No: F-G, S-G
Proper shipping name: METAL POWDER, FLAMMABLE, N.O.S.
Marine pollutant: No

IATA

UN number: 3089 Class: 4.1 Packing group: II
Proper shipping name: Metal powder, flammable, n.o.s.

15. REGULATORY INFORMATION

OSHA Hazards
Flammable solid, Carcinogen, Target Organ Effect, Skin sensitiser

SARA 302 Components
SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

	CAS-No.	Revision Date
Nickel, powder [particle diameter < 1 mm]	7440-02-0	2007-07-01

SARA 311/312 Hazards
Fire Hazard, Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Nickel, powder [particle diameter < 1 mm]	7440-02-0	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Nickel, powder [particle diameter < 1 mm]	7440-02-0	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Nickel, powder [particle diameter < 1 mm]	7440-02-0	2007-07-01

California Prop. 65 Components

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the State of California to cause cancer. Nickel, powder [particle diameter < 1 mm]	7440-02-0	2007-09-28

16. OTHER INFORMATION

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

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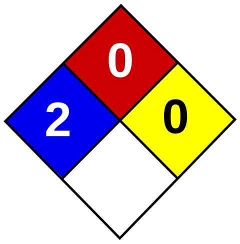
Chemicals & Laboratory Equipment



Health	2
Fire	0
Reactivity	0
Personal Protection	G

Material Safety Data Sheet

Tetrachloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Tetrachloroethylene

Catalog Codes: SLT3220

CAS#: 127-18-4

RTECS: KX3850000

TSCA: TSCA 8(b) inventory: Tetrachloroethylene

CI#: Not available.

Synonym: Perchloroethylene; 1,1,2,2-Tetrachloroethylene; Carbon bichloride; Carbon dichloride; Ankilostin; Didakene; Dilatin PT; Ethene, tetrachloro-; Ethylene tetrachloride; Perawin; Perchlor; Perclene; Perclene D; Percosolvel; Tetrachloroethene; Tetraleno; Tetralex; Tetravec; Tetroguer; Tetropil

Chemical Name: Ethylene, tetrachloro-

Chemical Formula: C2-Cl4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Tetrachloroethylene	127-18-4	100

Toxicological Data on Ingredients: Tetrachloroethylene: ORAL (LD50): Acute: 2629 mg/kg [Rat]. DERMAL (LD): Acute: >3228 mg/kg [Rabbit]. MIST(LC50): Acute: 34200 mg/m 8 hours [Rat]. VAPOR (LC50): Acute: 5200 ppm 4 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (anticipated carcinogen) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, peripheral nervous system, respiratory tract, skin, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with skin. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, metals, acids, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:
Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 25 (ppm) from OSHA (PEL) [United States] TWA: 25 STEL: 100 (ppm) from ACGIH (TLV) [United States] TWA: 170 (mg/m3) from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Ethereal.

Taste: Not available.

Molecular Weight: 165.83 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 121.3°C (250.3°F)

Melting Point: -22.3°C (-8.1°F)

Critical Temperature: 347.1°C (656.8°F)

Specific Gravity: 1.6227 (Water = 1)

Vapor Pressure: 1.7 kPa (@ 20°C)

Vapor Density: 5.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 5 - 50 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.4

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Miscible with alcohol, ether, chloroform, benzene, hexane. It dissolves in most of the fixed and volatile oils. Solubility in water: 0.015 g/100 ml @ 25 deg. C It slowly decomposes in water to yield Trichloroacetic and Hydrochloric acids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, metals, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Oxidized by strong oxidizing agents. Incompatible with sodium hydroxide, finely divided or powdered metals such as zinc, aluminum, magnesium, potassium, chemically active metals such as lithium, beryllium , barium. Protect from light.

Special Remarks on Corrosivity: Slowly corrodes aluminum, iron, and zinc.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2629 mg/kg [Rat]. Acute dermal toxicity (LD50): >3228 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5200 4 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (Some evidence.) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. May cause damage to the following organs: kidneys, liver, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Publishe Lethal Dose/Conc: LDL [Rabbit] - Route: Oral; Dose: 5000 mg/kg LDL [Dog] - Route: Oral; Dose: 4000 mg/kg LDL [Cat] - Route: Oral; Dose: 4000 mg/kg

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects(teratogenic). May affect genetic material (mutagenic). May cause cancer.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation with possible dermal blistering or burns. Symtoms may include redness, itching, pain, and possible dermal blistering or burns. It may be absorbed through the skin with possible systemic effects. A single prolonged skin exposure is not likely to result in the material being absorbed in harmful amounts. Eyes: Contact causes transient eye irritation, lacrimation. Vapors cause eye/conjunctival irritation. Symptoms may include redness and pain. Inhalation: The main route to occupational exposure is by inhalation since it is readily absorbed through the lungs. It causes respiratory tract irritation, . It can affect behavior/central nervous system (CNS depressant and anesthesia ranging from slight inebriation to death, vertigo, somnolence, anxiety, headache, excitement, hallucinations, muscle incoordination, dizziness, lightheadness, disorentiation, seizures, enotional instability, stupor, coma). It may cause pulmonary edema Ingestion: It can cause nausea, vomiting, anorexia, diarrhea, bloody stool. It may affect the liver, urinary system (proteinuria, hematuria, renal failure, renal tubular disorder), heart (arrhythmias). It may affect behavior/central nervous system with symptoms similar to that of inhalation. Chronic Potential Health Effects: Skin: Prolonged or repeated skin contact may result in excessive drying of the skin, and irritation. Ingestion/Inhalation: Chronic exposure can affect the liver(hepatitis,fatty liver degeneration), kidneys, spleen, and heart (irregular heartbeat/arrhythmias, cardiomyopathy, abnormal EEG), brain, behavior/ central nervous system/peripheral nervous system (impaired memory, numbness of extremeties, peripheral neuropathy and other

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 18.4 mg/l 96 hours [Fish (Fatthead Minnow)]. 18 mg/l 48 hours [Daphnia (daphnia)]. 5 mg/l 96 hours [Fish (Rainbow Trout)]. 13 mg/l 96 hours [Fish (Bluegill sunfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Tetrachloroethylene UNNA: 1897 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Tetrachloroethylene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Tetrachloroethylene Connecticut hazardous material survey.: Tetrachloroethylene Illinois toxic substances disclosure to employee act: Tetrachloroethylene Illinois chemical safety act: Tetrachloroethylene New York release reporting list: Tetrachloroethylene Rhode Island RTK hazardous substances: Tetrachloroethylene Pennsylvania RTK: Tetrachloroethylene Minnesota: Tetrachloroethylene Michigan critical material: Tetrachloroethylene Massachusetts RTK: Tetrachloroethylene Massachusetts spill list: Tetrachloroethylene New Jersey: Tetrachloroethylene New Jersey spill list: Tetrachloroethylene Louisiana spill reporting: Tetrachloroethylene California Director's List of Hazardous Substances: Tetrachloroethylene TSCA 8(b) inventory: Tetrachloroethylene TSCA 8(d) H and S data reporting: Tetrachloroethylene: Effective date: 6/1/87; Sunset date: 6/1/97 SARA 313 toxic chemical notification and release reporting: Tetrachloroethylene CERCLA: Hazardous substances.: Tetrachloroethylene: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects. R51/53- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. S23- Do not breathe gas/fumes/vapour/spray S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S37- Wear suitable gloves. S61- Avoid release to the environment. Refer to special instructions/Safety data sheets.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: g

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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Appendix D

NYSDOH Generic CAMP

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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